THE CARBON REMOVALS NETWORK

carbon-removals.net

Funding Proposal: September 2025

CONTENTS

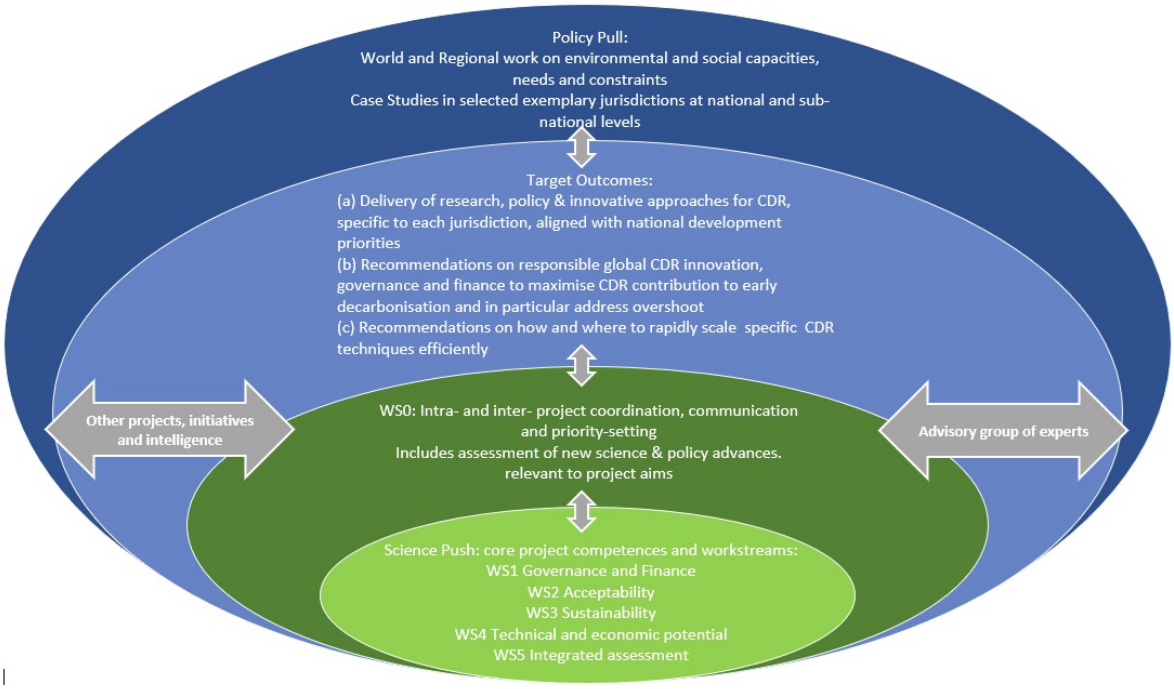
I – Executive Summary:

THE INTERNATIONAL CARBON REMOVALS NETWORK – ONE MINUTE READ

The Network's purpose is to develop and apply knowledge in order to maximise responsible CDR as part of national sustainable development strategies:

- Three interacting streams of work – world regional and country case studies and international governance
- Country case studies nationally owned, building national capacities, ruthlessly aligned to local development priorities, and going beyond lists of potential CDRs to provide research support for environmental, economic and policy studies needed to develop portfolios of sustainable and responsible CDR through to deployment
- International governance seen not only in terms of issues of regulation and standard setting on cross-boundary issues but also supporting and facilitating CDR development in individual jurisdictions (eg through appropriate knowledge transfer)
- Open structure, widely recruiting and mobilising research and policy specialists to join our core group in custom designed ad hoc project teams to support particular work targets
- Rigorous open & accountable knowledge-based work to aid rapid, robust learning
- By locating CDR within sustainable development, potentially opening new sources of finance

Diagram 1: project elements and target outcomes

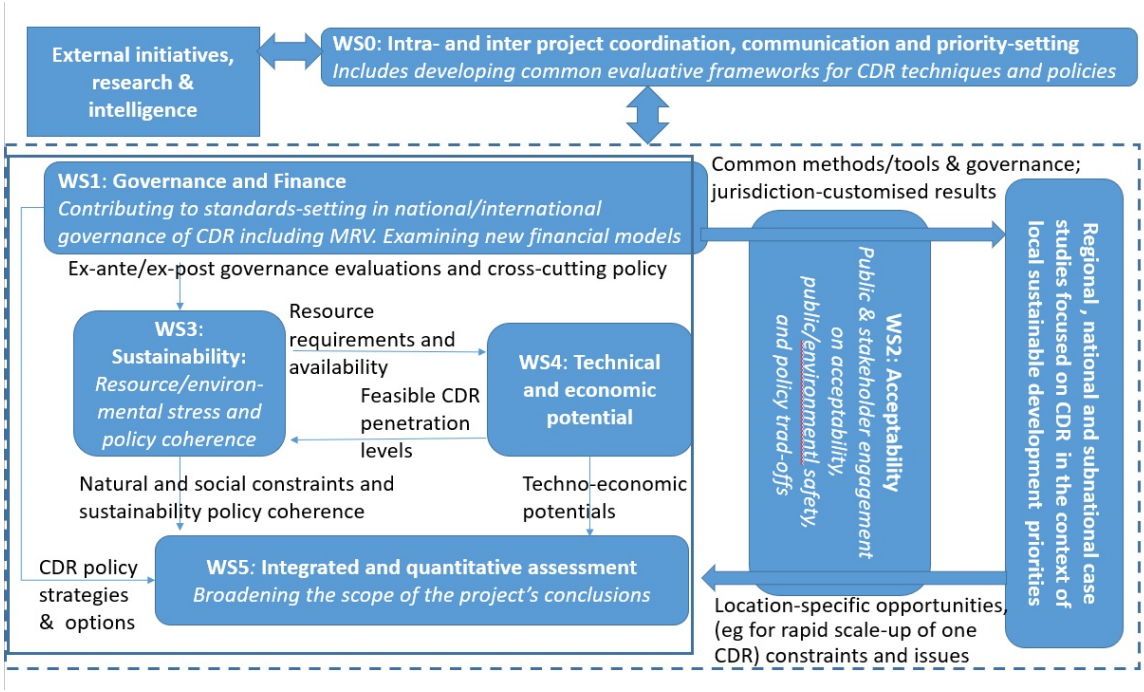


WHY CDR AND WHY THE NETWORK

- Stabilising climate requires both radically reducing emissions and in parallel maximising removals of greenhouse gases in the atmosphere and oceans – CDR
- The salience of the CDR contribution at scale increases as the delivery of short-term emission reductions fall short of targets, and emissions grow year by year
- Indicators of global climate change published in June 2025 indicate the urgency of the situation: the remaining carbon budget for 1.5°C would be exhausted in a little more than three years at current levels of carbon dioxide (CO_2) emissions

  Yet there is a widespread delay in the submission of the Nationally Determined Contributions (NDCs) due by February 2025, and many NDCs currently either do not mention CDR, and/or have made no assessment of its local potential
- If we wish to arm the near future with cost-effective CDR, the period up to 2030 is crucial. Our work might supply efficient means to address climate overshoot, avoid the worst damages of global warming and even inhibit dangerous negative tipping points
- Our proposal is to develop an international research and policy knowledge network, bringing together existing capacities and selectively developing new ones to meet tasks critical to develop CDR capacity at scale/speed
- We embrace the principle of the 2010 Hartwell Paper (Prins et al. 2010) that: "decarbonisation will only be achieved successfully as a benefit contingent upon other goals which are politically attractive and relentlessly pragmatic" emphasising the importance of alignment with local development priorities
- We will work on five interacting tasks which will contribute to robust CDR assessment and governance, and to the development of removals:
- Undertake studies of contexts, capacities and needs in world regions. broadly defined, and use these to develop regional policies and select jurisdictions for intensive case-study work on CDR in local environmental and social contexts;
- To use these case studies:
  - to assess the potential for responsible removals on a jurisdiction-by-jurisdiction basis, at different scales, and to employ environmental and policy research to support their development into actionable programmes leading to the maximum deployment of responsible removals in national portfolios;
  - to make recommendations on the environmental, industrial, social and regulatory contexts which offer the best opportunity to scale each particular CDR technology responsibly and at speed;
- Ensure that national portfolios are up-to-date by horizon scanning on new CDR approaches and organising activities which allow them to be interrogated and compared within common evaluative frames;
- Work on the international governance for CDR to help coordinate activity globally, to spread appropriate learning and support, and to develop common quality and regulatory standards not only for individual technologies, but also for the research and development needed to test and scale them in real jurisdictions;
- Broaden the opportunities for international public and private finance by emphasising CDR co-benefits and locating removals portfolios within investment plans for sustainable development with significant financial returns.

Diagram 2: Workstream contributions and links



OUR AIMS AND VALUES: HOW WE APPROACH COUNTRY STUDIES OF CARBON REMOVAL

1. **Anchored in realism about the socio-political nature of all assessments**:
   a. Avoiding the myth of an asocial world against which 'ideal' maximum possible removals can be referenced;
   b. Embracing the principle of the Hartwell Paper (Prins et al. 2010) that: "decarbonisation will only be achieved successfully as a benefit contingent upon other goals which are politically attractive and relentlessly pragmatic."
   c. Ensuring local ownership of country studies and their results: jurisdictions as the network's clients.
2. **Strong scientific base**: work to be grounded in, and carried out by, current experts in science and policy, matching the local environmental, social and cultural conditions that apply in each jurisdiction, and drawing on and strengthening local capacities.
3. **High research standards**: work to involve fully informed consent from participants and conform to the Oxford principles on R&D (see footnote 2 in the proposal) to ensure open and accountable results, and such other conditions on research practice as the network might agree.
4. **Going beyond advocacy**: a full assessment to include support for work on issues that may be key to building and implementing a local removals portfolio:
   a. Full economic assessment of impacts, taking account of synergies/ trade-offs;
   b. Distribution of impacts on lives and livelihoods, including economic and safety/health issues;
   c. Work to integrate proposals for removals within other climate action, and climate action within other sustainable development goals and/or local development priorities, with the aim of encouraging international public and private finance to support development packages in which removals play a significant part.
5. **Contributing to, and drawing on, international knowledge**, norms, and incentives, and acknowledging ignorance and constraints where these apply.

II -The Need for CDR and the Network Contribution

THE NEED FOR CDR: SCALE, URGENCY AND PLACE

The challenge: "Everything, everywhere, *all at once" – emission gaps and CDR policy needs*

To stabilise the climate it will be necessary to achieve, and then go beyond, Net Zero. This will involve radically reducing emissions of carbon dioxide and other greenhouse gases into the atmosphere and simultaneously maximising permanent removals of greenhouse gases already in the atmosphere and oceans. As António Guterres has put it in commenting on the IPCC AR6 release, what is needed is "Everything, everywhere, all at once".

There are many initiatives which focus on reducing emissions – this proposal focuses on removals. The need for removals involves both scale and urgency. On **scale** IPCC reports forecast the need for hundreds of billions of tonnes of carbon dioxide in order to stabilise global temperatures. As a range of reports underline (Friedlingstein et al., 2014, Rogelj et al. 2016, Riahi et al 2022) these estimates, however, assume unrealistically optimistic short-term reductions in emissions; consequently the actual amount required to achieve a safe and sustainable climate is highly likely to run into the trillions of tonnes of carbon dioxide removed from the atmosphere by the end of the century. It will be particularly important to develop and robustly assess a wide range of removals technologies in the period up to 2030, during which the achievement of emissions reductions is likely to continue to lag significantly behind intentions and pledges.

The need for **urgency** has been emphasised by the third edition of the Indicators of Global Climate Change, published by *Earth System Science Data* in June 2025. This involved 60 international climate scientists led by Professor Piers Forster, Director of the Priestley Centre for Climate Futures at the University of Leeds. This concludes that the estimate of the remaining carbon budget for 1.5°C would be exhausted in a little more than three years at current levels of carbon dioxide (CO_2) emissions, and that the budget for 1.6°C or 1.7°C could be exceeded within nine years.

