Engaging the US Environmental Community in the Assessment of Carbon Removal

A summary of the September 6-8, 2018
meeting at the Wingspread Retreat & Conference Center
of the Johnson Foundation in Racine, Wisconsin

INSTITUTE *for* CARBON REMOVAL
LAW AND POLICY

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Meeting Planning, Facilitation, and Report by

RESOLVE

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Executive Summary

There is growing recognition among the scientific community that humanity will need to supplement its emissions reductions with some forms of carbon removal, or negative emissions technologies, in order to meet the targets laid out in the Paris Agreement. Carbon removal approaches vary widely, from afforestation to direct air capture of carbon dioxide, and create a range of opportunities and challenges. Some communities working on climate policy see carbon removal as a necessity, while others view it as a threat.

To promote broader engagement on carbon removal within the environmental community, American University's new Institute for Carbon Removal Law and Policy (ICRLP) convened a meeting at the Wingspread Center in Wisconsin. The meeting brought together representatives from seventeen non-governmental organizations (NGOs) that work on climate change and related issues. During the meeting, meeting participants learned about and discussed the science, policy, and politics of carbon removal technologies and practices. They also discussed strategic questions and concerns about carbon removal as a piece of the broader climate response portfolio and near-term decisions about policy, research, and advocacy.

The meeting began with four presentations from experts on various aspects of carbon removal. Christa Anderson, Stanford University, surveyed the science of carbon removal, focusing on the potential benefits and challenges of a range of carbon removal technologies and practices. Wil Burns, American University, explained the legal institutions and international agreements that have been or could be used to govern carbon removal, and Rick Duke, Gigaton Strategies, addressed the relationship between carbon removal and the Paris Agreement in particular. Finally, Ellie Johnston led the group through a simulation exercise using Climate Interactive's En-ROADS software, which highlighted the difficulty of meeting the Paris Agreement's temperature targets without carbon removal.

The second day of the meeting focused on the NGO community's engagement with the topic of carbon removal. The morning began with an overview of the community's current thinking on carbon removal. The meeting facilitators, RESOLVE, presented findings from their pre-meeting interviews with thirteen of the participants, exposing a range of opinions on key questions, including whether carbon removal is necessary and whether carbon removal counts as mitigation. The pre-meeting interviews also revealed while a few NGOs have staked out positions on at least some forms of carbon removal, many NGOs have yet to formulate public positions and remain cautious about doing so. Later in the day, three breakout groups delved into the details of various approaches to carbon removal, identified research needs of special relevance to the NGO community, and explored the conditions under which NGOs might endorse different kinds of carbon removal research, policy, and development.

On the final day of the meeting, the meeting participants compiled resources of interest to NGOs, including resources created or provided by the participants themselves. The participants agreed to establish a Carbon Removal Working Group as a space for sharing information and coordinating on carbon removal issues, facilitated by RESOLVE and the ICRLP.

Introduction

There is growing recognition among the scientific community that some forms of carbon removal, or negative emissions technologies, will need to play a role to limit global temperature rise due to climate change and meet the targets laid out in the Paris Agreement. Carbon removal approaches vary widely, from afforestation to direct air capture of carbon dioxide, and pose a range of opportunities and challenges. Some communities working on climate policy see carbon removal as a necessity, while others view it as a threat.

The Institute for Carbon Removal Law and Policy (ICRLP), a new initiative of American University related to the university's Forum for Climate Engineering Assessment (FCEA), convened a meeting of non-governmental organizations (NGOs) working on climate change and related issues to learn about and discuss carbon removal science, policy, and technologies, including strategic questions and concerns about carbon removal as a piece of the broader climate response portfolio and near-term decisions about policy, research, and advocacy. The meeting was facilitated by Maya Breitburg-Smith and Stephen D'Esposito of RESOLVE. The meeting was sponsored by The Johnson Foundation at Wingspread, the V. Kann Rasmussen Foundation, and the New York Community Trust.

Please see Appendix A for the full meeting agenda. Meeting objectives included:

1. Establish a shared information baseline on the state of carbon removal science, economics, and policy, as well as determine areas where more information is needed;
2. Bolster environmental community readiness (strategic and communications) for ongoing and upcoming activities, such as the 45Q discussions, anticipated release of a National Academy of Sciences (NAS) report on a research strategy for carbon removal, anticipated release of the Intergovernmental Panel on Climate Change's (IPCC) upcoming special report on 1.5C, and continuing conversations about carbon removal under the Paris Agreement;
3. Identify and respond to policy, strategic, and scientific questions and begin to establish shared definitions and a framework to help the environmental community assess carbon removal technologies and policies, noting both areas of convergence and divergence;
4. Discuss needs or opportunities for ongoing policy and strategic engagement and learning related to carbon removal; and
5. Identify and confirm next steps.

A list of meeting participants is available in Appendix B.

