White House Environmental Justice Advisory Council Recommendations: Carbon Management Workgroup

November 17, 2023

Prepared by:

White House Environmental Justice Advisory Council Carbon Management Workgroup

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Acknowledgements

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Disclaimer

This report of recommendations has been written as part of the activities of the WHEJAC, a public advisory committee providing independent advice and recommendations on the issue of environmental justice to the Chair of the Council on Environmental Quality (CEQ) and to the White House Environmental Justice Interagency Council (IAC). In addition, the materials, opinions, findings, recommendations, and conclusions expressed herein, and in any study or other source referenced herein, should not be construed as adopted or endorsed by any organization with which any Workgroup member is affiliated. This report has not been reviewed for approval by the EPA or CEQ, and hence, its contents and recommendations do not necessarily represent the views and the policies of the EPA or CEQ, nor of other agencies in the Executive Branch of the Federal government.

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WHITE HOUSE ENVIRONMENTAL JUSTICE ADVISORY COUNCIL

November 17, 2023

Honorable Ms. Brenda Mallory, Chair
Council on Environmental Quality
Executive Office of the President
Washington, DC 20500

Dear Chair Mallory:

The White House Environmental Justice Advisory Council (WHEJAC) submits the following recommendations on carbon management, a topic of extreme timeliness and urgency, given the challenging environmental justice issues that lay ahead if the federal government continues to make investments before coming to terms with the regulatory process, data and evidentiary gaps, and risks.

Since the charge was solidified in June 2023, the WHEJAC quickly sought to develop preliminary recommendations based on an initial review of relevant information pertaining to carbon management. The information and recommendations contained herein are the results of this early information gathering. Based on initial findings of our information gathering, the WHEJAC determined that it was essential to develop a set of early recommendations as soon as possible. The WHEJAC and Carbon Management Workgroup intend to continue learning and making future recommendations. Future recommendations will follow up on more details regarding information deemed to be hard to access and requiring significant time to fully review.

The initial recommendations we are putting forward include the following five recommendations: (1) cease carbon management investments and projects, (2) clarify the landscape of carbon management initiatives and technologies that federal agencies are advancing, (3) conduct a systematic review of the evidence of risks related to carbon management, (4) engage in accountable communications with EJ communities and (5) ensure free, prior and informed consent and meaningful engagement of the most impacted communities be put into practice.

These recommendations can be considered and added to the CEQ's CCUS guidance and be taken up for consideration by the interagency workgroup on CCUS. We also request that responses to "Recommendation 1" and specifically recommendations 1A. - 1E. be provided at the WHEJAC public meeting planned for December 6, 2023.

We look forward to your swift response to our recommendations and further discussion of the critical environmental justice concerns relayed.

Sincerely,

Richard Moore, WHEJAC Co-chair

Peggy M. Shepard, WHEJAC Co-chair

cc: Members of the WHEJAC
Michael S. Regan, EPA Administrator
Dr. Jalonne L. White-Newsome, Federal Chief Environmental Justice Officer, CEQ
Corey Solow, Senior Advisor to the Chair, CEQ
Ryan Hathaway, Director, White House Environmental Justice, Interagency Council
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Acronyms

BECCS	Bioenergy with Carbon Capture and Storage
BSER	Best System of Emissions Reductions
CCS	Carbon Capture and Sequestration
CCUS	Carbon Capture, Utilization and Storage
CEQ	Council on Environmental Quality
DAC	Direct Air Capture
DOE	Department of Energy
DOI	Department of Interior
EJ	Environmental Justice
EJI	Environmental Justice Index
EO	Executive Order
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FY	Fiscal Year
GHG	Greenhouse Gas
HUD	Department of Housing and Urban Development
IRA	Inflation Reduction Act
NAS	National Academy of Sciences
NASEM	National Academy of Sciences, Engineering, and Medicine
NETL	National Energy Technology Laboratory
NOx	Nitrous Oxides
OCED	Office of Clean Energy Demonstration
OSTP	Office of Science and Technology Policy
PHMSA	Pipeline and Hazardous Materials Safety Administration
PM	Particulate Matter
RNG	Renewable Natural Gas
SOx	Sulfur Oxides
USDA	United States Department of Agriculture
WHEJAC	White House Environmental Justice Advisory Council

Glossary of Key Terms

Biochar	A form of charcoal produced from biomass sources (i.e., wood chips, plant residue, manure or other agricultural waste products) for the purpose of sequestering carbon.
Biologic Carbon Sequestration	Biologic carbon sequestration refers to storage of atmospheric carbon in vegetation, soils, wood products, and aquatic environments. For example, by encouraging the growth of plants – particularly larger plants like trees – advocates of biologic sequestration hope to help remove CO_2 from the atmosphere.
Direct Air Capture	The extraction of CO_2 directly from the atmosphere for CO_2 storage or utilization.
Blue Carbon	Carbon captured by the world's ocean and coastal ecosystems. This includes natural carbon sinks (e.g., sea grasses, mangroves, and salt marshes) and coastal habitat conservation.
Renewable Natural Gas	Biogas (the gaseous product of the decomposition of organic matter) that has been processed to the purity standards of conventional natural gas. Sources of biogas include organic waste from industrial, institutional, and commercial entities.
Carbon Capture and Sequestration	Carbon capture and sequestration is the process of capturing and storing atmospheric carbon dioxide. It is one method of reducing the amount of carbon dioxide in the atmosphere with the goal of reducing global climate change. The two major types of carbon sequestration are geologic and biologic.
Carbon Capture, Utilization and Storage	A suite of technologies that enable the mitigation of CO_2 emissions from large point sources such as power plants, refineries and other industrial facilities, or the removal of existing CO_2 from the atmosphere.
Geologic Carbon Sequestration	Geologic carbon sequestration is the process of storing CO_2 in underground geologic formations. The CO_2 is usually pressurized until it becomes a liquid, and then it is injected into porous rock formations in geologic basins. This method of carbon storage is also sometimes a part of enhanced oil recovery, otherwise known as tertiary recovery, because it is typically used later in the life of a producing oil well.

Hydrogen Fuels	A fuel that, when consumed in a fuel cell, produces only water. Hydrogen can be produced using natural gas, nuclear power, biomass, and renewable power like solar and wind. Currently, the most common methods of producing hydrogen fuel are natural gas reformation (a thermal process), and electrolysis. Other methods include solar-driven and biological processes. Classifications of hydrogen fuel include the following: • **Grey Hydrogen**: Fuel generated by steam methane reforming (SMR), made from natural gas. • **Blue Hydrogen**: Fuel generated by steam methane reforming, made from natural gas with the addition of carbon capture and sequestration technology. • **Green Hydrogen**: Fuel generated through electrolysis (the process of using electricity to split water to generate hydrogen and oxygen) fueled by renewable energy. • **Turquoise Hydrogen**: Fuel generated through methane pyrolysis, which involves heating methane (the primary component of natural gas) to high temperatures without oxygen. This process produces hydrogen and solid carbon. • **Brown Hydrogen**: Fuel generated by heating coal with steam and oxygen to produce a gas that contains hydrogen, carbon monoxide, and carbon dioxide. The byproducts are released into the atmosphere.
Hydrogen Co-Firing	The combustion of hydrogen and another type of fuel in the same combustion system.
Industrial Carbon Removal	The application of industrial methods to remove carbon from the atmosphere.
Mineralization	Carbon mineralization is a versatile and thermodynamically downhill process that involves converting CO_2 to solid inorganic carbonates, thereby capturing, storing, and utilizing CO_2.
Ocean Alkalinity Enhancement	Ocean alkalinity enhancement is a carbon removal technique that involves adding alkaline substances to seawater to enhance the ocean's natural carbon sink. These substances could include minerals, such as olivine, or artificial substances, such as lime or some industrial byproducts. Adding alkalinity to the ocean removes CO_2 from the atmosphere through a series of reactions that convert dissolved CO_2 into stable bicarbonate and carbonate molecules, which in turn causes the ocean to absorb more CO_2 from the air to restore equilibrium.
Soil Amendments/Regenerative Farming	A suite of soil management practices aimed at improving soil health, optimizing resource management, alleviating climate change by increasing the soil's organic carbon, sequestering and improving water quality and availability.

Nitrous Oxides	A family of greenhouse gas compounds with the chemical structure NO_x, including nitrogen dioxide (NO_2), which is a greenhouse gas. It is the most prevalent form of atmospheric NOx and is generated by anthropogenic (human) activities.
Sulfur Oxides	A family of gases with the formula SO_x that includes sulfur dioxide (SO_2) and sulfur trioxide (SO_3) that are emitted when fuels containing sulfur, such as coal and oil, are burned.
Information Quality Act	Section 515 of Public Law 106-554, known as the Information Quality Act, required OMB to promulgate guidance to agencies ensuring the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by Federal agencies.

Preamble

In December 2022, the WHEJAC received a document with information about a charge from CEQ, in collaboration with DOE and other agencies, to form a workgroup on environmental justice and carbon management. A draft charge document was then suggested in March 2023. The language in both documents focused on several technologies, including certain carbon capture technologies, and requested comment on processes such as community benefits agreements and a pipeline mapping project.

Initially, during the WHEJAC's December 2022 and March 2023 public meetings, numerous WHEJAC members expressed surprise and dissent that plans for the implementation of many carbon management technologies had already been solidified in their earliest stages. For there had not been widespread meaningful engagement with communities and the public. Some WHEJAC members requested information on what scientific and engineering studies on health, energy use, carbon reduction, cumulative impacts, and scale had been performed so as to ensure safety and efficacy of the technologies, especially given that many billions of dollars were set to be invested by the federal government for implementation.

Moreover, some WHEJAC members also expressed shock and disappointment that some agencies considered that communities already saddled by environmental injustice are receiving 'a Justice40 benefit' if they are targeted to host a new carbon management technology. This investment in "experimentation" of technology that lacks sufficient research of both its safety and efficacy further creates barriers of distrust between impacted communities, particularly those who have been historically and currently disenfranchised, and the respective government agencies.