The UNFCCC Paris process is not currently well positioned to respond to these challenges. There is a widespread delay in the submission of the Nationally Determined Contributions (NDCs) which should have been submitted by the end of February 2025. So far, with just a few months remaining to COP 30, less than 30 have done so and at least two of the biggest emitters - the European Union and China - are not among them. Whilst it is likely that in the majority of cases face-saving formulas will be found which may disguise the impact of the new policy emphases on national security, prospects for stronger plans for climate action in the following round of NDCs are not good and even backsliding is possible amongst some who formerly considered themselves in positions of climate leadership.

There is a further lag in understanding that CDR can make a significant contribution to decarbonisation alongside emissions reductions, given the right governance structures, framings and incentives. Many NDCs currently either do not mention CDR, and have made no comprehensive assessment of its local potential, let alone the issues involved

in and testing and scale-up of individual CDR approaches, and the social, economic and environmental trade-offs involved in the development of a CDR portfolio. Carbon Action Tracker reported in May 2024 that of 34 countries pledged to net zero only 15 give more detail on net zero plans. 28 countries suggest removals targets totalling 6.3- 7.6 Gt (16-20% of their 2019 emissions) compared with the need for 7-9 Gt of removals a year identified by the second State of CDR report published in June 2024. Only 8 countries suggest employing 'engineered CDR' (which Carbon Action Tracker they identify with DACCS and BECCS), accounting for 0.7-1.3 Gt a year.

It would be naïve to say that CDR can be in position to contribute substantially to avoiding the exhaustion of the remaining global carbon budget for 1.5° in the very near future, over the first four years of the network's proposed work. Nevertheless, every degree of warming avoided is a huge humanitarian and economic gain, and in the current policy deadlock there is an overwhelming need to understand how it might contribute, advance the elaboration of policies and mechanisms, further the development of appropriate portfolios at the country and subnational level, as well as the dissemination of the opportunities associated with CDR. If we wish to arm the future with cost-effective CDR, we had best start doing everything we can now. Our work might supply efficient means to address climate overshoot, avoid the worst damages of global warming and even inhibit dangerous negative tipping points.

Meeting the Challenge: Growing the Removals Contribution

In retrospect Paris itself in 2015 was a late high point of international consensus against the background of increasing primacy of diverging national priorities, especially around the perceived need to exploit national resources for development. Paris' planned accelerating momentum for change, involving annually increasing national climate ambitions, slowed to a hesitant crawl. Fossil fuel companies became increasingly confident in pursuing a revisionist narrative, and populist political parties tried to exploit denialism of anthropogenic climate change, although research evidence suggests that in many countries public appetites for climate action are ahead of their governments (Bedsted and Klüver 2009; Bested, Mathieu and Leyrit 2015; Smith 2024).

Against this background removals policy must have two principal objectives: to rapidly increase the global total of responsible CDR alongside conventional mitigation, and in the course of so doing discover the most cost-effective routes to scale-up for further removals growth: which technique works best in each physical and social environment. Drawing on its contribution to research and policy development which goes back to the Royal Society report *Geoengineering the Climate* of 2009, and embracing as our core t5heory of change the principle of the Hartwell Paper (Prins et al. 2010) that:

> "decarbonisation will only be achieved successfully as a benefit contingent upon other goals which are politically attractive and relentlessly pragmatic"

we see our work as rooted in the local: local research and policy focused on the alignment of CDR with the local environment and local social and development priorities, country by country, drawing on and contributing to local capacities. ***The case study becomes one key strand of our network's approach, applied at regional, national and sub national levels: case studies which go beyond prescription in helping to facilitate the whole process which can lead to successful deployment of responsible CDR.***

Effective achievement of this aim will rely on the network's ability to keep up to date with new CDR techniques and detailed developments and assess them in common evaluative frameworks, and we will put in place mechanisms to do this and communicate the results.

Whilst the national focus is important, it is clearly not enough. CDR faces particular challenges of purpose and governance to ensure effectiveness and safety both locally and across international boundaries. On safety international law covers some but not all issues, human rights law is increasingly being used to challenge the limits of what governments and corporations can do. On purpose and effectiveness, since the Clean Development Mechanism the main use of removals has been to generate climate credits to offset 'hard to reduce' emissions as the 'net' component in achieving 'net zero'. In general this had led to concerns about the extent to which offsets lead to 'mitigation deterrence' on the demand side – emission reductions slowing beyond the rate that would otherwise have been the case (Markusson et al 2018, McLaren 2020)– and specific concerns about whether particular CDR initiatives deliver what they claim to, either in drawing down CO_2 or storing it safely over long periods of time (Trencher et al 2024, Wilkinson and Gattuso 2022, Gruber and Talati 2023).

We will work on all aspects of monitoring, reporting and verification (MRV), to rationalise and make more robust the baroque arsenal of different assessment systems currently in use, thereby helping to reduce the reduce the considerable burden of due diligence which individual organisations seeking to invest in climate credits currently face. In addition we hope to open up new sources of finance beyond offset trading by positioning removals as an integral component of investable programmes of sustainable development.

Work to consolidate robust knowledge on governance issues thus becomes an important second strand of our planned work.

The Wider Context of Climate Change

Dealing with climate change involves dealing not only with environmental degradation but also inequalities in wealth and power within and between societies which undermine that traditional social knowledge and practice which can support community and environmental sustainability. Whilst it is well beyond the scope of this project to try to remedy these wider issues directly we will be conscious of the impacts of what we propose on structural inequalities, and inequalities of voice and representation (Hagendijk, Healey and Santos Pereira 2009).

THE NETWORK'S CORE TASKS:

This proposal seeks to bring together an international knowledge network of researchers and policymakers to complement and synthesise existing activity, and to work in parallel on five interacting tasks which will contribute to robust CDR assessment and governance, and to the development of removals at scale:

- Undertake studies of contexts, capacities and needs in world regions. broadly defined, and use these to develop regional policies and select jurisdictions for intensive case-study work on CDR in local environmental and social contexts;
- To use these case studies:
    - to assess the potential for responsible removals on a jurisdiction-by-jurisdiction basis, at different scales, and to employ environmental and policy research to support the development of these potentials into actionable programmes leading to the maximum deployment of responsible removals in national CDR portfolios;
    - to make recommendations on the environmental, industrial, social and regulatory contexts offer the best opportunity to scale each particular CDR technology responsibly and at speed;
- Ensure that national portfolios are up-to-date by horizon scanning on new CDR approaches and organising activities which allow them to be interrogated and compared within common evaluative frames;
- Work on the international governance for CDR to help coordinate activity globally, to spread appropriate learning and support, and to develop common quality and regulatory standards not only for individual technologies, but also for the research and development needed to test and scale them in real jurisdictions;
- Broaden the opportunities for international public and private finance by emphasising CDR co-benefits and locating removals portfolios within investment plans for sustainable development with significant financial returns.

II – A Proposed Work Programme

Conceptual Approach and Definitions

What do we mean by 'responsible removals'?

The network's research and development will adhere to general guidelines for responsible research and innovation and in particular the AREA framework precepts: to anticipate, reflect, engage and act.

But by 'responsible removals' we mean not only this commitment to responsible process allied to a substantive commitment to initiatives that avoid harm to humans or the environment. Our definition includes a further commitment to removals that also contribute to national development priorities including the achievement of other sustainable development goals (SDGs). We believe that integration of climate removals into development in this way will help ensure that local plans realistically address trade-offs and synergies between local aims and interests and establish a degree of local 'buy-in' that will contribute to their being carried through to completion.

We encourage this broader developmental perspective since it may also yield additional sources of international finance from private and public sources, as the climate emergency becomes increasingly seen as part of a strategic global sustainability challenge which includes the need to reconcile biodiversity with the requirements of a stable climate, clean water and air, and meeting increasing, and increasingly varied, food demands.

Framing what counts in removals: from planetary perspectives to the real world

To be effective our network needs to adopt framings and methodologies that are both analytically coherent and politically and socially realistic, and which cut through constraints that have been inhibiting the rapid scale up of responsible and robust CDR[1]. The first required shift is one of general perspective: to ensure that CDR research and policy agendas are locally formulated and reflect the real-world diversity of values, human and natural resources and priorities. The Paris Agreement, in recognising that progress towards global targets to limit climate change needs to be based on nationally determined contributions, fully embraced this 'bottom-up' approach. Yet too much CDR research is universalistic in tone, focussed on the potential of individual technologies, with local political and social factors being seen as constraints on the maximum possible idealised yield in removals.

In contrast to this 'planetary' approach, we embrace a 'world' perspective in which social and natural scientists work together with policymakers to build bottom-up portfolios of climate action, centred on issues of governance, jurisdiction by

[1] Both the broad perspective and detailed methodology we have adopted are set out in detail in a recent paper: Healey, P., Kruger, T., and Lezaun, J (2024) Responsible innovation in CDR: designing sustainable national Greenhouse Gas Removal policies in a fragmented and polycentric governance system. Front. Clim,. 11 January 2024 Volume 5 - 2023 | https://doi.org/10.3389/fclim.2023.1293650

jurisdiction, centred on local opportunities and constraints. These contrasting analytic perspectives are summarised in table 1.

TABLE 1. PLANETARY AND WORLD PERSPECTIVES IN CONSTRUCTING STRATEGIES FOR RESPONSIBLE CDR

Dimension	Planetary perspective	World perspective
Overall framing and approach	Climate physics and climate economics are the basis for universalistic climate scenario modeling. Local scenarios based on increasing model resolution. Either entirely apolitical and asocial, or assume that key social parameters are fixed spatially or temporally.	Rooted in belief that more ambitious climate actions are only likely to be adopted if they are congruent with local conditions and linked to local strategies for the remaining sustainable development goals (SDGs).
Geographical/epistemological focus	Focus on global potential. Particular CDR approaches considered individually. Assessment of global potentials leading to identification of local targets. Use of burden-sharing approaches based on top-down assessments of local potentials ('under-utilized land', etc) to allocate national targets.	Focus on local potential; culturally and politically sensitive to local environmental and human resources and their synergies and trade-offs. Assessment of local potentials leading to identification of global contributions.
View of social and political agency: role assigned to governments and stakeholders	As consultees in granting 'social license to operate', often in terms of consent for experimentation or deployment of a particular CDR technique (although sometimes inappropriately extended to other places and times).	As customers for scientific and governance capacities to set CDR portfolio strategies in line with other development requirements; co-working with interdisciplinary science/social science researchers.
Wider social engagement, outreach and dissemination	Primarily an 'end-of-pipe' add-on	An integrated function of the co-creation of locally appropriate CDR portfolios and their governance.
Broader legacy of research	Restricted application. Applicability to national portfolio building typically, beyond scope of approach.	Multidimensional mapping allows broad general conclusions and knowledge transfer, but always subject to local test.

Source: Healey, Kruger and Lezaun, Op. cit. 2024, p.2

Comprehensive CDR assessment: the Principles and Protocols approach

A second requirement is a comprehensive framework for the assessment and governance of CDR. A range of policy inputs and research on climate engineering governance led to our adoption of the 'principles and protocols' framework for assessment and governance which we plan to use in this network. It has three broad components:

- a set of high level governance principles[2] to apply throughout the processes of assessment and governance;
- technology-specific protocols related to the opportunity and risk profiles of particular technologies (which may be embodied in 'stage-gates' specifying detailed requirements a technology might need to meet in order to be allowed to progress);

[2] one example, the Oxford Principles (Rayner et al. 2013), was devised in 2010 in response to a UK Parliamentary enquiry into climate engineering governance but could apply to any field of R&D. It advocates mechanisms to ensure that knowledge is regarded as a public good, there is public engagement about options, open publication and independent scrutiny of research results, and that regulation is put in place before deployment of new technologies.

- and specific geopolitical considerations which relate to the environmental characteristics of any country in which the technology is to be applied, and the political and cultural values and priorities which may be called into play. This last element is crucial to our 'world perspective' approach, and lead it to be rooted in national case studies.

World Regional and Country Studies

National case studies, drawing on and contributing to international governance and knowledge exchange

The core of our proposal is to undertake a series of studies which assess the potential of deploying the full range of proposed CDR techniques on a country-specific (or even more local) basis. These individual country studies will both contribute to and draw on an international network of stakeholders (policymaking, academic, industry and civil society actors) with an interest in the CDR space. The network would comprise a group of volunteer countries; because the work would be carried out in partnership with each locality, government commitment would be required for each jurisdiction to participate.