DAY 1

The State of Carbon Removal

On Thursday, September 6, the meeting focused on information-sharing to set a baseline for the discussions that followed. Experts presented on the current state of the science around carbon removal technologies and practices, the international legal and policy landscape, and the domestic policy landscape, economics, and other considerations. Meeting participants also engaged in a participatory simulation utilizing the En-ROADs platform developed by Climate Interactive (web-friendly version available online).

Rightsizing: Carbon dioxide removal towards ambitious climate goals (Christa Anderson, Stanford University)

Christa Anderson, Stanford University, provided an overview of carbon dioxide emissions and trends, making the case that the current pledges to reduce carbon emissions alone will not be enough to meet the goal of combatting climate change. Ms. Anderson also provided an overview for a sampling of proposed negative emissions technologies, including bio-energy with carbon capture (BECCS), direct air capture (DAC), enhanced weathering, afforestation/reforestation, changes in agricultural practices, and ocean fertilization/alkalinization. Ms. Anderson reviewed the potential benefits and challenges of those technologies with regard to engineering complexity, environmental co-benefits, land area required for large-scale deployment, risk of later carbon dioxide release, and energy consumption (or production). Ms. Anderson emphasized that carbon removal must be paired with emissions reduction. While some land-based carbon removal approaches show promise, there is a need for research and development of nascent carbon removal technologies, and we must be realistic about the limitations of carbon removal in combatting climate change.

Summary of questions and answers:

In response to a question on the interaction between land use change and diets, Ms. Anderson agreed that is a potentially impactful interaction to better understand. Currently, there is a large range of uncertainty in related research, because it is unclear how demand for different agricultural products will change.

In response to a comment on DAC, Ms. Anderson acknowledged that the energy requirements are high compared to other carbon removal technologies. However, DAC is still in the early stages of development and has a high level of engineering complexity, so the energy requirements may lower as the engineering is refined and further developed.

International Climate Geoengineering Governance (Wil Burns, American University)

Wil Burns, American University, provided an overview of institutions and international agreements that have already been used to regulate carbon removal technologies, as well as institutions and agreements that may be used in the future. In particular, Dr. Burns highlighted relevant implications from the London Dumping Convention, the Convention on Biological Diversity, the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (ENMOD), Resolution LP.4(8) on the Amendment to the London Protocol of Matter for Ocean Fertilization and Other Marine Geoengineering Activities, and the Paris Agreement. A particularly interesting legal question noted by Dr. Burns was whether the language concerning preserving and enhancing sinks and reservoirs of greenhouse gases in the Paris Agreement includes technological carbon removal, such as DAC, in its call to action. Additionally, ENMOD allows for environmental modifications techniques for peaceful purposes, but Dr. Burns raised the question of whether knowledge of potential negative impacts would be considered hostile.

Summary of questions and answers:

In response to a question on whether there are forthcoming agreements relevant to carbon removal, Dr. Burns indicated that potentially relevant future agreements include trade regimes, human rights regimes, and regimes regulating land use and forestry.

The Role of Carbon Removal in the Paris Agreement (Rick Duke, Gigaton Strategies)

Rick Duke, Gigaton Strategies, provided an overview of key takeaways from the Paris Agreement, as well as projections showing a likely failure to meet the goal of holding the increase in the global average temperature to below 2°C above pre-industrial levels through emissions reductions alone. Dr. Duke presented evidence that the nationally-determined contributions (NDCs) – the emissions reductions goals set by each nation signing on to the Paris Agreement – were insufficient to meet the 2°C goal, and many countries are not on track to deliver on even these weak NDCs. Climate Action Tracker, an independent scientific analysis produced by three research organizations, found that all major economies other than India are falling short of the 2°C trajectory due to a combination of insufficiently ambitious NDCs and/or failure to deliver associated reductions. Dr. Duke reasoned that carbon removal will be a crucial complement to emissions reductions, and increased institutional support and investment in technology development are needed in order to realize the potential of carbon removal.

En-ROADS: Energy policy and investment simulator (Ellie Johnston, Climate Interactive)

Ellie Johnston, Climate Interactive, provided an overview of the simulation tool En-ROADS, which stands for Energy – Rapid Overview and Decision-Support. Ms. Johnston provided an overview of how En-ROADS is used to situate carbon removal within the broader set of available climate change response options, including an overview of the assumptions and variable inputs in the simulation. Meeting participants were invited to adjust the variables in the simulator and view the projected impact of those changes. Through the presentation and exploration of the model, participants learned that no single climate change response option will be able to meet the challenging goals of the Paris Agreement alone; we will likely need a combination of climate mitigation methods, including carbon removal, to prevent catastrophic warming.

