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**Human Rights Council  
Advisory Committee  
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Item 3(d) of the provisional agenda **Requests addressed to the Advisory Committee stemming from Human Rights resolutions:  
Impact of new technologies for climate protection on the enjoyment of human rights**

Impact of new technologies for climate protection on the enjoyment of human rights prepared by Patrycja Sasnal, Rapporteur of the drafting group

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

1. So far, new technologies for climate protection (NTCPs) have not been extensively examined from the human rights angle, save from a general perspective and in an indirect manner. This is due to the fact that these are emerging technologies and thus there is a lack of clarity about the state of development, characteristics and applicable legal framework. The persistent uncertainty around the regulation of NTCPs does not mean that they are being developed in a *vacuum*. States have undertaken a number of obligations and political commitments to meet climate change goals. Their action in this field must be guided and aligned with principles and norms on human rights and environmental protection.

2. In this context the Advisory Committee was requested by the Human Rights Council’s Resolution 48/14 of 8 October 2021 to conduct a study and to prepare a report on the impact of new technologies for climate protection on the enjoyment of human rights, and to submit the report to the Council at its fifty-fourth session. At its twenty-seventh session, the Advisory Committee established a drafting group, currently composed by Buhm-Suk Baek, Milena Costas Trascasas (Chair), Ajai Malhotra, Javier Palumno, Patrycja Sasnal (Rapporteur), Vassilies Tzevelekos and Frans Viljoen. In the elaboration of this report, the AC has worked in close cooperation with the Special Rapporteur on the promotion and protection of human rights in the context of climate change, and has met with representatives of Indigenous Peoples. Our Committee is very grateful to those States and other stakeholders that replied to the questionnaire distributed. All responses received can be consulted at the AC website.

3. This report adopts solely a human-rights based approach to NTCPs, which however includes social, political, economic and legal aspects of their development and potential implementation. It is not in a position to engage authoritatively in the scientific debates about the physical characteristics and effectiveness of these technologies: such discussions are a rapidly evolving, inconclusive process and require specialized knowledge in physics, chemistry, biology, climatology etc. To draw conclusions for human rights it does, however, take into account the scientific knowledge publicly available, inputs from NGOs, Indigenous Peoples representatives, States, public institutions, academics, and business.

4. The relevance of a human rights approach in the policy and decision-making processes related to climate change responses is indisputable.[[1]](#footnote-2) There is, however, a need of further reflection on how to operationalize this normative framework to effectively address the challenges and solve the conflicts of interests that will most probably arise in this process. The human rights perspective introduces a principled approach together with a methodological guidance allowing States to prevent, avoid or mitigate potential negative impacts. Precisely, this report aims at providing a coherent framework under which the human rights impacts of these new technologies can be assessed. The goal is to ensure that responses and measures that are being adopted by States in the context of the climate change emergency be coherent and align with their human rights obligations.

I. Introduction

5. New technologies for climate protection (NTCPs), a term requested by the HRC, are defined for the purpose of this study by three characteristics: as technologies that (a) have been developed in the last two decades, and are still in development (time), (b) for the exclusive purpose of abating the effects of climate change without focusing on reducing CO2 emissions as opposed to, i.e., industrial or agricultural production technologies with a carbon capture component, renewable energy or integration of artificial intelligence in the production of renewable energy (purpose) and (c) have the hypothetical potential of altering the Earth’s planetary climate if implemented at scale (scale) with cascading effects that come with it. There are two general kinds of such technologies: greenhouse gas removal from the atmosphere (CDR), although not all CDRs satisfy the NTCP definition, and solar radiation modification (SRM), although both kinds are fundamentally different from each other and should be analysed as such.[[2]](#footnote-3) As far as some CDR methods could conditionally be considered mitigation measures, the SRM as a cluster of technologies should not be considered an adaptation measure, as elucidated by the IPCC definitions.[[3]](#footnote-4)

6. Planetary climate is characterized by intense interconnectedness, the nature of which is a subject of ongoing studies. No human action comes without an impact on the Earth’s climate, which is a complex holistic, often counterintuitive system. Likewise, no technology, even if implemented for the positive purpose of mitigating climate change, comes without negative impacts. A holistic approach to the impact of all technologies for climate protection on human rights would have the benefit of collecting most of the information available in one study and would reflect the interconnectedness of biological and social life. Yet, it would risk diluting the analysis of impacts posed by already implemented few technologies that have a significant growth potential. Even this smaller group of NTCPs is heterogenous, frequently at an early, start-up stage of development with non-existent surrounding and supporting infrastructure. Therefore, electric vehicle and battery production, and associated with it mining for lithium or cobalt, for example, is not assessed in this report even if it carries great risks for human rights.

7. The capacity of some of these technologies, although only some of them are the subject of this report, to furthering the negative impacts of climate change on human rights is at stake. There is concern about the different proposals that are being put forward under the label of ‘geoengineering technologies’.[[4]](#footnote-5) Since there is no clear definition of such technologies, attributing a “protective” function to them may be tricky and even misleading. It may give a false impression that there is a scientific certainty around the efficacy of such technologies, which is not currently the case. In 2022, the International Panel on Climate Change (IPCC) has highlighted the “large uncertainties and knowledge gaps as well as substantial risks” facing the use of SRM measures.[[5]](#footnote-6) In relation to CDR, the IPCC has indicated that there are uncertainties as to the potential contribution CDR might make to achieving climate goals. It has also indicated that there are substantial concerns as to the potential adverse impacts of this range of technologies.[[6]](#footnote-7)

8. Therefore, the report does not use the term geoengineering for three reasons: (a) to avoid semantic ambiguity since there is no consensus in literature as for the broad meaning of the word “geoengineering”; (b) because the component “engineering” may connote greater scientific certainty associated with these technologies than currently proven; and (c) to follow the definitions used in IPCC reports, which discuss CDR and SRM separately to reflect their “very different geophysical characteristics”. The reports talk about “more speculative technologies” that counteract climate change by removing CO2 from the atmosphere (CDR) or directly modify the Earth’s energy balance at a large scale (SRM). This report neither uses the term “negative emission technologies” – NETs – as many of these are not new (afforestation and reforestation, AF). Still, some of the conclusions and recommendations in this report should have an application to many other NETs and so-called geoengineering technologies.

9. It needs to be considered what are the mechanisms or actions to be undertaken by the international community in order to foresee and mitigate in advance the social impacts also in human rights terms that the deployment of NTCPs may have. Apart from assessing the efficacy of the current framework and instruments what is needed are proposals to fulfil the existing gaps at both the normative and the institutional levels. A common understanding around the tools and mechanisms would allow forging a consensus around the solutions that are urgently needed. Only under such circumstances it could be affirmed that NTCPs will genuinely be “protective” as they would contribute or be directed to human rights promotion and protection.

10. In reality, technological solutions have gained traction as a *realpolitik* solution to meet the Paris Agreement commitments. Proponents claim that there is a lack of international governance framework applicable to these technologies and call for a regulatory framework that facilitates their increased use. Those who oppose the use of these technologies, advocate the opposite: the need for instituting a *moratorium* (or even a total ban) on their use until the environmental and social risks they may pose be solved.[[7]](#footnote-8)Authors argue that technologies for actual climate protection would rather include those technologies whose purpose is to address the root causes of climate change rather than its symptoms, such as renewable energy technologies and others.[[8]](#footnote-9)

II. The technological component

11. Easing the climate crisis 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 last year. According to the Paris Agreement, 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. 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.

12. 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 emissions[[9]](#footnote-10). As of today, there isn’t a single technology in operation that has a negative emission impact. Yet, in the current circumstances emission-free human existence is impossible. Therefore, some level of carbon dioxide removals (CDR), provided they become emission-negative, is necessary according to the IPCC: “the deployment of CDR to counterbalance hard-to-abate residual emissions is unavoidable if net zero CO2 or greenhouse gas (GHG) emissions are to be achieved”.[[10]](#footnote-11)

13. Yet, that holds true if “net effect of adding and subsequently subtracting a given quantity of CO2 only equals zero when there is no significant time difference between the addition and subtraction processes”[[11]](#footnote-12). Cutting emissions needs to be supplemented **simultaneously and quickly** by CDR rather than wait for hypothetical future greater CDR capabilities. By then, in a timeframe of a couple of decades, the consequences for the Earth system may be irreversible. “For those reasons, the evaluation of the potential role of CDR techniques should focus on their effectiveness in helping to reduce net emissions to zero on a shorter timescale.”

14. The slow progress in international negotiations to cut GHG emissions has led the UN Secretary General to declare that “we are on a highway to climate hell with our foot still on the accelerator” in November 2022. Large portion of the scientific community, including of the IPCC panel, believe that it may be too late to avoid a drastic rise in temperatures, which will take many human lives. If today 1% of the world is unlivably hot, that figure may grow to 19% by 2070. In the worst-case scenario in the future extreme weather conditions may force governments and/or the international community to take whatever action at hand to save lives and/or avoid turmoil including reverting to invasive technologies with not fully understood consequences. SRM is such a speculative technology – it aims to change the Earth’s energy balance at a large scale.

15. Reaching real zero emissions in the removal component requires the use of scientifically-viable technology. It is a relatively new and fast developing sector, the need for which is recognized by many states and scientific community. Yet, research on the impact of CDR technologies on human rights lags behind the speed of research, trial and implementation of these technologies per se. In the Paris Agreement process states have agreed to CO2 emission cuts and removals, and there is a large societal pressure to mitigate the climate crisis, meaning emission cuts. Large-scale international surveys find that more than 70% of respondents are concerned that the climate crisis will harm them. Pro-climate action youth movements and NGOs are growing in numbers. In several states the private sector needs to abide by government regulations to cut emissions.

16. The offset carbon market, however, allows them 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. The sense of urgency increases with new private actors, or public-private partnerships, 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.