The focus of the network would be global: to generate knowledge that would support a rapid scale-up in responsible CDR. Consequently care would need to be taken to ensure that individual volunteer jurisdictions taken together provide requisite global variety in terms of geography, stage of development, natural and human resources, and governance structures and processes. Such variety is useful for research purposes to determine which factors are crucial to CDR development but also to encourage wider buy-in and scale up. In particular there would need to be assurances for smaller and developing states to ensure that within this network their voices and needs are recognised at least to the same extent as in principle they receive under UNFCCC auspices.

Country studies would be carried out by a core group of international academic and policy analysts, growing as studies accumulate, plus ad hoc consultants for specialist work and to provide necessary local insight and contact networks.

We believe the information produced by our case studies will be of wider use in developing policy on CDR and its funding. For example, we are already engaging with the World Bank's Climate Change Fund Management Unit. In the course of our regional work we plan to engage with the appropriate regional development banks.

World regional studies

The individual country case-studies will be based on world regional studies, initially in India, Sub-Saharan Africa and Latin America and the Caribbean. The first stage of these will:

- discover existing work, capacities, appetites and key issues for CDR in three initial world regions (broadly defined): India, Sub-Saharan Africa and Latin America and the Caribbean;
- introduce network capacities and workstreams to be developed and applied with local partners;

- broadly test against local contexts, policies and priorities the work that we plan to do;
- and select an appropriately varied set of jurisdictional cases (including leaders and laggards in climate and CDR policies and capacities) for intensive research/policy development and knowledge exchange.

In parallel with these national case-studies, individual regions will undertake further work to develop policies and governance for CDR at various scales, and align these where possible and useful, drawing on national/jurisdictional case-studies and work in the international governance stream.

Country studies in detail: developing understanding and action in individual jurisdictions

After a short initial visit to establish agreed ways of working, country studies would follow a pattern of two broad tasks: mapping the country's CDR potential given its physical and industrial capacities, development priorities and the outcomes of detailed citizen and stakeholder engagement on ways forward; and such research and planning work needed to support the realisation of that potential. The case-study country would act as client for both pieces of work.

Whilst the essence of our approach is always to be sensitive to local factors and needs, the aim would be to employ a broadly similar set of methods in carrying out the mapping tasks: desk research to establish the history and capacities for CDR, followed a combination of interviews, focus groups and workshops in the local language, and visits to key sites and institutions. This core common approach would help us establish comparable information across cases which in turn would facilitate global learning and scale-up. This mapping stage would occupy 17 months. The base information on resources and preferences would inform reference in detail to CDR in country's Nationally Determined Contribution under the UNFCCC Paris process: a broad statement of intent. In parallel a more detailed statement of what we learned from the case study – agreed with the country client - would be made available across the network.

Because reviews of climate policy to date have suggested that setting plans and targets is a lot easier than achieving them, the network is committed to going beyond the broad recommendations of the mapping exercise to working with each country client on a possible portfolio of CDR actions, en route to demonstration and deployment – or rejection - of individual CDR technologies. This second research and planning stage of country studies would necessarily closely reflect the policies, institutions and interests of the individual country concerned and the substantive issues and methods – and the expertise involved - would vary correspondingly. In most cases this work would include, for example:

- Local research to calibrate wider findings on costs, effectiveness and safety issues of different CDR technologies in the local context;
- Work on trade-offs and synergies in building a portfolio of climate actions (including the distribution of benefits and harms in terms of lives and livelihoods);

- Assessment and planning to maximise co-benefits between planned CDR portfolios and other sustainable development priorities;
- Continuing efforts to widen financial resources for sustainable development plans which include removals;
- The development and application of MRV.

This further stage of work would be specified in advance with the country-client and would lead to detailed implementation plans for the country's CDR portfolio. Because the aim would be to nest the CDR plan within climate action, and to nest climate action within each country's sustainable development plans, it would also be expected to contribute to the country's report to UNFCCC on its long-term low-emission development strategy (LT-LEDS).

Importantly the network's core expertise would in large measure be provided by the participating countries themselves: drawing on and strengthening national capacities to develop CDR will be one of the network's key priorities. The proposed studies would draw on the experience of a number of similar 'bottom-up' studies that have been undertaken in the US (Roads to Removals), in France, Norway and the UAE (by Carbon Gap) and are under development in Canada and Australia, seeking to learn lessons from each and, as appropriate, adopt similar standards and methodologies and coverage of key issues. Maintenance of high academic standards will be key.

Network Capacities and Workstreams

The programme will be carried out by core teams working under five workstreams. These core team capacities will be augmented as needed by consultants. The workstreams (see p.28 for details) are:

- Governance and Finance
- Acceptability and citizen and stakeholder engagement
- Coherence with sustainability
- Technical and economic potential and impacts
- Integrated and quantitative assessment

The First Three World Regional Programmes in Detail

The world regional programmes kick off our work programme. They help establish the context for the network's detailed jurisdictional case-studies and work on national and international governance. In turn the regional programmes draw on case and governance studies to help develop research and policy in their specific geographical and political contexts. In addition we expect each of them to provide substantial insights which may provide the basis for innovation elsewhere.

India - Harnessing Carbon Dioxide Removal for Sustainable Development: Policy Pathways, Innovation, and Market Transformation

Transitions Research [3]

Led by Dr. Vikrom Mathur, Teenu J Thaikattil

The Broader Context

India's Carbon Dioxide Removal (CDR) market is in its infancy, with very few recorded investments predominantly in biochar and enhanced rock weathering projects. Globally, the demand for CDR is growing rapidly, driven by the necessity to meet IPCC-projected needs of 4.7 to 9.8 gigatons annually by 2050. India has the potential to contribute 10-30% of global CDR requirements, leveraging its vast agricultural resources and biomass availability[4]. However, current efforts remain at the kiloton scale, far from the gigaton levels required for impactful climate action.

Specific Issues

Despite its potential, India's CDR sector faces significant challenges:

- **Policy Gaps:** There is no unified national policy to align ministries and create a cohesive framework for scaling CDR technologies.
- **Resource Constraints:** Scaling biochar production could require 500 million tons of biomass annually, straining logistical and supply systems.
- **Operational Challenges:** Diverse climatic conditions, such as high monsoon rainfall, increase costs and disrupt carbon sequestration processes.
- **Market Development:** A nascent domestic market for CDR credits and high international standards hinder growth.
- **Energy Intensity:** Technologies like Direct Air Capture (DAC) demand renewable energy infrastructure currently lacking in India.
- **Behavioral Barriers:** Resistance to selling crop residues for biochar highlights the need for local engagement and adaptation.

These challenges show the urgency for innovative, scalable solutions that address the barriers while leveraging India's unique strengths.

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[3] Transitions Research (https://transitionsresearch.org) has a mission to discover sustainable transition pathways for India's future by conducting policy and action research, filling knowledge gaps, co-creating solutions and enabling citizen engagement.

[4] Durable Carbon Dioxide Removal in India: The Opportunity to Lead the World While Improving Agricultural Systems, Increasing Export Revenue and Generating Job:s A White Paper for Indian Policy Makers December 2023

Goal and Objectives

Goal: To create an enabling ecosystem for scaling India's CDR technologies by fostering policy alignment, innovation, financial support, and market development, contributing to India's net-zero goals and global carbon removal targets.

Objectives:

1. Develop a unified national policy for CDR, including a 10-year roadmap and standards for carbon removal and trading.
2. Accelerate innovation through research, startup engagement, and knowledge-sharing platforms.
3. Mobilize finance by promoting transparency, scalable business models, and integration with corporate sustainability goals.
4. Establish robust MRV (Monitoring, Reporting, and Verification) standards to align India's CDR projects with global carbon credit markets.
5. Foster multi-stakeholder collaboration, including policymakers, researchers, and industrialists, to drive market readiness and co-benefits.

Approach

India, at this stage, requires a growing alignment between policy, innovation, finance, and corporate demand to create a conducive environment for scaling carbon removal technologies. The following key interventions outline how this alignment can be achieved:

Policy coordination: Conduct workshops and develop a white paper to create a unified policy framework, including best practices and trade-off evaluations.

Innovation Acceleration: Host India's first CDR conference, engage startups through panel discussions, and showcase case studies of successful CDR projects.

Finance Mobilization: Organize investor and CSR panel discussions to activate demand and explore upcoming business models for CDR integration.

Knowledge Dissemination: Document and share findings through roundtable proceedings, a white paper on best practices in India, and a 10-year policy roadmap.

This alignment can foster the development and deployment of innovative solutions while ensuring they are financially viable and supported by robust policy frameworks.

Activity and Timeline for a 33 month project

Stage 1 – Understanding Contexts

(a) World regional CDR audits: initial mapping and planning (months 1-14)

This phase establishes the groundwork for the initiative through strategic networking, outreach, and key stakeholder engagement.

- **Building Partnerships:** Connecting with CDR industry leaders, research institutions, government bodies, and civil society to form a collaborative network.
- **Proposal Sharing:** Disseminating project objectives and value propositions to potential partners to secure alignment and support.
- **Stakeholder Dialogues:** Conducting initial interviews and discussions with key stakeholders to gain insights into the challenges, opportunities, and landscape of CDR in urban contexts.

The work will include a workshop which will:

- introduce capacities and workstreams from the wider carbon removals network and from work developing in Latin America and Sub-Saharan Africa;
- broadly test the work that the wider network plans to do against local contexts, policies and priorities;
- and select an appropriately varied set of jurisdictional cases (including leaders and laggards in climate and CDR policies and capacities) for intensive research/policy development and knowledge exchange in stage 2.

(b) <u>World regional CDR audits: policy and capacity development</u> (months 15-34)

Work to create an enabling ecosystem for mainstreaming CDR

- **Roundtables & Panel Discussions:** Organizing discussions in three cities, strategically aligned with clusters of CDR startups. Key themes will include Policy, Innovation, and Finance, fostering dialogue among industry leaders, policymakers, and investors.
- **Citizen Assemblies**: Host inclusive public forums in the same cities to engage local communities in conversations around carbon removal. These assemblies will create space for citizens to share perspectives, ask questions, and contribute to shaping locally relevant and socially accepted CDR pathways.
- **Organizational-Level Interviews & Case Studies:** Conducting in-depth interviews and documenting case studies of CDR startups and operations across urban and rural contexts, capturing challenges, successes, and scalability insights.
- **White Paper Development:** Publishing a comprehensive ten-year roadmap outlining best practices, policy recommendations, and case studies to guide the mainstreaming of CDR.

<u>Output</u>

- 3 round table discussions and 3 citizen assemblies and Proceedings of the events.

- 25 interviews and documentation of case studies- CDR startups & operations
- 2 white papers developed on the following topics:
    1. Best practices from global south - compendium of case studies
    2. Ten year road map on policy development

Budget

A rough estimation indicates that the programme budget might amount to €450k over 2 years, nine months.

Team and Capacity

Our team brings interdisciplinary expertise in sustainability science, policy analysis, and community engagement. We have extensive experience in piloting climate solutions in urban contexts, supported by strong partnerships with government and private stakeholders. Additional key members will be added as the project progresses. Work in India will contribute to and draw on work across the carbon removals network and especially its parallel programs in Africa and Latin Amrica and the Caribbean.

Conclusion

By addressing India's CDR challenges through policy alignment, innovation acceleration, and market integration, this project aims to create a scalable and sustainable ecosystem for carbon removal technologies, contributing significantly to India's net-zero goals and global climate action.

Enhancing Africa's Involvement in Carbon Dioxide Removal Efforts

Pius Yanda, Institute of Resource Assessment[5], University of Dar es Salaam

Introduction

Africa is significantly impacted by climate change, with rising temperatures, shifting precipitation patterns, and an increased frequency of extreme weather events threatening its environment and socio-economic stability. As the continent grapples with these challenges, compounded in some regions by political instability and conflict ,clean energy initiatives, such as solar and wind projects, are essential for transitioning away from fossil fuels and reducing future carbon emissions. Programmes like the African Renewable Energy Initiative aim to increase renewable energy capacity by 10 GW.