Ms. Johnston and the participants engaged in an open discussion, which included the following responses to questions about the simulator:

- Model Assumptions
    - Climate sensitivity is variable input controlled by the user.
    - The Kigali Agreement is taken into account through the assumptions related to other greenhouse gases.
    - Climate Interactive conducted a literature review and found estimates for DAC that range from 4 gigatons CO2/year to 12 gigatons CO2/year of carbon removal; they used this to develop their assumption that, if successful, DAC could draw down a maximum of 7 gigatons CO2/year.
    - The model assumes permanent sequestration through CCS, but this assumption, like other assumptions in En-ROADS, can be adjusted based on user preferences. In response to a follow up question, Ms. Johnston indicated that carbon capture, utilization, and storage (CCUS) is not currently represented in the model. Ms. Johnston explained that carbon utilization in materials is somewhat represented by proxy through the energy efficiency input, which is separated into transport energy efficiency (e.g., vehicles) and stationary energy efficiency (e.g., buildings). In response to a follow up question, Ms. Johnston indicated that retrofitting and fleet replacement are included in the energy efficiency inputs.
- Carbon Price
    - The carbon price input, as decided by the simulator user, escalates rapidly initially and then is sustained in the model output.
    - Carbon price impacts on land use are not factored into the model at this point.

  - The model does not yet have the capability to set different carbon prices for different sectors.
- Energy Costs
  - Energy storage cost estimates are not yet calibrated well. Ms. Johnston explained that a challenge for all models is continually updating the model with emerging information and technological developments.
  - In response to a comment on the high energy use of DAC, Ms. Johnston agreed and explained that Climate Interactive had done some rough calculations that showed DAC would not be carbon negative unless the energy demands for the technology decreased.
  - The renewable energy input in the simulator largely represents wind and solar energy, while bioenergy is modeled separately. Ms. Johnston also indicated breakthrough cost is another variable input in the simulator.
- Land Use
  - The land use emissions input is a measure of the total reduction of land use and forestry carbon dioxide emissions relative to the reference scenario used in the simulator.
  - The land use outputs include land used for afforestation and reforestation. Ms. Johnston indicated Climate Interactive anticipates a better ability to constrain this variable after incorporating new research on the subject.

DAY 2

Where is the U.S. environmental community on carbon removal?
On Friday, September 7, the meeting focused on developing a shared understanding of the perspectives held by individuals in the room and the organizations that they represent in order to identify future strategic opportunities and needs, particularly in the context of upcoming activities and milestones related to carbon removal policy. Meeting facilitators presented their findings from the pre-meeting interviews and facilitated small group discussions.

Themes from Pre-Meeting Interviews (Stephen D'Esposito, RESOLVE)
In advance of the meeting, RESOLVE conducted interviews with 13 of the meeting participants to understand perspectives on carbon removal. Mr. D'Esposito presented findings from these pre-meeting interviews, summarizing responses to three main questions: 1) Is carbon removal necessary?; 2) Is carbon removal mitigation?; and 3) What is the state of NGO engagement right now? Meeting participants engaged in discussion throughout the course of the presentation. The pre-meeting interview guide and list of questions is available in Appendix C.

Is carbon removal necessary?
Mr. D'Esposito reported that interviewees agreed there is some degree of need for carbon removal, but many interviewees shared skepticism around implementation or cautioned against unintended impacts.

Key points raised during the discussion include:
- The moral hazard of carbon removal is that awareness of or expectation about carbon removal (whether accurate or not) might cause a reduction in efforts to cut greenhouse gas emissions, either relative to current baselines or future rates.
  - Relatedly, there is some concern that funding from the philanthropic community is a zero sum game, so any funding devoted to carbon removal means less funding for other strategies addressing climate change.

- Carbon removal is a critical tool for avoiding the catastrophic impacts of unmitigated climate change.
    - Carbon removal may be particularly important in the U.S. context as an approach that can gain bipartisan support due to the lack of political will around emissions reductions.
- It will be critical to establish a system of governance for carbon removal in order to enact constraints and minimize risks.
- In order for carbon removal technologies to be viable and scalable in time to meet the goals of the Paris Agreement, research and development must begin as soon as possible.
- Carbon removal may or may not be considered geoengineering, and it may depend on the scale of the carbon removal intervention. For example, when pursuing afforestation as carbon removal, are you restoring degraded ecosystems or creating new ecosystems (which may have their own risks)?
- There are a variety of risks and benefits within the spectrum of carbon removal technologies. Rather than categorically rejecting types of carbon removal (or geoengineering), it may be important to weigh the potential risks against the potential contributions to addressing climate change. A portfolio approach to carbon removal is likely necessary.
- Carbon removal should be prioritized over solar radiation management (SRM), given that carbon removal directly addresses the cause of climate change and that SRM may have negative unintended consequences.
- From an economics standpoint, it is more expensive to remove carbon dioxide from the atmosphere than it is to not emit it initially, so emissions reductions will be favored over carbon removal.
- Several of the NGOs not directly represented in the room are fundamentally opposed to carbon removal.

