Carbon Capture Projects Deemed a Crucial Climate Change Strategy

The Environmental Law Institute's 11th GreenTech webinar held July 18 on *The Role of Carbon Capture (CC) and Direct Air Capture (DAC) Technology in Our Climate Strategy* couldn't have been timelier. A week later, on July 27, Democratic negotiators reached an agreement with Sen. Joe Manchin (D-W. Va.) on a proposal that will invest $369.75 billion over the next decade in energy and climate programs, including billions in CC technologies. That same day, the White House Council on Environmental Quality (CEQ) announced two new task forces to inform the responsible development of Carbon Capture, Utilization, and Sequestration (CCUS).

In opening the ELI webinar, moderator **Sarah Grey**, a Senior Associate with Arnold & Porter, noted the speakers' basic assumption that socially responsible CC technologies will play a major role in addressing climate change. Grey briefly explained that CCUS captures carbon dioxide (CO_2) from industrial processes and stores it underground, while DAC removes CO_2 from the ambient air as a kind of "CO_2 vacuum" and then stores it. Speakers were:

- **Dr. Jennifer Wilcox**—the Principal Deputy Assistant Secretary in the Department of Energy's (DOE's) Office of Fossil Energy and Carbon Management (FECM);
- **Ethan Shenkman**, a Partner with Arnold & Porter who served as the U.S Environmental Protection Agency's (EPA's) Deputy General Counsel;
- **Dr. Rudra Kapila**, Senior Policy Advisor for Carbon Management at Third Way's climate and energy program;
- **Dr. Julio Friedmann**, Chief Scientist and Chief Carbon Wrangler at Carbon Direct; and
- **Jeremee Wetherby**, General Electric (GE) Gas Power's Product Line Leader for the Emerging Technologies and Incubators Team.

After 20 years of research and development in point source CC at a lower technological readiness level, Wilcox began, FECM is focusing now on a higher readiness level by pursuing the first steps toward pilot demonstration projects. DOE is making investments in hard-to-decarbonize sectors such as cement, steel, and pulp and paper, recognizing that when those industrial facilities are retrofitted with CC and storage (CCS), it also will produce a "low-carbon supply chain." DOE recently launched its "Carbon Negative Shot" involving many departmental offices investing their annual appropriations to reduce carbon removal costs to $100 per ton over the next decade. Significant funding to demonstrate these approaches is "on the horizon," she said, including $3.5 billion for large-scale CO_2 capture pilots and demonstrations and additional investments in more robust monitoring, reporting, and verification across the suite of DAC efforts.

A key question is where to put all the captured CO_2. Across the United States, infrastructure will be needed for permanent storage deep underground. Supporting that need, DOE has $2.5 billion for storage and validation and aims to build capacity for 60-100 million tons of CO_2 injection per year. DOE is also funding CO_2 transportation work, including $100 million for a transportation redesign study and $2.1 billion for transportation infrastructure loans in collaboration with the Loan Programs Office.

Wilcox said that DOE's diverse efforts seek to create the baseline for first-of-its kind expensive projects with a goal of making the costs transparent and informing policy. Ultimately, DOE wants to lower costs enough to move third- and fourth-of-its-kind projects and spur the private sector "to take us the rest of the way." Finally, she mentioned two tools DOE is making available: the Carbon Matchmaker Tool designed to help teams self-assemble when DOE announces funding opportunities, and the Interactive Carbon Management Tool outlining all of DOE's investments and provisions.

Responding to a question about how the government can build more trust in CC technologies as facilities are built nationwide, Wilcox said that public engagement is a significant part of FECM and DOE overall, and forthcoming funding announcements will include engagement guidance. She stressed the importance of transparency about the risks of injecting CO_2 underground and the availability of tools to mitigate those risks. Various co-benefits must also be recognized, as when a cement plant is retrofitted with CC that simultaneously reduces co-pollutants, just as DAC would capture other airborne pollutants besides CO_2.