17. 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 as “plan B” to emission cuts. 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.[[12]](#footnote-13)

Carbon Dioxide Removal (CDR)

18. Carbon Dioxide Removal technologies durably store CO2 on land, in the ocean or in geological formations[[13]](#footnote-14). They can be grouped into artificial and natural methods. Currently, natural methods,[[14]](#footnote-15) which primarily include afforestation and reforestation as the most popular one, make up 99,9% of all 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[[15]](#footnote-16).

19. Artificial methods include pre- and post-combustion Carbon Capture and Storage, Bioenergy with CCS (BECCS), Direct Air Capture (DAC), Enhanced Weathering and Ocean Fertilization. With the exception of the first three, 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, satisfy the definition of NTCPs. CDR deployment is still relatively small, making conclusions for human rights general and inconclusive. Yet, it is proven that artificial CDR currently uses resources extensively – water, land, energy – and puts pressure on environmental protection goals such as biodiversity maintenance, lesser water consumption and pollution. For example, widespread deployment of CCS to meet the 1.5C climate target would almost double anthropogenic water footprint, which would exacerbate water scarcity in many regions worldwide.[[16]](#footnote-17)

20. **Direct air capture (DAC)**. Out of artificial CDRs, DACs in particular have recently developed rapidly without equal consideration of their human rights implications, although that 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.[[17]](#footnote-18) Apart from being very expensive at the moment, DACs face biophysical constraints subject to geological storage underground, environmental side effects (see table 1.) and surface area[[18]](#footnote-19).

21.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.[[19]](#footnote-20) 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). [[20]](#footnote-21) 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 unintense 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. Not only does it have a bearing on the psychological comfort of living but can also affect tourism opportunities.

22. **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 surface area and applied to soils, open ocean and coastal zones. It has the potential to ameliorate 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.[[21]](#footnote-22) Side effects are enumerated in Table 1. 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.

23 **Ocean fertilization (OF)**. London Convention and London Protocol[[22]](#footnote-23) 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)

24. 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.”[[23]](#footnote-24)

25. 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 could 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”).[[24]](#footnote-25) There are other 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.[[25]](#footnote-26) 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.[[26]](#footnote-27)

26. SRM is ungovernable in the current state of international relations. Furthermore, one could make the claim that discussions about governing such a radical intervention in the earth’s climate take away the energy and focus from the clear and urgent current goal of putting all financial, political and social means into cutting emissions. In circumstances when loss of life will occur due to climate change, it can be assumed that a state/country with technology to stop it would use that technology. However, the argument to make in favour of SRM further research is that, in an event of global temperature rise and failed emission cuts in the future, the technology presents at the moment the only “plan B” for the planet, even if with unforeseen circumstances. Therefore, research in this direction should continue but in a complementary manner and without hindering or jeopardizing current mitigation and adaptation efforts.[[27]](#footnote-28)

III. Risks and side effects

Physical risks

27. NTCPs require extensive water, land, and energy use - none of the today known technologies currently has the capacity to create negative emissions. Some physical risks can be associated with the infrastructure itself,[[28]](#footnote-29) often non-existent yet. Specific physical risks posed by CDR NTCPs are listed in Table 1. 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 below. For example, the technological and environmental risks for DAC and enhanced weathering could exacerbate interlinkages in terms of environmental degradation and also negatively incite perceptions of social backlash or colonialist domination, which could in turn have environmental triggers.[[29]](#footnote-30)

Table 1. Positive and negative side effects of NTCPs

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| CDR Technology | Positive side effects | Negative side effects |
| **DACCS**  Potential: 0.5-5 GtCO2 yr-1  Cost: 100-300 US$/tCO2 | Business opportunities subject to a predictable CO2 price, certain applications can improve indoor air quality | CO2 penalty if high (thermal) energy demand satisfied by fossil fuels (**not NTCP**); currently high front-up capital costs; insufficiently studied; material/waste implications (the chemical footprint of the processes: production of chemicals, production of waste, and for hydroxide-based DAC, the amount of chlorine produced); spacial requirements |
| **Ocean fertilization**  Potential: extremely limited | Potential increase in fish catches, enhanced biological production | Limited potential; possible adverse impacts on marine biology and food web structure; deep water oxygen decline; changes to nutrient balance; anoxia in surface ocean; probable enhanced N2O and CH4 production |
| **Enhanced weathering**  Potential: 2-4 GtCO2 yr-1  Cost: 50-200 US$/tCO2 | 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 |

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

As for Solar Radiation Modification (see above) the possible negative physical effects can be vast: on hydrological patterns, ozone layer, biodiversity. There can be weakened food production and access – particularly for key crops.

Social and societal risks

28. All of NTCPs require land or/and have impact on land, although to a different extent. Exposure to effects on land is greater for indigenous communities, underprivileged, and certain professions: farmers, fishermen, as it is from a broader perspective in the global south. Social consequences can be uneven geographically, potentially harsher for poorer states and the global south, depending on where certain technologies are used. That may in turn strengthen persistent inequalities and risks of deepening climate injustice. Surveys show that societies around the world are not familiar with CDR nor SRM – majority of respondents. There is little familiarity, which may result in increased distrust should a technology be used at a larger scale. Already several conspiracy theories have a potential relation to NTCPs (i.e. chemtrails). 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.

Vested interests

29.Not infrequently the group of scientists and stakeholders involved in the research of a particular technology is small. According to several scientists, there is a tendency of these groups to exaggerate certainties of a technology in question, while undermining uncertainties. Vested interests in promoting technologies cannot be ruled out. When 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. Additionally, discussions about the 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 of a couple dozen thousand papers focus on nature-based CDR methods, and very few are published in social sciences or humanities journals. The scientific community working on CDR excludes social scientists both at the stage of research as well as development and implementation. Local geographical focus is lacking.

Emission cuts deterrence and ‘greenwashing’

30. Some fossil fuels extraction and production companies use carbon capture and storage technique to be able to continue their fossil fuel production. The business model even of the technology with potentially lesser negative impact on human rights – DAC – raises questions about the investors, who not infrequently are big emitters, and their intentions. Investment in these technologies may be used to improve their otherwise negative image as big GHG emitters. On the other hand, ill will cannot 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.

31. One of the largest risks that the examined technologies for climate protection pose is emissions cut deterrence, sometimes called the “moral hazard”. Civil society and Indigenous Peoples in particular point to the fact that development, investment and promotion of these technologies reduces the impetus to cut GHG emissions, which is undoubtedly the only viable solution to the climate crisis. Counting on technological removal of CO2 slows down reforms to cut emissions and diverts public attention from this utmost and primary goal, giving a false promise of a hypothetical future solution to the problem that requires immediate action now. The longer the emissions are not reduced, the more CDR will be needed if real or net zero is the goal. CDR only makes sense if the system is decarbonized (90%) and can only serve as a supplementary tool (10%) to achieve that goal.

32. The deterrence risk of new technologies for climate protection 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 (as already seen at COP-27), and by business entities, which are interested in continued emissions but can buy carbon credits by investing in these technologies. 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.[[30]](#footnote-31) Interestingly, on the individual level, when it comes to SRM, one study found that individuals who learn about aerosol injection do not reduce their mitigation efforts but rather increase them. They do not do it out of belief in the technology, but vice versa - out of fear of it.

33. Another cluster of risks pertains to the carbon markets and carbon credits, used to offset emissions. Majority of these credits are investment in projects that prevent deforestation or promote reforestation or afforestation. However, the portion of carbon offsets from artificial CDR technologies is growing. Overall demand for credits has become larger than supply. There are initiatives (i.e. CSS+) to create methodology to allow offsetting emissions with the scaled-up CSS projects. The offset market is unregulated, the credits sold do not meet efficiency goals or, simply, do not contribute to emissions reductions at all. 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 avoided. If the situation persists, it will not only work against emission cuts but expand venues for greenwashing, misinformation, and social distrust of these technologies. Currently, major emitters already put offsetting at the heart of their climate strategies rather than reduce emissions.

Other ethical risks

34. Betting on NTCPs, which are unproven at large scale, may create climate-related harms in the future if these technologies prove not as efficient as current assumptions. If the gamble fails, future generations and the poorest 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 human ability to understand complex natural 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.

Political and security risks

35. Climate action, apart from the almost universally accepted notion of the global north being responsible for overwhelming majority of historical GHG emissions, has not been a subject of political conflict. With the usage of NTCPs it can change, when countries begin unilateral large-scale investments or take unilateral action that can transgress boundaries.[[31]](#footnote-32) Climate engineering risks ‘securitizing’ climate politics. Currently emissions are known to be harmful but there is no intended harm.[[32]](#footnote-33) SRM projects would be intentional and therefore could be seen as deliberate and political acts of aggression. Hostile use of weather-modification technologies is prohibited by the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques. If the climate becomes a tool an actor can use against another actor, it could radically change climate politics. It would also be a challenge to political systems. An esteemed environmentalist James Lovelock warned that climate change meant that it may be necessary to “put democracy on hold”. Like nuclear weapons, the use of SRM could bring about an unknown political and social order, dividing states into climate interventionist and non-interventionist. The cascading distribution of harms and benefits resulting from SRM in particular would potentially be global. SRM proponents recommend a well-structured global governance of this technology, but an international agreement on the usage of such a controversial a technique in the current political circumstances borders on the impossible.