<u>Is carbon removal mitigation?</u>

Mr. D'Esposito reported that interviewees expressed a wide range of views on whether carbon removal is mitigation, with some interviewees seeking a clear distinction and others less concerned with drawing such distinctions. Some interviewees also suggested calling the technologies something other than carbon removal (e.g., negative emissions technologies, carbon drawdown) in order to avoid concerns regarding the moral hazard of carbon removal, as well as to more clearly communicate the intended outcomes of carbon removal.

Key points raised during the discussion include:

- Climate restoration may be a useful framing to explain the goals of carbon removal technologies and to make carbon removal distinct from traditional mitigation efforts (i.e., emissions reductions). Reducing the impacts of climate change is important to preserving the integrity of ecosystems.
    - One participant referenced preliminary survey research, suggesting that framing carbon removal as restoration ties carbon removal to a larger, more energizing goal, as opposed to sending the message that traditional mitigation (i.e., emission reductions) is not working to meet our climate goals.
- From a policy perspective, the Paris Agreement frames actions taken to meet nationally determined contributions (NDCs) as mitigation through reducing emissions and enhancing carbon sinks, so it will be important to determine whether carbon removal can count toward meeting NDCs. While other frames may be useful for public communications, the legal implications for international agreements are important to consider.

- In order to maintain a sense of urgency regarding emissions reductions, carbon removal should be kept distinct from traditional mitigation.
- Mitigation may be a more appropriate frame for the management and protection of natural carbon sinks as mitigation rather than more technological/engineered carbon removal approaches.
- Whether carbon removal should be considered mitigation may depend on how the carbon is used. For example, if captured carbon is used in enhanced oil recovery, then that should not be considered mitigation. If captured carbon is used in ways that result in long-term or permanent storage, then that could be considered mitigation.
- Presenting carbon removal as a climate change solution without contextualizing it may have the negative consequence of reducing the urgency for emissions reductions.

What is the state of NGO engagement right now?

Mr. D'Esposito reported that the majority of interviewees' organizations are working internally on research and determining what their strategy on carbon removal will be, with some organizations engaging with other organizations or developing partnerships. Fewer organizations have established positions on carbon removal and begun targeted advocacy work.

Key points raised during the discussion include:

- While some organizations have established positions regarding particular carbon removal technologies, often the full range of potential technologies is not well understood. Many organizations are in an information-gathering stage to better assess which carbon removal approaches are acceptable.
- Many organizations are cautious about engaging in carbon removal advocacy because of the current political climate in the U.S.
- Some organizations are considering how to best balance issues of equity and environmental justice in the context of carbon removal.
- The philanthropic community has not signaled that carbon removal is a priority for funding.

Breakout Group Discussions

Based on the preceding discussion, meeting organizers identified areas of common interest for small group discussion. Meeting participants joined one of three groups described below and reported their groups' discussions back to the full group. Following each groups' report, the full group engaged in discussion around their topic.

Technologies

This breakout group focused on sharing information on outstanding questions related to different carbon removal options or technologies. In particular, the group discussed outstanding questions they had concerning BECCS, including the feasibility of BECCS with regard to acreage requirements and available land, as well as potential social justice issues related to land use changes. The group agreed that further research is needed to understand the available land for BECCS and what the carbon budget would be for the process. The group also discussed land use and land management as a carbon removal approach.

Key points raised during the full group discussion include:

- When considering the value of carbon, it is important to consider not only the price of carbon but also ways that carbon adds value (e.g., products made from carbon).

- Considering the effects of climate change on ecosystems will be important for modeling future climate change scenarios. Climate impacts could convert ecosystems from carbon sinks to sources.
- BECCS faces complicated technological, economic, and political challenges.
- Though many models project large-scale use of BECCS in future scenarios, actual implementation is likely to be far more limited, due in part to competing interests in land use and infrastructure challenges.
- Accurate carbon accounting, including accurate baseline assessments, will be critical for assessing lifecycle implications and impacts for any carbon removal technology.

Research Needs

This group was guided by the following questions:

- What are the NGO communities' research needs?
- What should a government funded research agenda look like, what should be in it, and how should it be developed?

The breakout group identified the following areas of needed research:

- Monitoring (and improved monitoring) of land use change (and carbon flux from land use change)
- Techno-economic assessment of speculative carbon removal options (e.g., biochar, wood dump, rock weathering, carbon utilization)
- For core, current carbon removal options, what is the available land and/or the geological storage potential
- Assessment and refinement of carbon removal models (i.e., integrated assessment models used by the IPCC)
- A synthesis (by literature review or gap analysis) of the implications of a warming world on "natural" carbon removal
- Political and strategic communications analysis for appropriate audiences and methodologies (e.g., what is viable politically, what is mobilizing for citizen groups)
- White papers on carbon removal policy at a gigaton scale (i.e., what policies are feasible that will enable carbon removal at impactful scales?)

