south pole

South Pole discussion paper

Six imperatives for scaling high-quality carbon dioxide removal systems

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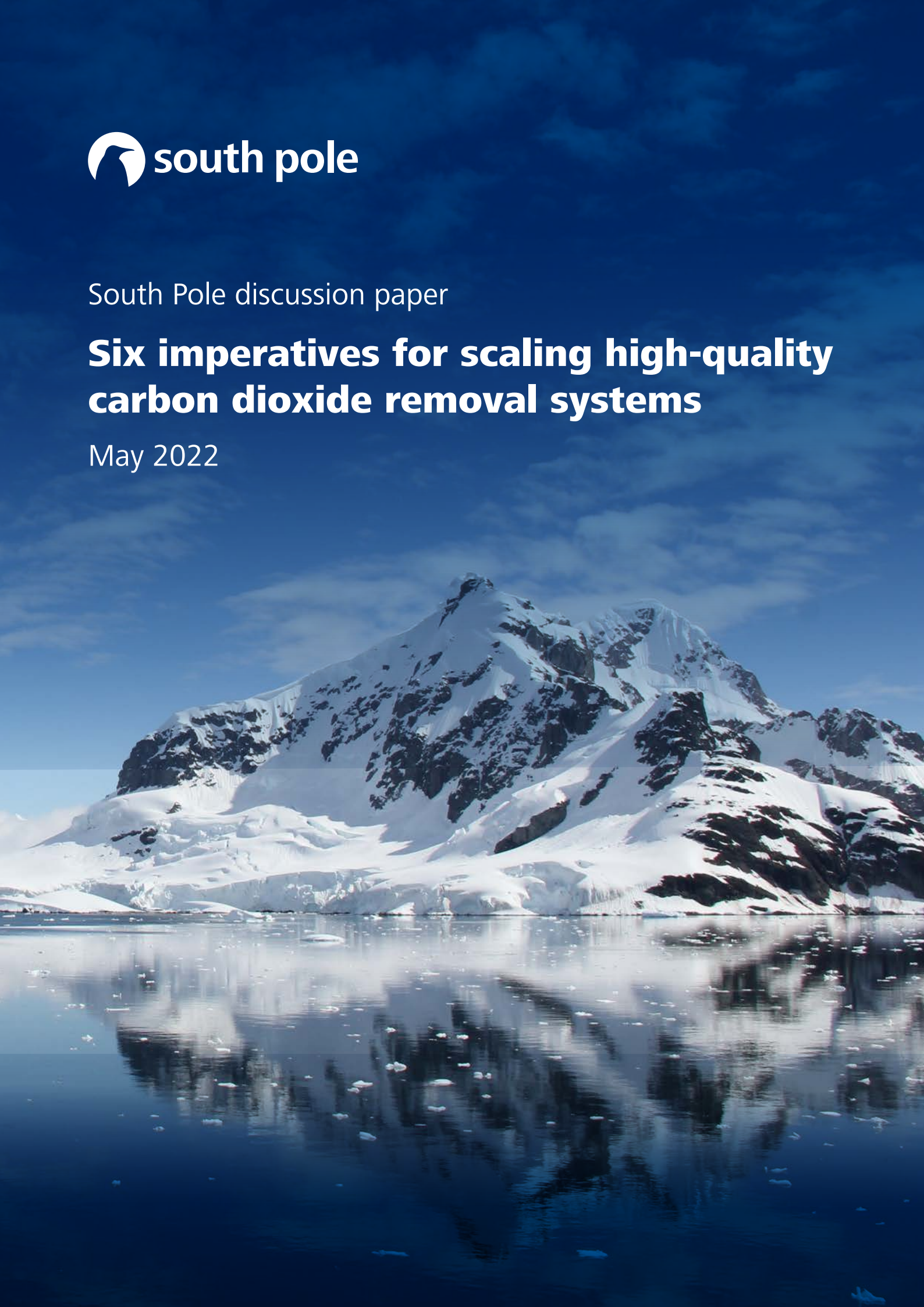