Speaker Shenkman described his basic interest in the governance of CC technologies in a way that ensures societal benefits while avoiding societal harms. At present, both the federal and state legal governance frameworks are "somewhat splintered," he said. EPA's CO_2 underground injection permitting program provides the only comprehensive regulations. The program requires intensive study and analysis, testing and monitoring, post-injection site care and closure, financial assurances, and other measures. But it is still at a very early stage, with only six permits issued for Class VI CO_2 injection wells and 15 pending. State primacy applications are an important emerging development. Shenkman predicted that in coming years many states will apply with EPA for primacy, although right now only Wyoming and North Dakota have primacy, Louisiana's application is pending, and three states are in the pre-application phase.

Beyond EPA, two significant programs exist for CC on federal property. In June 2022, the U.S. Department of the Interior's (DOI's) Bureau of Land Management (BLM) issued a policy on the consistent processing of right-of-way licenses for CCS projects on BLM-administered lands. Currently, BLM is reviewing two license applications. Also, DOI's Bureau of Ocean Energy Management (BOEM) and the Bureau of Safety and Environmental Enforcement have a rulemaking underway to address offshore CCS projects in Outer Continental Shelf federal waters. The U.S. Congress paved the way for offshore CCS projects in the 2021 Infrastructure Act by stipulating that CCS projects are lawful and mandating a regulatory proposal by this November. Generally, for any infrastructure project on federal lands, including CCS, permit applicants must run a gauntlet of environmental review and permitting requirements, with the National Environmental Policy Act (NEPA) serving as "a huge overlay" applicable to all projects involving federal funding or decisionmaking.

In the states, a high level of CCS legislative activity is occurring, Shenkman noted, but it has produced a "patchwork quilt" of more than a dozen state-by-state laws enacted over the past 10-15 years. State laws address such matters as pore space estate ownership; ownership of the

carbon at various points in the supply chain; long-term liability and stewardship of storage sites; permitting procedures; and other issues, including special considerations for offshore CCS. To follow developments, Arnold & Porter created a "multi-state tracker" of state laws organized around five key policy issues, such as pore space and primacy.

Comparing CCS with DAC technologies, Shenkman noted that CCS is more developed. One of DAC's big challenges is that atmospheric CO_2 has a very low concentration, making it potentially more expensive and less effective than CCS. It also requires significant land use and energy, raising separate legal and policy questions. But DAC allows flexibility in siting, thereby offering such advantages as avoiding communities that "are not ideal," or locating facilities to minimize transport costs. DAC also has the potential for far greater volumes than point source CO_2 capture. Agencies will have to determine how to regulate an activity that removes a pollutant from the atmosphere, and a major question concerns how NEPA will treat DAC projects.

Discussing responsible development of CC technologies within a climate justice context, Kapila said the United States has the most developed policy landscape and capacity for regulating CCS and DAC, but domestic environmental groups are split into two significant factions. One faction supports CC technologies because of their potential for boosting local economies with manufacturing and other jobs and is keen to have CC technologies deployed in communities where fossil fuel jobs have been lost. A second faction, however, opposes CCS and DAC as "false solutions" that will extend the life of polluting industries, and critics point to "greenwashing" and the U.S. legacy of race as the determining factor in siting polluting facilities.

Few projects currently exist, Kapila noted, so knowledge has distinct gaps. As mentioned by Wilcox, benefits are crucial both domestically and internationally when educating communities about projects. But public information on the direct and indirect air quality impacts of projects hardly exists, making it difficult to inform and empower communities. In considering CC technology deployment internationally, a key cohort is emerging economies that are going through industrialization. Any bilateral agreement will affect global supply chains, trade in construction materials, and carbon markets, and will involve a broad range of complex socioeconomic issues. Intellectual property rights challenges could arise, given the long-standing legacy of adverse tech transfer between the global North and South.