Key points raised during the full group discussion include:

- It will also be important to better understand the interaction between the natural carbon cycle and carbon removal strategies. For example, if carbon dioxide is removed from the atmosphere, how much marine carbon dioxide will be released from the oceans?
- Further research is also needed to better understand how climate change may impact migration and what additional impacts may result from changing migration.
- Broadly, it will be important to understand the social impact of scaling carbon removal technologies.
- In response to a question on whether there are currently groups organized around researching and funding research on carbon removal, a meeting participant indicated some such groups include the Carbon Capture Coalition, the Center for Carbon Removal (now called Carbon180), and a consortium of universities.

Conditionality and Sequencing

This group was guided by the following questions, considered under the scenario of a U.S. Department of Energy supported DAC research agenda:

- What conditions should be in place to move forward with carbon removal?
- Is there a particular sequencing or timing aspect to a transition towards carbon removal?
- What are next steps to move this issue forward?

The breakout group distinguished between conditions, which would be used to ensure that pursuing a course of action would contribute to the overarching goal of combating climate change, and desirable qualities, which speak to underlying values. The group also discussed how there may be different conditions for different stages of activity related to carbon removal, such as a compliance regime for carbon removal, public investment in carbon removal implementation, or public investment in carbon removal research.

The breakout group discussed the following desirable qualities for carbon removal:

- Do no harm
- Do good
- Do not take away from mitigation efforts

Conditions discussed by the breakout group included:

- Accurate carbon accounting
- A pathway to end a particular action if it is ineffective or counterproductive (i.e., off-ramp)
- Transparency with civil society
- Not taking funding away from emissions reduction
- Appropriate scale (relevant to deployment)
- Funding a diverse portfolio of climate change solutions
- Recommitment to the Paris Agreement and related emissions reductions
- Equity
- Long-term conditions (in addition to short-term conditions)
- Sustainable development goals as conditions
- Domestic controls that are stronger than international agreements

The breakout group also discussed what next steps might help move forward the conversation on conditionality and sequencing. The group identified the following points:

- What risks exist for different carbon removal options/technologies?
- Incentives for aggressive emissions reduction
- What other sectors may be impacted by action on carbon removal (e.g., energy sectors)?

Key points raised during the full group discussion include:

- We must carefully consider how carbon removal technologies may entrench the fossil fuel industry or agricultural industry.
- Moving forward will involve carefully balancing suppressing potential negative consequences without quashing essential research and development.
- As an example of challenges associated with conditionality, meeting participants discussed the advantages and disadvantages of the recent amendment to Section 45Q of the U.S. tax code, which created incentives for carbon capture but also allowed for the use of captured carbon in enhanced oil recovery (EOR). Some meeting participants maintained that the CCS incentives

could not have passed without the EOR condition, noting the bridge between carbon removal technologies and the fossil fuel industry will be important during the transition away from fossil fuels, and the negative impacts from EOR as a result of this amendment are relatively minor. Others contended that allowing the use of subsidized, captured carbon to extract fossil fuels is counterproductive to the overarching goals to transition away from fossil fuel energy sources and reverse climate change.

DAY 3

Moving Forward

On Saturday, September 8, the meeting focused on next steps to build on momentum developed over the last two days of meetings.

What are the key resources from groups in this room?

Maya Breitburg-Smith, RESOLVE, asked meeting participants to share if they or their organizations have resources, people, or products that may be of interest to other meeting participants. Meeting participants shared the following points of information:

- The Institute for Carbon Removal Law and Policy (ICRLP) is an academic group that can play a convening role and provide support for this group into the future.
- The site www.co2removal.org documents a systematic review of negative emissions technologies, which was published as a three-part Topical Review in the open-access journal *Environmental Research Letters*.
- The World Resources Institute has published a series of working papers on carbon removal, including one paper that will provide a primer on the spectrum of technologies, as well as two papers that will dig deeper into land-based and technological carbon removal. The working papers are available online.
- In addition to the En-ROADS tool, Climate Interactive has a complementary tool available online, C-ROADS, which offers regional breakdowns in its simulations of climate policies. Climate Interactive is also available to provide additional demonstrations and custom scenario building.
- Environmental Defense Fund (EDF) is in the process of developing four tracks of work related to carbon removal:
    - Meta-analysis of restoration/reforestation literature to identify what the current understanding is about what does and does not work;
    - Mapping analyses to identify evaluate forest carbon dioxide removal potential and highlight potential risks to avoid or overcome;
    - Develop randomized control trial pilot projects to rigorously test alternative implementation and incentive approaches; and
    - "Moonshot" idea – proposal for Lidar satellite for forest carbon monitoring.
- Linden Trust is providing support for a number of papers on the topic of carbon removal, including on DAC storage and utilization and on research and development incentives.
- The New Carbon Economy Consortium, a university consortium, is developing an academic research roadmap on carbon removal.
- The National Aeronautics and Space Administration (NASA) and the University of Maryland are partnering on the Global Ecosystem Dynamics Investigation (GEDI) initiative, which will provide a valuable update on detailed biomass and land use data.
- Climate Nexus may be able to provide strategic guidance and/or communications support in high leverage moments in the future.