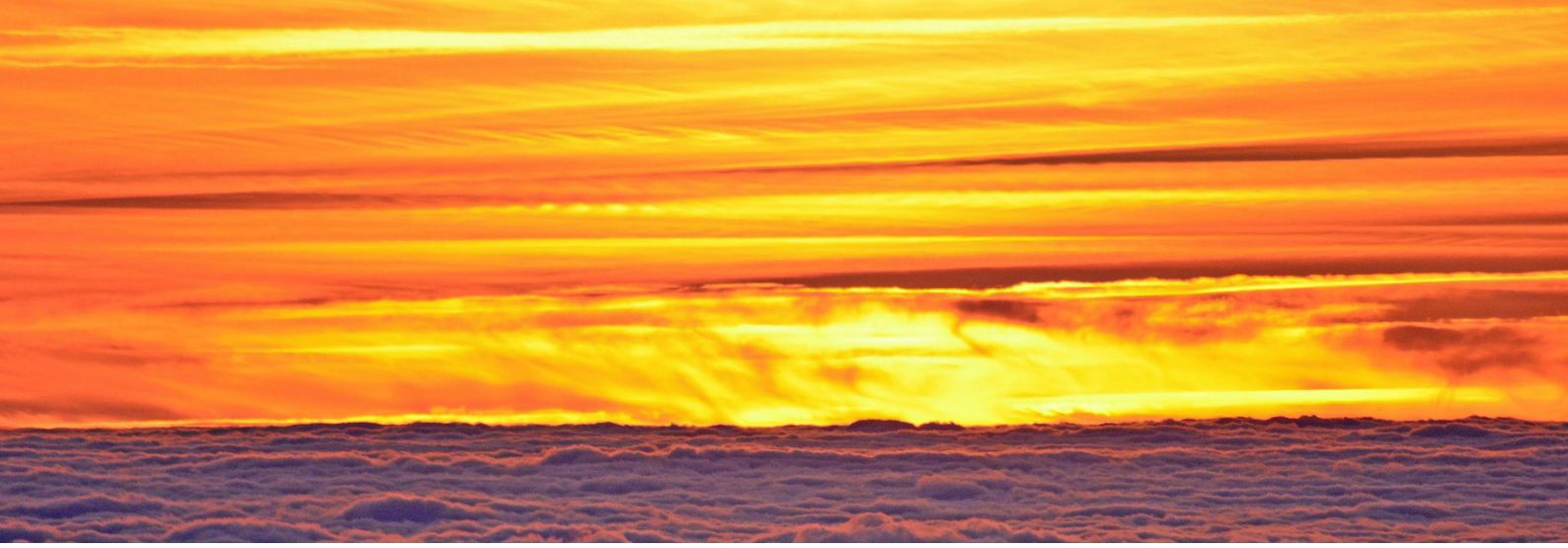

The Intergovernmental Panel on Climate Change (IPCC) states that the targets of the Paris Climate Agreement will not be met without the additional and large-scale removal of carbon dioxide (CO_2) out of the atmosphere. This can lower net emissions today, will compensate for humanity's remaining emissions to reach net zero, and may eventually help bring down absolute levels of CO_2 concentrations to return global warming to 1.5°C after an expected emissions overshoot. A global approach to carbon dioxide removal (CDR) is needed to succeed in this mission.

Establishing a global approach to CDR is a daunting task. Similar to other pillars of climate action – decarbonization and adaptation – it involves bringing together a complex set of scientific and social factors under an integrated framework for action. Managing such complexity requires a high degree of policy resilience, with standards and definitions of carbon removal processes able to resist challenges to its critical premises and remain effective and relevant over time. This global approach must also consider the variety of CDR methods and how they differ in terms of maturity, potentials, costs, risks, co-benefits, as well as the trade-offs between climate change effectiveness and environmental or social side impacts.

The contributors* to this discussion paper have identified six imperatives, accompanied by recommendations, for scaling high-quality CDR-systems. They pertain to all removal methods, irrespective of the removal process (land-based biological; ocean-based biological; geochemical; chemical) or the duration of storage (decades to centuries; centuries to millennia; ten thousand years or longer).

Six imperatives:

1. **Definitions: align on the basic principles of removals**
2. **Mitigation deterrence: prevent removals from delaying reductions**
3. **Scarcity: manage removals as a finite resource**
4. **Equivalence: implement CDR methods in line with their merits**
5. **Liability: allocate responsibility for maintaining storage**
6. **Valuation: negotiate an effective monetary value**

This discussion paper outlines the imperatives and makes recommendations on how to begin addressing them. These imperatives can only be met through an approach that is comprehensive and inclusive. Many of the proposed steps may apply to multiple imperatives. Most recommendations are interdependent and need to be considered as a whole to unlock their full impact.