IV. Applicable framework

36. Human rights considerations have not been explicitly included in most of the treaties dealing with climate change or environment. This “original sin” was soon purged as the interdependency between the human and the environment is undisputable. Environmental conditions are essential for human existence so everyone has a fundamental right to live in an environment that permits a life of dignity and well-being.[[33]](#footnote-34) Connections between the human rights regime and environmental protection have been developed by human rights monitoring bodies. Increasingly these bodies are interpreting the human rights obligations in light of the environmental commitments. At the same time, individuals are granted new procedural means to enforce environmental justice while at the same time preventing that human rights violations, particularly of the most vulnerable, be justified on behalf of the “climate emergency”.[[34]](#footnote-35)

37. Pressure to resort to “technological emergency strategies” without certainty of the results and impacts may be counterproductive. It holds true in a scenario, where the use of speculative technologies is being proposed as a matter of “force major”. The acceptance of a technology as “plan B” (if plan A – cutting emissions – fails) may imply large and uncertain environmental and human rights risks. It is clear that existing human rights **norms and standards on state of emergency do not permit overriding protections**, in particular those that apply to the right to health, which is intimately connected with the right to life. Moreover, the principle of proportionality would compel States to use those alternatives that carry fewer human rights risks, also bearing in mind the transboundary effects and implications. In light of these risks, including transboundary risks and the existence of alternative responses to the threat of climate change, it is not apparent that deployment of NTCPs meets the strict requirements for recourse to emergency powers, which derogate from human rights protections.[[35]](#footnote-36) It appears doubtful that a State would, consistent with its obligations under international law, be completely free to adopt and apply far-reaching unilateral emergency powers legislation in order to justify being able to proceed to authorise and carry out climate engineering activities.[[36]](#footnote-37) The principles of legality, necessity and proportionality will enter into play and will be scrutinized in case of a misuse of extraordinary powers to face the “climate emergency”.[[37]](#footnote-38) The right to life offers a particularly strong protection as it is not subject to derogation. Principles of free, prior and informed consent and public participation and transparency are also relevant.

38. The relevance of human rights in the context of climate change policymaking had not been explicitly recognized until 2015. The UN Framework Convention on Climate Change (UNFCCC) is the first treaty that explicitly recognizes it, in its preamble, by stating that States Parties in this context should “respect, promote and consider their respective obligations on human rights”[[38]](#footnote-39). The Paris Agreement provides the most comprehensive international framework for a coordinated and collective response to climate change.[[39]](#footnote-40) Its universal application provides a good proof of the importance that the international community attaches to this common cause as well as the need for preserving a broad consensus around the implementation of the landmark treaty.[[40]](#footnote-41)

39. NTCPs are not explicitly mentioned by the Paris Agreement, which nevertheless privileges the realization of technology development by providing a framework aimed at “improving resilience to climate change” and “reducing GHG emissions”. These are precisely the goals, which States actions should target primarily.[[41]](#footnote-42) The need to assess the potential human rights impacts of climate change responses remains particularly pertinent in the context of the potential deployment of NTCPs.[[42]](#footnote-43) Here, the reminder about human rights obligations included in the preamble acquires all its relevance and should be taken into account by policy and decision makers.

40. This report seeks to contribute to the process of operationalization of these obligations into standards and measures to be embedded in legislation and policies related to climate change. Identifying such norms and standards is of utmost importance given that there is no specific international treaty or regime addressing these climate change-related emerging technologies. Several UN special procedures have already expressed their concerns regarding the human rights impact of these technologies while highlighting both States’ obligations and businesses’ responsibilities in this respect.[[43]](#footnote-44) The IPCC has warned against overreliance on unproven technologies that could disrupt natural systems and disproportionately harm Global South communities. In the achievement of climate change goals, States have both positive and negative obligations. In the absence of a specific regulation or treaty, the content of these obligations is to be drawn bearing in mind the framework and the objectives set forth by the Paris Agreement, which should be implemented in light of the relevant human rights and environmental protection regimes.

Restrictions to the development and deployment of NTCPs

41. Until now international bodies have been rather cautious about the technological solutions that do not offer a solid scientific base. It can be assumed that human rights and socio-economic considerations were part of the decision-making process and that the risk of impacting the life, health and livelihood overweigh the perceived potential benefits. In the context of the treaties on environmental protection (MEAs)[[44]](#footnote-45) the development and deployment of certain technologies have been regulated or restricted due to the uncertainties regarding their effectiveness and potential negative impacts.

42. The framework of the 1992 UN Convention on Biological Diversity (CBD) for example, used the opportunity of analysing potential benefits of resorting to certain novel technologies.[[45]](#footnote-46) A first decision was adopted by the Conference of the Parties (COP) in 2010 and proposed a broad restriction on all climate-related technologies capable of affecting biodiversity.[[46]](#footnote-47) The specific proposal of prohibiting SRM techniques, such as the release of stratospheric aerosols and cloud whitening, until all risks and impacts have been thoroughly assessed was ratified by the States parties in 2016.[[47]](#footnote-48) They referred to need for more interdisciplinary research and greater knowledge-sharing to better understand the impacts and regulatory options. The IPCC has acknowledged that arrangements for the governance of these technologies are being considered under the CBD, where an international governance mechanism for research and development of a form of ocean fertilization (EDC) already exists. In this sense, the Subsidiary Body for Scientific and Technological Advice (SBSTA) is considered to offer possibilities.

43. In one specific case of ocean fertilization, the Scientific Group of the London Convention and Protocol said in 2008 that so far there is “insufficient scientific evidence to determine whether ocean fertilization activities would or would not pose significant risks of harm to the marine environment.”[[48]](#footnote-49) Non-binding decisions were adopted in the context of the London Convention and London Protocol and CBD. In October 2008 Contracting Parties to the Convention and the Protocol adopted Resolution LC-LP.1 on the Regulation of Ocean Fertilization (LC 30/16, Annex 6). It allowed for legitimate scientific research to proceed but placed a moratorium on other ocean fertilization activities.[[49]](#footnote-50) An integrated and coordinated response from the relevant international organizations/bodies is required to ensure that ocean fertilization activities do not jeopardize human health or breach the protection, conservation and sustainable management of the marine environment or living resources.[[50]](#footnote-51)

44. Contracting Parties to London Protocol also opted for different regulatory approaches with regard to CO2 sequestration and ocean fertilization. Whereas for the first research and deployment were regulated as generally permissible (following assessment of their environmental impact), in the case of ocean fertilization deployment was prohibited and research was put under control. The decisive difference was the level of uncertainty and of potential detrimental effects. **The regulatory approach to only allow research (after assessment of the effects) and to prohibit deployment is recommendable** if major uncertainties exist. Projects can thus be conducted to increase knowledge without significant risks to the marine environment.[[51]](#footnote-52)

45. The 1978 Convention on the Prohibition of the Use of Environmental Modification Techniques for Military or Other Hostile Purposes (ENMOD Convention) is an instrument of international disarmament law related specifically to the protection of the environment in the event of hostilities. This instrument includes “all techniques that are intended to alter - through deliberate manipulation - the natural processes, dynamics, composition or structure of the Earth, including its biotics, its biosphere, its lithosphere, its hydrosphere and its atmosphere or of outer space”. Even if it only contemplates the possibility of damaging the environment when done by a military instrument, it is clear that this prohibition reflects the concerns of the international community with regard the use of these techniques.[[52]](#footnote-53)

46. **The *rationale* and arguments underlying these decisions and instruments − which are equal to a *de* *facto moratorium −* should be taken into account when considering the development or deployment of NTCPs**. It may be actually argued that these provisions reflect fundamental principles laid down in other international environmental treaties and in customary law particularly the principle of due diligence which entails a precautionary approach when considering the development and use of speculative technologies.[[53]](#footnote-54)

National legislation and business regulations

47. National legislation and practice regarding business regulations are also contributing to the development of the regulatory framework applicable to NTCPs.[[54]](#footnote-55) Currently, there are more than a thousand climate engineering projects around the world being developed and implemented, mostly in Europe, North America and Asia. For example, in the case of the U.S. National Environmental Policy Act is applicable in the context of CCS because many of these and resulting pipeline projects, occur on federal and Tribal lands or require federal agency approval or financial assistance. Required environmental impact statements are only informational, non-biding tools but they are important for public participation, transparency, information sharing, and decision making. US department of Energy admitted that “the lack of robust and standardized monitoring, reporting and verification (MRV) practices to quantify and compare CDR solutions, including direct air capture, for net greenhouse gas removals in an apples-to-apples manner is a market formation bottleneck impeding the ability to commercialize promising new CDR technologies.”[[55]](#footnote-56)

48. Another example of national relevant legislation for the unfulfilled SCoPEx experiment in Tucson, Arizona (see below) is U.S. Federal law (National Weather Modification Policy Act of 1976), which stipulates that any modification of the weather is required to be reported to the National Oceanic and Atmospheric Administration, and the results of research must be made public. The O’odham Nation live in the area, where the experiment was to be run, and, under US law, tribal governments exercise extra-constitutional sovereignty over traditional territories. The sovereign rights are a legally emerging are but several federal entities have signed Memoranda of Understanding with the tribal governments about their use of O’odham airspace, acknowledging their special rights to it.[[56]](#footnote-57)

49. In December 2022 European Commission adopted a proposal for a first EU-wide voluntary framework to reliably certify high-quality carbon removals. The proposal sets out rules for independent verification of carbon removals, as well as rules to recognise certification plans that can be used to demonstrate compliance with the EU framework. To ensure the quality and comparability of carbon removals, the proposed regulation establishes four criteria: quantification (CDR activities need to be accurately measured and deliver unambiguous benefits for the climate); additionality (CDR activities need to go beyond existing practices and what is required by law); long-term storage (certificates are linked to the duration of carbon storage so as to ensure permanent storage); sustainability (CDR activities must preserve or contribute to sustainability objectives such as climate change adaptation, circular economy, water and marine resources, and biodiversity). The proposal aims to accelerate the deployment of high-quality CDR, build trust with stakeholders and industry by countering greenwashing, and enable a wide variety of financing options. However, it will not be possible to use the certified CDR for compliance with the EU Emission Trading System. Experts point to the problem of lacking monitoring, reporting and verification (MRV) and accounting gaps for many CDR methods in EU policies. There is no objective mechanism to monitor what is in fact being stored and in what quantities – an independent monitoring infrastructure is needed and a form of registry.