- The social science academic community may be able to provide insight into the human-related elements of carbon removal, such as strategic messaging in particular.

What are the next steps?
Participants agreed to establish a Carbon Removal Working Group (CRWG) as a space for sharing information and coordination on carbon removal issues. ICRLP agreed to create an online work space (Slack group) for members to connect and share resources. A Steering Committee will help establish participation guidelines and direction for the CRWG.

On the topic of Work Group membership, the group discussed whether or not fossil fuel companies should be allowed to participate. Many meeting participants expressed concern with allowing members of the fossil fuel industry, and the Steering Committee agreed to consider the issue and write a formal description of membership guidelines.

In addition to the establishment of the CRWG and tasking the Steering Committee with exploring membership guidelines, participants agreed that there is an overwhelming urgency for action on climate change now, making this group particularly useful for coordination among NGOs. The group also discussed the value of a resource presenting a prioritized portfolio of carbon removal options, though some participants raised concerns around whether a portfolio approach is actionable from a policy perspective. Participants also agreed that the CRWG would be particularly useful for:

- understanding research needs to bridge needs between research and policy;
- sharing information about the science of carbon removal, including the risks and benefits of technologies, modeling and research regarding climate projections; and
- sharing information regarding relevant policy developments, both in the U.S. and internationally.

Ms. Breitburg-Smith reviewed some potential areas of future coordination that the meeting facilitators identified through the discussions, including:

- Messaging
    - Public
    - Political
- Information and Research
    - Quick Info Sharing
    - Assess Approaches
    - Synthesize, Translate
    - Research Agenda
- Strategic Coordination
    - Roles, Capacity
    - Steering Committee
    - Debate
    - Inform/Info Broader Community

Action Items

The following action items were shared following the conclusion of the meeting.

Participant Resource Sharing – Next Steps:

1. Share information on EDF workshop on the nexus of CO2 and other greenhouse gases (e.g., NO2) – *Joe Rudek*
2. Share brief explanation of vision for a carbon removal (CR) research and development agenda – *Rafe Pomerance*
3. Share information on governors' coalition to manage carbon sinks – *James Mulligan*
4. Share information on TNC and WRI efforts to map CR research – *Michelle Passero and James Mulligan*
5. Share information on carbon removal communications research efforts – *Kate Gordon, Hunter Cutting, Holly Buck*

Meeting Follow up - Next Steps:

1. Create Slack space for Carbon Removal Working Group (CRWG) that includes a tool to share available resources, including but not limited to: – *Institute for Carbon Removal Law and Policy (ICRLP)*
    a. An annotated timeline of forthcoming reports/milestones
    b. Resources that outline the risks and benefits of different carbon removal (CR) options in one location
2. Share a draft meeting report with participants for review – *ICRLP and RESOLVE*
3. Explore path forward for Solar Radiation Management (SRM) meeting – *RESOLVE, FCEA*
4. Share information about Steering Committee discussions regarding CRWG – *RESOLVE*

Steering Committee Tasks:

1. Define CRWG goals, purpose, and membership, including an approach to engaging other groups
2. Determine best approach for information sharing and strategy discussions around forthcoming reports (i.e., IPCC 1.5 report, NAS study, etc.)
3. Determine interest in and best approach for sharing information on different CR technologies
4. Determine best approach for sharing information about the Working Group externally (e.g., a web presence)
5. Identify next steps for developing a document outlining a prioritized portfolio approach to carbon removal options
6. Identify and pursue fundraising options to support CRWG

Appendix A – Meeting Agenda

Thursday September 6

2:00 p.m. ARRIVAL AND REFRESHMENTS

2:45 p.m. GATHERING AND OVERVIEW OF ACCOMMODATIONS

3:00 p.m. SESSION 1 – WELCOME

Welcome to The Johnson Foundation at Wingspread
Roger C. Dower
President
The Johnson Foundation at Wingspread

Welcome, Introductions, and Goals of the Summit
Forum for Climate Engineering Assessment
Simon Nicholson and Wil Burns
Co-Directors, Forum for Climate Engineering Assessment

Framing the Agenda: What We Heard
An overview of the meeting, including an outline of the meeting's core objectives, a summary of the process rules that will guide the meeting, and a brief overview of the main insights gained from pre-interviews with meeting participants.

Stephen D'Esposito and Maya Breitburg-Smith
RESOLVE

Participant Introductions
A period to allow meeting participants to introduce themselves and to establish meeting goals.

3:45 p.m. SESSION 2 – THE STATE OF CARBON REMOVAL

Presentations: The State of Carbon Removal Science, International and Domestic Policy, and Economics
A set of three presentations to set a baseline of common knowledge for the discussions to follow. Presenters will look in turn at the current state of the science around carbon removal technologies and practices, the international legal and policy landscape, and the domestic policy landscape, economics, and other considerations. A brief question and answer period will follow the presentations.