A humane approach to carbon management would be to prioritize sound research (not influenced by polluters) that includes a robust focus on potential public health and environmental risks. To bring forward a charge to the White House Environmental Justice Advisory Council that lacks adherence to the 17 Principles of Environmental Justice and the Jemez Principles is counterproductive to what Executive Orders 14008 (Tackling the Climate Crisis at Home and Abroad) and 14096 (Revitalizing Our Nation's Commitment to Environmental Justice for All) aim to achieve. Any threat of harm discussed without alignment with and without respect for these principles and Executive Orders is not a reflection of environmental justice.

The draft charge itself was also divided into numerous questions that were very agency specific, requiring capacity and resources far exceeding that which the WHEJAC has been allotted by the White House. WHEJAC members made this assessment based on their diverse and extensive experience in scientific and scholarly publishing, authoring high quality reports, and reviewing assessment and permitting processes. In addition, their extensive interaction with communities provided another context for their assessment. Some felt that the questions did not get to the core of environmental justice issues and the questions were instead requesting advice after the major decisions relevant to environmental justice had already been made by agencies.

The WHEJAC requested from CEQ a revision of the charge that would make it possible for a Carbon Management Workgroup to learn and understand what is known and unknown about carbon management and environmental justice. The charge asks, "What criteria should be applied to the evaluation and permitting of carbon management strategies and projects in ways that prevent harm, align with, and advance environmental justice and protection for communities?"

Since the charge was solidified in June 2023, the WHEJAC undertook preliminary information gathering about carbon management. The information and recommendations furnished here are the results of early information gathering. Based on initial findings, the WHEJAC determined that it was essential to develop a set of recommendations at the earliest possible time. The WHEJAC and Carbon Management Workgroup intend to continue learning and making future recommendations. Future recommendations will follow up on more details regarding information deemed to be hard to access and requiring significant time to fully review. There is much information that has been revealed to us that is in federal records, but that the federal spokespeople we have spoken with have no specific knowledge of what is in those reports, studies, and documented processes.

The Charge and Approach to the Response

The charge, stated again: What criteria should be applied to the evaluation and permitting of carbon management strategies and projects in ways that prevent harm, align with, and advance environmental justice and protection for communities?

The workgroup selected Dr. Kyle Whyte, Dr. Beverly Wright, and LaTricea Adams as co-chairs and began hosting meetings every two weeks. Workgroup members took on particular research tasks, heard perspectives from federal agencies, and the workgroup invited external experts to assist and inform the workgroup, including one who joined as a member of the workgroup, and one who gave a presentation prior to the issuance of these recommendations. The workgroup assembled an in-person workshop on August 16-18, 2023 in Washington, DC to come to a consensus on and draft recommendations. Workgroup co-chairs, Adams and Whyte, facilitated the workshop. Before and after the workshop, staff from the Department of Energy met often with the workgroup and provided responses to its questions.

Explanation of Tiered Recommendations

Our recommendations are tiered in terms of the degree of urgency of implementation and the urgency of the need to receive responses from federal agencies. Tier 1 recommendations request the immediate achievement of outcomes and have a set of response deadlines. Tier 2 recommendations request changes in federal processes pertaining to the assessment of evidence, communication, and meaningful engagement with communities and the public. Tier 3 recommendations are requests for information. Tier 2 and Tier 3 recommendations also have response deadlines.

Recommendation 1, Tier 1: Cessation of Implementation of Carbon Management

Recommendation 1: Halt the implementation of the following carbon management technologies and associated programs now: Carbon Capture and Sequestration (CCS); Carbon Capture, Utilization and Storage (CCUS); Direct Air Capture; Bioenergy with Carbon Capture and Storage (BECCS); and Hydrogen co-firing.

Specific Recommendations

A. De-classify as "Justice40 Covered Programs" those programs that advance CCUS, CCS and any other carbon management technologies that do not immediately reduce dependency on fossil fuel sources of energy.

B. Make public the permitting and regulatory decision trees - such as "Go/No-Go" schemes - for all carbon management projects and programs, including delineation of where opportunities are located for potential host communities and state officials to intervene and influence project decisions.

C. Potential host communities must have a right of refusal for carbon management projects that do not immediately reduce dependency on fossil fuel sources of energy. This right must be clearly delineated in the publicly available permitting and regulatory decision. Communities do not need to be formal project partners with proponents to have the right of refusal.

D. Federal agencies should issue a disclaimer on all future carbon management projects that the projects have been approved in the absence of public health and cumulative impacts or EJ analysis.

E. The EJ Scorecard should include an indicator specific to carbon management projects: if a community is facing a carbon management project of any sort, they should be tracked for emissions increases such as co-pollutant emissions, or other potential risks to the environment and human health.

F. Federal agencies of the Interagency Council (IAC) should provide public updates on their progress toward outcomes asked for in Recommendation 1 and Specific Recommendations 1A.- 1E.

G. It is requested that CEQ create a spreadsheet for documenting updates from IAC agencies. For agencies with no involvement in the referenced carbon management programs and technologies, a response of "not involved" is sufficient.

H. It is requested that the first responses to outcomes for Recommendation 1 and Specific Recommendations 1A.- 1E be provided at the WHEJAC public meeting on December 6, 2023.

I. EO 14096 states the following:

"Public meetings. In coordination with the White House Environmental Justice Advisory Council, the Interagency Council shall hold at least one public meeting per year. The Interagency Council shall prepare, for public review, a summary of the comments and recommendations discussed at public meetings of the Interagency Council."

It is requested that the WHEJAC and IAC have a public meeting devoted to carbon management, which will include formal updates from agencies sometime between March and August 2024. At this public meeting, a new response framework will be established for future updates.

Discussion

While still in its early phases of information gathering, the WHEJAC is surprised by what they have learned. The WHEJAC is surprised at how environmental justice concerns related to safety, public health, environmental risks, cumulative impacts, and efficiency are unaddressed, addressed inefficiently, or

addressed haphazardly by the federal government and other proponents of carbon management. This surprise warrants the aforementioned pressing recommendations.

The rationale behind the Tier 1 recommendations is that carbon management programs such as Carbon Capture and Sequestration (CCS); Carbon Capture, Utilization and Storage (CCUS); Direct Air Capture (DAC); Bioenergy with Carbon Capture and Storage (BECCS); and Hydrogen fuels have serious impacts on communities affected by environmental injustice. The relationships we considered are listed below:

- Proposed and existing pipelines for some carbon management, such as CCS projects, correspond with the location of EJ communities already overburdened by fossil fuel infrastructure. The technologies are ones that seek to be inserted into existing fossil fuel infrastructure. As research has shown for decades, existing fossil fuel infrastructure, such as power plants, have been disproportionately sited in or within several miles of Black, Brown, and Indigenous communities and communities with lower incomes. Carbon management infrastructure will add risks and further burden EJ communities because it must be added to existing energy infrastructure.
- Research and scientific assessment, including the U.S. National Climate Assessment, demonstrates Black, Brown, and Indigenous communities suffer the most severe impacts from climate change. In the effort to replace fossil fuels, the use of green energy (water, wind, and solar), especially distributed renewables, has less impact on overburdened communities than using fossil fuel energy to produce hydrogen or sequester carbon. Programs that advance carbon management technologies that do not immediately reduce carbon dependency and emissions are not addressing the causes of climate vulnerability that negatively affect communities who have long struggled with environmental injustice.

Because these technologies are not proven as safe and effective alternatives to non-carbon-based energy sources, carbon management programs that have already been approved or funded must have a mandatory host community review, where the community is afforded the right of refusal on the project. Community veto is warranted in such cases where carbon management strategies have not been fully vetted for environmental justice, public health and safety, and cumulative impacts implications and where the federal government has not yet adopted affirmative cumulative impacts, regulatory policies that are protective of EJ communities.

Federal agencies should not count carbon management projects towards Justice40 goals. This is a direct subversion of the Justice40 initiative and is an indicator of burden rather than a community benefit. In fact, they should be tracking the harms that carbon management projects may introduce. The Justice40 policy was not designed to represent benefits through programs that, for diverse reasons, increase the burdens of health and environmental risk on communities already saddled with environmental injustice. The introduction of “community benefits” agreements perpetuates environmental injustice and environmental racism by targeting overburdened communities for accepting risks and burdens in exchange for the promise of some future potential economic returns historically granted outright to non-disadvantaged communities. Communities should not have to trade off their health and well-being for basic economic survival.

Cases

1. The recently announced direct air capture hubs are an opportunity for the Department of Energy to publicly produce its “Go/No-Go” decision tree and to show, in that decision tree, how potential host communities can have the opportunity to halt the advancement of either of these projects.

2. CCS and hydrogen fuel mixing in EPA's power sector rules require state implementation plans. These state implementation plans give states leeway in the approaches that will achieve the required carbon emissions reduction goals for covered power plants. For example, states have the power to opt for plant closures or plant-wide improvements, investments in renewable energy or energy efficiency programs.
3. States, either through their existing regulatory review processes or through additional protective laws such as cumulative impacts laws, are able to halt projects and withhold support or legally challenge projects that threaten public health, environmental and social wellbeing. As such, projects funded by the federal government have the potential to fail if communities oppose installation. This would result in a needless loss of funding.