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* The contributors' lists are on page 8

1. Definitions: align on the basic principles of removals

There is a general lack of agreed-upon definitions and principles of CDR – its scope, process, accounting, the durability of CO_2 storage, in terms of planned duration of the storage and the risk of reversal – and how it differs from emission reductions; CDR should not be confused or used interchangeably with reductions under any circumstances. Without alignment on definitions and the basic principles of removals, it will not be possible to formulate robust guidelines, standards, and accounting methodologies. Inputs over the entire chain of removal and storage should be quantified using a life cycle assessment (LCA), where emissions related to such inputs are material, but there is currently no clarity on where an environmental impact assessment or an LCA starts and ends. Relevant stakeholder groups can thus not pursue cohesive long-term planning for the development and scaling of CDR. This lack of alignment risks undermining the development of a globally applicable approach to carbon removal as a distinct part of the solution to limit global warming to 1.5°C.

Steps need to be taken to achieve a minimum understanding of CDR that is clear in its purpose, equitable in its approach to decision making, and scientifically-sound in its way of ensuring the durability of stored carbon. This will help incentivize a critical mass to adopt such solutions across geographies and sectors, facilitate the creation of monitoring, reporting, and verification (MRV) best practices, and develop mechanisms to assess, mitigate and handle reversal risk for all forms of storage – especially for those removal methods where this does not yet exist. This minimum understanding should also help ensure that CDR is not conceptually mixed up with carbon avoidance or reduction, especially in the context of carbon credits – although this does not preclude overlapping physical and carbon accounting infrastructure.

Recommendations:

1. Develop, regulate, and disseminate a basic set of definitions of CDR and related concepts to create a common understanding at international levels. This should, at the very least, define a minimum duration and durability requirement for carbon storage and distinguish between CO_2 removal and CO_2 emission reduction activities.

2. Acknowledge that the basic principles for defining a system as 'carbon removal' must include that CO_2 is physically removed from the atmosphere (either directly or via biogenic means), durably stored – with all material emissions over the entire chain of removal and storage included in the life cycle assessment – so that the total amount of CO_2 removed and stored exceeds the amount emitted.

3. Ensure a robust and transparent CO_2 accounting infrastructure to facilitate independent verification and certification of projects, and guarantee the durability of storage over time. Such accounting should keep track of the carbon molecule's origin and storage across all CDR methods.

2. Mitigation deterrence: prevent removals from delaying reductions

Given the deepening climate crisis, there is an imperative to urgently deploy scalable, high-quality CDR systems. At the same time, the perceived (future) availability of removals might delay immediate decarbonization, known as mitigation deterrence, and may incentivize pathways that are misaligned with the Paris Agreement. Mitigation deterrence should be avoided at all cost. Accurate differentiation of removals and reductions, especially in compliance and voluntary offset markets and by market actors, as well as adequate targets, regulations, and policies, can help ensure the efficacy of climate action by different stakeholder groups.

A transparent separation of reduction and removal targets will be fundamental to effectively prevent the mitigation deterrence of removals. Removals can then be treated and perceived as a clear imperative, complementary to reductions. A clear separation of targets also provides a basis for robust regulation for the deployment and use of CDR by governments and standardsetting bodies, which can mitigate the risk of greenwashing more effectively. Greater clarity of CDR's role in global climate change mitigation efforts, underpinned by principles of equity and fairness, will strengthen CDR's social license to operate over time.

Recommendations:

1. Introduce a transparent process to set absolute, and legally binding reduction and removal targets separately, with distinct metrics and reporting standards to account for the origin and destination of the CO_2, and ensure public policies reinforce an integrated net-zero pathway. This should complement the Science-Based Target initiative's guidance to companies on separate reduction and removal targets.

2. Establish an inclusive and transparent global process to define and help guide carbon removal deployment and use cases in light of the scarce resources available to operate CDR projects. Recognize constraints and trade-offs related to planetary boundaries, available capital, renewable energy, and land, depending on the specificities of the project.

3. Identify and address common and dedicated financial, regulatory, and physical infrastructure needs to deploy different CDR methods.

3. Scarcity: manage removals as a finite resource

Scaling CDR is limited by scarcity. This relates both to the physical capacity to capture and store CO_2 durably and sustainably, and to the socio-political pressures of allocating the use of that capacity and the resources required for deployment – such as land, energy, sustainable biomass, and capital. There is no scientific consensus regarding the potential sustainability limits of different CO_2 capture and storage or sequestration methods. Nor is there agreement on how to prioritize the use of CDR in line with climate science and prevent the risk of mitigation deterrence. Market forces cannot guarantee the equal and effective distribution of this limited resource without appropriate regulation and oversight by public entities, thereby undermining the role of CDR in mitigating climate change. Managing removals as a finite resource demands (public) policy and regulation. Markets may be used as a mechanism to implement such policies and regulations.