Christa Marie Anderson
Stanford University

Rick Duke
Gigaton Strategies

Wil Burns
Forum for Climate Engineering Assessment

5:00 p.m. BREAK

5:15 p.m. Simulation: Carbon Removal in the Context of the Goals of the Paris Agreement
A participatory simulation utilizing the En-ROADs platform developed by Climate Interactive, to situate carbon removal within the broader set of available climate change response options.

Ellie Johnston
Climate Interactive

6:45 p.m. ADJOURN

7:00 p.m. RECEPTION AND DINNER

9:00 pm EVENING HOSPITALITY

Friday, September 7
7:30-8:30 a.m. BREAKFAST BUFFET

9:00 a.m. SESSION 3 – WHERE IS THE US ENVIRONMENTAL COMMUNITY ON CARBON REMOVAL?

Welcome and Day 1 Review
Introduction of new participants, reflections and takeaways from day 1, and overview of day 2 agenda

9:30 a.m. Presentation and Group Discussion: Themes from the Pre-interview s
A presentation of pre-meeting interview results and facilitated discussion among participants, with a focus on three major questions and themes:

1. *Is carbon removal necessary?*
2. *Is carbon removal mitigation?*
3. *What is the state of NGO engagement right now?*

10:45 a.m. BREAK

11:00 a.m. Continue Group Discussion: Themes from the Pre-Interviews

12:00 noon LUNCH

1:30 p.m. SMALL GROUP DISCUSSIONS
Scenarios and Discussion - Questions, Concerns, Barriers, and Opportunities
In the context of current policy issues, participants will have the opportunity to learn how others are considering and/or working on carbon removal in small groups.

3:15 p.m. Scenarios and Discussion – Full Group Review
Share updates from small groups and discuss shared questions, concerns, or possible barriers/opportunities. Receive responses to technical questions.

Guiding Questions:

- *What is the state of engagement on carbon removal?*
- *Are there common questions or uncertainties that would be helpful to address?*
- *Are there shared definitions and frameworks that can steer evaluation of specific carbon removal technologies and policies?*

4:30 p.m. SESSION 4 – CRAFTING AN AGENDA ON CARBON REMOVAL

What are the implications of carbon rem oval technologies and policies for the US environmental com m unity with regard to policy, strategy, and communications?
Building on earlier discussions about how the environmental community is considering and working on carbon removal, begin identifying future strategic opportunities and needs, particularly in the context of upcoming activities and milestones.

Guiding Questions:

- *Report from pre-meeting interviews: How are some organizations thinking about responses to the IPCC 1.5 C report?*
- *What near term policy choices must be made, and at what scale, if these technologies are to be eventually deployed at scale?*
- *What outcomes should we be assessing?*
- *How could carbon removal impact other forms of climate response?*

5:30 p.m. WRAP UP AND ADJOURN

5:45 p.m. RECEPTION AND DINNER

8:30 p.m. EVENING HOSPITALITY

Saturday September 8

7:30-8:30 a.m. BREAKFAST BUFFET

9:00 a.m. SESSION 5 – LOOKING FORWARD

Welcome and Day 2 Review
Share reflections and take-aways from day 2 and provide an overview of day 3 agenda

9:15 a.m. Discussion: Looking Forward on Strategy – Assessing Carbon Removal Technologies and Policies

How can the US environmental community assess carbon removal technologies and policies at the strategic level? What is the value of strategic coordination, how should it take place? Illuminate future information and coordination that may be most productive.

10:00 a.m. BREAK

10:15 a.m. Discussion: Looking Forward on Communications – Communications, Information Sharing, and Engagement

Facilitated discussion concerning next steps for this group and for an expanded set of organizations. Are there shared strategies for communicating about carbon removal opportunities and challenges? Illuminate future information and coordination that may be needed among those in this group and others.

11:45 a.m. Closing Discussion and Review

Discuss and confirm any additional next steps identified during the meeting. Closing commentary from RESOLVE and FCEA

Simon Nicholson
Director FCEA

12:00 p.m. ADJOURN AND LUNCH BUFFET

Appendix B – Meeting Participants

Meeting participants included the following:

Name	Organization / Affiliation
Angela Anderson	Union of Concerned Scientists
Christa Anderson	Stanford University
Laura Bartock	RESOLVE
Maya Breitburg-Smith	RESOLVE
Holly Buck	University of California Los Angeles
Wil Burns	Institute for Carbon Removal Law and Policy
Hunter Cutting	Climate Nexus
Stephen D'Esposito	RESOLVE
Rick Duke	Gigaton Strategies
Steven Feit	Center for International Environmental Law
Jason Funk	Center for Carbon Removal
Kate Gordon	Linden Trust for Conservation
Bruce Hamilton	Sierra Club
Aliya Haq	Natural Resources Defense Council
Ellie Johnston	Climate Interactive
David Morrow	Institute for Carbon Removal Law and Policy
James Mulligan	World Resources Institute
Deepika Nagabhushan	Clean Air Task Force
Simon Nicholson	Institute for Carbon Removal Law and Policy
John Noel	Clean Water Action
Michelle Passero	The Nature Conservancy
Rafe Pomerance	Arctic 21
Joe Rudek	Environmental Defense Fund
Stephan Singer	Climate Action Network International
Sasanka Thilakasiri	Oxfam America
Michael Thompson	Carnegie Climate Geoengineering Governance Initiative
Carolyn Turkaly	Institute for Carbon Removal Law and Policy