Regarding environmental justice best practices when permitting and siting CC projects, Kapila noted that earlier this year DOE published a Request for Information that adopted Third Way and WWF recommendations. DOE has gone to great lengths to ensure that developers submit a comprehensive community engagement plan with their overall project proposals. Legacy issues clearly are a concern because neighborhoods still must deal with older pollution even after existing infrastructure receives CCS retrofits. Additionally, communities often learn about projects late in the process rather than early on, when community engagement should begin. Historically Black Colleges and Universities are an important resource for bringing community representatives on board at a project's initial development and deployment stages.

Friedmann emphasized that "an enormous body of knowledge" already exists about CC technologies because industrial-scale CC began in 1938 and has expanded ever since. Each year, about 40 million tons per year of CO_2 is injected "safely and well," and worldwide there are 27 facilities in operation. Given that experience and knowledge, the Intergovernmental Panel on Climate Change, the International Energy Agency, the Joseph Biden Administration, and others all recognize that CCS is required at multi-gigaton levels to achieve climate goals. In addition, most recent estimates suggest that 7-10 billion tons of CO_2 must be removed—about one-half of it through point source capture and one-third through DAC. Because CC is needed at an enormous scale, "We have to figure out how to get to yes on real projects," Friedmann said. Money is available, but now projects must be deployed.

Heavy industry accounts for 37% of global CO_2 emissions, much of them not tied to fossil fuels, so a "killer app" is needed for such sectors as steel, cement, and chemicals, Friedmann suggested. Although industrial sectors are hard to decarbonize, CC is the least expensive option. However, deployment faces barriers, although many efforts are underway to remove them, Friedmann said, such as the First Movers Coalition. The greatest barrier is a lack of "dedicated infrastructure" for transportation and storage, wells, and pipelines, which are needed for hydrogen, ammonia, and "clean fuels of all kinds." A lack of skilled workers is another barrier, including welders, lawyers, regulators, and permit writers. Policy should make development of the necessary human capital a priority. Lastly, broad and deep international cooperation and collaboration must be "supercharged" to decarbonize existing assets.

In a slide presentation on "The Future of Energy," Wetherby provided an industry perspective on what CC technologies entail and where they are headed. The 2021 International Energy Agency's *World Energy Outlook* and other forecasts conclude that gas turbines will be part of future electricity generation, albeit decarbonized. Although GE supports rapidly deploying renewable energy, wind and solar are not dispatchable. Battery storage is currently insufficient for long-running, reliable power, but gas turbines are a solution, he said. To ensure reliable dispatchable energy, GE is positioning its gas turbine power plants and related products to drive cost-effective, efficient, and clean energy systems. GE aims to demonstrate its technology at full-scale before 2030.

Wetherby described gas turbine components and how they operate. For the first step of burning coal to gas, GE's combined-cycle efficiency holds the world record of 64% in overall CO_2 emissions reduction, "a massive first step," he said. CC technologies have been available for decades, but a full-scale CC system has never been applied to a gas turbine. CO_2 concentrations in a turbine's large gas flow volumes are low, about 4%. Today, the technology requires "a significant capital investment," so GE's team is working to optimize the CO_2 capture and thereby lower the investment cost and make the economics feasible for gas turbines.

During Q&A, audience members asked about the experience to date with CCS projects. Wilcox cited several successful projects, including a Class VI permit that separates CO_2 from bioethanol production, Air Products' blue hydrogen facility, and Petra Nova's project involving 300 times more concentrated CO_2 than DAC. Friedmann added that virtually all CC projects are for saline

aquifer storage because the 45Q incentive for such projects is better than for enhanced oil recovery.

About the legal framework, Shenkman said that although no federal law governs the technology cradle-to-grave, when state laws are added to the picture, a more cohesive framework is emerging, potentially paving the way for federal legislation. Kapila noted several international developments, including the European Union's (EU's) carbon storage directive that EU members are adopting into law. India, Brazil, and other countries want a global norm to show them how CC deployment would work.