[5] The Institute of Resource Assessment (IRA) is a multidisciplinary/interdisciplinary research institute dealing with issues related to natural resource assessment and environmental management in general, including climate change adaptation and vulnerability assessments. During the last fifty years, the Institute established in 1967, has acquired vast experience in developing integrated methodologies and techniques involving local communities in planning and management of natural resources for sustainable development.

Alongside these emission reduction initistives, Africa still has the potential to play a crucial role in global carbon dioxide removal (CDR) efforts. This proposal outlines the current status of Africa's participation in CDR initiatives,and identifies future actions, including those necessitating external support, to maximise its potential, enhance resilience, and contribute to global climate goals.

CDR strategies are gaining momentum as the global community underscores the urgent need to combat climate change. Although Africa contributes minimally to global greenhouse gas emissions, it is increasingly acknowledged as an essential player in CDR initiatives due to its abundant resources and unique ecological landscapes. This review examines the current state of Africa's involvement in CDR, highlights ongoing initiatives, and identifies areas for future action.

The Current State of CDR in Africa

Africa's engagement in CDR is multifaceted, spearheaded by various stakeholders including governments, non-governmental organisations, and grassroots initiatives. Notable CDR strategies across the continent include:

Afforestation and Reforestation

Initiatives such as the Great Green Wall seek to restore 100 million hectares of land in the Sahel region to combat desertification and enhance carbon sequestration. Similarly, countries like Ethiopia have launched mass tree-planting campaigns to reclaim degraded lands and sequester carbon. This initiative aimed to plant 4 billion trees by 2022.

Agroforestry

Many African countries integrate trees into their agricultural systems, improving soil health, enhancing biodiversity, and capturing carbon. Traditional practices, such as growing Indigenous crops alongside trees, provide food security and carbon storage benefits.

Soil Carbon Sequestration

Practices like no-till farming, crop rotation, and cover cropping are being adopted in conservation agriculture to increase soil organic carbon content. In Southern Africa, conservation agriculture, agroforestry, and regenerative farming are encouraged to enhance resilience and sequester carbon. The African Union's Agenda 2063 acknowledges the significance of sustainable agricultural practices.

Geological Storage Capacity as the basis for Direct Air Carbon Capture and Storage (DACCS)

There are significant geological storage possibilities for CO2 in the Great Rift Valley and Kenya plans to exploit them and draw in DACCS projects from the Great Carbon Valley initiative in association with the Swiss company Climeworks.

Challenges Facing Africa in CDR Efforts

African countries are pursuing carbon dioxide removal (CDR) efforts; however, several challenges hinder their effectiveness.

Financial Constraints: Accessing finance hampers the scaling of both existing projects and investment in new technologies. Finance for climate action is a central challenge for all countries, reflecting the low and uncertain economic return on projects, but there are additional difficulties in some African initiatives. For example under the Great Green Wall finance has been selectively available only for politically stable countries.

Infrastructure Deficiency: Poor infrastructure hampers transportation, making it difficult to implement large-scale CDR initiatives efficiently

Knowledge and Technology Gaps: A lack of local expertise in advanced CDR technologies and practices hinders progress.

Governance and Policy Issues: Inconsistent policies and regulations and poor MRV can undermine long-term CDR initiatives.

Future Actions Requiring External Support

To enhance Africa's role in global CDR efforts, the following actions are recommended:

Capacity Building and Knowledge Transfer

- Initiatives to train local scientists, agricultural specialists, and policymakers on CDR technologies.
- Partnerships with academic institutions and NGOs to disseminate best practices and innovative solutions.

Financial Investment

- Increased investment from international donors, development banks, and private sector actors to support CDR projects.
- Creation of green financing frameworks enables better access to funding for local initiatives.

Infrastructure Development

- Support for building and upgrading infrastructure to facilitate effective implementation of CDR projects (e.g., transportation for reforestation efforts, irrigation systems for sustainable agriculture).
- Investment in data collection and monitoring systems to track CDR progress effectively.

Policy Development and Governance Strengthening

- Support for formulating coherent and robust national policies that foster responsible CDR initiatives in line with sustainable development.
- Engagement of local communities and stakeholders in the design and implementation processes to ensure sustainable practices.

An initial programme to explore and develop local capacities

We propose the following initial programme to explore and develop local capacities for CDR in collaboration with the north-south Carbon Removals Network, which works in parallel in other world regions. Sub-Saharan Africa can be classified into several key regional blocs for this program, each characterised by distinct environmental, economic, and political contexts. For this research, we propose the following classifications:

East Africa:

- **Countries**: Kenya, Tanzania, Uganda, Rwanda, Burundi, South Sudan, Ethiopia, Djibouti, Somalia.
- **Characteristics:** High biodiversity, reliance on agriculture, and emerging initiatives in sustainable land management and renewable energy. Some countries, like Kenya, are pioneers in renewable energy and have begun exploring CDR options like afforestation soil carbon and geological , and development of DACS.

West Africa:

- **Countries**: Nigeria, Ghana, Senegal, Ivory Coast, Burkina Faso, Mali, Benin, Togo, Sierra Leone, Liberia.
- **Characteristics**: West Africa is a mix of resource-rich countries and vulnerable nations facing environmental degradation. Its diversity in economic activities—from agriculture to oil production—affects its capacity to implement CDR strategies. There are ongoing discussions about agroforestry practices and energy transition.

Central Africa*:*

- **Countries**: Cameroon, Central African Republic, Democratic Republic of the Congo (DRC), Republic of the Congo, Gabon, Chad.
- **Characteristics:** Home to one of the world's largest rainforests, Central Africa is crucial for carbon storage. However, deforestation pressures from logging, agriculture, and mining pose significant challenges, exacerbated in some areas by armed conflictSignificant potential exists for initiatives focused on REDD+ (Reducing Emissions from Deforestation and Forest Degradation) and sustainable forest management, although developing credible MRV and assured longevity for carbon credits from forestry has long been a huge challenge,.

Southern Africa:

- **Countries**: South Africa, Botswana, Namibia, Zimbabwe, Zambia, Lesotho, Swaziland, Mozambique, Angola.
- **Characteristics**: This region has varying capacities for CDR, with South Africa being a leader in renewable energy policies and climate actions. Other countries, like Zimbabwe and Mozambique, possess rich biodiversity and community-based land management strategies that could be leveraged for CDR practices.

Horn of Africa:

- **Countries**: Somalia, Ethiopia, Eritrea, Djibouti, Sudan.
- **Characteristics**: This area has arid and semi-arid climates, severe land degradation, food insecurity, and periodic political instability and conflict. Communities are actively seeking sustainable agricultural practices and resilience-building initiatives, which can include CDR methods like those aimed at boosting soil carbon.

Activity and Timeline for a 33 month project

Stage 1 – Understanding Contexts

(a) World regional CDR audits: initial mapping and planning (months 1-14)

This phase establishes the groundwork for the initiative through strategic networking, outreach, and key stakeholder engagement.

- **Building Partnerships:** Connecting with CDR industry leaders, research institutions, government bodies, and civil society to form a collaborative network.
- **Proposal Sharing:** Disseminating project objectives and value propositions to potential partners to secure alignment and support.
- **Stakeholder Dialogues:** Conducting initial interviews and discussions with key stakeholders to gain insights into the challenges, opportunities, and landscape of CDR in urban contexts.

Activities under (a) to include:

- Conduct a survey of researchers, policymakers, and other stakeholders, supported by selected in-depth interviews, to discover existing work, capacities, appetites and key issues for CDR across Sub-Saharan Africa;
- Issue a report on these findings, together with a brief introduction to the Carbon Removals Network;
- Hold a workshop comprising a selection of leading countries in working on/developing thinking on CDR in Africa, together with some others who are positive but less advanced, to pursue:
  - Introduce the network and its capacities and look for African partners;
  - Set out the network's broad agenda to develop responsible CDR and learn about parallel work to date in other world regions;
  - Broadly test this against local contexts, policies and priorities;
  - Draw up a detailed African programme of work, issued as a report.
- Select an appropriately varied set of jurisdictional cases (including leaders and laggards in climate and CDR policies and capacities) for intensive research/policy development and knowledge exchange in stage 2 of the wider network programme.

(b) World regional CDR audits: policy and capacity development (months 15-34)

- Undertake further work to develop policies and governance for CDR at various scales and align these where possible and useful, drawing on the network's jurisdictional case studies and international governance stream.
- Hold the first conference in Africa on CDR in the context of development, with a major theme on finance.

Budget

The indicative budget for these activities is €400k over two years, nine months.

Conclusion

Africa has the potential to substantially contribute to global carbon dioxide removal (CDR) efforts through various initiatives, such as afforestation and innovative agricultural practices, and potentially DACCS. However, to fully realise this potential, comprehensive external support is necessary to tackle financial, infrastructural, and knowledge-related challenges. By investing in capacity building, infrastructure development, and practical policy formulation, the international community can enable Africa to play a vital role in combating climate change and achieving global carbon neutrality goals.

Call to Action

We encourage governments, international organisations, NGOs, and the private sector to collaborate to support, recognise, and enhance Africa's carbon dioxide removal initiatives to benefit the continent and the global community. By working together, we can forge a sustainable future for all.

Developing Carbon Dioxide Removal in Latin America and the Caribbean

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Introduction: the broad regional context

Countries in the Latin American and Caribbean (LAC) region share a number of distinctive characteristics that provide a background for common approaches to policy: a young, vibrant population that includes a diversity of ethnic origins, still considerable demographic growth trends, highly urbanized societies, an endowment of extremely rich natural resources and a wealth of biodiversity, including several megadiverse countries. Against these conditions, the region is significantly unequal, secular growth has been low, including alternating period of stagnation and unstained growth, political instability has pervaded efforts to seek more integrated and equitable societies, electoral processes have brought a measure of pendular shifts and the one defining feature in recent decades has been unsustainable development styles. Differences

[6] Fundación Torcuato Di Tella (FTDT - https://ftdt.cc) was established in 1958. It is a research and advisory not-for-profit organization whose mission is to promote regional integration, enhance public policy design and implementation and contribute to improve informed decision-making processes in Latin America and the Caribbean (LAC). Core activities include assessing and supporting the efforts of governments in LAC and at the global scale to address climate change and pursue sustainable development.

include large and small economies, landlocked and insular countries, and disparity in conditions for democratic stability and absence of conflict.

These circumstances provide the basis for climate policy stances and priorities across the region. It is worth noting that originally one common position of LAC countries resulted from the fact that the region (and individual) contributions to global carbon emissions was marginal, while impacts resulting from climate change are large and growing and the region is highly vulnerable to extreme weather events. The understanding of this asymmetry had a strong influence on government, civil society and economic agents and contributed to define an initial overall approach to climate negotiations towards an international climate regime.

Notwithstanding that, LAC countries had somewhat different priorities in the process of international negotiations throughout the last three decades. During the Kyoto Protocol (KP) era several LAC countries were particularly eager to include afforestation and reforestation as part of project activities that would allow to benefit from carbon markets through the Clean Development Mechanism (CDM), even if those activities were not included explicitly in the KP text. A more nuanced approach has evolved from those negotiations and adaptation and loss and damage have attained a substantive role in national climate policies.

Countries in the region participate in climate negotiations under different groups: the Independent Alliance of Latin America and the Caribbean (AILAC), Bolivarian Alliance for the Peoples of our America (ALBA in Spanish), and the group SUR (formerly known as ABU; Argentina Brazil and Uruguay). However, groupings are not mutually exclusive, and some members participate in and/or with multiple negotiating groups such as the Alliance of Small Island States (AOSIS), or the Coalition for Rainforest Nations. Mexico, on the other hand integrates the Environmental Integrity Group. This reveals a multifaceted approach to the construction of an international climate regime reflecting countries' priorities and interests.

<u>Specific issues influencing the scope for CDR development</u>

Strengthening adaptive capacity - while addressing pre-existing socioeconomic stresses -, and tackling vulnerability is an imperative for the region. However, insufficient adaptation finance, typically scarce fiscal space and remaining (but progressively decreasing) knowledge gaps restrict or delay crucial adaptation efforts.