Recommendation 2, Tier 2: Clarify the landscape of technologies that fall within carbon management

Recommendation 2: The term "carbon management" is an umbrella term that can blur and include diverse technologies, carbon reduction strategies or low/non-carbon fuels (i.e., CCS, CCUS, BECCS, biochar, hydrogen fuels, direct air capture, blue carbon, RNG, etc.) for climate mitigation.[1] The term carbon management strategies and carbon dioxide removal are also terms that are often conflated and used interchangeably as umbrella terms to describe industrial and biological approaches to remove and reduce carbon.[2] These terms can obscure from the public and communities affected by environmental injustice important information about the attendant risks and impacts of carbon management proposals. WHEJAC recommends, as a starting point, draft materials from the DOE, EPA, and any other relevant federal agencies, on the landscape of the relationships among different technologies and their related risks, which are being referred to as carbon management. This information should be provided online, in language accessible to diverse public audiences and accompanied by visuals that can aid in public understanding of complex risks. The importance of identifying the danger of conflated terminology is that communities with already limited resources and capacity face undue burdens in trying to understand the environmental justice implications and risks of these technologies.

Discussion

Mounting public concern about the impacts of climate change, coupled with the acceleration of government investment in climate mitigation has resulted in the rapid adoption of a wide range of carbon management technologies and demonstration projects. The fossil fuel industry has been one of the main beneficiaries of programs enacted by Congress (i.e., Inflation Reduction Act) led by the Department of Energy and other federal agencies, to accelerate the adoption of these carbon management projects. According to a 2022 Congressional Research Service Report on CCS, "*The U.S. Department of Energy (DOE) has funded research and development (R&D) in aspects of CCS since at least 1997 within its*

[1] Carbon management technologies aim to manage anthropogenic releases of greenhouse gasses, such as those associated with the combustion of fossil fuel use, in an effort to mitigate the potential impacts of these emissions on climate systems. (Encyclopedia of Energy. 2004. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/carbon-management)

[2] Industrial carbon management (ICM)—defined as the linked processes of capturing the carbon content of fossil fuels while generating carbon-free energy products, such as electricity and hydrogen, and sequestering the resulting carbon dioxide. https://www.ncbi.nlm.nih.gov/books/NBK44136/

Fossil Energy and Carbon Management Research, Development, Demonstration, and Deployment program (FECM) portfolio. Since FY 2010, Congress has provided a total of $9.2 billion (in constant 2022 dollars) in annual appropriations for FECM, of which $2.7 billion (in constant 2022 dollars) was directed to CCS-related budget line items. The Infrastructure Investment and Jobs Act (IIJA; P.L. 117-58) provided $8.5 billion (nominal dollars) in supplemental funding for CCS for FY2022-FY2026, including funding for the construction of new carbon capture facilities, plus another $3.6 billion (nominal dollars) for DAC."[3] These significant allocations of public resources require careful consideration of the impact that these investments will have on communities already overburdened by fossil fuel infrastructures and pollution burdens.

The term "carbon management" covers a multitude of strategies, approaches, and technologies. The government needs to explicitly identify individual technologies when engaging with federal and state agencies, local bodies, and the public. Carbon management or carbon dioxide removal can include, but is not limited to, industrial forms of carbon capture or removal technologies as well as "low" or no carbon fuels that include carbon capture and sequestration, carbon capture, utilization, and storage, direct air capture, bioenergy carbon capture and sequestration, hydrogen fuels, renewable natural gas, and biofuels.

There are also biological carbon removal or management approaches such as: reforestation, afforestation, and soil enhancements, and myriad others. The Department of Energy defines carbon dioxide removal (CDR) as: "*...refers to approaches that remove carbon dioxide (CO2) from the atmosphere. CDR encompasses a wide array of approaches, including direct air capture (DAC) coupled to durable storage, soil carbon sequestration, biomass carbon removal and storage, enhanced mineralization, ocean-based CDR, and afforestation/reforestation. CDR does not refer to point source carbon capture for the fossil fuel or industrial sector.*"[4] While the DOE distinguishes Carbon Dioxide Removal from point source capture of emissions (CCS/CCUS), scholars use terms such as Industrial Carbon Removal to encompass both Direct Air Capture and Point Source Capture (CCS/CCUS) since both mechanisms are industrial in nature and both remove CO2, albeit from different sources.[5]

DOE does not explicitly define the term "Carbon Management" as a distinct approach but uses the term to describe a diverse range of strategies and technologies under their carbon management programs which include the following: (1) point source carbon capture (i.e. CCS and CCUS) (2) carbon dioxide removal (i.e. Direct Air Capture), (3) CO2 conversion into products, (4) CO2 transport and storage, and (5) hydrogen.[6] There are other definitions in use around these terms, for example, "*The term "carbon dioxide removal" (CDR) has been widely adopted in the international literature. The term often includes both mechanical–chemical methods and biological methods of carbon drawdown and sequestration. Note that CDR does not include "geoengineering," which refers to interventions, like solar radiation management (SRM), designed to limit the amount of sunlight/energy reaching the planet's surface. Also, note that the term "negative emissions technologies" (NETs) is often used interchangeably with CDR in much of the*

[3] Jones, A. C., & Lawson, A. J. (2022). *Carbon capture and sequestration (CCS) in the United States*. Congressional Research Service. https://sgp.fas.org/crs/misc/R44902.pdf

[4] US Department of Energy. (2023). Carbon Dioxide Removal. https://www.energy.gov/fecm/carbon-dioxide-removal

[5] Sekera, J., & Lichtenberger, A. (2020). Assessing Carbon Capture: Public Policy, Science, and Societal Need. *Biophysical Economics and Sustainability*, *5*(3), 14. https://doi.org/10.1007/s41247-020-00080-5

[6] National Energy Technology Laboratory. (2023). Carbon Management. https://www.netl.doe.gov/carbon-management

literature."[7] These varying definitions of complex technologies, approaches and fuels can lead to confusing public messaging and communications about the nature and attendant risks of carbon management.

Carbon management is an umbrella term that can include a range of biological, chemical, and industrial forms of carbon removal and sequestration. This umbrella term should be better defined for the public in clear and concise terms that include explicit disclosure of the potential risks. Unclear or unspecified terminology and definitions in carbon management obscure the unique risks associated with each of the different technologies and approaches and the accountability for assessing the respective impacts of each. WHEJAC offers the following graphic (Figure 1) as a starting point to provide increased clarity concerning carbon management and carbon dioxide removal technologies.

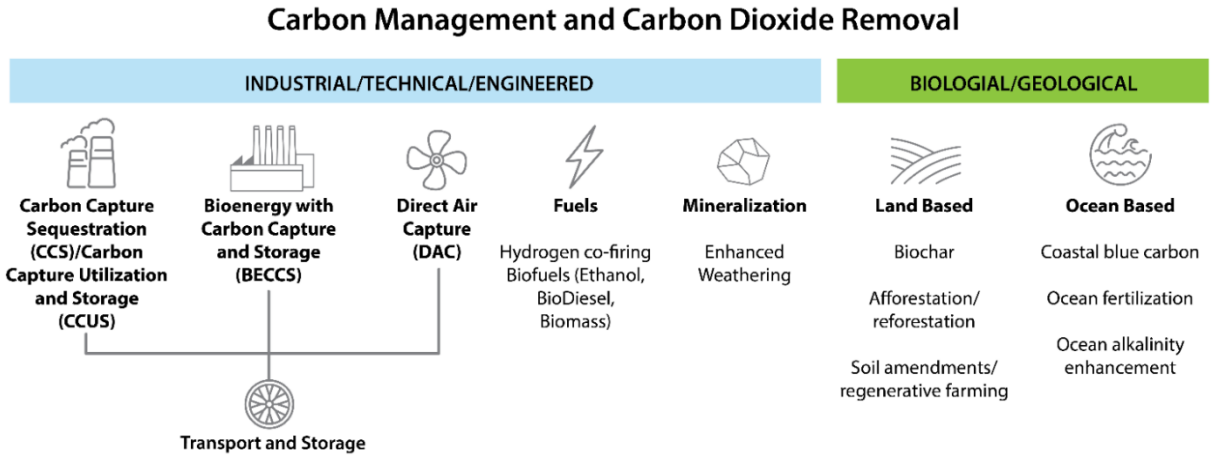

Figure 1. Carbon Management/Carbon Dioxide Removal Methods

In addition to clarifying the types of technologies and fuels covered by the term carbon management, more publicly accessible information is needed to clarify the associated risks and potential impacts to environmental justice communities. A future graphic can elaborate on Figure 1 to include the environmental (air, water, soil, species, habitat, aquifer, etc.), public health, safety, cumulative impacts, and environmental justice risks related to carbon management strategies. Also, the life cycle of each of these technologies, fuels, or methodologies should be carefully detailed and disclosed to the public.

The wide range of industrial and biological carbon management and removal approaches are covered by a large number of federal agencies with oversight and investments across multiple technologies. The governance structures and jurisdictions overseeing the regulation, permitting, monitoring, funding, and reporting along each phase and type of carbon management strategy must also be further clarified for the public in clear and accessible terms. Where jurisdiction or oversight is unclear, this too should be indicated clearly in public information.