Appendix C – Pre-Meeting Interview Guide and Questions

Introduction
We are with RESOLVE, a non-profit organization that specializes in designing, facilitating, and managing collaborative processes to achieve outcomes in areas of natural resources, energy, public health, and agriculture.

We have been asked by the Forum for Climate Engineering Assessment (FCEA) to help prepare for and facilitate a meeting of key NGOs working on climate policy. In preparation for that meeting, this interview is intended to learn about your perspective on carbon removal technologies and policies. At the meeting we'll explore how U.S. environmental NGO community can engage on the rapidly evolving issues related to proposed carbon removal technologies, including near-term decisions about research and advocacy agendas.

What you share with us during interviews will help us develop the agenda and other supporting materials. We will compile useful information and may use it as background for the deliberations at the meeting, however, we will not attribute statements to any one organization or individual.

Only RESOLVE and FCEA will have access to the notes from each interview. Interviewees are welcome to let us know if they would like specific comments to remain completely off-the-record. FCEA will also use the input from these interviews to develop a report outlining the current state of the carbon removal conversation within the US environmental NGO community. The report will reflect information gathered in the interviews but will not reference specific organizations. FCEA will use information from the interviews to help prepare this analysis. FCEA we will not attribute comments to specific individuals nor will it share confidential information.

We will not necessarily go through the whole list of questions or in the outlined order when we speak with you, but we are providing this list in advance to give you a sense of the information that we think would be helpful to touch upon. If there are topics you do not see, but think important to discuss, please let us know and we will add them.

Thank you for taking the time to join an interview.
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NGO Interview Questions

1. **What's your role in your organization?**

2. **How is your organization defining carbon removal / what counts as carbon removal for your organization?**
    a) Some people draw a distinction between "biological" and "technological" forms of carbon removal. Is your organization drawing such distinctions?
    b) Are there any carbon removal techniques your organization has decided are off the table?
    c) Some people have talked about carbon removal as a kind or geoengineering or climate engineering. Is that, for your organization, a useful way to look at carbon removal?
    d) Does your organization view carbon removal as a form of mitigation? What does your organization see as the risks and benefits of this framing?

3. **How would you characterize your organization's engagement with carbon removal?**
    a) When did your organization first start discussing carbon removal? What was the driver motivating you to first discuss or consider carbon removal?
    b) Has the conversation changed through time? If so, how and why?
    c) Is there a lot of or a little engagement with carbon removal?
    d) Within what divisions or departments is carbon removal being discussed? (e.g., lands, biodiversity, etc)?
    e) With what stakeholders (e.g., boards, funders, senior leadership, memberships)?
    f) Do you have staff who dedicate time to research or advocacy on carbon removal? If so, how many and what positions?
    g) Is your organization considering carbon removal in your preparation for the upcoming release of the IPCC Special Report on 1.5? If so, how?
    h) Some scientists and policymakers have also proposed looking at so-called solar geoengineering or solar radiation management strategies. Is your organization considering solar geoengineering or solar radiation management in your preparation for the 1.5 report?

4. **How would you characterize your organization's current internal conversation about carbon removal?**
    a) When your organization discusses carbon removal, is it more often in terms of maximizing benefits (the shrinking carbon budget means carbon removal needs to be looked at) or of minimizing risks (carbon removal is going to happen -- how do we make sure it's not bad OR carbon removal may never materialize at large scale)?
    b) Is carbon removal being viewed as similar to other issues on which your organization works?

5. **What makes for "good" carbon removal?**
    a) From your organization's perspective, are there principles or measures that could guide evaluation?

6. **I'd like to pose a hypothetical. Imagine that the US government is launching a large R+D project on carbon removal. How would your organization respond?**
    a) Which technologies would you prioritize? What factors would help you make decisions about priorities?
    b) What conditions do you think should be put upon it?
    c) Hypothetically, if the US government were to propose a solar geoengineering or solar radiation management research program, how would your organization respond?

This question will only be asked of Wingspread attendees.

1. What would be most valuable for you at the Wingspread meeting to discuss with other NGOs?
2. What does your organization need to assess these technologies? (Examples could include access to technical information, space to discuss advocacy strategies with other organizations, etc.)
3. Does your organization coordinate or collaborate with other organizations on carbon removal? If so, how do you work together, and on what? If you're not currently working with others on carbon removal, do you see opportunities to do so? What are some of the areas where this could happen?