50. The CDR business models are not transparent. Removing carbon solely is not a production of goods that has intuitive customers. Governments who make international pledges can be customers but also companies that are already large emitters. Often CDR methods are coupled with production (not NTCPs). Good will cannot be assumed although it should not be discarded altogether. For example, one DAC project was financed by the EU in its initial phase but when it required larger investments the developers turned to private investors and individuals. To speed up the development of CDR technologies advance market commitments (AMCs) have been established.[[57]](#footnote-58) Through such mechanisms buyers (companies) promise to buy a certain amount of captured carbon in the future once a technology is available and meets certain conditions, such as durability, low cost, net negativity, environmental safety. Even if it is a potentially efficient way to scale up the least risky technologies (DACs without EOR), already companies with dubious human rights record have partnered in these endeavours.

51. Strong policy and private sector guardrails are needed to ensure countries and companies do not over-rely on carbon removal at the expense of emissions reductions. For example, the Science Based Target initiative’s recent net-zero guidance requires companies to meet their climate targets by reducing more than 90% of their own emissions and using carbon removal to compensate for only the remaining 5-10% that they cannot directly mitigate.

Principled approach

52. In the absence of a legal treaty or regulations decision and policy makers should follow a principled approach in order to ensure human rights and environmental protection in situations where there is a risk that speculative technologies have uncertain or uncontrolled impacts. In addressing the technical and political choices to be made, States will need to anchor their decisions in the existing international environmental and human rights regimes. Having a common goal - protecting the human being and the environment - the connection between these norms is increasingly reflected by practice. Decisions in this field should also be coherent with the global strategies and policies on climate change that are being adopted at the multilateral level. The deployment and use of any technology is currently supervised by national bodies that also assess the potential risks or impacts. The States “duty of due diligence” requires that State’s policies and decisions be taken on the basis of the general principles of precaution and prevention of harm. Risks assessments are important tools to ensure that human rights are respected, and that States adopt protective measures to face human rights risks. Because of the speculative character of some NTCPs assessments need to be adjusted to the particular features and risks attached to such technologies.

Duty to protect human rights

53. Under international law States have the general obligation to demonstrate due diligence which, in the context of human rights violations means that a state must take action to prevent human rights violations, and to investigate, prosecute and punish them when they occur. This obligation applies even in the lack of a specific prohibition and comprises the failure or omission to take preventive or protective action from human rights and environmental risks. Under this general approach, the State’s duty to protect human rights includes protecting against human rights abuses involving companies developing NTPCs. Moreover, States should ensure that they have the necessary policy coherence—as well as capacity and ability—to effectively protect people against harms from technology companies. The need for policy coherence extends to States participating in multilateral fora and multi-stakeholder processes which are essential tools in ensuring the international legitimacy, coherence and effectiveness of State action.[[58]](#footnote-59)

54. Even if there is a need to develop more effective regulatory and policy responses to the risks associated with NTCPs, it is clear that States should adopt appropriate measures to prevent and address human rights abuses involving business and including technology companies. This duty is anchored in States’ existing human rights obligations and elaborates on the legal, policy and other measures States should adopt to protect people from harm. According the 2011 UN Guiding Principles on Business and Human Rights also business has to demonstrate a due diligence and therefore has responsibilities concerning the adverse impacts on human rights that it causes, contributes to or to which it is directly linked. Protection in light of due diligence encompasses prevention, regulation, monitoring, sanctioning and remedies.

Precautionary principle

55. Scientific uncertainty as to some of the risks posed by these technologies and the impacts of their use at the global level on complex planetary systems and the irreversibility of those potential impacts make the precautionary principle particularly relevant. At the international level, the precautionary principle was first endorsed in the 1982 UN Charter for Nature, and later 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 UN Convention on Biological Diversity, adopted in 1992, encapsulates the precautionary principle, without directly naming it, in its preamble: ‘Noting also that where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat’. Article 3.3 of the 1992 United Nations Framework Convention on Climate Change required States, among the principles, to ‘take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects’. [[59]](#footnote-60)Similarly, in 2000, States parties to the Convention on Biological Diversity agreed on the Cartagena Protocol on Biosafety; according to its provisions, States can refuse imports of modified organisms where scientific certainty is lacking, in order to avoid or minimize their adverse effects.[[60]](#footnote-61)

56. The European Environment Agency provided a working definition of the precautionary 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.”[[61]](#footnote-62) Whether a given technological option for mitigating climate change should be pursued in spite of scientific uncertainty regarding its impacts must be evaluated against alternative options, including those about which there is more scientific certainly. In the event that there is a total or partial governance gap, precaution is potentially legally significant in weighting alternatives, so that less uncertain and or risky alternatives (*moratorium* on fossil fuel extraction) might be recognized as preferable, being the less potentially harmful option.

Prevention of harm

57. Human rights obligations also provide a framework to prevent environmental transboundary harms that can result in violations of the right to life or the right to property among others. The Human Rights Committee has stated in this regard that the State bears responsibilities to ensure the right to life of individuals outside its territory, whose right to life is nonetheless impacted by its activities in “a direct and reasonably foreseeable manner”. However, the responsibility of States in extraterritorial cases presents some new challenges when it comes to climate change.[[62]](#footnote-63) NTCPs may cause damage to the environment of other States or to areas beyond the limits of national jurisdiction, including the atmosphere and the high seas, and therefore to the right to a safe, clean, healthy and sustainable environment. In case of a risk of significant transboundary harm States have also obligations of procedural character, the obligation of carrying out an ex ante environmental impact assessment and that to notify and to consult and negotiate in good faith with the potentially affected States or populations.[[63]](#footnote-64) In its important Advisory Opinion, the Inter-American Court of Human Rights set the legal basis for putting responsibility of the transboundary environmental damage on States holding effective control over the activities causing such harm as well as over the ensuing human rights violations.

In dubio pro natura (when in doubt, favour environment)

58. This maxim means that, when in doubt as to whether an activity harmful to the environment should proceed, the doubt should be resolved in favour of protecting the environment.[[64]](#footnote-65) In cases of doubt, all matters before courts, administrative agencies, and other decision-makers shall be resolved in a way most likely to favour the protection and conservation of the environment, with preference to be given to alternatives that are least harmful to it. The premise for the application of the precautionary principle is a situation of scientific incertitude and the need to avoid environmental degradation. This is not necessarily the case for the *in dubio pro natura* principle, which can be used even absent scientific incertitude and is not necessarily related to potential environmental degradation. It can be used as a means of interpretation of existing laws, whose application might be dubious in terms of impact on the environment, or as an instrument to solve conflicts of interests in favour of the protection of nature, or to shift the burden of proof in environmental disputes. This principle therefore must be distinguished from the precautionary principle’s evolving practice at national level as it locates the debate in the more general attitude of certain States to protecting and putting nature at the core of the legal reasoning.

59. The Climate Change Framework Law (Decree 7-2013) of Guatemala expressly refers to these principles in article 6 relating to those applicable to environmental matters and that must be observed by all entities when making decisions and acting in their respective areas of competence. a) "In dubio, Pro natura" - principle of action for the benefit of the environment and nature requiring that when in doubt that an action or omission may affect the environment or natural resources, the decisions taken must be for the purpose to protect them. b) "Precaution"- precautionary measures will be taken to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there is a threat of serious or irreversible harm, the lack of complete scientific certainty should not be used as a reason to postpone such measures. c) Whoever pollutes pays and rehabilitates. Principle that requires that once the damage caused has been established, the person responsible is obliged to compensate it. The individual or legal person responsible for the contamination is obliged to bear the costs of remediation and rehabilitation, taking into account the public interest.

V. Assessing the human rights impact

60. The question is what are the concrete human rights that would be mostly impacted by NTCPs, to what extent States can undertake measures to palliate or mitigate negative impacts and what instruments are at the disposal of individuals to be part of this process or to defend their rights against potential violations as well as preventive measures that can be enacted in order to prevent violations against potential responses to climate change.

Human rights assessments

61. Human rights bodies and organizations have underlined the importance of undertaking assessments of actions designed to alleviate the effects of climate change.[[65]](#footnote-66) Authors have in this sense advanced ideas on how human rights assessments could be implemented for emerging high-risk technologies. These protocols would allow assessing whether policies, legislation, projects and programmes are compliant with human rights obligations and should: a) identify rights-holders and duty bearers, and develop relevant indicators to use in this process with a view of assessing potential impacts and their relevance particularly in relation to marginalized groups; b) an independent evidence gathering process to feed the assessment of the potential impacts of deployment; c) ex-ante deliberative process (public consultation) to identify specific concerns. [[66]](#footnote-67)

62. It is clear that in the context of NTCPs human rights assessments may be extremely complex and that is why they should be implemented by specific bodies composed of technical and independent human rights experts. It has been suggested to establish a human rights subsidiary body under the Paris Agreement,[[67]](#footnote-68) and new possibilities, relying on the existing human rights institutional network, still need to be explored.

Impact on specific rights

63. There is an important range of human rights that potentially could be negatively impacted by the deployment of speculative NTCPs. The role of environmental procedural rights is particularly prominent in this field.

