EACo2
Energy Advance Center

Need for CCUS Research, Development, and Demonstration

Carbon capture, utilization, and storage (CCUS) supports environmental goals, drives economic development, and enhances U.S. energy leadership

The suite of carbon capture, utilization, and storage (CCUS) technologies has enormous potential; however, CCUS costs remain a barrier to deployment. While federal and private research, development, and demonstration (RD&D) programs have reduced CCUS costs, more investment is needed to further reduce the cost of CCUS technologies as they scale up to larger demonstration and commercial deployment.

CCUS technologies are critical to reducing carbon dioxide (CO_2) emissions, enhancing U.S. energy security and competitiveness, and maintaining U.S. leadership in the development and deployment of new, transformational energy solutions. Moreover, the International Energy Administration (IEA) states that no credible pathway exists to reach international CO_2 emissions reduction targets, such as the Paris Agreement, without dramatically scaling up the use of CCUS.[1]

It is well-known from experience that costs decline substantially with additional technology development and deployment. Because investment in and deployment of CCUS technology lags behind other clean energy technologies, RD&D remains critical in improving performance and driving down costs of CCUS technologies.

While CCUS technologies have strong potential, cost remains a barrier to wide-scale deployment.

Significant capital investment is required to design and construct integrated systems for CCUS. The capital and operational costs for these systems are beyond those needed for electricity generation and the process consumes energy which decreases the generation plant efficiency. Costs vary for many reasons including the specific carbon capture technology, the desired CO_2 purity, the fuel type, and the site location. Consequently, added RD&D is vital to decrease the energy penalty, the capital cost for installation, and the operating and maintenance costs for these systems.

Continued support through public-private research funding is essential. Funding in this manner helps CCUS technologies experience the same type of benefits seen in other clean energy technologies. Public-private partnerships also provide opportunities to have carbon capture technologies deployed as demonstrations at power plants.

Recommendations for Fostering Effective CCUS RD&D

The U.S. Department of Energy (DOE) promotes RD&D for advanced technologies to reduce the impact on generating facilities, scale up innovative technologies to full-scale deployment, and improve the cost effectiveness of CO_2 capture on fossil-based systems. DOE's Fossil Energy program leverages public-private partnerships to further the development and deployment of cost-effective CCUS. Added attention is needed in the following RD&D areas for commercial development of CCUS.

[1] International Energy Agency, *Global Energy & CO2 Status Report 2017*, March 2018.

Support Technologies at All Levels of Development

Commercial success requires assisting technologies through all stages of development and building on each experience toward increasingly larger and more efficient projects. CCUS RD&D should support technology from "first-of-a-kind" to "next-of-a-kind", so that the private sector is able to leverage cost reductions from experiential learning to widely deploy CCUS at commercial scale. Beyond cost measures, deployment of large-scale projects can result in additional questions related to other operational impacts that need to be addressed. With increased support from the Administration for CCUS RD&D, project developers can confidently progress to fully deploying technically viable, cost-efficient technologies.

Continue and Enhance Early-Stage Research

RD&D that supports technological breakthroughs is important to creating new opportunities for CCUS deployment. Strengthening early-stage research improves data gathering, analysis, and technology evaluation to maximize CCUS investments. Continued research increases the probability of efficient development of new CCUS technologies that bring about substantial advances and cost reductions. For example, the Administration and Congress should continue to support early-stage CCUS research projects because it drives innovation and generates a significant return on investment. One such project is the DOE's National Carbon Capture Center, which demonstrates the success of this model by directly participating in the reduction of the projected cost of carbon capture by one-third. With continued early-stage testing, further reductions in the cost of carbon capture are expected, which supports stakeholder and public interaction for technology acceptance.

Pursue Carbon Capture for Natural Gas

In 2016, the Energy Information Administration (EIA) reported that U.S. power plants fueled by natural gas surpassed those fueled by coal in terms of CO_2 emissions.[2] With the strong growth of natural gas use in the power generation, expanded carbon capture research is essential to further reduce the nation's carbon emissions from the use of natural gas. Although first-generation carbon capture technologies are available, significant RD&D is needed to advance the technology for widespread adoption from natural gas power generation. Moreover, many unique opportunities exist for concentrated research on CO_2 capture from natural gas-fired flue gas due to its higher oxygen content, lower CO_2 content and higher flue gas temperatures relative to coal-based systems. Focused RD&D is needed for the entire system including potential turbine impacts.

Broaden Research Scope and Application

CCUS can be applied effectively across many different sources of CO_2, both energy and industrial, and across a range of fuel types in different environments. RD&D should not be confined to just one source, but instead should embrace the full range of potential CCUS applications to encourage widespread deployment of the technology. Additionally, broad deployment of CCUS may require systems-wide thinking. RD&D should not be limited to just CCUS technology, but could also include integration studies with the host facility or other supporting facilities.

Explore RD&D for Additional Storage and Utilization Pathways

While enhanced oil recovery (EOR) remains a viable and economic option for long-term CO_2 storage, many large CO_2-emitting sources are not located near suitable EOR fields. For these facilities, RD&D in storage and non-EOR utilization options may be imperative for significant global CO_2 emissions reduction. Further RD&D opportunities exist for carbon use and reuse with National Energy Technology Laboratory-supported research by providing technological mechanisms for utilizing CO_2, and have the potential to provide economic benefits for fossil fuel-fired power plants or industrial processes.

[2] U.S. Energy Information Administration, 2016. Energy-related CO_2 emissions from natural gas surpass coal as fuel use patterns change. August 17, 2016.