Progress needs to be made in framing removals as part of the larger climate action toolkit, with clarity on the role that different CDR methods can fulfill in addressing climate change. Limited CDR capacity and associated resource needs and costs must be distributed equitably, effectively, and sustainably for CDR development to run in lockstep with the urgency of climate action and with environmental integrity, notably in terms of biodiversity, water, and soil. Ultimately, CDR will have to be deployed in a standardized and equitable way, through a global process that is inclusive, science-based, and led by an international body, such as the UNFCCC Secretariat, creating the required governance framework.

Recommendations:

1. Develop a roadmap under the IEA, for example, to assess on a rolling basis how much carbon needs to be removed by when in order to reach global net zero by 2050 and net negative thereafter. To further incentivize the inclusion of removal objectives in Nationally Determined Contributions, this should be coupled with a mapping of the required energy feedstocks and total available capacity for CO_2 storage across all removal methods and geographies, considering physical, socio-political and sustainability limits on land, energy, and biomass.

2. Formulate clear guidance and regulations under the UNFCCC to facilitate the equitable distribution of available CO_2 removal capacity, for example by type of actor, sector, and geography, acknowledging the risk of 'colonization' of this scarce resource by actors with the greatest financial means and political leverage.

3. Define minimum principles and guidance under the UNFCCC, for example, to enable regions or countries to define their hard-to-abate or residual emissions and historical emissions, but also to calculate their associated carbon removal needs – pegged against different milestones on the road to 2050 – and to differentiate between them to ensure corresponding distribution of available CO_2 removal capacity.

4. Equivalence: implement CDR methods in line with their merits

There is a risk that different CDR methods are treated as similar in their climate impact over time, but also in their applicability across geographies and in different socio-economic and ecological contexts, and their inherent co-benefits, trade-offs and risks – despite there being fundamental scientific differences between them. Current rules for the accounting of individual removal methods are insufficient and not rooted in climate science. This precludes removals from being effective, equitable, and publicly accepted.

Preventing the pitfalls of equivalence means that removals and reductions cannot be conflated, but it also means that different removal methods should not be treated as equivalent. Standards and regulations will need to take into account the variability of CDR methods, enabling society to judge such methods on their specific merits and to deploy them in the most effective way at different times and across geographies. Transparent systems must be put in place to prevent the conflation of CDR methods across the spectrum of storage durability, so that CDR at large is deployed in an equitable and scientifically-sound way.

Recommendations:

1. Differentiate removal methods by origin and destination of the CO_2, but also storage durability features, and reflect this in the carbon accounting frameworks and the broader climate policy agenda.

2. Create a scientifically sound framework for evaluating different CDR methods as the basis for a taxonomy of CDR methods; ensure CDR methods are evaluated based on their merits and trade-offs in terms of durability of storage and reversal risks, and clearly map potential co-benefits associated with each, including benefits such as air quality, biodiversity, ecosystem resilience, and human health.

5. Liability: allocate responsibility for maintaining storage

Carbon that is claimed as durably removed should be accurately, comprehensively, and transparently accounted for to prove that claim. This has implications for the custodianship of the stored CO_2. The lack of visibility in certain regions on the liability for storage reversal risks, ownership of storage sites, and the role of the public good challenges the deployment of high-quality CDR. Organizing liability and its transfer is feasible, but is challenged by the longevity of the storage needs and the importance of ensuring intergenerational equity. Since long-term risks associated with the storage of removed CO_2 inevitably lie with future generations, mitigating such risks demands public policies that regulate liability.

A global approach to carbon removals will need to couple the legal ownership and custody of stored CO_2 with transparent and equitable liability regimes enshrined in law. Such rights and responsibilities could be shared between private and public stakeholders, according to principles of equity and fairness, and in line with the distinct types and qualities of storage techniques and related reversal risks and liabilities. The responsibility should not fall disproportionately on public institutions, who may not have the financial, technical, and legal capabilities to organize effective management. The roles and responsibilities of different CDR stakeholders have to be clear, while dedicated international support mechanisms are a necessity in the absence of financial, technical, and legal capabilities to organize effective management.

Recommendations:

1. Define and distinguish the liability and ownership models for specific CO_2 storage options so that they can be embedded in an international legal framework and adapted at project-level to serve specific needs, thereby unlocking the development of appropriate insurance mechanisms.