On the other hand, climate change mitigation efforts in the LAC region are primarily focused on achieving emissions reductions, on the understanding that there are many benefits - direct and indirect - of implementing climate mitigation action, including enhancing competitiveness, introducing innovative technologies in global value chains and hopefully accessing climate finance and building beneficial partnerships with developed countries. Opportunities related to the energy transition, renewable energies and energy efficiency are part of the menu of options to be considered and included in the national determined contributions that ought to be presented in early 2025.

In this context, consideration of CDR approaches is emerging, largely with an emphasis on research possibilities associated with expanding the knowledge base and explore new opportunities for climate action, be them within the framework of Article 6 of the Paris Agreement, or in leveraging emission reductions in conjunction with adaptation efforts including nature-based methods and practices.

The approach to, and the implicit policy stance related to utilizing, CDR is that only if Parties submit new nationally determined contributions (NDCs) that are significantly more ambitious in proposed climate mitigation action for 2030 and beyond, would it be acceptable to include CDR options at scale. Likely preconditions for CDR would need to include appropriate governance and for financial support mechanisms that avoided risks of mitigation deterrence.

Further, adopting decisions on the potential development of CDR technologies requires more precise and robust information about investment and operating costs, but also, importantly, about the potential for related climate mitigation and permanence issues associated with removal options, effects on level of economic activity, GDP growth, and employment, impacts on ecosystems and biodiversity, as well as understanding the gamut of implementation risks. Informed decision making requires specific knowledge in order to avoid misallocation of scarce resources to detrimental policy options.

Deployment of large-scale CDR approaches in LAC would have regional physical and socio-economic implications which are to be explored and understood, including for efforts to achieve the Sustainable Development Goals (SDGs), Comprehensive work is also needed to develop portfolios of CDR approaches that can maximize potential synergies with sustainable development goals. More transdisciplinary and geographically diverse research is required in LAC on the linkages of deploying large-scale CDR approaches.

Furthermore, those knowledge gaps confine the formulation of recommendations that would encourage governments in the region to consider the incorporation of CDR measures in national climate change action planning, in particular when elaborating NDCs and long-term low carbon development strategies, as well as introducing them in national sectoral plans.

In addition, LAC countries face persistent finance gaps, hence the decision on the potential CDR options development would require accurate abatement costs information and careful consideration and assessment of the spectrum of implementation risks.

Finally, given the high inequality conditions prevailing in LAC, issues of equity and inclusion need to be thoroughly considered, case by case, in the selection of options and the design of policies and incentives for CDR adoption by prioritizing technology options with positive impacts or those which allow to minimize adverse effects.

Objectives

Research and knowledge dissemination to be undertaken in the Latin America and Caribbean region (LAC) willl address seven different workstreams:

i. Expanding the scientific knowledge base

   - Intensification of ongoing scientific and technical research through regional cooperation schemes. To that end, aiming for the development of a regional platform to support cooperative research activities or even as a regional spinoff of the carbon removals network.
   - Identification and support of pilot projects (technical and socio-economic feasibility, replicability, policy priority). Again, it would be worth contemplating the creation of a CDR project LAB at a small scale.

ii. Exploring implications of the utilization of CDR approaches (needs and requirements) in planning, policy design and elaboration of nationally determined contributions, in particular considering progress in global climate action and notably national commitments.

   Analysis of policy implications of unfolding CDR approaches at a large scale in relation with the climate regime negotiations. Even if there might have been some prior progress made in the elucidation of these critical issues, there is a need to examine them strictly from a developing country perspective.

   This need is perhaps even more critical when considering a global context of potential backsliding in agreements, strategies, and policies because of the changes in the international political landscape and the consequent mutation of previous climate policy stances. A primacy of delay or denial at the global level might intensify concerns about the risk of inaction and entrench developing countries positions towards concentrating on emission reductions efforts. In the absence of adequate climate finance flows and fiscal strictures in developing countries climate action might be strictly focused on proven mitigation approaches, reducing the willingness to explore new options and technologies given resource scarcity. On the other hand, it is worth noting that protracted mitigation efforts and the potential propagation of climate laggards will reinforce the need for putting in play CDR approaches at scale.

iii. Examining the impacts, risks, and co-benefits of CDR deployment in the region.

   - Abatement costs analysis
   - Cost-benefit analysis at the country level, by type of technology, to be developed preferable in conjunction with national think tanks
   - Risk analysis by type of risk, by ecosystem, by resource (country or regional level)
   - Positive and negative potential impacts in terms of SDGs
   - Monitoring, reporting and verification methods and systems

iv. Assessing governance challenges: in particular, in LAC, on how to articulate with land use and land use change governance, policy planning to ensure that CDR implementation aligns with sustainable land use practices and does not adversely affect food security and on how to include subnational governments, civil society, scientific research institutions, industry and other relevant stakeholders.

v. Analyse the role of CDR approaches in carbon markets and access to new and additional financial resources in the context of overall financial astringency

vi. Development of positive policy narratives

vii. Knowledge dissemination and outreach through networking, organization of webinars and diffusion of publications and specific issue briefs

Activity and Timeline for a 33 month project

Stage 1 – Understanding Contexts

(c) World regional CDR audits: initial mapping and planning (months 1-14)

This inception phase establishes the groundwork for the for the LAC regional programme work and the wider network initiative through strategic networking, outreach, and key stakeholder engagement.

It comprises a set of activities to provide the key constituents for the operationalization and implementation of the LAC regional programme, including strategic networking, network initiatives dissemination, identifying/ engaging potential partnerships and key research centres, enabling stakeholder engagement and outreach.

Planned activities encompass:

- Extensive **review of the body of research** in countries the LAC region and, summarily, at the regional level.
- **Review of documentary evidence on governmental visions, strategies, plans**, programmes considering these technology options and of initiatives or projects aiming at the adoption of CDR technologies in LAC
- **Developing partnerships**: establishing connections with institutional networks, research institutions, civil society and economic actors from different value chains that might be involved in CDR initiatives.
- **Proposal Sharing**: Disseminating project and regional programme objectives and discuss propositions with potential partners to seek engagement, support and participation in the programme planned activities.

- **Series of Stakeholder Dialogues**: Conducting initial interviews, bilateral discussions and webinars to engage key stakeholders at the subregional level to identify perspectives, priorities and challenges associated with the introduction of CDR approaches in their different contexts and circumstances.
- **Platform to support public participation** and debate critical issues, at the regional level.

Work will include:

- the organization of three regional workshops with the aim of:
  - Engaging stakeholders by sharing the wider network vision, plans, tenets and methodological approaches.
  - Showcasing capacities and workstreams from the wider carbon removals network and provide insights from work being developed under the other regional programmes.
  - Validating the initial selection of jurisdictional cases and CDR options against the specific subregional priorities for in depth research and policy development and knowledge exchange in stage 2.
  - Providing preliminary insights on the potential benefits and implications of the introduction of CDR approaches and eventually of large-scale deployment.

- Preparation of a mid-term synthesis report of work done to disseminate experiences and lessons learned and substantiate further funding proposals

(d) <u>World regional CDR audits: policy and capacity development</u> (months 15-34)

Work to create an enabling ecosystem for mainstreaming CDR:

- **Stakeholders' consultations** to consider key issues associated with needs and requirement for the deployment of CDR methods (public policies, access to finance, addressing cost of capital issues, monitoring, reporting and verification methodologies to be utilized, technical-economic analysis, costs and benefits and socioenvironmental impacts of deployment at scale.
- **Drawing on and contributing to regional jurisdictional case studies being carried out under stages 2 and 3 of the network's programme**
- In the light of the the stakeholder consultations and jurisdictional cvase studies, examining the financial needs and requirements and the impacts, risks, and co-benefits of CDR deployment in the region through **further selected studies** which may include:
  - Afforestation and reforestation CDR measures and options in a selected LAC subregion/country
  - Mangrove restoration CDR measures and options in a selected LAC subregion/country
  - Bioenergy with Carbon Capture and Storage (BECCS) CDR measures and options in a selected LAC subregion/country

        - Categorisation and evaluation of policy instruments for various carbon dioxide removal methods: how policy can advance CDR deployment for various CDR options
        - Carbon pricing and market opportunities for CDR methods in the region in the context of Article 6 of the Paris Agreement
    - **Annotated guide**: elaboration and dissemination of an annotated guide for the consideration and adoption of CDR approaches in LAC countries.

Major Outputs

- Organization of the Series dialogues with key stakeholders (between 3 and 5)
- Three regional/subregional workshops
- Synthesis report Stage 1
- Detailed additional studies
- Annotated guide for the consideration and adoption of CDR approaches in LAC countries

Budget

A broad estimation indicates that implementing the LAC regional programme might require a budget amounting to €430k over three years.

THE NETWORK'S CORE CAPACITIES AND WORKSTREAMS

Workstream 1: **National and International Governance and Finance**

National and International Governance in the context of the network's aims

This workstream starts with the recognition that climate policy involves overlapping multiple levels of governance in a fragmented and polycentric world (Healey et al. 2024)

Our work focuses on the negotiation of order around the central issues of

- cost-effectiveness,
- safety/protection, and
- acceptability/justice

both within and between jurisdictions - in developing and deploying CDR

Although our network emphasises bottom-up nationally grounded initiatives, clearly these need to operate within a framework of international governance. Whilst national governance can address many of the issues, others they cannot, such as issues such as standards for trading of carbon credits, the regulation of removals affecting international waters, allocation protocols which avoid double-counting of removals that involve more than one country (for example, trees grown in Canada used as feedstock

for BECCS in the UK, with long term carbon sequestration from the project taking place in, say, Norway). Such issues have become very sensitive given widespread reports, for example, that many traded carbon offsets have failed to deliver, with some raising human rights concerns. Ecosystem Marketplace in its report *State of the Voluntary Carbon Market 2024* finds that the volume and value of the voluntary market was down for the second year from its peak in 2021, with the transaction value down 61% in a year. As conventional mitigation fails to deliver at the required scale, and emissions continue to grow, the issue of whether the international trading of carbon credits leads to mitigation deterrence gains prominence, and needs consideration, as does the issue post the Baku COP of who should pay for the transition to sustainability particularly in less developed and/or more immediately impacted countries. Finally recent abrupt changes in climate policy in the United States create a new challenge to global policy of the world's largest economy simultaneously abandoning constraints on carbon emissions and withdrawing from global collective climate action.

Some of these issues imply a need for regulation and standards – about control – including development of specific standards and criteria around the framework for the trading of carbon credits agreed at the Baku COP (Paris article 6.4). However, the overarching questions include how can international governance in its broadest sense help to facilitate - as well as control - research, development, demonstration and deployment of portfolios of CDR in the national development context? What kinds of definitions and processes would be involved? Which institutions would embody these, or would some new institution be required?

The international governance agenda is the responsibility of a separate team within the Carbon Removals network with a distinct work programme, led by Oxford and Linköping. The team will draw on significant contributions on CDR governance from Oxford, Linköping and Manchester originating with the influential Royal Society Report[7] It will have a broad scope not only to contribute to the core project programme, but also to pursue everything beyond, and complementary to, our bottom-up regional and national studies which will help deliver the project objective of maximum responsible CDR. A working definition of international governance in line with this approach is:

> "The international regulatory, informational, financial, research and organisational resources external to the starting capacities of individual jurisdictions which will be required to ensure that they can deliver responsible and accountable CDR and promote appropriate global learning."

Issues, capacities and tasks for the governance and finance team

The governance work programme will involve two parallel streams of work:

1. It will pursue a series of general issues and initiatives, running throughout the project (months 1-48). These will include:

[7] These include: Royal Society 2009, Rayner et al 2013, Bellamy et al 2013, Healey and Rayner 2015, Rayner and Healey 2018, Bellamy, 2018; Bellamy and Healey, 2018; Fridahl, 2018; Fridahl and Lehtveer, 2018, Healey et al 2021, Lezaun et al 2021, Bellamy 2022, Healey et al. 2024.

- From an initially top down perspective reconceptualising the governance of CDR and in particular going beyond its reduction to the assessment of individual CDR techniques outside any geographical or social context;
- Similarly, from an initially bottom-up perspective, an analysis of existing knowledge gaps which our emerging country studies suggest are important to the development of their own CDR agendas, or to the safety and security of other jurisdictions in cross-boundary effects;
- Developing a critical perspective on both sides of a contract in emissions offset trading, in the context of trying to develop radical and rapid decarbonisation;
- Defining what constitutes successful CDR by various measures in various contexts, and on rationalising MRV's current baroque arsenal of different approaches;
- Assessment of existing and potential funding sources for CDR in the context of development;
- Spreading best practice across similar contexts when valid to do so.

