INSIGHTS

Recent funding of pilot-scale testing of carbon capture technologies reflects commitment to drive down costs

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The Global CCS Institute has published a major report on the latest developments in Carbon Capture and Storage (CCS). The Global Status of CCS: 2015 (http://status.globalccsinstitute.com/) highlights new operational projects, policy and international climate discussions, new technology developments and the emergence of coordinated industrial hubs and clusters. With full-scale deployment of CCS projects and further development at pilot and research stages the cost of CCS will continue to come down. In this Insight the Institute's Principal Manager for Carbon Capture, Ron Munson discusses some of the current projects which will make up the second wave of lower-cost technologies.

Pilot-scale testing of 2nd generation technologies using actual process gases is a critical step in advancing more cost-effective carbon capture technologies. The US Department of Energy/National Energy Technology Laboratory (DOE/NETL) recently announced the selection of multiple technologies for pilot-scale testing. These technologies are candidates for the next significant wave of lower-cost demonstrations in the 2020 - 2025 time frame that may eventually lead to widespread deployment.

The importance of pilot-scale testing

As technology development advances from the laboratory to commercial development, there is a period during which a technology has been proven in the laboratory, but has yet to move from a research effort to commercialisation.

This period is referred to as the 'valley of death' amongst scientific and engineering communities concerned with the transfer of technology from discovery to commercialisation.

Two key hurdles that need to be overcome in this period are technical issues and scale-up for commercialisation.

Bridging these hurdles has been a major focus of carbon capture technology development programs for several years. Programs worldwide have supported the development of a range of technologies at the laboratory/bench scale. Efforts at this scale typically test performance of the technology under development on gas streams generated in the laboratory using bottled gases.

The most promising technologies - those that most successfully bridge the 'technology hurdle' - are selected for small pilot scale testing using a slipstream from an operating facility, typically at the 0.5 to 5 megawatts of electrical output (MWe) (~10-100 tonnes per day) scale for post-combustion capture applications.

Success at the small pilot scale can lead to testing at the large pilot scale. For post-combustion capture technologies, this is typically considered to be 10–25 MWe (~200-500 tonnes per day). An inability to move from large pilot-scale testing to full-scale demonstration means that the 'scale-up for commercialisation' hurdle has not been overcome.

High Priority for DOE

A year ago, Mike Matuszewski, the former Technology Manager for the DOE/NETL Carbon Capture R&D Program, noted that the number one priority for the program was pilot-scale testing of 2nd generation technologies. That high-priority designation was reflected in the September announcement that DOE had selected eight projects to receive funding to construct small- and large-scale pilots for reducing the cost of carbon dioxide (CO_2) capture and compression. The projects focus on advancing the development of a suite of post-combustion CO_2 capture and supersonic compression systems for new and existing coal-based electric generating plants, specifically:

1. ## Supersonic compression

   - **Dresser-Rand Company** – design, build and test a pilot-scale, supersonic CO_2 compressor that offers reduced capital costs, smaller footprint, and reduced parasitic load.

2. ## Small pilot-scale (from 0.5 to 5 MWe) post-combustion CO_2 capture

   - **FuelCell Energy Inc.** – design, fabricate and test a 3 MWe molten carbonate electrochemical membrane (ECM) technology that incorporates power production and CO_2 separation. Total funding for these two projects is just under $32M, with $20M coming from DOE, and the remaining from non-DOE cost-share.

3. ## Large pilot-scale (from 10 to more than 25 MWe) post-combustion CO_2 capture

   These projects were only selected for Phase 1, which will involve preliminary design work along with detailed estimates of technology cost and performance. Budgets for the Phase I efforts range from US$850,000 to $1.3 million, with approximately 80 percent DOE cost share. In 2016, the recipients will submit Phase 2 applications to be considered for full projects, which will include actual construction and testing of the technologies. The six projects selected for large pilot-scale testing include:

   - **University of Illinois** - 500 tonnes CO_2/day capture from the Abbott Power Plant on the campus of the University of Illinois using Linde/BASF's energy-efficient, compact, advanced amine-based system.
   - **University of Kentucky Research Foundation** – Design, install, fabricate and test an innovative carbon capture system - at a US-based facility or at Technology Centre Mongstad (TCM) in Norway - that will improve overall plant efficiency when integrated with an operating power plant.
   - **NRG Energy Inc.** - 10 MWe slipstream test of Inventys's reduced-footprint VeloxoTherm™ post-combustion capture system - projected to have lower

capital and operating costs than existing technologies - at a Gulf Coast coal-fired power plant.

- **Alstom Power Inc.** - Three year program to be implemented at TCM to lower the overall cost of Alstom's chilled ammonia process (CAP).
- **Southern Company Services** – Evaluate process improvements aimed at minimising steam consumption, reducing solvent degradation, and decreasing the process footprint for future capture systems based on testing at an existing 25 MWe, amine-based capture process at SCS's Plant Barry.
- **General Electric Company (GE Global Research)** – Testing of a non-aqueous amino silicone capture system at TCM to validate performance claims and de-risk the technology, which may represent a value proposition relative to aqueous amines in certain applications.

These substantial DOE expenditures reflect the importance placed on lowering capture costs in order to promote widespread deployment of CCS. As costs are reduced, CCS can play a vital role in meeting greenhouse gas mitigation targets at lower cost than could otherwise be achieved.