[7] Sekera, J., & Lichtenberger, A. (2020). Assessing Carbon Capture: Public Policy, Science, and Societal Need. *Biophysical Economics and Sustainability*, *5*(3), 14. https://doi.org/10.1007/s41247-020-00080-5

As shown in Figure 2, there are critical environmental justice concerns that have been expressed by communities across multiple carbon management strategies related to environmental, health, safety, and regulatory risks for EJ communities that include the following:[8]

1. Increases in co-pollutant emissions (i.e., particulate matter, NOx, SOx, hazardous air pollutants, etc.)[9] in air and water that contributes to cumulative burdens and places risks on already overburdened and/or vulnerable communities[10]
2. Threats from harmful chemical spills or leaks in soil, water, air, aquifers
3. Pipeline explosions
4. CO2 storage leaks
5. Exacerbating water scarcity
6. Hazardous waste storage and disposal
7. Seismic activity
8. Insufficient regulatory oversight at local, state and federal levels to protect EJ communities and significant uncertainty in state compliance
9. Fossil fuel infrastructure lock-in that extends the life of polluting fossil fuel use
10. Diversion of public funds and economic opportunity loss with resources diverted to risky experimental technologies
11. Inefficient climate mitigation approach in relation to renewable energy. Energy intensiveness of these technologies that often more than offset the carbon they are designed to remove

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[8] Studies on disproportionate exposure or proximity of people of Color to fossil fuel infrastructures and related pollution:

- Fleischman, L., & Franklin, M. (2017). *Fumes across the fence-line: The health impacts of air pollution from oil & gas facilities on African American communities* (p. 36). NAACP & CATF
- Zwickl, K. (2019). The demographics of fracking: A spatial analysis for four U.S. states. *Ecological Economics*, *161*, 202–215. https://doi.org/10.1016/j.ecolecon.2019.02.001
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[9] "In the case of CCS, the use of CO capture technology in power plants leads to a general energy penalty varying in the order of 15–25 percent depending on the type of capture technology applied. This energy penalty, which offsets the positive effects of carbon sequestration, requires the additional consumption of fuel, and consequently can result in additional 'direct' emissions (GHG and air pollutant emissions associated with power generation, CO_2 capture and compression, transport and storage) and 'indirect' emissions, including for example the additional fuel production and transportation required." Air Pollution Impacts from Carbon Capture and Storage. European Environment Agency, 2011. p.5

[10] According to the EEA 2011 report, there are expected co-pollutants across all processes and plant types for NOx, PM2.5, VOCs, and NH3 will increase, generally in proportion to the additional fuel combusted to power the CCS process and for coal plants in particular, NH3 will increase significantly, by a factor of three or higher (EEA 2011, p. 39).

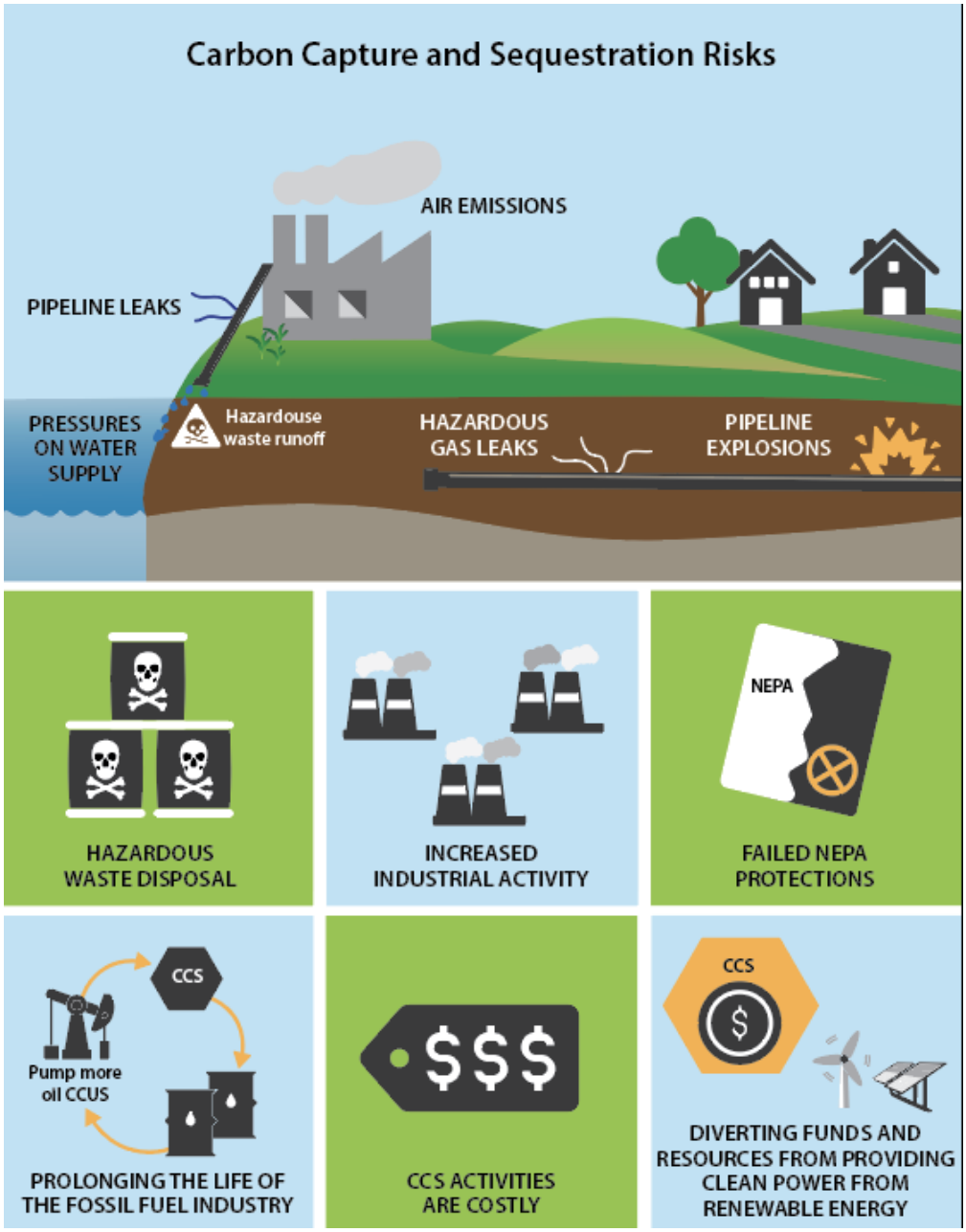

Figure 2. Carbon Capture and Sequestration Risks

Environmental justice concerns about carbon management strategies are important to consider precisely because EJ communities are often disproportionately impacted by existing fossil fuel infrastructure and proposed for future carbon management practices that coincide with these infrastructures. Figure 3 illustrates one example of the disproportionate risks that may be borne by environmental justice communities related to carbon management projects. The figure is derived from a 2023 study completed by the Tishman Environment and Design Center which depicts 35 planned or proposed carbon capture and sequestration projects in the power sector and their co-location with environmental justice communities.

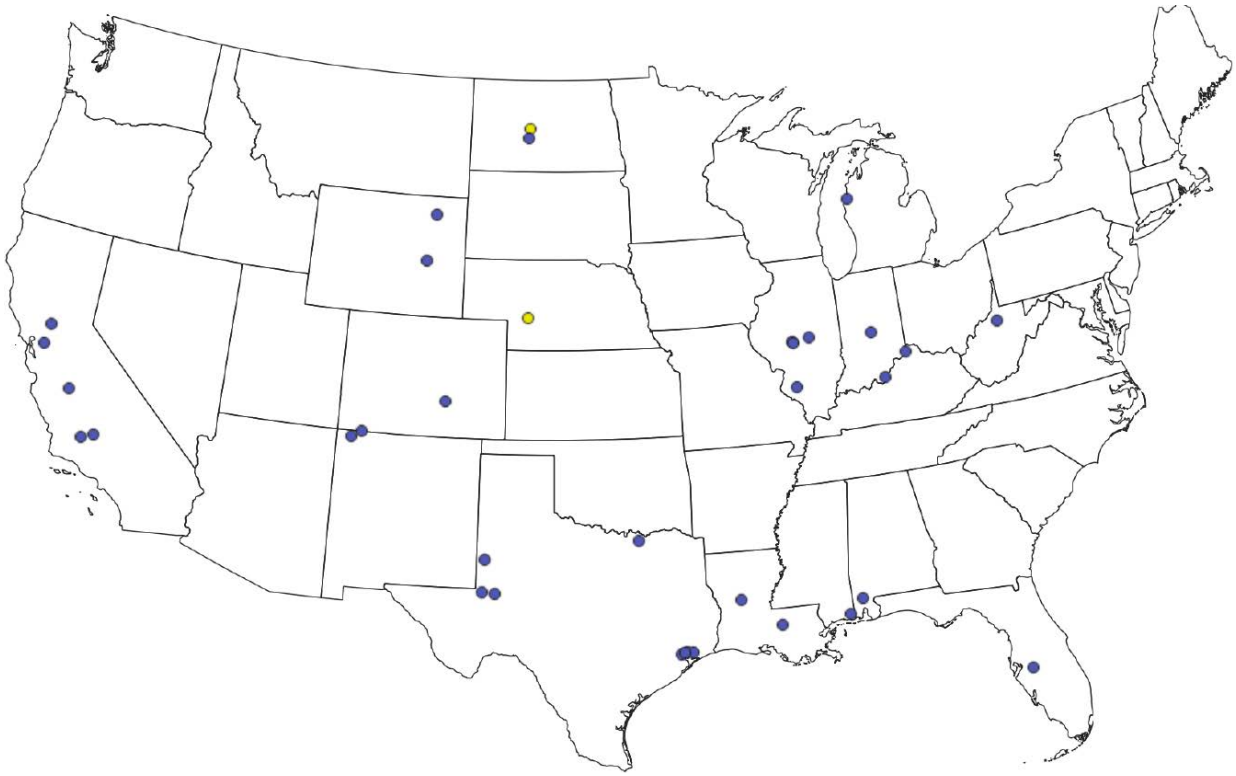

Figure 3. Proximity Between Planned CCS Projects in the US Power Generation Sector and EJ Communities

- Project located within 3 miles of an EJ community
- Project not located within 3 miles of an EJ community

Of the 35 planned CCS projects in the US power generation sector, 33 of these projects (94.3%) are located within three miles of an EJ community.[11] There is also evidence that planned and proposed CCS pipelines fall largely within disadvantaged and environmental justice communities that live in close proximity to many of the industrial hubs in regions such as the Gulf South.[12] The risks posed by diverse

[11] Lam, Y., Ventrella, J., Castellanos, J.D.R., Baptista, A. (2023). Briefing: Analysis of Proposed Carbon Capture Projects in the US Power Sector and Co-Location with Environmental Justice Communities, Tishman Environment and Design Center

[12] Rota, M. (2023). Carbon Dioxide Waste Capture and Injection: A False Solution for Louisiana and the World. https://healthygulf.org/carbon-waste-injection-false-solution-for-louisiana/

forms of carbon management on overburdened, environmental justice communities require further examination and consideration by relevant federal agencies.