Right to life and to right to health

64. The use of some NTCPs can further perpetuate the threats that climate change poses to the right to life.[[68]](#footnote-69)  Their impact on access to food and water will have also adverse impacts on the right to health. The Human Rights Committee, for example, has stated that human rights law and environmental law are to be interpreted and applied in a mutually informed way. The right to life should inform State obligations under international environmental law and vice-versa.[[69]](#footnote-70)

Right to a safe, clean, healthy and sustainable environment

65. The right to a healthy environment is particularly threatened by some of NTCPs due to their potentially catastrophic effects on weather patterns, biodiversity and ecosystems as a whole. The anticipated diversion of efforts and resources from a rapid phasing out of fossil fuels would have major effects on the environment, and could amount to a violation of the right to a healthy environment.[[70]](#footnote-71) The 2018 framework principles on human rights and the environment drafted by the UN Special Rapporteur on the issue of human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment are relevant in this regard and reflect the increasing relationship between human rights and the environment.[[71]](#footnote-72) In 2019 the Rapporteur clarified both State’s obligations and businesses responsibilities in this respect. He specifically referred to “some proposed geoengineering strategies to mitigate climate change” saying that they “involve the large-scale manipulation of natural systems through measures such as fertilizing the oceans with iron, installing mirrors in outer space to reflect solar radiation, or shooting aerosols into the atmosphere (imitating the effects of large volcanic eruptions. These untested technological approaches could have massive impacts on human rights, severely disrupting ocean and terrestrial ecosystems, interfering with food production and harming biodiversity.” He underscored that these types of geoengineering strategies should not be used until their implications are much better understood.[[72]](#footnote-73)

Right to food and water

66. States must take necessary actions to ensure freedom from hunger and access to adequate food even in times of natural or other disasters. At the same time, this implies that they should refrain from actions that imperil the livelihood of people. Particularly 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. SRM can also reduce the availability of fresh water on islands that already face severe constriction of their water resources[[73]](#footnote-74). Because of the massive water demands of these technologies, they are likely to affect the availability of potable water. The potential termination shock effect could undermine food production globally, but specifically in vulnerable areas in the Global South.[[74]](#footnote-75)

Right to a safe climate system of future generations

67. The rights of future generations might also be violated as a result of the use of these technologies. The risk is that the decisions of deploying these hazardous technologies today will lock them in a pathway that might be irreversible as a consequence of the termination shock effect. As it has been observed “promoting high-risk, still mostly underdeveloped, irreversible technologies in response to the climate crisis when effective, safe and immediately deployable climate protection measures are available is in direct contradiction to intergenerational equity and the rights of future generations.” The Human Rights Committee, in 2019 considered that “future generations, including the children named in the complaint, have a fundamental right to a stable climate system capable of sustaining human life, based on the right of the child to a healthy environment”. With respect to article 24 of the Covenant, the principle of intergenerational equity places a “duty on current generations to act as responsible stewards of the planet and ensure the rights of future generations to meet their developmental and environmental needs. (...) environmental degradation, climate change and unsustainable development constitute some of the most pressing and serious threats to the ability of present and future generations to enjoy the right to life.[[75]](#footnote-76)

Procedural rights and access to justice

68. States have also positive obligations relating to good governance and democratic accountability. The 1998 Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters was adopted on 25 June (Aarhus Convention) is founded on the principles of participative democracy and aims at empower the role of citizens and civil society organisations in environmental matters.[[76]](#footnote-77) It provides for: a) the right of the citizens to receive environmental information that is held by public authorities; b) the right of the citizens to participate in preparing plans, programmes, policies, and legislation that may affect the environment; c) the right of the citizens to have access to review procedures when their rights with respect to access to information or public participation have been violated. 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).[[77]](#footnote-78)

Right to information ant to public participation

69. The right to participation is also entrenched in the United Nations Framework  
Convention on Climate Change. Article 6 establishes that all parties to the Convention 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 General Assembly 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, and that indigenous peoples are important for effective action on all aspects of climate change.[[78]](#footnote-79)

Indigenous communities make up about 5% of the global population but are guardians of about 80% of biodiversity. Their connection with the environment often constitutes their cultures, ways of being and serves as guidance for societies’ sustainable, equitable and harmonious existence in nature. They bear the brunt not only of climate change but also of misplaced climate policies and unregulated carbon markets. They have not been systematically involved in technological planning, nor consulted in implementation.[[79]](#footnote-80)

70. Being among the most affected groups by climate change, for decades, indigenous peoples have been struggling for greater protection of their human rights and increased participation in the international discussions on climate change.[[80]](#footnote-81) The potential of indigenous peoples to assist in providing solutions to mitigate and adapt to the effects of climate change must be highlighted.[[81]](#footnote-82) The IPCC has recognized that “indigenous, local, and traditional knowledge systems and practices, including indigenous peoples’ holistic view of community and environment, are a major resource for adapting to climate change”.[[82]](#footnote-83) Integrating indigenous traditional knowledge with existing practices would increase the effectiveness of existing adaptation efforts.

Right to a free, prior, informed consent

71. This right has been developed in connection with indigenous peoples.[[83]](#footnote-84) Article 19 of the 2007 UN Declaration on Indigenous Peoples requires that States to consult and cooperate in good faith with the indigenous peoples concerned through their own representative institutions in order to obtain their free, prior and informed consent before adopting and implementing legislative or administrative measures that may affect them. States must have consent before the adoption of legislation or administrative policies that affect indigenous peoples. In accordance with article 32 such consent must be also given before undertaking of projects that affect indigenous peoples’ rights to land, territory and resources, including mining and other utilization or exploitation of resources. Experience shows that this requirement has been very often ignored. Collective organization and awareness of Indigenous Peoples is however increasing their capacity to influence decisions on climate issues, also in relation to NTCPs.

72. 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 (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” [[84]](#footnote-85). However, there had not been any consultations with local communities conducted prior to the experiment, nor had they been informed if it.

73. Through indigenous communities channels the Saami Council learned of the plans for the experiment in Sápmi, Saami land, and previous unrealized SCoPEx attempts in the United States. In 2018 there was a field test to be conducted in Tucson, Arizona, which did not materialize. Indigenous communities opposed to it[[85]](#footnote-86), which might have been the reason for stopping the test then. 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.”[[86]](#footnote-87) The letter did not focus on physical risks of SRM but on the problematic ethics, responsibility and decision making, and – predominantly on the risk of deterring the necessary climate action: “powerful measures for a rapid and just transition to zero emission societies, 100% renewable energy and shutdown of the fossil fuel industry”[[87]](#footnote-88). The Saami are of high opinion of the public Swedish Space Corporation, which in their words is well esteemed and conducts high quality space research. Their facility in Kiruna wanted to know the Saami position and explained their own. Upon learning of the Saami opposition to the test the facility informed them of the Corporation’s withdrawal from the experiment, although it remains unclear whether it was the decision of the Swedish Space Corporation or the SCoPEx advisory committee. The case study shows lack of consideration for Indigenous Peoples and local communities opinions in SRM (potentially other NTCPs) field tests, the need for free, prior and informed consent from local communities, lack of broader consultations with the government, local authorities, civil and scientific society.

74. The contribution of indigenous peoples to the development of a human rights-based approach to climate change has to be recognized[[88]](#footnote-89). The practical implementation of the right to be consulted and to a free, prior and informed consent may lead to the extension of this framework to other groups, such as migrants, peasants and marginalized socio-economic groups. Such groups may be particularly exposed to the negative effects attached to the use of these emerging technologies, including at the experimental or testing stage and should have a say to effectively determine decision-making that has an impact on them.[[89]](#footnote-90)

Impact on specific groups: the Indigenous People’s case

75. States should take additional measures to protect the rights of those who are most vulnerable to, or at particular risk from, environmental harms, taking into account their needs, risks and capacities.[[90]](#footnote-91) Consulted indigenous representatives and experts expressed major concerns regarding the massive and disproportionate impact that the potential deployment of these technologies in their territories would have on their rights. Among the key rights affected are self-determination; the right to development; free, prior and informed consent and the right to participation; land rights; the rights to health, food, water and an adequate standard of living; and cultural rights. They consider that their traditional lands and territories are particularly exposed and at risk of experimental uses.[[91]](#footnote-92) The use of such emerging technologies may violate other substantial rights of indigenous peoples as they will expose them to forced displacement and migration, deprivation of their lands through land-use changes or weather pattern changes and changes to their agricultural opportunities.

76. The vulnerability of indigenous peoples to human rights violations and abuses has been sufficiently proven in the past and well reported by human rights monitoring mechanisms. Mitigation projects affecting their rights have been often implemented in violation of their consultation right. With regard to the use of new technologies responding to climate change concerns they refer mainly to Bio-Energy with Carbon Capture Storage (BECCS), due to the significant risks they pose to the right to food and the right of peoples not to be deprived of their means of subsistence. Other technologies could disrupt entire ecosystems with widespread negative implications for the enjoyment of human rights.[[92]](#footnote-93) It is also claimed that the “political decision-making around these technologies poses particular risks to the right to information, the right to self-determination and the right to free, prior and informed consent of indigenous peoples”.[[93]](#footnote-94) It must be recalled in this context that, under human rights law, States have a duty to protect indigenous peoples as rights holders against any foreseeable environmental impairment of human rights. This obligation applies even when the harm is not directly caused by the State and independently on whether the particular environmental harm violates human rights law.[[94]](#footnote-95)

VI. Building-up a protective framework

77. The above-mentioned risks of negative impact on human rights would put on States the obligation of referring in the first place to the actual climate protection technologies and strategies capable of addressing the root causes of climate change while correcting inequalities and to those that are readily available.