2. It will pursue a number of specific tasks in relation to the development of the network's activities through its four stages of work. Since the network's approach is to adapt aims and methods in the light of experience earlier tasks are specified in most detail:

Stage 1. Understanding Contexts

(a) World regional CDR audits: initial mapping and planning (Months 1-14).

Parallel world regional exercises in which we discover existing work, capacities and appetites in three world regions (broadly defined); introduce and test against local contexts and priorities the work that we plan to do; and look for partners and an appropriately varied set of jurisdictional cases (including leaders and laggards in climate and CDR policies and capacities) for intensive research and policy development in stage 2).

Task 1.1.1: Through synthesis of existing research and policy literature, and structured engagement between stakeholders from a range of jurisdictions, determine the key issues of governance involving climate policy with particular emphasis on CDR (including issues of international governance and perspective), any technology/region specific issues on the governance of CDR, and major constraints and opportunities, mapping the (variability of) positions of the different participants and where possible the determinants of variance.

Task 1.1.2: Through structured engagement between stakeholders from a range of jurisdictions, experts on climate governance and finance, and representatives of relevant public and private sector financial institutions (including the relevant regional development banks), define the decision space for:

- Different forms of finance for removals in the context of sustainable development;
- MRV, standards and processes required to be associated with each;

- Forms of underwriting, insurance and penalties against contractual non-performance under different circumstances;

and map the (variability of) positions of the different participants and where possible the determinants of variance. *(Defining the decision space on a question involves trying to agree between stakeholders on the issues at stake in the matter, and the criteria, evidence and processes to be involved in resolving them, rather than actually resolving them with a concrete choice between options.)*

Task 1.1.3: In the context of tasks 1 and 2, and the introduction of the network's assessment capacities/work packages, add to or amend the latter, and identify regional partners and or other key individual or institutional capacities, and identify jurisdictional case studies from the region for stage 2.

(b) World regional CDR audits: local policy and capacity development (Months 15-34)

Further work in individual regions, driven by the regions themselves, to develop and integrate capacities, and consider use these policies and governance for CDR in different regional contexts and at various scales.

Task 1.1.4: Drawing on work in individual regions, early jurisdictional studies from stage 2, and work from the international governance workstream, conceptualise similarities and differences in governance approaches within and between regions, and examine the scope for aligning these.

Stage 2. Assessing Removals Potential (Months 17-34).

A total of up to 15 case studies across the three regions (approximately 5 each) to produce initial potential portfolios of CDR for each (stage 2 (a)), and helping to design and pursue policy and financial routes to their deployment (stage 2 (b)).

Task 1.2.1: Evaluate existing governance drivers and barriers to CDR at multiple levels of governance taking account of gaps in international law and new uses of the law and new political developments with salience for CDR, the way CDR is framed in wider development and finance policies.

Task 1.2.2: Map the governance architectures for CDR in the 15 case studies jurisdictions and their linkages to supranational (as appropriate), regional and international regimes.

Task 1.2.3: Develop technology-specific protocols for individual CDR developments, perceived risks and opportunities, market introduction and commercialization (as appropriate) in each of the case study jurisdictions, tailored to stakeholders demands and local contexts, drawing on work 2.2.2.

Task 1.2.4: Drawing in particular on the outcomes of tasks 1.2.2 and 1.2.3 and other parallel tasks in other workstreams, draw up a provisional removals portfolio for each jurisdiction as an entry point for stage 3, including multiple conditional recommendations if needed.

Stage 3. Implementation and Finance (Months 30-44)

Use research (as needed) and planning to produce removals portfolios integrated with development priorities, and propose funding sources.

Task 1.3.1: Working with other workstreams, propose responsible government pathways for CDR in each of the case study jurisdictions including, as appropriate, technology neutral as well as technology specific policies to enable the development to deployment of locally grounded and approved CDR portfolios, their integration into climate policies, supportive institutional arrangements and strategies to avoid mitigation deterrence.

Task 1.3.2: Also drawing on the findings of other workstreams, analyse whether there are one or more locations amongst those in the case studies or elsewhere, which would be particularly good candidates, in the light of environmental, social and industrial factors, for extensive and/or rapid scale-up of particular removals techniques.

Stage 4. Review and Disseminate (Months 45-48).

Bringing in global research and policy communities to assess our work. Synthesis into a process which we could deploy across other jurisdictions, and dissemination.

Task 1.4.1: In the light of results of the tasks above, explore alternative governance drivers and protocols for CDR in the case study jurisdictions, and draw general lessons for others.

Task 1.4.2: Working with other network capacities, and across regions and jurisdictions, develop a programme of activities to evaluate the network's work and disseminate its findings.

Task 1.4.3: Review mechanisms to take forward the network's work at scale and make recommendations.

Workstream 2: **Citizen and Stakeholder Engagement to Determine Acceptability**

Aligning removals with local priorities and concerns

The network's case studies seek to establish and help develop 'responsible CDR' within the context of each jurisdiction's development aims. 'Responsible CDR' includes establishing what is acceptable to citizens and stakeholders as the process unfolds and alternative courses of actions emerge. This workstream seeks to identify the space of acceptability for the development and implementation of CDR solutions, including understanding what risks and opportunities particular technologies are seen to present to human health and the environment. It will draw on practical experience with participatory Technology Assessment (pTA – Klüver 2024), Responsible Research and Innovation (RRI)[8], deliberative democracy, and public engagement in policy making (Smith 2024) to inform the identification of CDR assessment criteria and potentials in Stage 1 and the development of CDR portfolios in Stage 2.

Work would be led by Democracy X (Denmark). Although described as a workstream in its own right, the activities within it make sense through being combined and coordinated with activities planned in other workstreams.

Stage 1 – Understanding Contexts

[8] http://actioncatalogue.eu/

(a) World regional CDR audits: initial mapping and planning (Months 1-14).
(b) World regional CDR audits: policy development (Months 15-34).
Parallel world regional programmes to review the similarities and differences in the history of CDR, key institutions and capacities, governance machinery and cultural and political influences, as input to the selection of a group of varied jurisdictions to serve as case studies for potential CDR development.

Task 2.1.1 Understanding the acceptability space

Work to review public engagement activities in select regions and/or jurisdictions, aiming at the initial identification of a space of acceptability among wider publics, and the underlying values, priorities and understandings of policy responsibility which influence it.

Stage 2 - Assessing Removals Potential (Months 17-34)
A total of up to 15 case studies across the three regions to produce portfolios of potential responsible CDR for each in the context of local environmental and social capacities, priorities and concerns.

Task 2.2.1: Stakeholder engagement.

Collaborating with Tasks 1.1.2 and 4.1.3 about stakeholder mapping and engagement design.

Task 2.2.2: Mini-public processes.

Each of the case areas (national and/or sub-national), mini-public processes will be organized

a) An Advisory Group with 4-5 experts from the case study area will be selected.
b) Production of an overview of climate challenges in the case area, potential solutions that may fit this particular area from an environmental and social perspective, and (among those) the potential role CDR technologies can play, including their pros and cons, cross-cutting dilemmas, and the potential role of CDR in mitigating climate change. The overview will be produced in collaboration with the Advisory Group and Workstream 4.
c) A mini-public process with lay citizens chosen to reflect the demographic diversity in their area will be organized. The citizens will be led through a process of information, deliberation, and writing recommendations. Their recommendations will include their wishes for the future role CDR should play in climate mitigation efforts, their wishes and concerns for various CDR technologies and cross-cutting dilemmas, and the conditions under which they could be implemented.

Citizens' recommendations will inform Phase 1 assessment made in Task 1.1.1 (mapping the positions of different participants), Task 3.1.1 (typology of policy coherence), Task 4.1.3 (informing the stakeholder engagement process), and Task 5.1.2 (informing the development of the multicriteria assessment framework). It will also inform later activities in Tasks 3.1.2 (designing research protocols) and 5.1.3 (mapping multicriteria assessments).

Stage 3 – Implementation and Finance (Months 15-44).

Country case-studies: research and planning to develop CDR portfolios in line with development priorities.

Public engagement activities in select jurisdictions aiming at an iterative calibration of a decision space aligned with the specific conditions of each jurisdiction.

Task 2.3.1. Understanding jurisdictional decision spaces.

Work to establish the decision space for each jurisdiction, comprising the acceptability space as suggested above, and a location specific but not CDR specific dimension of sociotechnical readiness/capacity, made up of environmental capacities and existing industrial/human capacities which will be a factor in policy choice.

Task 2.3.2: Mini-public processes.

In each of the jurisdictions, a Citizens' Reference Panel with lay citizens will be established and stay operational throughout the Stage 2 (b) period, during which it will convene for 5-6 one day meetings at which citizens will form their own opinion about the desirability of available CDR portfolios and their potential implementation. Meetings in the Reference Panels will be designed to inform and shape activities in Tasks 1.2.4, 4.2.2, 4.2.3. And they will play an active part in helping jurisdiction design and employ CDR portfolios aligned with public wishes and concerns.

Task 2.3.3: Stakeholder engagement.

Collaborating with Tasks 1.2.3 about the proposal of responsible government pathways through broad stakeholder engagement; Contributing to stakeholder mapping and engagement design for Tasks 4.2.2 and 4.2.3.

Stage 4 – Review and Dissemination (Months 40-48).

Task 2.4.1 Inputs to synthesis, review and dissemination

Workstream 3: **Coherence with sustainability priorities**

Putting removals in the context of sustainable development

This workstream addresses calls from the scientific community and policy practitioners for better understandings and tools to enhance policy coherence between climate ambitions and sustainable development. It contributes to research on the linkages between climate and sustainability objectives, providing policy support on trade-offs and co benefits. It is therefore a key component of this network's aim to see removals, and climate policy more generally, as a component of wider environmental and development policies. In particular this workstream explores the coherence between CDR (removals) and the sustainable development goals (SDGs). This is the feasibility, effectiveness, and sustainability of removals considering local environmental conditions and agreed policy objectives. The aim is to evaluate removal's impact on sustainability of resilience focusing on ecosystem services related to land, water, biomass and food production, and biodiversity.

Our work has two innovative strands. The first critically examines natural resource is stainability in ecosystem impacts under various removals deployment scenarios. This involves combining national level assessments of resource (energy, water, land) and environmental implications of removals deployment with detailed regional local studies

to capture nuances not evident at the national level or to assess the impacts of sub national removals initiatives.

To assess the realisable potential of removals, the second strand combines the analysis of environmental and other resource stresses from actual or potential removals with the environmental objectives expressed in voluntary national reviews (VNR) to agenda 2030 and nationally determined contributions (NDCs) to the Paris Agreement.

In this way we will be able to assess the potential removal was in relation to environmental priorities and conditions in various jurisdictions. The detailed steps to achieve this will be mapping environmental objectives (task 3.1.1), combining these with output from our governance assessment to develop relevant indicators (task 3.1.2), evaluating these indicators in national level resource environmental stress assessment (task 3.2.1), and synthesising the results to identify synergies between removals and SDGs, proposing governance pathways for enhanced coherence .

Research has provided some clarity on coherence between the climate and SDG agendas (e.g. Browne et al 2023), including interactive tools for identifying alignment and synergies (Brandi et al. 2017). However, further research is needed to understand how removals will affect the synergies between countries' NDCs and VNRs.

More detailed issues and tasks for the coherence with sustainability team

Stage 1 (a). (Months 1-14). Parallel world regional exercises in which we discover existing work, capacities and appetites in three world regions (broadly defined); introduce and test against local contexts and priorities the work that we plan to do; and look for partners and an appropriately varied set of jurisdictional cases (including leaders and laggards in climate and CDR policies and capacities) for intensive research and policy development in stage 2.

