



FECM / NETL ANNUAL CARBON MANAGEMENT PROJECT REVIEW MEETING
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Regional Deploy Dialogue: Appalachia Industrial Decarbonization

On August 6, 2024, the U.S. Department of Energy (DOE) hosted a Deploy Dialogue focused on Industrial Decarbonization in Appalachia (including Pennsylvania, Ohio, West Virginia, and Kentucky) at the Fossil Energy and Carbon Management (FECM) / National Energy Technology Laboratory (NETL) Annual Carbon Management Project Review Meeting in Pittsburgh, Pennsylvania.

The Deploy Dialogues were first introduced at the Demonstrate, Deploy, Decarbonize 2023 (Deploy23) conference and provide an independent platform for further discussions around the Pathways to Commercial Liftoff reports and sectors. These invite-only, off-the-record workshops bring together senior leaders from both the private and public sectors to catalyze the deployment of clean energy and decarbonization technologies.

Over the past year, DOE built upon the momentum of Deploy23's Deploy Dialogues by bringing them to various conferences across the country. While the previous Deploy Dialogues have been focused on the growth of industry nationwide, this was the first one targeting a specific region and leverages the Appalachia Regional Report developed by DOE's Office of Fossil Energy and Carbon Management (FECM). The [FECM Regional Reports](#) curate relevant solutions to align with a region's unique energy and industry mix, local energy resources, and current initiatives and priorities.



This report summarizes the Deploy Dialogue session topic “Industrial Decarbonization in Appalachia.” The purpose of this session was to surface barriers and solutions to how industrial decarbonization technology investments in the region, specifically industrial carbon capture, can become bankable, and identify potential opportunities for financing from the DOE Loan Programs Office (LPO) to support. Dialogues were not designed to and did not result in a consensus of opinions, but rather drew on individual insights from a diverse set of participants.

All Deploy Dialogues have the same overarching objective – to convene key decisionmakers and build the open dialogue and trust needed to accelerate our clean energy transition; however, each Dialogue is tailored to a specific sector in focus, resulting in slight differences in structure and outputs.

Industry in Appalachia today

There are approximately 75 facilities in Appalachia across refining, petrochemicals, ammonia, lime, cement, pulp & paper, glass, bioethanol, and blast furnace/basic oxygen furnace (BF/BOF)-steelmaking, many of which are tightly clustered together. The energy (heat, transport, electricity) used by industry in the region is largely coal and natural gas-derived, with 93% of the energy mix from fossil energy. The region accounts for 26% of U.S. coal production and 34% of U.S. dry natural gas production.

In the region, the DOE has already funded several engineering-scale, pilot-scale and front-end engineering and design studies for capturing CO₂ from varying industrial sectors, including iron and steel, glass, and petrochemicals. The Inflation Reduction Act also boosted the 45Q tax credit, prompting a variety of proposed projects in the region. Additionally, the selection of the Appalachian Hydrogen Hub (ARCH2) as part of the DOE Regional Clean Hydrogen Hubs (H2Hubs) program is an important opportunity that could enable wider industrial carbon capture in the region. ARCH2 will span across West Virginia, Ohio, and Pennsylvania and leverage the region’s ample access to low-cost natural gas to produce clean hydrogen and permanently store the associated carbon emissions. This low carbon hydrogen will require CO₂ transport and storage infrastructure that could be more widely shared with other industries and facilities in the region.

The Appalachia workforce is skilled in industrial processes with world class universities, trade schools, and technology labs and research facilities, but the region has suffered from the closure of mines and plants, resulting in many disadvantaged communities today.



The overarching discussion question for the Dialogue was

“What is needed to support the development and deployment of carbon capture for hard-to-abate industries in Appalachia?”

Barriers

Many important barriers discussed are not unique to Appalachia:

- **Insufficient funding and the complexity** and need of combining different funding sources (e.g., tax credits, grants, loans) to make the economics work
- **Product price premiums and market uncertainties** that undermine value associated with decarbonization (e.g., consumers not willing to pay enough premium for low carbon products)
- **Local stakeholder buy-in**, including the support of state governments and community groups, required for regional CO₂ capture, storage and transport solutions.