Global south and racial contexts

78. Scientists from the global south show ambivalence towards CDR and SRM technologies, although no research until now has tested their positions towards specific techniques or NTCPs. Neither there has been one conducted among experts from the Pacific, south Asia, Latin America, nor sub-Saharan Africa. In a small study among South Asian experts some support natural-based CDR research and deployment but are cautious about SRM and artificial CDR research and deployment. [[95]](#footnote-96) These positions can be attributed to the usage of the word “natural” as more acceptable than “technological” or “technocratic” and to the salience of Southeast Asia’s agriculture, forestry, and coastal sectors as well as the experts’ individual lived experiences. The study is of relevance because South Asian countries have been exposed to dire consequences of climate change, represent heterogeneous social, political, and economic situations (poverty, maldevelopment, power imbalances, and violent conflicts) and their voices have not been sufficiently present neither in scientific production nor public debates on the topic. They underline the need to rethink existing development paradigms, climate justice for the poor and vulnerable people, international cooperation, and education. They would welcome research on these technologies, their risks and impacts, but also identify critical barriers in development and funding.[[96]](#footnote-97)

79. In the October 2022 Report of the Special Rapporteur on contemporary forms of racism, racial discrimination, xenophobia and related intolerance on ecological crisis climate justice and racial justice, it is noted that “carbon capture programmes are launched in places already overburdened by the heavy concentration of toxic industrial pollution. These places overlap with the “racial sacrifice zones” described. This trend is especially concerning because carbon capture can increase the emission of harmful air pollutants at the site of capture because of the increased energy required to power the capture equipment and the chemicals used in the process.“ The report also notes that “experts have described the operation of international climate institutions as a form of indirect colonization. Projects are often envisioned and directed by international institutions that tend to privilege Global North perspectives over Global South contributions.[[97]](#footnote-98)”

Operationalizing human rights approach and assessments

80. One important question is whether a more institutionalized framework to carry-out human rights standardized assessments in order to determine if emerging technologies are human rights compliant and mitigate potential impacts is possible.

Enforcing procedural environmental rights

81. A lack of protection of instrumental or procedural rights today (consultation, consent, participation, access to justice, education), in the long run, could lead to violations of more fundamental rights (right to life, food, safe environment, health) at a large scale. The occurrence of such violations with further impact on the rights of future generations would contribute to international and national instability.

Governance framework

82. To avoid this scenario and tackle this global challenge, there is a need of forging a common understanding on the solutions and frameworks that are required to address human rights violations in the context of the response to climate change. Human rights approach should be also embedded in the process of building-up the governance framework that is urgently needed to tackle this global issue. Only multilateral intergovernmental bodies, such as the IPCC, should be tasked with recommending future climate mitigation or adaptation strategies and policies. Relevant decisions in this field need to be taken by multilateral international bodies tasked and endowed by the international community as a whole with such competences. They must be representative and act in accordance with the requested standards of democracy, transparency, independency and objectivity,[[98]](#footnote-99)

Enhancing inclusive representation

83. 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”. 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”. This right is specifically recognized to indigenous peoples. They have a right to free, prior and informed consent to effectively determine decision-making that has an impact on them or their territories.

Fostering policies to protect vulnerable people from climate change

84. International human rights framework offers an enhanced protection to vulnerable groups. According to the IPCC, the poorest people are those who will continue to experience the worst effects of climate change. This includes human rights impacts such as lost income and livelihood opportunities, displacement, hunger and adverse health impacts. Persons with disabilities suffer from disproportionately higher rates of morbidity and mortality in emergencies, and face challenges in accessing emergency support. Climate and environmental change can affect their access to safe drinking water and sanitation, food and nutrition, and health-care services and medicines. These events can also negatively impact the enjoyment of their rights to education, adequate housing and access to decent work and will be amplified in the case of small island developing countries.[[99]](#footnote-100) It remains within a complex risk-risk assessment as to how NTCPs (provided they indeed abate the effects of climate change) with their own specific risks add to or dimmish the risks of climate change to the vulnerable.

VII. Conclusions

85. The climate crisis is unfolding in an international environment ridden by multilayered hostilities: global and regional rivalries, military conflicts, civil wars, deep societal polarization. Human rights, international law and the rule of law, in general, are eroding. Inequalities are constantly rising, while solely profit-driven business model dominates in the global economy. Many corporations’ wealth surpasses state budgets. Technological innovations have improved many people’s lives in terms of connectivity and participation but are happening at such quick a pace that they also cause exclusion and provide tools for societal control. When combined with social polarization and the spread of misinformation they are sometimes met with distrust. In those global circumstances, despite an urgent need for collaboration, more divisions and hostilities are to be expected. New and future global challenges will become politically problematic and will be used for conflict rather than cooperation. Peaceful and rational international relations should not be expected.

86. The conflict-ridden global relations do not allow to assume that introduction of climate engineering would lessen conflicts and help abate climate change. Vice versa, it would more likely exacerbate conflicts, negatively impacting human rights. Assuming a catastrophic scenario of dramatic increase in earth temperature and the possibility of a mass loss of life, states most likely will use unilateral actions regardless of international legal obligations.

87. If climate change leads to loss of life and curtails the enjoyment of a number of human rights it must be mitigated as an urgent priority. The dominant, logical, and scientifically proven method of mitigation requires immediate GHG emission cuts. If the Paris Agreement goals are to be met, in most scenarios these cuts need to be supplemented by CDR technologies. Recent reports point to the insufficient development of CDR and the gap between what is needed to meet the Paris goals and the state of CDR, concluding that closing that gap requires rapid development of novel CDR. Therefore, it can be argued that their development is desirable and necessary to protect and safe lives. But this needs to be primarily realized through GHG emission cuts, and **CDR must only be a supplemental, immediate and small portion of climate change abating efforts**.[[100]](#footnote-101)

88. If near-term emission reductions follow the pathways suggested by current nationally determined contributions (NDCs) there will be a fundamental dependence on negative emissions by 2030 in 2 ◦C scenarios. Yet, it is crucial in light of prevailing uncertainties surrounding all negative emission technologies, including NTCPs, to keep the dependence on them for achieving the climate targets as small as possible.[[101]](#footnote-102)

89. New CDR technologies for climate protection are only theoretically emissions negative. None of the currently implemented projects captures more GHG than the process that leads to their development and the energy requirements for their operation emits. Out of all NTCPs DACs (without EOR and uncoupled with any production process) present the fewest risks to human rights, but they are still unscaled, economically inefficient and require an independent MRV framework. SRM is a qualitatively completely different technology and, given proven and possible risks that it poses, it may, under strictly defined circumstances, only be called a NTCP in a future scenario when the current climate policies of cutting emissions will have failed.

90. None of the technologies currently in development and use are implemented at scale to counteract climate change. Some have the potential to be used at scale if their energy and cost effectiveness raises but most probably it will not be the case in the next few years. All NTCPs need to be assessed within the timeframe of two, three decades to come if they are taken as supplementary to GHG emission cuts. If emissions are not cut there will be a growing need for NTCPs with growing unpredictable consequences of their use, such as SAI. Nobel laureate in chemistry Paul Crutzen, known for being the scientific mastermind behind stopping the depletion of the ozone later, famously wrote in 2006 that climate engineering is the most effective way of stopping global warming but strongly cautioned against its their use in 2014. The failure to design and implement effective and equitable mitigation plans that will rapidly achieve ambitious emission reduction targets is inconsistent with the obligation of States to protect human rights from grave and foreseeable risks.[[102]](#footnote-103)

91. The effect of NTCPs on climate is very hard to assess due to interconnectedness of a variety of factors and the cascading effect of risks and benefits. Often science is inconclusive about these technologies and the assessment is a work in progress and – at a maximum – can be made at local level and with regard to a single kind of technology. Even if scientific uncertainly is still large with regards to many of these technologies, it is possible to assume that several CDR methods are examinable when it comes to risks and benefits. However, given the controversies about SRM and SPI in particular and criticism of scientists thereof, the uncertainties connected with SRM make it possible to negatively assess their overall impact. Yet, their usage cannot be ruled out.

92. A general conclusion can be made that CDR, if used as small complementary tool to emission stoppage and developed to the point that they provide negative emissions (which is not the case at the moment), could hypothetically compensate for unavoidable emissions and therefore help getting to real net zero of emissions. Should that be the case they would be an indispensable factor in improving prospects for humanities existence in many areas – a cascading positive effect on many human rights.

93. Lack of scientific certainly does not allow for a well-functioning, aligned with SDGs carbon offset market. Likewise, there is a lack of a „guarantee that any offsets are used for actual removal of carbon from the atmosphere, not the avoidance of emissions, and that offsets are being used for genuinely unavoidable emissions rather than a convenient way of avoiding hard choices and zero-carbon investment.” Lack of these guarantees, however, have more to do with nonexistent objective monitoring mechanisms and bodies to oversee them.

94. Human rights law is clearly relevant to the assessment of the risk posed by NTCPs. The range of rights potentially impacted and the scale of potential interferences with those rights supports a preventive approach. The duty to protect from human rights risk would push States and international community towards a preventive stand. Restrictive regulations (and potentially a *moratorium*) should be adopted when large and unforeseen negative impacts can be advanced and rationally be expected and as long as the contrary is not proven.[[103]](#footnote-104) This seems to be the case of SRM technologies which in the current state of development represent a high risk of human rights violations and environmental harm if implemented.

95. Building confidence among public opinion and the most affected populations is also an important requirement in order to legitimise the decision of using a concrete NTCP. It is extremely important that decisions in this field be taken at the multilateral level and by representative bodies endowed with such competency by States and acting in a consensual and transparent manner. International consortiums bringing together funds and capacities would be advisable. Without such requirements it is expected that any proposal, even the most meaningful, will induce mistrust among States and public opinion slowing-down the process towards the adoption of an effective solution.

96. Lack of informed consent sought from communities where these technologies are being implemented is of utmost concern. Local communities, professional associations, Indigenous Peoples are not informed about these technologies; there is low level of literacy about them. However, since these technologies are new there cannot be broad information available about them. A public and publicly funded information campaign and debate is needed for the public to get more acquainted with the role of NTCP – their benefits and risks.

97. From a human-rights based perspective the current carbon markets should be separated from the efforts to solely retain or capture carbon in the lithosphere. Should that be the case and only then natural CDR solutions (proper afforestation and reforestation) as well as certain DACs (if, when and as long as they are scientifically proven to de-emit, meaning produce negative emissions overall) could be separately and publicly funded, internationally monitored, producing greater social trust. As long as there are ways for emitters to offset their emissions there will be little incentive to cut them, and the cuts are needed immediately. With regard to climate justice and development a possible solution would be for properly identified CDR NTCPs to be financed by the Global North but only the Global South could offset its emissions with these technological projects. It would require an international agreement and a strong international oversight.