Cases

1. DOE's Office of Carbon Management under the Office of Fossil Energy and Carbon Management website (https://www.energy.gov/fecm/office-carbon-management) includes several carbon management programs that treat different aspects of industrial carbon removal or carbon management separately. This program organization can lead to confusion about the various technologies and how they are implemented on the ground. For example, the Office divides "Point Source Carbon Capture" (i.e., CCS/CCUS) as a separate program from "Carbon Storage and Transport" despite the fact that point source carbon capture technologies are accompanied by some form of carbon transport and storage. In fact, these two types of carbon management are funded jointly by DOE as evidenced by their recent announcement of $13 million in funding for carbon capture and sequestration projects.[13] Furthermore, the program websites detailing these programs fail to disclose any potential risks or environmental justice impacts that these connected program areas may have for host communities.
2. The infographics and factsheets related to industrial carbon removal and carbon management approaches provided by DOE's Office of Fossil Energy and Carbon Management are insufficient to relay the potential risks of these approaches for local, host communities. For example, the infographic describing Carbon Dioxide Removal simply restates the agency's definition without any elaboration of all the forms of CDR implied by this term. The infographic on Direct Air Capture also does not describe any uncertainties or risks related to this approach.[14] Similarly, the fact sheets on Carbon Capture Use Transport and Storage make no mention of the environmental, public health, safety, or cumulative impacts concerns raised by EJ communities.[15] The fact sheet characterizes "societal impacts" by focusing on economic benefits, engagement, and DEI, stating, "*As we advance these efforts, it is critical to understand and address the societal considerations and impacts of these projects at local and regional levels. To that end, projects funded by FECM must develop plans in the following areas to ensure that they provide tangible economic and environmental benefits to affected communities:*
    - Community, Tribal, and Stakeholder Engagement
    - Diversity, Equity, Inclusion, and Accessibility
    - Justice40

[13] Office of Fossil Energy and Carbon Management. (2023). DOE Invests Over $13 Million for Projects That Capture Carbon Emissions from Industrial Facilities, Power Plants, Air, and Oceans. https://www.energy.gov/fecm/articles/doe-invests-over-13-million-projects-capture-carbon-emissions-industrial-facilities

[14] Office of Fossil Energy and Carbon Management. (2022). Infographic: Carbon Dioxide Removal. https://www.energy.gov/fecm/articles/infographic-carbon-dioxide-removal

[15] Office of Fossil Energy and Carbon Management. (2023). FECM Homepage Fact Sheetshttps://www.energy.gov/fecm/listings/fecm-homepage-fact-sheets

- Quality Jobs."[16]

These resources do not elucidate any of the environmental justice concerns and material risks raised by communities to date.[17]

3. In many instances, fuel alternatives such as hydrogen fuels are not clearly described or delineated under the various definitions in use as carbon management or carbon removal. In particular, the many varied forms of hydrogen fuels, the feedstock used to produce the hydrogen, the method of transport and storage, and the end use of this fuel is complex and difficult for the public to understand. The embodied, life cycle carbon intensity and environmental and public health impacts of these fuels are not fully discussed in the information provided by federal agencies such as DOE.[18] For example, the DOE's Hydrogen Economy factsheet makes no mention of environmental justice or the full carbon accounting or co-pollutants related to the various forms of hydrogen fuel production or use.[19] The various types of hydrogen organized by color classification based on production feedstock is an example of where the DOE can better clarify the respective risks, uncertainties, and carbon mitigation potential of each pathway (i.e. Earthjustice guide - Figure 1). Some grey literature, including a report by Earthjustice, includes documented costs, intensive energy use, and health and safety risks to the public of some of the different hydrogen production methods, citing color classification concepts that are worth review and adoption by federal agencies.[20]

Further Reading

- Sekera, J., & Goodwin, N. (2021, November 23). Why the oil industry's pivot to carbon capture and storage – while it keeps on drilling – isn't a climate change solution. The Conversation. (*Example of divergent terms and definitions of carbon management*).
- Carnegie Climate Governance Initiative, Carbon Dioxide Removal Governance, *(example of key governance considerations)* https://www.c2g2.net/project/infographic-lets-ask-the-big-questions-on-the-governance-of-carbon-dioxide-removal/
- IPCC AR6 WGIII: CDR Factsheet, *(example of how to include risk factors)* https://www.ipcc.ch/report/ar6/wg3/downloads/outreach/IPCC_AR6_WGIII_Factsheet_CDR.pdf
- Reclaiming Hydrogen for a Renewable Future. Earthjustice, November 2021. *(Example of comprehensive hydrogen landscape review and delineation of hydrogen fuels)*

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[16] Office of Fossil Energy and Carbon Management. (2023). Carbon Capture, Use, Transport, and Storage. https://www.energy.gov/sites/default/files/202306/Carbon%20Capture%20Use%20Transport%20and%20Storage%20FACTSHEET_6.20.23.pdf

[17] Office of Fossil Energy and Carbon Management. (2023). At a Glance: Societal Considerations and Impacts Plans. https://www.energy.gov/sites/default/files/2022-08/At_a_Glance_Societal_Considerations_and_Impacts_Plans_8.3.22.pdf

[18] Office of Energy Efficiency and Renewable Energy. (2027). Hydrogen: A Clean, Flexible Energy Carrier. https://www.energy.gov/sites/default/files/2017/09/f36/fcto-infographic-h2-energy-carrier-sept17.pdf

[19] Office of Fossil Energy and Carbon Management (2023). Hydrogen Strategy Enabling a Low-Carbon Economy. https://www.energy.gov/sites/default/files/2020/08/f77/Hydrogen%20Economy%20Strategy%20Fact%20Sheet.pdf

[20] Earthjustice. (2021). Earthjustice 2021 Annual Report. https://earthjustice.org/wp-content/uploads/earthjustice-annual-report-2021.pdf

Agency Specific Recommendations and Requested Responses

1. DOE must provide an enhanced level of transparency and clarity about each carbon management technology, fuel, or strategy, including the policy framework directing each technology, and the ways that each technology may continue fossil fuel utilization and increase risks to environmental justice communities.[21]
2. DOE's Office of Fossil Energy and Carbon Management and other relevant federal agencies should provide more comprehensive infographics and factsheets that delineate the risks, uncertainties and data gaps, cumulative impacts, environmental justice concerns, and any data on the performance of the technologies and approaches related to carbon management. Wherever carbon management technologies or approaches implicate fossil fuel use or infrastructures, this should also be made explicit in the descriptions and explanation of these techniques (i.e., Enhanced oil recovery, natural gas-powered CCS, blue hydrogen, etc.).
3. EPA, in coordination with relevant federal agencies such as DOE, should create (and keep up-to-date) a comprehensive map and listing of all proposed, planned, in-process, and completed carbon management projects (i.e., CCS, CCUS, pipelines, hydrogen hubs, etc.). These maps and accompanying documentation should include relevant socio-demographic, environmental, health, climate risks, environmental justice, and disadvantaged indicators of host and adjacent communities derived from existing data sources already in use (EJScreen, CEJST, etc.). Co-location of carbon management sites should be mapped within a one-mile and three-mile radius (including all pipelines and other transport routes) and should be inclusive of all US territories and regions (i.e., Puerto Rico, Guam, etc.) These maps should be made publicly accessible and updated on a regular basis.
4. CEQ should coordinate with DOE, EPA, PHMSA and other related federal agencies with oversight of carbon management projects, to explicitly disclose the governance jurisdiction of all carbon management programs and projects. This includes creating factsheets and visuals detailing all the entities and agencies responsible for regulatory, funding, monitoring, reporting, and permitting related to all phases of carbon management projects across the entire life cycle of these technologies. Furthermore, these agencies must coordinate and clarify the environmental justice implications of all programs related to carbon management strategies, not only the Justice40 programs but all programs that may impact EJ communities.

[21] Office of Fossil Energy and Carbon Management. (2023). FECM Homepage Fact Sheetshttps://www.energy.gov/fecm/listings/fecm-homepage-fact-sheets

Recommendation 3, Tier 2: Perform a systematic review of the evidence relating to carbon management risks

Recommendation 3: The federal government should focus on and prioritize technologies that immediately reduce dependency on fossil fuel sources of energy and immediately stop environmental injustices. The WHEJAC recommends that the relevant federal agencies, including DOE and EPA, undertake a systematic review of the scientific evidence relating to risks and uncertainties, of all of the carbon management and hydrogen strategies under the purview of DOE's carbon management programs.

Specific Recommendations

The systematic review must:

A. Address the following topics: ecological and environmental impacts (air, water, soil), human and public health risks and impacts, cumulative impacts, explosion and seismic risks, full life cycle assessments of greenhouse gas emissions outcomes, and co-pollutant emissions, among other topics. It should be drawn from sources that are both supportive and opposed to the use of the various carbon management methodologies.

B. Be undertaken by an independent expert panel that includes scientists, representatives of environmental justice community organizations, multi-disciplinary scholars, environmental justice scholars, as well as scientists from relevant federal agencies such as EPA, NAS, and OSTP, among others.

C. Assess the scientific evidence of risk and uncertainty by centering no-harm, precautionary principles[22,23,24] before any further action is taken or projects funded.