2. Outline an equitable reward scheme for CDR that takes into account corresponding adjustments, facilitates private-public collaboration, and ensures a fair distribution of rewards.

3. Develop common MRV methodologies and standards for all aspects of CDR systems – including inputs, capture, transport and storage – and enact them into law, with the quality of removal determined by the quality of CO_2 storage and a context-specific assessment of the environmental integrity and trade-offs.

4. Ensure tools are in place to manage impermanence, reversals, and liability. This could involve transparent methodologies that mandate appropriate financial and carbon buffers in line with specific reversal risks and ensure conservative accounting.

6. Valuation: negotiate an effective monetary value

To scale high-quality durable carbon removals, the price of individual CDR methods should be proportional to the physical and socio-political scarcity of this limited resource. The cost of carbon removals should be low enough to incentivize large-scale deployment of high-quality removals and high enough to prevent it from delaying reductions or compromising on environmental integrity. The current regulatory and market landscape for removals is not sufficient to create the right conditions for cost reductions, or to generally incentivize innovation and deployment, hampering investment security and efforts to realize economies of scale.

Clarity on the role of market and non-market instruments will affect the level of impact that interventions have. Concerns about potential negative externalities of carbon pricing – including the short-term costs of climate action over the long-term benefits of addressing climate change – will have to be addressed to ensure carbon pricing can be an instrument for a resilient carbon removal policy and a driver for innovation and large-scale deployment of high-quality durable removal systems. All the different deployment tools need to have clear roles and prevent the double counting of impact, while realizing synergies between different voluntary and regulatory systems.

Recommendations:

1. Prioritize policy resilience by developing transparent and effective decision-making tools that can ensure the primacy of science and ethics over the economic viability and political economy of specific carbon removal methods.

2. Develop and implement concrete incentives at a national or city-level for the adoption of carbon removal methods, such as obligations on specific players to remove carbon, public subsidies, and CDR trading within a separate section of a compliance carbon markets, reverse auctions or other market-based incentives

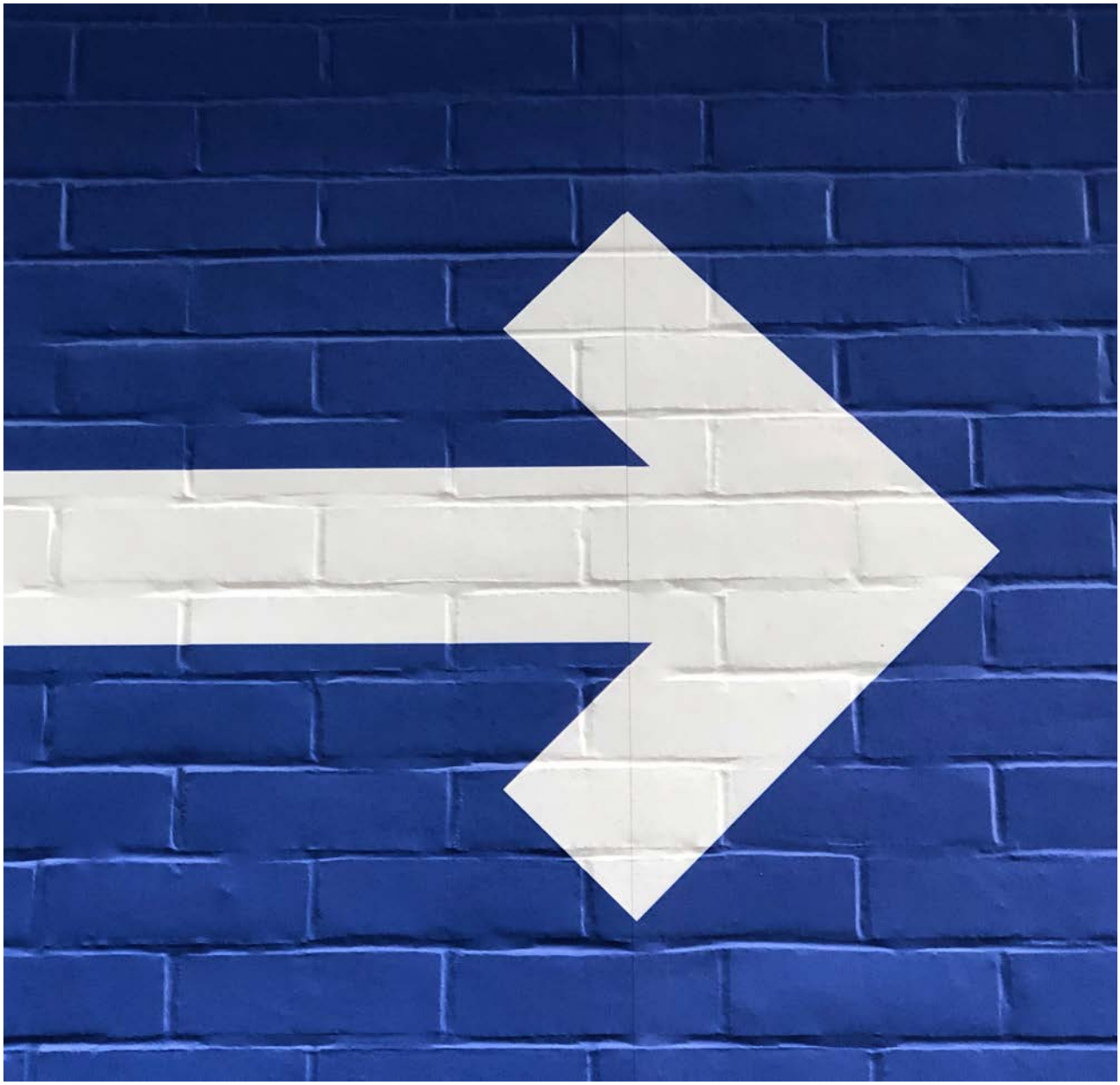
3. Ensure transparent interaction between different market instruments by improving the quality of removals as they are brought into the voluntary carbon market so that it can become a high-integrity precursor to compliance markets, while enabling a conditioned use of certified removal credits for specific compliance regimes in the future.