Task 3.1.1: Mapping of environmental objectives to align removals with the latest NDCs and sustainability priorities as expressed in VNRs. (led by Linköping). Studies have highlighted conflicts between SDG and NDC implementation (Wouda Kuipers & Korwatanasakul 2024; Iyer et al. 2018), with national planning processes often operating in silos (Gomez Echeverri et al. 2024). This research task reviews recent academic and grey literature on negative emission policies and SDGs, codes and analyses selected VNRs and NDCs, and identifies relationships to Removals. This task leverages our network's longstanding capacity to analyse NDCs and VNRs (Brandi et al. 2017; Jernnäs & Linnér 2019;; Persson & Runhaar 2018). The task will develop a typology of policy coherence for removals implementation, considering policy objectives, instruments, and implementation practices

Stage 1 (b). (Months 15-34). This second research and planning stage of a subset of consenting country studies would necessarily closely reflect the policies, institutions and interests of the individual country concerned and the substantive issues and methods – and the expertise involved – would vary correspondingly. In most cases this work would include, for example:

- Local research to calibrate wider findings on costs, effectiveness and safety issues of different CDR technologies in the local context;
- Work on trade-offs and synergies in building a portfolio of climate actions (including the distribution of benefits and harms in terms of lives and livelihoods);

- Assessment and planning to maximise co-benefits between planned CDR portfolios and other sustainable development priorities;
- Continuing efforts to widen financial resources for sustainable development plans which include removals;
- Governance and application of MRV.

Task 3.1.2: Designing the research protocol. (carried out jointly under Oxford leadership). This task integrates the mapping and coding from Task 3.1.1 with removals governance evaluations and techno-economic assessments. The goal is to support the data selection for the environmental and resource stress assessment. It will identify relevant environmental and resilience aspects and define indicators that accurately represent them, drawing on stakeholder consultations at the stage 1 regional workshops (Neset et al. 2018), as input to workshops in Task 3.2.4

Stage 2 – Assessing Removals Potential (Months 17-34)

A total of up to 15 case studies across the three regions (approximately 5 each) to produce candidate portfolios of CDR for each.

Task 3.2.1: Environmental and resource stress assessment, through developing a mechanism for assessing Removals' requirements of energy, water, land and other resources and their environmental impacts at national level 1 (led by Oxford). As the first step, this task will extract from existing sources CDR-specific information pertaining to resource and environmental implications and any available knowledge on how the resource requirements and environmental impacts are affected by climatic conditions. . *In the second step*, a geographical information system (GIS) such as ArcGIS (ArcGIS, n.d.) will be used to gather national data on land use, water availability and climatic conditions.

Stage 3 – Implementation and Finance (Months 30-44).

Helping jurisdictions to design and pursue policy and financial routes to CDR deployment.

Task 3.3.1: Developing, a software tool which can integrate the removals knowledge base from the first step and GIS data from the second step to calculate resource requirements and environmental implications for a given country and given deployment level of a specific NET or a specific combination, as advised by task 3.2.1. Potential resource conflicts between the deployment of removals and other SDG priorities (Task 3.1.1), such as food production, will also be assessed. This tool and the overall approach will be evaluated by the representatives from participating countries for validation and improvement. Eventually, this tool will be applied to produce national-level assessment for all the participating countries.

Stage 4 - Review and Dissemination (Months 45-48).

Synthesis into a process which we can deploy across other jurisdictions, and dissemination.

Task 3.4.1: Assessment of the synergies between different removals implementations and national priorities for sustainable development, based on the three earlier tasks, led by Linköping. The primary outcomes will be tools for evaluating synergies and proposing governance pathways to address them. Additionally, the task will adapt the

NDC-SDG Connections tool (Brandi et al. 2017), endorsed by the UN, to include negative emission policies. A series of stakeholder workshops will be conducted to validate findings, identify additional indicators and criteria, and explore decision support options. These workshops will facilitate the co-creation of tools to identify synergies and trade-offs between removals implementation and SDG and NDC. The results from these efforts will be coordinated and discussed with national stakeholders before being integrated into the multi-criteria mapping in workstream 5.

Workstream 4: **Techno-Economic Potential and Impacts**

Scope, Capacities, and Methodology

This workstream's primary role is to assess the potential economic impacts and wider physical and human resource uses of CDR in regional, national and sub-national contexts as the network's work progresses. The work is a key contribution to the overall project aim to develop a comprehensive portfolio of CDR strategies for each jurisdiction, assessing the potential for integrating CDR into region-specific climate mitigation policies, and to ensure that climate policy as a whole aligns as closely as possible with local development aims. It this focus on alignment with development, especially if it is itself tied-in to the provision of adequate international financial resources, that provides the major political motivation for the use of removals in the short term decarbonization of the atmosphere and oceans and the transition to long term sustainability.

These nested, interacting aims in turn require methodologies that highlight synergies and trade-offs between potentially alternative policy pathways to a range of possible CDR portfolios for jurisdictions to choose between.

The work will be led by the New University of Lisbon (NOVA) and the Royal Swedish Institute of Technology (KTI). The work will build on the long experience of both lead partners in which all aspects regarding infrastructure for CCS – including BECCS – in the Baltic Sea Area (Grönkvist et al. 2010) and in the Iberian Peninsula and Morocco (Kanudia et al 2013) were studied, as well as their contribution to carbon-neutral futures (Seixas et al 2019), and industrial biogenic CO_2 streams for uses other than BECCS. The team also has considerable experience in the use of techno-economic assessment modelling.

Issues, capacities and tasks for the techno-economic potential workstream

Stage 1 - Understanding Contexts.

(a) World regional CDR audits: initial mapping and planning (Months 1-14).

Parallel world regional exercises in which we discover existing work, capacities and appetites in three world regions (broadly defined); introduce and test against local contexts and priorities the work that we plan to do; and look for partners and an appropriately varied set of jurisdictional cases (including leaders and laggards in climate and CDR policies and capacities) for intensive research and policy development in stage 2).

The first stage focuses on a broad assessment of the potential capacities for CDR within jurisdictions in each world region, employing desk research and structured stakeholder elicitation processes to identify key challenges, opportunities, and contextual factors that influence CDR deployment.

Task 4.1.1: Selection of CDR Processes: Identify CDR processes relevant to a range of jurisdictions in each region by evaluating their historical development, planned projects, resource availability, land use, CO_2 storage potential, economic and other factors.

Task 4.1.2: Estimating CDR Potential: Conduct detailed assessments of each jurisdiction's CDR potential based on published methodologies, existing regional studies and Task 4.1.1 outcomes. This task includes consultations with key institutions to gather localized insights and deepen the understanding of physical, industrial, and economic capacities of the country.

*Task 4.1.3: Stakeholder Elicitation***.** In collaboration with team 2, engage stakeholders through interviews and focus groups, organized as part of each regional workshop to validate findings, refine the selection of CDR processes and their potentials, address knowledge gaps, and incorporate societal perspectives into the analysis.
Task 4.1.4: Synthesis of Findings. Analyze and synthesize findings to outline jurisdiction-specific challenges, opportunities, and constraints, as an input to the selection of detailed case-studies for stage 2.

(b) World regional CDR audits: local policy and capacity development (Months 15-34).

Task 4.1.5: Inputs as required to policy development in the three regions.

Stage 2 – Assessing Removals Potential (Months 17-34)

A total of up to 15 case studies across the three regions (approximately 5 each) to produce candidate portfolios of CDR for each.

The second stage of team 4's work focuses on techno-economic assessments, contributing to the creation of medium- and long-term scenarios for CDR deployment, analyzing their cost-effectiveness, trade-offs with other systems and policy enablers. This stage provides deeper insights tailored to local contexts and priorities.

Task 4.2.1: Cost-Effectiveness of CDR: Evaluate and calibrate previous findings, assessing the costs and effectiveness of various CDR technologies within the specific jurisdictional context.
Task 4.2.2: Detailed assessment of location-specific risks and opportunities. Carry out or commission from experts' assessments of specific risks and opportunities, including those potentially threatening eco-systems or human safety, conducting small scale local research as necessary.

Stage 3 – Implementation and Finance (Months 30-44).

Country case-studies: research and planning to develop CDR Portfolios.

*Task 4.3.1: Development of CDR Portfolios***.** Analyze trade-offs and synergies between CDR and other systems (e.g., energy systems, forests) to create one or more portfolios of climate actions that align with national climate goals and development priorities. Develop strategies that maximize CDR co-benefits (e.g., biodiversity conservation, employment growth) while minimizing potential negative impacts.

Task 4.3.2: Mobilization of Financial Resources and Development and Application of MRV Frameworks. Drawing on the experiences of this team, contribute to:

- the identification of financial resources for sustainable development plans that include CDR, leveraging both international and domestic funding mechanisms.
- the design of a Measurement, Reporting, and Verification (MRV) system to ensure accountability and monitor progress in CDR deployment and integration with broader climate goals.

Stage 4 – Review and Dissemination (Months 40-48).

Task 4.4.1 Inputs to synthesis, review and dissemination

Workstream 5: **Integrated and quantitative assessment**

Questioning the framings in the individual assessments, and building a bigger picture

This workstream responds to the need for quantitative assessment of the potential, effectiveness and impacts of CDR by providing a comparative framework that integrates the different assessments done under the other four assessment elements (governance; acceptability as assessed through public and stakeholder engagement; natural resource and policy sustainability). It will be led by the University of Manchester.

As an 'upstream' suite of technology proposals that are currently in advance of significant research and development, CDRs and their assessments are particularly sensitive to framing assumptions. The way in which problems to be solved are defined, the perspectives that are included, the methods that are used and the criteria mobilised, and the reflexivity – an awareness of and attention to framing effects – with which outputs are conveyed constitute sites of framing which act to condition the outcomes of assessments (Stirling, 2008).

Existing assessments of CDR have come under a great deal of criticism for their narrow framings, which have marginalised alternative problem definitions, perspectives, methods, criteria and technologies (Bellamy et al., 2023; Bellamy, 2022). This work package therefore seeks to 'broaden out' the inputs to assessment and 'open up' the outputs from assessment to render ambiguities and uncertainties explicit, and thereby decision making more robust.

It will develop a multicriteria assessment framework, inspired by multicriteria mapping, a method that has been successfully trialled in relation to CDR (Bellamy, 2022) and mobilised in relation to a wide range of analogous complex and contested science policy issues in the past, including genetically modified crops (Stirling &

Mayer, 2001), transgenic medicine (Burgess et al., 2007), climate geoengineering (Bellamy et al., 2013), and sustainable energy systems (Chilvers et al., 2021). Unlike other methods of assessment this approach welcomes divergent framings, is open about uncertainties and serves as a heuristic for mapping (as opposed to prescribing) assumptions. As a result, rather than producing singular and prescriptive recommendations it produces plural and conditional ones – systematically and transparently revealing the relative rankings of different technologies under different framing assumptions.

All work under this programme element is subject to a comprehensive data management plan completed through DMPonline. Data will be stored and backed-up on secure, password-protected University computers and in the dedicated University of Manchester Research Data Storage Service (Isilon). The data will be held for a maximum of 5 years, after which it will be deleted. Audio recordings of interviews will be fully anonymised to ensure confidentiality of participant's information. Survey data will be supplied by an approved market research company already anonymised. Written consent will be obtained from forms issued to interview participants.

More detailed issues and tasks for the integrated assessment workstream

Stage 1 – Understanding Contexts

(a). World regional CDR audits: initial mapping and planning (Months 1-14).

Parallel world regional exercises in which we discover existing work, capacities and appetites in three world regions (broadly defined); introduce and test against local contexts and priorities the work that we plan to do; and look for partners and an appropriately varied set of jurisdictional cases (including leaders and laggards in climate and CDR policies and capacities) for intensive research and policy development in stage 2.

Task 5.1.1: Critical analysis of existing assessments
The first task is to undertake a critical analysis of existing assessments of CDR using an established review method (Bellamy et al., 2012). This desk-based analysis will utilise a systematic search and screen strategy to identify different types of CDR assessment, including but not limited to computational modelling studies, cost-benefit economic analyses, expert opinions and public perception elicitations. The assessments will then be subject to a frame analysis in which the breadth of their stated problem definitions, methods and criteria used and technologies assessed, and the openness with which their outputs are conveyed, will be examined. It will identify dominant framings, and crucially, those that are underrepresented or altogether absent. The findings will be used to inform the development of a multicriteria assessment framework in Task 5.1.2 that seeks to broaden out and open up CDR assessment.