D. Make the evidence publicly accessible and published online.

E. Provide a plan for how to direct research and funding to develop a long-term, independent, non-industry focused body of evidence about risks, impacts, gaps in knowledge, and sustained assessments.[25]

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[22] Pinto-Bazurco, J. F. (2020). Precautionary Principle. International Institute for Sustainable Development. https://www.iisd.org/articles/deep-dive/precautionary-principle

[23] Goldstein B.D. (2001). The precautionary principle also applies to public health actions. Am J Public Health. 91(9): pp. 1358-61. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1446778/

[24] National Oceanic and Atmospheric Administration. (2023). Precautionary Approach. https://www.noaa.gov/precautionary-approach

[25] Studies can be vetted according to the Information Quality Act (OMB, 2002): https://www.whitehouse.gov/wp-content/uploads/legacy_drupal_files/omb/assets/OMB/fedreg/reproducible2.pdf; https://www.energy.gov/cio/department-energy-information-quality-guidelines

Discussion

Based on an initial review of some of the technologies that fall within the landscape of carbon management (i.e., CCS, CCUS, BECCS, hydrogen fuels, direct air capture), the WHEJAC finds insufficient scientific evidence regarding the effectiveness of multiple carbon management technologies as climate mitigation strategies and risk factors that may impact human health and the environment. Most glaring is the lack of clarity and evidence characterizing the public health and safety risks, the cumulative impacts, and the long and short-term ecological effects and risks that justifies the implementation of these technologies. Accompanying these gaps in scientific knowledge is a lack of clarity and accountability about the regulatory protections and oversight authority for all aspects related to these complex projects and technologies. At the same time, some of the evidence that does exist about carbon management like CCS/CCUS point to detrimental impacts and risks to already vulnerable and overburdened communities or disadvantaged, environmental justice communities.[26] The WHEJAC has not found any systemic environmental justice analysis of carbon management programs and projects to date.

There is a lack of independent, robust, peer-reviewed studies that clarify the impacts of carbon management, particularly with respect to environmental justice concerns. The body of published research on many of the carbon management technologies, such as CCS, is based on bench-scale or pilot studies, studies that may be outdated or are products of industry-funded, industry-led, or industry-associated research Federal agencies, like EPA and DOE, must support the development of robust, peer-reviewed research looking at these technologies from the perspective of public health and safety, cumulative impacts, and environmental justice. The federal government should focus on and prioritize alternatives and technologies that immediately reduce dependency on fossil fuel sources of energy and immediately stop exacerbating environmental injustices. The WHEJAC recommends:

- Any research or evidence used/cited in support of carbon management and hydrogen strategies should be made publicly accessible and published online.
- Relevant federal agencies should support research and evidence that demonstrates no-harm, precautionary principles before any further action is taken to advance or fund projects.
- Research and development funding should be directed to develop a long-term, independent, non-industry biased body of evidence related to the ecological and environmental risks and impacts (air, water, soil), human and public health risks and impacts, cumulative impacts, environmental justice analysis, explosion and seismic risks, full life cycle assessments of greenhouse gas emissions outcomes, and co-pollutant emissions.
- Relevant federal agencies, such as DOE, must undertake a systematic review of the scientific evidence, of all of the carbon management strategies under the purview of its carbon management programs, which addresses the following topics: public health and safety risks, full life-cycle carbon reduction efficacy, ecological and environmental impacts and risks (air, soil, water), and cumulative impacts.
    - Such a scientific review must be undertaken by an independent expert panel that includes scientists, representatives of environmental justice community organizations, multi-disciplinary scholars (i.e., social scientists), including environmental justice scholars.

[26] US Department of Transportation. (2023). Equity and Justice40 Analysis Tools https://www.transportation.gov/grants/dot-navigator/federal-tools-determine-disadvantaged-community-status

This review can also include scientists and relevant staff from federal agencies such as EPA, the National Academy of Sciences, Engineering, and Medicine (NASEM), and the White House Office of Science and Technology Policy among other relevant agencies. Such an expert panel could be convened by the National Academy of Sciences, Engineering, and Medicine. Scoping meetings to establish a National Academies expert panel should ensure that its members include diverse experts and sources of evidence and ensure that members do not have conflicts of interest related to the receipt of funding from the fossil fuel industry.

- Carbon management projects receiving federal funding should have external reviewers that include representatives from EJ communities before advancing. These projects should also be required to produce a cumulative impacts analysis and a health impacts analysis for any proposed projects in disadvantaged or overburdened communities.

Cases

We highlight three examples that elucidate the evidentiary and environmental justice concerns related to carbon management approaches. These examples include: (1) Moratoriums on CCS and on carbon capture enacted in Louisiana, (2) Air Products and Chemicals' proposed carbon capture and sequestration project in Ascension Parish, Louisiana, (3) EPA's proposed Power Plant Rules, and (4) the Petra Nova carbon capture and sequestration facility at a coal-fired power plant in Texas.

1. The first moratorium in the United States to prohibit the build-out of any carbon capture and sequestration project and related carbon pipelines, was enacted by the New Orleans City Council in 2022. This moratorium described the inherent risks of CCS to communities and the environment, as well as the lack of regulatory protections. In the same year, the Livingston Parish Council in Louisiana issued a year-long moratorium to ban carbon capture injection wells in order to allow time for evaluations, including a risk assessment.

2. Air Products and Chemicals, Inc. has proposed to build a blue hydrogen and carbon capture and sequestration facility in Ascension Parish, Louisiana that would be one of the world's largest blue hydrogen and CCS facilities. This case demonstrates a lack of sufficient evidence of public health and safety studies, of cumulative impacts studies, as well as a lack of protective regulatory oversight. The residents of the Parish impacted by this proposal have raised concerns about the dangers of seismic activity, adverse impacts of planned detonation of dynamite under Lake Maurepas, groundwater contamination, air pollution, chemical spills, pipeline explosions and other dangers in the largely of Color and low wealth communities in Ascension Parish and surrounding communities in Livingston, Tangipahoa, and St. John Parishes.[27] The project is in the

[27] https://www.eenews.net/articles/la-legal-showdown-may-preview-national-battle-over-hydrogen/; https://www.desmog.com/2023/02/17/air-products-lake-maurepas-louisiana-ccs-blue-hydrogen/;v.com/article/news/community/theres-several-hundred-commercial-fisherman-make-livelihood-out-of-this-lake-community-tells-gas-supplier-to-go-away/289-8e0327c8-e6f8-444e-b90e-93dce0271318; https://www.desmog.com/2023/02/17/air-products-lake-maurepas-louisiana-ccs-blue-hydrogen/.

proposal and pre-permitting phase, but many of these questions have not been answered and no systemic environmental justice or cumulative impacts analysis has been done.[28]

3. EPA's New Source Performance Standards for Greenhouse Gas Emissions From New, Modified, and Reconstructed Fossil Fuel–Fired Electric Generating Units Rule issued in May 2023 provides evidence of the co-pollutant risks related to CCS and hydrogen fuel mixing associated with power plants. It also demonstrates the lack of attention to cumulative impacts in environmental justice communities.[29] The rule applies standards for CO2 reductions for existing coal-fired power plants and certain new and existing natural gas plants based on the Best System of Emissions Reductions (BSER). EPA determined that CCS and hydrogen co-firing qualifies as the Best System of Emissions Reductions to achieve 90% CO2 reduction rates. As part of this rule, EPA concedes that the energy penalty related to CCS installations can result in increased co-pollutant emissions at plants.[30] The rule also describes the potential risks of increasing co-pollutants such as NOx when co-firing with hydrogen at power plants. *"The combustion characteristics of hydrogen can lead to localized higher temperatures during the combustion process. These ''hotspots'' can increase emissions of the criteria pollutant NOx. NOx emissions resulting from the combustion of high percentage by volume blends of hydrogen are also of concern in many regions of the country.*[31] The proposed rule also fails to provide a sufficient environmental justice analysis, omitting the natural gas plants subject to the rule from their analysis altogether. The rule also failed to consider cumulative impacts that may result from the introduction of CCS and hydrogen co-firing at covered power plants. The agency's failure to substantively evaluate environmental justice concerns, including cumulative impacts, is in direct contradiction of federal Executive Order (EO) 14096 (Section 3(a)) that clearly sets out a mandate to federal agencies to identify, analyze, and address cumulative impacts.

4. One example of a CCS project that has environmental and public health impacts that have not been addressed is the Petra Nova CCS demonstration project in Texas. DOE touts the Petra Nova project as a successful example of CCS at scale, stating, "*Petra Nova, the largest post-combustion carbon capture system on a coal-fired power plant in the world successfully began commercial operations on January 10, 2017. The Petra Nova project continues to make progress in CO_2 storage and EOR. As of August 2019, Petra Nova has captured and sent over 3.27 million short (U.S.) tons of CO2 into associated storage. Thanks to Petra Nova, the depleted West Ranch Oil Field has produced over 3.3 million barrels of oil through Enhanced Oil Recovery (EOR).*

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[28] https://www.theadvocate.com/baton_rouge/news/business/4-5-billion-facility-in-ascension-parish-to-be-louisianas-first-carbon-capture-project/article_711aa81e-2d0b-11ec-b4db-ff8a4e7c6569.html; https://www.opportunitylouisiana.gov/led-news/news-releases/news/2021/10/14/air-products-announces-$4.5-billion-blue-hydrogen-clean-energy-complex

[29] Citation to the TEDC, CEED, Kean, NJEJA Power Plant Comments Submitted to EPA, August 8, 2023, https://ceed.org/wp-content/uploads/2023/08/EPA-New-Source-GHG-Comments-Tishman_CEED_NJEJA_Watson.pdf

[30] EPA (2023). Proposed rule on "New Source Performance Standards for Greenhouse Gas Emissions from New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units; Emission Guidelines for Greenhouse Gas Emissions From Existing Fossil Fuel-Fired Electric Generating Units; and Repeal of the Affordable Clean Energy Rule" (hereinafter "Proposed rule"). Federal Register Vol. 88, No. 99 Section VII.F.3.b.iii.(A).(1), p. 33291.

[31] US EPA Proposed rule, Section X.D.1.iii.(A), p. 33349.