4. Set up dedicated blended financing instruments, including advance market commitment, that can reward early-phase project developers and buyers of carbon removal credits who prioritize developing the removals market and driving capital into innovation.

Conclusion

Establishing a global approach to CDR will build an extra pillar to support the house of climate action. Today, this house is shaking under the weight of climate change. Building a carbon removal pillar , to shore up the pillars of decarbonization and adaptation, will help humanity reduce that weight over time. But the builders need a common language to construct this house together, and to avoid miscommunications along the way, which may lead to poor foundations.

The carbon removal pillar will have to stand as long as the world needs to reduce atmospheric concentrations of CO_2 to counter global warming; most probably deep into the 22nd century. The criteria that guarantee minimum standards for carbon removal projects must reflect this time horizon. They have to be agreed as part of a universal, inclusive dialogue, as climate action is a global house. We hope this discussion paper may contribute to this dialogue.



This discussion paper was developed by Christiaan Gevers Deynoot, Senior Manager, Carbon Removal Platforms, and Dylan Marks, Specialist, Climate Investments, at South Pole. It builds on contributions and technical comments from a wide range of external experts, including:

CONTRIBUTORS

Dr. Wim Carton, Senior Lecturer, Lund University Centre for Sustainability Studies (LUCSUS), Lund University
Dr. Emily Cox, Research Associate, School of Psychology, Cardiff University
Dr. Stephen Hall, University Academic Fellow, University of Leeds
Prof. Dr. Andrea Ramírez, Professor of Low Carbon Systems and Technologies, Technical University Delft
Dr. Mischa Repmann, Senior Sustainability Risk Manager, Swiss Re
Elise Roc, Business Development Manager, Northern Lights
Tom Spencer, Environmental Management Specialist, Swiss Re
Louis Uzor, Climate Policy Manager, Climeworks
Keith Whiriskey, Deputy Director, Bellona Europe
Naomi Swickard, Head of Public Affairs, South Pole
Nadia Kahkonen, Associate Director, Global Communications, South Pole

TECHNICAL COMMENTERS

Ian Kuwahara, Director of Industrial GHG Innovations, Verra
Dr. Nils Meyer-Ohlendorf, Head, European and International Governance, Ecologic Institute
Fabien Ramos, Carbon Removals Policy Officer, European Commission Wijnand Stoefs, Policy Officer, Carbon Market Watch
Emma Watson, Senior Net Zero Manager, Science-Based Target initiative
Dr. Oliver Geden, Senior Fellow, German Institute for International and Security Affairs (SWP), Stiftung Wissenschaft und Politik

Technoparkstrasse 1 · 8005 Zurich · Switzerland
info@southpole.com · southpole.com