VIII. Recommendations

International Community, States and policy-makers

* Ensure that procedures are put in place to effectively seek the “Free Prior and Informed Consent” from Indigenous peoples, local communities, and other particularly interested groups such as peasants. Such procedures should be activated whenever a local test or the implementation of a NTCP or its effects may have a bearing on their livelihoods and land;
* Set up a global and independent MRV (measurement, reporting, verification) standard as well as certification, applicable to all novel CDR technologies, by an independent body responsible for designing a global MRV framework, that consists i.a. of social scientists and human rights lawyers, and takes into account human rights;
* In the case of research of speculative NTCPs or technologies whose effects may transcend the jurisdiction of a single State, under all circumstances the entity carrying out such works should confirm that human rights assessments are integrated in their work and specific protocols to assess human rights impacts are developed in advance. Expert bodies should be entitled to monitor and evaluate such assessments and to address recommendations to the decision-making bodies.
* Keep the current legal restrictions on SAI implementation together with the current rules for scientific research in place, improved by consultation with rightsholders at test stages;
* Work toward greater inclusion of Global South scientists in the public debate about NTCPs, production of science, discussion thereon;
* Run an information campaign about the difference between emission cuts and CDR – with a clear information about the primary necessity of emission cuts and the supplementary role of CDR if proven emissions negative, ideally with information about the workings of carbon markets, thus reducing distrust, improving technological and climate literacy, including a broad range of rights and stakeholders.

Human Rights Council and Mechanisms

* Enhance the protection of Indigenous Peoples in the context of decisions regarding development, testing and deployment of NTCPs;
* The Special Rapporteur on Indigenous Peoples consider the elaboration of thematic report on the impact of NTCPs on their rights;
* Explore the possibility of stablishing an ad-hoc mechanism in charge of coordinating the action of relevant Special Rapporteurs in connection with NTCPs.
* Consider the possibility of appointing a new mandate-holder on NTCPs and human rights;
* Provide a new mandate to the Advisory Committee to explore the possibility of developing a set of soft law principles and guidelines on States obligations in relation to these new technologies or to follow up on the recommendations contained in this report with a view to operationalizing them;
* Request the Advisory Committee to study the remaining climate engineering technologies and their impact on the enjoyment of human rights and to follow up on the current study with a view to updating it since the topic is rapidly evolving from the technological point of view.

Office of the High Commissioner for Human Rights

* Support States by elaborating protocols on human rights assessments specifically tailored for NTCPs.

1. See: ‘Climate Change and Human Rights’, Joint ECLAC/OHCHR publication on Climate change and human rights: contributions by and for Latin America and the Caribbean (December 2019). The assertion according to which the human rights approach tends to reinforce anthropocentric values at the expense of ecological consideration has to be firmly challenged. [↑](#footnote-ref-2)
2. [↑](#footnote-ref-3)
3. There is 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 [↑](#footnote-ref-4)
4. The UK Royal Society defines “climate geoengineering as “the deliberate large-scale manipulation of the planetary environment to counteract anthropogenic climate change”. The Royal Society, Geoengineering, the Climate Science, Governance and Uncertainty, 11 (2009). [↑](#footnote-ref-5)
5. Special Report: Global Warming of 1.5 ºC Ch 00. Summary for Policymakers, 2022, C.1.4 . [↑](#footnote-ref-6)
6. [↑](#footnote-ref-7)
7. « The restriction of Geoingeneering under international law », Joint Opinion, Hands Off Mother Earth (HOME) to the AC. Biermann, F., et al, “Solar Geoengineering: The Case for an International Non-Use Agreement” (2022), Wires Climate Change 1, p. 3. [↑](#footnote-ref-8)
8. “Referring to such techniques as protection technologies is misleading because these technologies do not actually protect the global climate system, but rather manipulate it—with significant risks for the

   enjoyment of human rights”- AC Submission by members of the network of academics for an

   International Non-Use Agreement on Solar Geoengineering [↑](#footnote-ref-9)
9. *Statement,* Real Zero Europe, https://www.realsolutions-not-netzero.org/real-zero-europe. [↑](#footnote-ref-10)
10. IPCC AR6 WG III. [↑](#footnote-ref-11)
11. https://www.cbd.int/doc/publications/cbd-ts-84-en.pdf [↑](#footnote-ref-12)
12. Several private initiatives already propagate including SAI and other SRMs in international strategies for the future. [↑](#footnote-ref-13)
13. „Products” are another kind of storage. However, the definition of a “product” is broad and unclear for a human-rights based perspective. [↑](#footnote-ref-14)
14. 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”. [↑](#footnote-ref-15)
15. 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 BECSS. 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. [↑](#footnote-ref-16)
16. https://www.documentcloud.org/documents/22090373-wf-ccs-rser-2020-1 [↑](#footnote-ref-17)
17. 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 the technology is a fossil fuel producing technique, which is used by fossil fuel companies and cannot be considered a NTCP. [↑](#footnote-ref-18)
18. 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. [↑](#footnote-ref-19)
19. Mineralization into calcite, argonite, magnesite, depending on local circumstances in the reservoir. The storage is to be permanent, counting in thousands of years. [↑](#footnote-ref-20)
20. 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. [↑](#footnote-ref-21)
21. 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. [↑](#footnote-ref-22)
22. For the purpose of Resolution LC-LP.1 (2008) on the Regulation of Ocean Fertilization. [↑](#footnote-ref-23)
23. IPCC AR6 WGII. [↑](#footnote-ref-24)
24. Since the atmospheric greenhouse gas concentration is not changed by SRM, these approaches would have to be maintained or permanently repeated. Sudden termination of any SRM deployment could cause a disruptive change in the climate and a sudden global temperature increase that would have potentially massive detrimental impacts on human life and development and natural ecosystems. [↑](#footnote-ref-25)
25. https://www.nature.com/articles/d41586-021-02290-3 [↑](#footnote-ref-26)
26. 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/ [↑](#footnote-ref-27)
27. See G. Wagner, “Geoengineering: The Gamble”, Polity, 2021. [↑](#footnote-ref-28)
28. One particular example of physical risks are possible leakages, although not directly related to NTCPs studied in this report but to fossil fuel industry. A CO2 pipeline used in enhanced oil recovery leaked in Mississippi in 2022, sickening dozens of people. Such events weaken the public’s trust in technological innovations. [↑](#footnote-ref-29)
29. 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. [↑](#footnote-ref-30)
30. “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 [↑](#footnote-ref-31)
31. There have already been instances of political conflict of that sort. For example, Iran has accused Israel of harmful weather modification. [↑](#footnote-ref-32)
32. Corry O. *The international politics of geoengineering: The feasibility of Plan B for tackling climate change*. Secur Dialogue. 2017 Aug;48(4):297-315. [↑](#footnote-ref-33)
33. See: Stockholm Declaration adopted at the 1972 UN Conference on the Human Environment. [↑](#footnote-ref-34)
34. Joanna Bourke Martignoni, “Intersectionalities, human rights and climate change: Emerging linkages in the practice of the UN human rights monitoring system”, in the Routledge Handbook of Human Rights and Climate Governance, Sébastien Duyck, Sébastien Jodoin and Alyssa Johl, eds. (London, Ro [↑](#footnote-ref-35)
35. « The restriction of Geoingeneering under international law »,, op.cit. [↑](#footnote-ref-36)
36. « The restriction of Geoingeneering under international law »,op.cit.,p. [↑](#footnote-ref-37)
37. General Comment n° 29. States of Emergency (Article 4). CCPR/C/21/Rev.1/Add.11, 31 August 2001. [↑](#footnote-ref-38)
38. A particular mention to the right to health, the right to environment and intergenerational equity is also included. The indigenous peoples and local communities, together with children, persons with disabilities as the groups that most probably will be particularly affected by climate change [↑](#footnote-ref-39)
39. As it is well-known, this treaty seeks [↑](#footnote-ref-40)
40. This legally binding treaty has 195 State Parties; Eritrea, Iran, Libya and have signed but not ratified the treaty. [↑](#footnote-ref-41)
41. Not all developing countries have sufficient capacities to deal with many of the challenges brought by climate change. As a result, the Paris Agreement places great emphasis on climate-related capacity-building for developing countries and requests all developed countries to enhance support for capacity-building actions in developing countries. It establishes a technology framework to provide overarching guidance to the well-functioning Technology Mechanism. The mechanism is accelerating technology development and transfer through its policy and implementation arms. <https://unfccc.int/topics/what-is-technology-development-and-transfer> [↑](#footnote-ref-42)
42. B. Ugochukwu, CIGI Papers, n. 82- Climate Change and Human Rights: How? Where? When? 9, 2015. [↑](#footnote-ref-43)
43. The SR on contemporary forms of racism has said that “experimental or speculative technologies proposed in response to climate change, potentially pose significant risks to human rights. For example, experts believe that some “geoengineering” projects meant to adapt to climate change may have significant adverse impacts, including termination shock, rainfall disruption, water depletion, and the erosion of human and ecological resilience. [↑](#footnote-ref-44)
44. The Convention on Biological Diversity (CBD), the 1972 London Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matter and its 1976 London Protocol (LCLP) and the Montreal Protocol on Substances that Deplete the Ozone Layer. [↑](#footnote-ref-45)
45. This international instrument aims at "the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits derived from the use of genetic resources", which has been ratified by 196 States (except the USA and the Holy See). The Secretariat of the Convention on Biological Diversity (SCBD) is based in Montreal, Canada. [↑](#footnote-ref-46)
46. Decision XX/33 of October 2010. This ban is broader than the 2008 ban on ocean fertilization. Although these decisions are not legally binding, they are considered to represent a broad consensus for what is important for global governance. [↑](#footnote-ref-47)
47. ‘Geopiracy – The Case Against Geoengineering’, ETC Group, demonstrates the need for a moratorium, arguing that geoengineering is “a political strategy to get industrialized countries off the hook for their climate debt”. [↑](#footnote-ref-48)
48. IMO Doc. LC/SG 31/16. [↑](#footnote-ref-49)
49. Paragraph 8 states that ocean fertilization activities, other than legitimate scientific research, should be considered contrary to the aims of the Convention and the Protocol and therefore prohibited. Paragraph 3 provides that, in order to allow for legitimate scientific research, such research should be regarded as ‘placement’. In 2010 the Contracting Parties adopted the so called Ocean Fertilization Assessment Framework (Resolution LC-LP.2 (2010). It is worth noting that the six criteria of research (as opposed to deployment) in Annex 5 of the London Protocol are legally binding: addition to scientific knowledge, appropriate scientific methodology, subject to peer review, no economic interest involved, commitment to publish scientific results, available financial resources. [↑](#footnote-ref-50)
50. https://www.cbd.int/doc/publications/cbd-ts-45-en.pdf [↑](#footnote-ref-51)
51. 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. [↑](#footnote-ref-52)
52. The International Law Commission is about to approve a text of articles aimed at making effective the protection of the environment in situations of armed conflict. [↑](#footnote-ref-53)
53. https://www.cbd.int/climate/geoengineering/ [↑](#footnote-ref-54)
54. [↑](#footnote-ref-55)
55. https://www.energy.gov/technologytransitions/articles/department-energy-releases-2023-technology-commercialization-fund [↑](#footnote-ref-56)
56. https://www.geoengineeringmonitor.org/2017/11/scopex/ [↑](#footnote-ref-57)
57. Such as Frontier. [↑](#footnote-ref-58)
58. See: OHCHR, Bridging Governance Gaps in the Age of Technology – Key Characteristics of the State Duty to Protect A B-Tech Foundational Paper. https://www.ohchr.org/sites/default/files/Documents/Issues/Business/B-Tech/b-tech-foundational-paper-state-duty-to-protect.pdf [↑](#footnote-ref-59)
59. Communication from the European Commission on the precautionary principle (COM(2000) 1 final. [↑](#footnote-ref-60)
60. The precautionary principle was invoked before the International Court of Justice by Hungary in the Gabcikovo-Nagymaros case, but not further discussed in the merits by judges. [↑](#footnote-ref-61)
61. “The precautionary principle. Definitions, applications and governance”. European Parliamentary Research Service, 2015, p.. 10. At the regional, European, level, the precautionary principle was first added in Art. 130 r, para. 2, of the EC Treaty with the Treaty of Maastricht, then defined by the CJEU as a ‘fundamental principle of environmental law’, and eventually clearly enshrined in Art. 191 TFEU. [↑](#footnote-ref-62)
62. Advisory Opinion OC-23/17of November 15, 2017, requested by the Republic of Colombia on the Environment and Human Rights; [↑](#footnote-ref-63)
63. Kazım Berkay Arslan, Arslan KB, “The Extraterritorial Application of Human Rights Treaties in the Context of Environmental Transboundary