Petra Nova was declared a 2017 Plant of the Year by Power Magazine and a 2017 Coal Project of the Year by Power Engineering Magazine."[32] Despite this praise, Petra Nova has been characterized as a failed project and highlights the potential environmental and public health impacts related to such projects.[33] Some of the key concerns related to this project include:

a. The projected high capture rates for CCS have not been produced or verified. Predicted levels were 90 percent but estimates of real capture rates are at about 55-58 percent and further monitoring data is needed to verify Petra Nova's claim of a 90 percent capture rate.

b. The technology does not capture co-pollutant air pollution emission streams from the site but rather produces additional co-pollutants such as NOx from the energy penalty associated with running the CCS equipment. The Energy Information Administration estimated substantial NOx emissions not only for the CCS facility (908 to 1,184 tons for the three years it was operational), but also for the natural gas cogeneration facility used to power the CCS (on the order of 467 to 750 tons per year for those years). (EIA 2023).

c. The upstream coal mining emissions of methane are not taken into account in the accounting of carbon capture for this project, as well as other CCUS projects.

d. Downstream emissions from the facility and from the use of captured CO_2 for Enhanced Oil Recovery have not been considered in carbon emissions accounting.

Further Reading

CCS/CCUS

- Jacobson, Mark Z. "The health and climate impacts of carbon capture and direct air capture." Energy & Environmental Science 12.12 (2019): 3567-3574.
- Robertson, Bruce. "Carbon capture has a long history. Of failure." The Bulletin of Atomic Scientists. September 1, 2022.
- Pehnt, M., & Henkel, J. (2009). Life cycle assessment of carbon dioxide capture and storage from lignite power plants. International Journal of Greenhouse Gas Control, 3(1), 49–66. https://doi.org/10.1016/j.ijggc.2008.07.001
- The post-combustion approach [at lignite coal plants with ccs], which is closest to commercial application, leads to sharp increases in many categories of impacts, with the impacts in only one category, acidification, reduced.

[32] DOE, 2019, Fact Sheet https://www.energy.gov/fecm/articles/major-carbon-capture-utilization-and-storage-demonstration-projects-fact-sheet

[33] DOE Technical Report (2020), https://www.osti.gov/servlets/purl/1608572; https://www.energy.gov/fecm/petra-nova-wa-parish-project#:~:text=The%20Petra%20Nova%20CCS%20project,of%20this%20greenhouse%20gas%20annually. https://www.bloomberg.com/news/articles/2023-02-08/the-world-s-largest-carbon-capture-plant-gets-a-second-chance-in-texas#xj4y7vzkg; https://ieefa.org/resources/ill-fated-petra-nova-ccs-project-nrg-energy-throws-towel; https://www.reuters.com/article/us-usa-energy-carbon-capture/problems-plagued-u-s-co2-capture-project-before-shutdown-document-idUSKCN2523K8

- GAO. (2021). Carbon capture and storage: Actions needed to improve DOE management of demonstration projects (GAO-22-105111). Government Accountability Office. https://www.gao.gov/assets/gao-22-105111.pdf
    - GAO is making one matter for congressional consideration: that Congress considers implementing a mechanism for greater oversight and accountability of DOE CCS demonstration project funding.
- Drugmand, Dana and Muffett, Carroll. Confronting the Myth of Carbon-free Fossil Fuels: Why Carbon Capture is not a Climate Solution. Environmental Working Group. April 22, 2021
- Wang, N., Akimoto, K., & Nemet, G. F. (2021). What went wrong? Learning from three decades of carbon capture, utilization and sequestration (CCUS) pilot and demonstration projects. Energy Policy, 158, 112546. https://doi.org/10.1016/j.enpol.2021.112546
    - This study statistically evaluates the reasons for this unfavorable outcome by estimating a hazard model for 263 CCUS projects undertaken between 1995 and 2018. The results indicate that larger plant sizes increase the risk of CCUS projects being terminated or put on hold; increasing capacity by 1 Mt CO2/y increases the risk of failure by nearly 50%.
- Sekera, J., & Lichtenberger, A. (2020). Assessing Carbon Capture: Public Policy, Science, and Societal Need. Biophysical Economics and Sustainability, 5(3), 14. https://doi.org/10.1007/s41247-020-00080-5
    - Point-source CCS cannot reduce atmospheric CO2, since it can never store more than it captures, and as currently practiced is also net additive...Point-source CCS even at its theoretical best is somewhat net CO2 additive.
- van Harmelen, Toon, et al. "Air pollution impacts from carbon capture and storage (CCS)." (2011).
- Kristoff, Maura McGrath. "Petra Nova Mothballing Post-Mortem: Closure of Texas Carbon Capture Plant Is a Warning Sign." (2020).
- Schlissel, D. "Boundary Dam 3 Coal Plant Achieves Goal of Capturing 4 Million Metric Tons of CO2 but Reaches the Goal Two Years Late." Ohio Institute for Energy Economics & Financial Analysis (2021).
    - Shell originally promised to capture 90% of emissions, had to admit failure, and changed their target to 65%, but according to the Institute for Energy Economics and Financial Analysis, the Quest plant failed to reach its target every year from 2015 to 2020.

Hydrogen

- Howarth, R. W., & Jacobson, M. Z. (2021). How green is blue hydrogen? Energy Science & Engineering, 9(10), 1676-1687.
    - Perhaps surprisingly, the greenhouse gas footprint of blue hydrogen is more than 20 percent greater than burning natural gas or coal for heat and some 60 percent greater than burning diesel oil for heat, again with our default assumptions... Our analysis assumes that captured carbon dioxide can be stored indefinitely, an optimistic and unproven assumption. Even if true though, the use of blue hydrogen appears difficult to justify on climate grounds. (Howarth, 2021, p.1676).

- Longden, T., Beck, F. J., Jotzo, F., Andrews, R., & Prasad, M. (2022). 'Clean' hydrogen? – Comparing the emissions and costs of fossil fuel versus renewable electricity-based hydrogen. Applied Energy, 306, 118145. https://doi.org/10.1016/j.apenergy.2021.118145
    - We find that emissions from gas or coal based hydrogen production systems could be substantial even with CCS, and the cost of CCS is higher than often assumed.
- Hydrogen's Global Emissions: Shell's misleading climate claims for its Canadian fossil hydrogen project. January 2021. Global Witness Briefing.
    - Global Witness found that although Shell's Quest plant was capturing 4.81-million tonnes of carbon annually (Mt/yr), it was emitting 12.47 Mt/yr in greenhouse gasses from on-site and supply chain emissions and from the power required to operate the CCS system. The plant therefore annually is responsible for 7.66-million tonnes of greenhouse gasses, even after the CCUS bookkeeping tricks.

Pipelines & Sequestration

- Williamson, R. (2023, June 15). Problems at two CCS "success stories" cast fresh doubt on the technology. RenewEconomy. https://reneweconomy.com.au/problems-at-two-ccs-success-stories-cast-fresh-doubt-on-the-technology/
    - Snøhvit highlights the need for CCS projects to have continuous monitoring, extensive backup plans and the money to implement them. Sleipner proves that injected CO2 can start behaving in unexpected ways despite what appears to have been years of nominal performance.
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    - It seems that the results reported from the laboratory experiments are still inconclusive and not comparable with the field observations.
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    - Ensuring storage is securely maintained implies a high level of proactive regulatory oversight, activities for which governments may not be adequately equipped.

Agency Specific Recommendations and Requested Responses

1. DOE, and in particular the Office of Fossil Energy and Carbon Management as well as the Office of Clean Energy Demonstration (OCED) which oversee CCS/CCUS demonstration and pilot projects, Direct Air Capture, and Hydrogen Hubs. DOE's National Energy Technology Laboratory (NETL) should prepare a publicly accessible and online bibliography of any research or data sets used or cited in support of carbon management and hydrogen strategies. These agencies should also publicly disclose any data or research related to the ecological and environmental risks and impacts (air, water, soil), human and public health risks and impacts,

cumulative impacts, environmental justice analysis, explosion and seismic risks, full life cycle assessments of greenhouse gas emissions outcomes, and co-pollutant emissions for carbon management programs under their respective purview.

2. The National Technology Science Committee, EJ subcommittee that is managed by OSTP and CEQ (EO 14096) should be tasked with overseeing independent reviews and directing the development of research that fills the gaps associated with the risks to environmental justice communities stemming from carbon management strategies.[34]
3. EPA's Office of Air and Radiation, Office of Environmental Justice and External Civil Rights (OEJECR), Office of Research and Development (ORD) and any other relevant programs with oversight of permitting, regulation, compliance and enforcement related to carbon management projects, should make their regulatory and oversight jurisdiction clear in terms of how decisions and community involvement can influence the outcome of project approvals and funding.
4. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA) should prepare an EJ analysis, public health risk assessment and cumulative impacts analysis for all proposed pipelines under their review. Furthermore, PHMSA should publicly clarify their position with regards to local and state governments exercising their authority over the conditions such as land use, siting, setbacks, emergency response, and other related matters.
5. Department of the Interior, USDA should prepare an EJ analysis, public health risk assessment and cumulative impacts analysis for any proposed projects on federal lands.

Recommendation 4, Tier 3: Government should Engage in Accountable Communication

Recommendation 4: Some federal communication about carbon management has expressed with confidence that carbon management technologies are safe for communities, effective in lowering emissions and carbon use, and absolutely necessary as part of a portfolio of climate mitigation measures that advance environmental justice. The WHEJAC recommends that communication about carbon management accurately and fully reflects that status of known and unknown information about environmental risks and harms, environmental justice impacts, cumulative impacts, public health implications, and reduction of carbon emissions and life cycle emissions, as well as the potential for the extension of fossil fuel use.

Discussion

Communications to the public about carbon management technologies should align with the available evidence and cover the relevant information that communities and the public need to know to be informed. Communication must be accountable.