Focusing on challenges unique to Appalachia, the barriers highlighted included:

1. Small-scale capture and small storage

Although there are large facilities, the region has many smaller facilities (from a diverse set of industries). The potential geological storage sites are also smaller. DOE's programs, the 45Q tax credit, and R&D for both industrial carbon capture and carbon storage favor larger facilities. Additionally, industry's conversations with developers reveal that many are not interested in standalone emitters at less than 1 million tons per year.

2. Need for more geologic characterization

Industry has identified opportunities to store carbon in shale and saline deposits local to the region, and developers are also evaluating the feasibility of using empty shale gas wells (there will be thousands of empty wells). However, compared to other basins, there is not as much data or technology developed suited to the geology in the region, contributing to uncertainty of first investment decision (FID) and project maturity.



3. Access to clean electricity

Unlike other regions with greater renewable or nuclear generation capacity, Appalachia doesn't have a clear pathway to low carbon electricity. Generation from renewables is less than 5% of the electricity mix, and over 76% is generated from coal and natural gas. The electricity requirements of carbon capture facilities more than doubles facility electricity requirements.

4. CO₂ Transport and Storage Infrastructure

The approach to CO₂ transport and storage in Appalachia has consider both the constraints present in the region (e.g., lack of pipelines, challenges in permitting and routing for transport and storage given the abundance of public land, topography and space constraints) as well as how to leverage the existing infrastructure (e.g. barges used to transport coal, depleted shale gas wells, the CO₂ infrastructure that will be required for the Appalachia H₂ Hub).

5. Competitiveness and risk profile of Appalachia relative to other regions.

Other regions are further along in geologic characterization, infrastructure development, have larger facilities (e.g. potential to capture 0.5 million tons of CO₂ or more per year in a single site), and larger geological storage sites resulting in economies of scale for individual capture projects not available to many facilities in Appalachia. There should be a regional lens to funding opportunities (e.g., Appalachia Hydrogen Hub, ARCH2). 45Q incentives also do not account for regional considerations.

Solutions

The participants then worked in groups to identify potential solutions to the barriers specific to Appalachia, including:

- Updating the 45Q credit to better reflect the circumstances of different industries and regions
- Treating CO₂ infrastructure like a highway (e.g., government led public good, trunk line, shared across the region) and considering funding approaches like those offered for transmission (government is transitional off-taker, capacity payment) or being used in other regions (e.g. [the Alberta Carbon Trunk Line](#))



- Establishing a local carbon capture, transport and storage hub (including industry, power, direct air capture) to bring together local officials, the Environmental Protection Agency (EPA), and other key players to perform their roles in tandem and unlock opportunities for industry to engage in strategic partnerships
- R&D specifically tailored to smaller scale industrial capture
- R&D that reduces the energy/electricity requirements of carbon capture
- Incentives for shale gas operators who are already drilling to gather more data (drill deeper, e.g. piggy-back drilling)
- Mechanisms to add a financial value to the low carbon intensity products that will be produced, e.g., through carbon markets, carbon border adjustments.
- Messaging backed by action on job creation, emphasizing new kinds of employment from carbon management, and on industry partnering with government and community groups to allay environmental concerns, using historical examples such as Clean Water and Clean Air Acts
- Workforce development to attract students to this industry. Although many skillsets can be utilized for implementing carbon capture, transport, and storage (process engineering, mechanical engineering, gas treatment, operational systems), there is still a need for training.

What 2035 could look like

About a third of the participants were able to continue the conversation in a second Deploy Dialogue on Networked Infrastructure the following day. This “Appalachia” group (a subset of those who participated in the first dialogue along with transport and storage providers interested in building out CO₂ infrastructure in Appalachia) was asked to work backwards from 2035 and scenario in which the U.S. had successfully captured 100MT of CO₂. For this successful future to materialize—where Appalachia reaches 20MT capture—what would have to have happened? Building on the barriers and solutions, the team developed the following aspirational timeline for Appalachia.



What would need to have happened for Appalachia to have captured 10–20 million tons of CO₂ per year by 2035

Dialogue group notes