    Harm” , 2022, p. 5. PPIL. Advanced online publication. <https://doi.org/10.26650/ppil.2022.42.1.1002432>. [↑](#footnote-ref-64)
64. 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> [↑](#footnote-ref-65)
65. AI Submission- A/HRC/31/52, par. 53. Furthermore, the International Court of Justice has affirmed that it is a requirement under general international law to undertake an environmental impact assessment where there is a risk that an activity may have a Human rights particularly affected by the deployment and use of these technologies under the current circumstances would be. [↑](#footnote-ref-66)
66. W.C.G. Burns, ‘Human Rights Dimensions of Bioenergy with Carbon Capture and Storage: A Framework for Climate Justice in the Realm of Climate Geoengineering’, Climate Justice: Case Studies in Global Regional Governance Challenges, 2016, pp. 165-166. [↑](#footnote-ref-67)
67. Ibid. [↑](#footnote-ref-68)
68. The Human Rights Committee has said in this regard that “climate change and unstainable development constitute some of the most pressing and serious threats to the ability of present and future generations to enjoy the right to life”. [↑](#footnote-ref-69)
69. General comment No. 36 on article 6: right to life, UN Doc. CCPR/C/GC/36, par. 62. <https://www.ohchr.org/en/calls-for-input/general-comment-no-36-article-6-right-life> [↑](#footnote-ref-70)
70. For some, “the scale and scope of the human rights risks that these technologies carry is likely to be even greater than that of nuclear testing”. [↑](#footnote-ref-71)
71. A/HRC/37/59: In 2017, the Inter-American Court on Human Rights has considered that the right to a healthy environment, unlike other rights, protects the components of the environment per se. These are legal interests that have to be protected in themselves, even in the absence of the certainty or evidence of a risk to individuals. [↑](#footnote-ref-72)
72. A/74/161, 15 July 2019, par. 83.

    <https://documents-dds-ny.un.org/doc/UNDOC/GEN/N19/216/42/PDF/N1921642.pdf?OpenElement> [↑](#footnote-ref-73)
73. 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. [↑](#footnote-ref-74)
74. Burns, p. 157-158. [↑](#footnote-ref-75)
75. Daniel Billy and others v Australia Torres Strait Islanders Petition [↑](#footnote-ref-76)
76. 46 States have ratified this Convention. [↑](#footnote-ref-77)
77. To date the treaty has only been ratified by 14 countries. [↑](#footnote-ref-78)
78. Resolution 67/210, para. 12. [↑](#footnote-ref-79)
79. See SRM case study above. [↑](#footnote-ref-80)
80. The voluntary nature of the references to indigenous knowledge systems in article 7 (5) of the Paris Agreement on adaptation is viewed as falling short of the goals of indigenous peoples. [↑](#footnote-ref-81)
81. A/HRC/36/46, par. 16 and 24. [↑](#footnote-ref-82)
82. Intergovernmental Panel on Climate Change, Climate Change 2014, chap. 2, p. 198. [↑](#footnote-ref-83)
83. https://www.ohchr.org/sites/default/files/Documents/Issues/IPeoples/FreePriorandInformedConsent.pdf [↑](#footnote-ref-84)
84. https://www.keutschgroup.com/scopex [↑](#footnote-ref-85)
85. 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.” [↑](#footnote-ref-86)
86. https://static1.squarespace.com/static/5dfb35a66f00d54ab0729b75/t/603e2167a9c0b96ffb027c8d/1614684519754/Letter+to+Scopex+Advisory+Committee+24+February.pdf [↑](#footnote-ref-87)
87. Ibid. [↑](#footnote-ref-88)
88. Sioux Nation Treaty Council submission: We strongly recommend that before any new technology is planned, Indigenous spiritual leaders, both men and women, who still have a direct connection to Mother Earth and all life must be consulted for their spiritual guidance. Mother Earth is a living being not in the sense that is understood by Western thinking. Mother Earth has been cruelly and drastically abused and all life forms are suffering the consequences. [↑](#footnote-ref-89)
89. A/HRC/50/57. [↑](#footnote-ref-90)
90. A/HRC/37/59 [↑](#footnote-ref-91)
91. Climate finance has been provided for mitigation measures such as biofuel production and renewable energy projects, including hydroelectric dams, on indigenous territories without undertaking consultation. Human rights treaty bodies have expressed concern over how climate change mitigation measures such as biofuel projects affect indigenous peoples, and in particular the threats monoculture poses to food security. A/HRC/36/46 [↑](#footnote-ref-92)
92. Submissions [↑](#footnote-ref-93)
93. Sumission [↑](#footnote-ref-94)
94. A/HRC/25/53, A/HRC/31/52 [↑](#footnote-ref-95)
95. Laurence L Delina 2021 Environ. Res. Commun. **3** 125005 [↑](#footnote-ref-96)
96. One commendable project that aims to fill the voice gap is the “Degrees Initiative”. It brings SRM research to the global south by connecting researchers from global south and global north to write and publish scholarly articles about SRM also from the perspective of the global south. The initiative is, however, limited to one kind of NTCPs. [↑](#footnote-ref-97)
97. Report of the Special Rapporteur on contemporary forms of racism, racial discrimination, xenophobia and related intolerance, E. Tendayi Achiume , https://documents-dds-ny.un.org/doc/UNDOC/GEN/N22/651/88/PDF/N2265188.pdf?OpenElement [↑](#footnote-ref-98)
98. 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/. [↑](#footnote-ref-99)
99. The impacts of climate change on the human rights of people in vulnerable situations. Report of the Secretary-General, A/HRC/50/57; https://documents-dds-ny.un.org/doc/UNDOC/GEN/G22/336/00/PDF/G2233600.pdf?OpenElement [↑](#footnote-ref-100)
100. “No country so far has pledged to scale novel CDR by 2030 as part of their Nationally Determined Contribution, and few countries have so far published proposals for upscaling novel CDR by 2050.” https://www.stateofcdr.org/resources [↑](#footnote-ref-101)
101. https://iopscience.iop.org/article/10.1088/1748-9326/aabf9b/pdf [↑](#footnote-ref-102)
102. Amicus curiae brief submitted by SR on toxics and human rigths; the SR on human rights and the environment; the IE on the enjoyment of all human rights by older persons. [↑](#footnote-ref-103)
103. Various respondents to the questionnaire considered that these technologies not only distract from the goals undertaken by State under international agreements on climate change, particularly, the Paris Agreement, but more importantly will carry a wide range of human rights risks. Actually, suggesting that these technologies may contribute to the promotion and protection of human rights is misleading. They should contribute to the protection of human rights against climate change but in reality the potential to do so remains highly/entirely speculative. 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 [↑](#footnote-ref-104)