[34] Environmental Justice (EJ) Subcommittee of the National Science and Technology Council (NSTC). The Office of Science and Technology Policy (OSTP) has established this subcommittee, in consultation with CEQ, pursuant to Section 5 of Executive Order 14096 on Revitalizing Our Nation's Commitment to Environmental Justice for All.

A. Accountable communication means that claims about carbon management fit the source of evidence justifying those claims.

B. Accountable communication means that sources of evidence are explicitly referenced, and their authorship, peer review processes, scale, and scope (of the studies), compliance with the Information Quality Act, and sponsorship (funding) are disclosed clearly. If such information cannot be provided in the course of a presentation or other communications segment, access should be provided to the information.

C. Accountable communication means that any evidence referenced should be situated within the field of the given topic. For example, if a federal agency has issued a report on the efficiency of a case of carbon capture, it should be openly discussed whether there is peer reviewed literature also available on that same topic, and whether the report and literature are in agreement. In cases where an article, report or study is the only such body of work on a given topic, that absence of literature should be stated.

D. Accountable communication means that logical fallacies are avoided. For example, the absence of studies on a given topic, such as public health, does not prove that a technology is safe.

E. With numerous carbon management technologies, the implementation of the technology may be for the sake of reducing carbon emissions. But, to be able to run the technology, there may be new fossil infrastructure that needs to be built, the generation of more fossil fuel energy and emissions, the generation and discharge of co-pollutants, and the building of pipelines. Accountable communication means that this array of factors leading up to implementation must be discussed and the potential risks and impacts disclosed, including any uncertainties.

We are not including cases here and recommendations to agencies, though we did collect particular cases that drive this recommendation.

Recommendation 5, Tier 3: Consent and Engagement of Communities Must be Put in Practice

Recommendation 5: The WHEJAC's preliminary review suggests that Black, Brown, and Indigenous communities and communities with lower average incomes will be overwhelmingly subjected to hosting carbon management projects. Prior to any future recommendations on community benefits agreements, potential host communities should receive accurate information about key questions pertaining to whether studies exist about public health and environmental risks, cumulative impacts and co-pollutants, whether the particular technological intervention requires further fossil-fuel based energy and infrastructure, and whether new pipelines and other transportation infrastructure will need to be built. A full environmental justice analysis should also be undertaken to review the underlying vulnerabilities, socio-demographics, and existing burdens in project areas relative to surrounding areas and the state. The WHEJAC recommends that any initiative that would provide answers to these questions would have to be guided by principles of meaningful engagement; free, prior and informed consent; and precaution. Municipal or government to government engagement should not be a substitute for community engagement. Meaningful community engagement encompasses two elements: (1) technical support and resources for independent consulting for communities; and (2) decision-making power in processes. Both of these

require prior clarification of what the decision-making processes are across jurisdictions for different kinds of projects.

Specific Recommendations

The federal government should not have the sole responsibility of disseminating information on project impacts because communities would benefit greatly from having easy access to more than one perspective on complex carbon management initiatives. Instead of acting alone, lead agencies should partner with community-based groups and trusted local organizations to provide reliable information on the project and its potential impacts. In some cases, communities may need to hire their own, independent technical advisors, similar to the EPA's Technical Assistance Grants under the Superfund program.[35]

A. There must be meaningful engagement based on environmental justice principles.

B. Engagement requires use of appropriate language(s) for the potentially affected community.

C. Community engagement should be available to any affected local resident without any restrictions or requirements for participation, such as non-disclosure agreements (NDAs). This should be a requirement for any organization, agency or company receiving any public funding.

D. Funding recipients should demonstrate their ability to engage with community members through the memoranda of agreements (MOAs) signed with funding agencies.

E. Types of information on project impacts must include, but not be limited to, public health implications, cumulative impacts, and environmental risks from sources other than government agencies.

F. There must be free, prior, and informed consent with all stakeholders from the specific community (i.e., residents) that may be potentially affected, not just the local government.

    a. Consent should be sought at all stages of project development - at project conception to completion, including ongoing monitoring throughout operations.

    b. The process for obtaining consent needs to be documented, including a full accounting of any dissenting opinions of community members and elected officials.

G. We are concerned about the trend of use of CBPs as part of the approval process which may be construed as exerting undue influence over communities. These agreements are appropriate only after meaningful engagement and consent processes take place with effected communities. They should not be used to negotiate for approval with historically impoverished, underfunded communities, which could be construed as exploitative and opportunistic. Non disadvantaged communities already have many of the resources offered in CBPs.

H. Currently, community organization and outreach funding is included in industry applications to DOE and EPA for specific carbon management projects. In some instances, community groups may be required to partner with companies proposing carbon management initiatives in order to receive funding through community benefits agreements. Direct air capture program and hydrogen hub programs, along with any other carbon management programs, must have a separate and independent funding track for community-based organizations to do outreach and

[35] EPA, Technical Assistance Grants, Accessed 10/1/2023, https://www.epa.gov/superfund/technical-assistance-grant-tag-program

education and hire their own trusted consultants or experts to weigh in on the process without undue influence by companies.

Discussion

There is little publicly accessible information about the broad category labeled carbon management that is available to communities that may be approached to host technologies including carbon capture utilization and storage (CCUS), carbon capture and sequestration (CCS), bioenergy with carbon capture and storage (BECCS), direct air capture and the production and combustion of hydrogen fuels. It is also true that multiple institutions must be involved in ensuring that communities are adequately informed and educated concerning carbon management, and that there is meaningful public and community participation regarding any carbon management project. These tasks should not be left to government alone but should also involve organizations that have a proven history of working with communities. Ultimately, communities must also have the authority to reject carbon management and hydrogen projects that are proposed to be sited within their borders or that will significantly impact their residents.

Cases

Byhalia Pipeline

In Memphis, TN, largely majority African American communities protested against Texas-based Plains All American Pipeline and Valero Energy Corporation's efforts to use eminent domain to acquire private property needed to finish building the Byhalia Pipeline. In a unique series of collaborations, community members and local government officials, both through the Memphis City Council and the Shelby County Board of Commissioners, brought forward local policy that prevented further exploration of the establishment of the Byhalia Pipeline which resulted in the proposed pipeline project being halted. Despite clear opposition from Memphis and Shelby County (Tennessee), members of the Tennessee State Legislature introduced Tennessee House Bill 2246: "*As enacted, prohibits political subdivisions of this state from, arising from or as a result of a local action, prohibiting the development and implementation of the types or sources of energy that may be used, delivered, converted, or supplied by certain entities; enacts other related provisions."* which seeks (sought) to override local community dissent. This is an example that reflects the general concern of how community opposition and voices can be usurped by way of coercive, state-enacted statutory mandates.

Denbury Gulf Coast Pipeline LLC

On February 22, 2020, Denbury's Delhi Pipeline ruptured, releasing liquid. The site of the rupture was approximately one mile from Satartia, Mississippi. Partial results of the ruptured pipeline were as follows: 45 people needed immediate hospitalization and treatment, 200 Satartia residents were evacuated by Yazoo County Office of Emergency Management as a precaution to avoid harm from what they believed to be a chlorine leak from a different source. Vehicles operating in the local area malfunctioned due to air/ fuel intake and oxygen disruption. Modeling performed by the company had not included the topographical nature of this area which led to the CO2 not dissipating as predicted, resulting in the impact on local residents. Another failure in planning for danger included the company not reaching out to the county's office of emergency management. The Yazoo County Office of Emergency Management initially believed that the emergency was a result of a chlorine leak from water utilities. As CO_2 pipelines are built across the county, this type of incident is likely to be repeated. The leak happened as a result of increased rainfall which raises the question: How many other sites will be affected by weather events,

which may or may not be influenced by climate change, but which has not been factored into any risk modeling?

Further Reading

- Guzman, D. (2022). Bill to override local control of pipelines spurs statewide backlash. Tennessee Lookout. https://tennesseelookout.com/2022/03/21/bill-to-override-local-control-of-pipelines-spurs-statewide-backlash/
- House Bill 2246. Tennessee General Assembly. (2023). Tennessee State House Bill 2246 (Byhalia Pipeline).

Agency Specific Recommendations and Requested Responses

The agencies and offices listed below should respond to the recommendations detailed in this section, with special attention to the following specifics: (1) the immediate development of language accessibility for all materials, (2) removal of any pre-conditions or barriers prior to community engagement efforts, (3) dissemination of information related to environmental, health, emergency management, safety, cumulative impacts and other community EJ related concerns, (4) make MOUs with communities required and publicly disclosed prior to funding for projects, (5) provide evidence of free, prior and informed consent of host communities impacted by carbon management projects and (6) fund independent, community technical support and engagement of community's choosing.

Department of Energy, and in particular the Office of Fossil Energy and Carbon Management as well as the Office of Clean Energy Demonstration (OCED) which oversee CCS/CCUS demonstration and pilot projects, Direct Air Capture and Hydrogen Hubs should make all MOAs and community benefits agreements publicly available.

1. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA).
2. Environmental Protection Agency
3. FERC-The Office of Public Participation should provide notice and opportunities for meaningful public participation to communities within the impact zones of infrastructure projects.

Concluding Remarks

The WHEJAC has taken on diverse charges in its tenure as a federal advisory committee. Each charge is unique, differentiated by its context (including regulatory context), available information, etc. For environmental justice, carbon management represents a topic of extreme severity for public health, environmental well-being, and community and public participation. While still in its preliminary phase of information gathering, the WHEJAC has identified unprecedented degrees of concern about accountability, information quality, and inequality in how carbon management and hydrogen projects are being communicated, implemented, and justified. For this reason, we have undertaken early recommendations to sound an alarm about environmental justice, an alarm that any advancements in environmental justice made through other programs (e.g., Justice40, EO 14096) are in jeopardy. The WHEJAC seeks to sound an alarm about whether carbon management technologies are even defensible based on current knowledge as effective climate mitigation methods, especially in comparison to other technologies and alternatives.

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