(b) World regional CDR audits: local policy and capacity development (Months 15-34)

Task 5.1.2: Developing the multicriteria assessment framework
This task will involve the development of a novel multicriteria assessment method to provide a comparative framework for the expert CDR assessments taking place

through the work of teams 1-4. The method will be inspired by multicriteria mapping (Stirling & Mayer, 2001), which is composed of four principal stages: (1) developing a set of options to appraise (identifying any case study country specific additional CDRs to include alongside the project's core options); (2) characterising a range of criteria against which to assess those options (in conversation with assessment capacities 1-4 to ensure feasibility); (3) scoring the relative performance of the options against the criteria (to be done through translation of the findings under each assessment element in Task 5.2.1); and (4) assigning a weighting to each criterion to indicate their relative importance (according to case study country representatives).

Stage 2 – Assessing Removals Potential (Months 17-34).

A total of up to 15 case studies across the three regions (approximately 5 each) to produce candidate portfolios of CDR for each.

Task 5.2.1: Mapping public multicriteria assessments
This task will involve the development and execution of a novel, large-scale public multicriteria assessment of CDR across different case study countries (n = ~9,000 individual participants), following Bellamy (2022). The method will be inspired by deliberative mapping (Burgess et al., 2007), which follows a similar process to that of multicriteria mapping described in Task 5.1.2. One key difference is that it is an assessment undertaken by citizens rather than specialists, and will therefore complement and feed into the multicriteria mapping assessment. Informed by citizen perspectives uncovered in the workstream2, the assessment, executed in nationally representative online surveys, will ask citizens to select criteria most important to them, weight them, and score the performance of different CDRs against their criteria.

Stage 3 – Implementation and Finance (Months 30-44). Helping jurisdictions to design and pursue policy and financial routes to their deployment.

Task 5.3.1: Translation of different assessments
This task will involve gathering and 'translating' the findings of workstreams 1-4 into quantitative scores of performance for each technology, qualified by technical uncertainties and social ambiguities. The method and conduct of this translation will be developed through semi-structured interviews with members of respective work packages. All other project partners will have appropriate time dedicated to assisting in this key process. This will lay the groundwork for overall comparative assessments of CDR in Task 5.4.1

Stage 4 – Review and DIssemination (Months 45-48).

Synthesis into a process which we can deploy across other jurisdictions, and dissemination.

Task 5.4.1: Analysis of overall assessments
The final task will involve undertaking an overall analysis and clustering of the findings translated in Task 5.3.1. This will include producing overall comparative assessments of CDRs under different criteria and within and between different case study countries.

Workstream 0: **Intra- and inter-project coordination, priority-setting, and communication strategy**

Workstream 0 will be the locus for the management and governance of the network itself, including task allocation, priority setting, and oversight of the network's communication strategy and the synthesis and dissemination of results, subject to decisions of the network executive (months 1-48).

This workstream will also be the locus for horizon scanning on relevant new knowledge and activities – on techniques, methods or governance issues - which will help network members interrogate these and wherever possible assess them within a common framework.

Workstream 0 will also be the locus for meetings of the project executive and contact point for the wider project advisory committee.

COMMUNICATIONS STRATEGY

Communications will take place at three levels:

- each region will have its own direct and media communications plan to contribute to the fullest engagement with, and learning from, the programme of activities and studies;
- similarly national case studies with ensure full documentation of the local programme, will use local media, and will encourage participating institutions to reach out to their networks in an information cascade, which will include feedback and assessment of the network's work;
- the global information strategy will include work, through a website, appropriate social and mainstream media, and conference and workshop activity, to ensure that the network's work is well known to the wider CDR, climate policy, and sustainability communities, and that we learn from their new knowledge (see horizon scanning above).

In line with our general open source philosophy we will try to work with existing conference and other programmes rather than duplicating efforts.

IV – Further information

WHO WE ARE: THE NETWORK'S FOUNDERS AND KEY CONTRIBUTORS TO DATE

The network's core founders are:

Björn-Ola Linnér, Linköping University, Sweden (PI) (https://liu.se/en/employee/bjoli28)

Mathias Fridahl, Linköping University, Sweden (https://liu.se/en/employee/matfr55)

Peter Healey, University of Oxford, UK (Coordinator – peter.healey@insis.ox.ac.uk) (https://www.insis.ox.ac.uk/people/peter-healey)

Tim Kruger, University of Oxford, UK (https://netzeroclimate.org/about-us/#kruger)

Rob Bellamy, University of Manchester, UK (https://www.research.manchester.ac.uk/portal/rob.bellamy.html)

Pius Yanda, Institute of Resource Assessment, University of Dar Es Salaam, Tanzania (https://www.udsm.ac.tz/web/index.php/institutes/ira/staff/detail/Pius/16)

Hernán Carlino, Centro de Estudios en Cambio Climático Globál, Fundación Torcuato di Tella, Buenos Aires, Argentina

Vikrom Mather, Transitions Research, India

In addition, researchers from a number of research institutions have central roles in the network: Stefan Grönkvist, The Royal Swedish Institute of Technology (KTH), Bjørn Bedsted, Democracy X (formerly The Danish Board of Technology) , Patricia Fortes, New University of Lisbon, Aidong Yang, University of Oxford, Teenu J Thaikattil, Transitions Research, India.

The network acknowledges the work of Gabor Gyurfi in building the network website (carbon-removals.net).

How You Can Help

You can help in a variety of ways, initially by contacting the network coordinator:

peter.healey@insis.ox.ac.uk

By commenting on this proposal

This proposal is still under development prior to approaching potential funders, and will still aim to continually focus our role and improve our performance once we start work. All comments welcome.

By Pointing up Potential overlaps and Complementarities with other Initiatives

Our work is aimed at being complementary with other initiatives, so if you run or participate in one, or have ideas as to how we can support each other, please let us know.

By Giving us your Public Support

If you are willing to be quoted in support of what we aim to do, this will greatly help us build momentum.

By Offering to Work with Us

Our work, and in particular our country studies, will be done through ad hoc teams involving not only the core network participants and local researchers and practitioners, but specialist consultants whose time the network would purchase. If you would like to be considered for such a role please send us a capsule CV giving an indication of the range of expertise and experience you offer.

By Suggesting a Potential Recruit to our Management Team

Our network coordinator, Peter Healey, has indicated that he wishes to gradually hand over the role to a successor in the course of the first four years of the network's operation. The coordinator's role is to support the network executive in making key decisions and to lead the network's delivery on time and budget. Because the current team contains a majority from the northern hemisphere it would be good to hear from potential southern hemisphere candidates. Other suggestions, particularly of potential women members of the executive, would be welcome.

By Considering Funding for the Programme, in Whole or in Part

We are always happy to hear from potential funders, whether willing to respond to a full proposal, or to work with us to develop a programme of work which meets both our objectives. Similarly a recommendation to a funder which doesn't accept direct submissions would be a great help.

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TABLE 2 -BROAD PROJECT STRUCTURE AND INDICATIVE TIMING AND BUDGET

Stage	Title	Indicative Timing	Content	Network Workstreams/Teams and Invitees involved	Parallel work on international governance	Indicative Budget
1. Understanding Contexts	(a) World regional CDR audits: initial mapping and planning	Months 1-14 14 months	Three parallel world regional exercises in which we will: ○ discover existing work, capacities, appetites and key issues for CDR in three world regions (broadly defined): India, Sub-Saharan Africa and Latin America and the Caribbean; ○ introduce network capacities and workstreams to be developed and applied with local partners; ○ broadly test against local contexts, policies and priorities the work that we plan to do; ○ and select an appropriately varied set of jurisdictional cases (including leaders and laggards in climate and CDR policies and capacities) for intensive research/policy development and knowledge exchange in stage 2.	***Governance and Finance network team co-lead with local regional lead institution team and in conjunction with local regional lead institutions*** Representatives of each of the network workstreams on:- - Acceptability and citizen and stakeholder engagement - Coherence with sustainability - Technical/economic potential - Integrated and quantitative assessment Invitees from significant regional institutions in research, policy and finance, such as the local regional development bank Key members of other two regional lead institution teams	***The international governance agenda is one of the three strands of the network's Governance and Finance workstream*** *(along with responsibility for the governance of the network and contributing to its four stages of work). The team* would have a broad scope to pursue everything beyond, and complementary to, our bottom-up national studies which will help them deliver the project objective of maximum responsible CDR. A working definition of international governance in line with the approach is: "The international regulatory, informational, financial, research and organisational resources external to the starting capacities of individual jurisdictions which will be required to ensure that they can deliver	€1.75m for 1 (a) and (b) and early work on international governance
	(b) World regional CDR audits:	Months 15-34 19 months (overlaps with 2(a))	Further work in individual regions to develop policies and governance for CDR at various scales, and align these where possible and useful, drawing on jurisdictional case-studies in 2 and	*Local regional lead institution (lead)* Other workstreams as required		

	local policy and capacity develop-ment		work in the international governance stream.		responsible and accountable CDR, and promote appropriate global learning." Specific initiatives may include: ○ From an initially top down perspective reconceptualising the governance of CDR, in particular going beyond its assessment of individual CDR techniques outside any geographical or social context; ○ Similarly, from an initially bottom-up perspective, an analysis of existing knowledge gaps	
2. Assessing Removals Potential	Country case-studies; mapping potential	Months 17-34 17 months (overlaps with 1 (b)) NOTE: some case studies may move more quickly into the research and planning for implementa-tionstage 3	A total of up to 15 case studies across the three regions (approximately 5 each) to produce portfolios of potential responsible CDR for each in the context of local environmental and social capacities, priorities and concerns.	***Acceptability and citizen and stakeholder engagement (lead)*** Technical/economic potential Representatives of each of: - Governance and Finance - Coherence with sustainability - Integrated and quantitative assessment Appropriate national invitees		€3.0m including further work on international governance

3. Implementation and Finance	Country case-studies: research and planning in the service of the develop-ment of CDR portfolio s	Months 30-44 14 months (overlaps with 2 and 4)	This second <u>research and planning CRD portfolios stage</u> of a subset of consenting country studies would necessarily closely reflect the policies, institutions and interests of the individual country concerned and the substantive issues and methods – and the expertise involved – would vary correspondingly. In most cases this work would include, for example: ○ Local research to calibrate wider findings on costs, effectiveness and safety issues of different CDR technologies in the local context; ○ Work on trade-offs and synergies in building a portfolio of climate actions (including the distribution of benefits and harms in terms of lives and livelihoods); ○ Assessment and planning to maximise co-benefits between planned CDR portfolios and other sustainable development priorities; ○ Continuing efforts to widen financial resources for sustainable development plans which include removals; ○ Governance and application of MRV.	***Technical/economic potential (lead)*** Coherence with sustainability Acceptability and citizen and stakeholder engagement Governance and Finance Integrated and quantitative assessment <u>Invitees</u>: Specialist consultants engaged to contribute on particular environmental and governance issues of individual jurisdictions Representatives of appropriate national and local bodies	which our emerging case studies suggest are important to the development of their own CDR agendas, or to the safety and security of other jurisdictions; ○ Developing a critical perspective on both sides of a contract in emissions offset trading, in the context of trying to develop rapid decarbonisation; ○ Defining what constitutes successful CDR by various measures in various contexts, and on rationalising MRV's current baroque arsenal of different approaches; ○ Assessment of existing and potential funding sources for CDR in the context of development; ○ Spreading best practice across similar contexts when valid to do so.	€3.75m including work on international governance (to month 38)

4.Review and Disseminate	Synthesis, review and dissemi-nation	Months 40-48 9 months (overlaps with 3)	Review, synthesis into a process which we can deploy across other jurisdictions, and dissemination.	***Governance and Finance (lead) in conjunction with local regional lead institutions*** All other project participants The global CDR research and policy community		€0.75m
Completion of funded project **Total indicative cost €9.25m** Funding could come from a single (ideally charitable, independent) source or a consortium						
5	***Commis-sioned studies***	***Month 49 (say, October 2030) onwards***	***Any further case-studies we would pursue on a basis of cost-recovery from clients (with richer jurisdictions subsidising poorer).***		***The organisational basis for delivering further studies is to be decided.***	