



FOSSIL ENERGY TECHLINE

Techlines provide updates of specific interest to the fossil fuel community. Some Techlines may be issued by the Department of Energy Office of Public Affairs as agency news announcements.

Issued on: September 7, 2010

New Recovery Act Funding Boosts Industrial Carbon Capture and Storage Research and Development

\$575 Million for Projects in 15 States Will Position U.S. as Leader in Clean Coal Technologies

Washington, D.C. – U.S. Energy Secretary Steven Chu today announced the selection of 22 projects that will accelerate carbon capture and storage research and development for industrial sources. Funded with more than \$575 million from the American Recovery and Reinvestment Act, these R&D projects complement the industrial demonstration projects already being funded through the Recovery Act. Together, these projects represent an unprecedented investment in the development of clean coal technologies. This program supports the President's goal to overcome the barriers to cost-effective deployment of carbon capture and storage within 10 years and helps to position the U.S. as a leader in the global clean energy race.

"This is a major step forward in the fight to reduce carbon emissions from industrial plants. These new technologies will not only help fight climate change, they will create jobs now and help position the United States to lead the world in clean coal technologies, which will only increase in demand in the years ahead," said Secretary Chu.

Today's selections include projects from four different areas of carbon capture and storage (CCS) research and development: 1) Large scale testing of advanced gasification technologies; 2) advanced turbo-machinery to lower emissions from industrial sources; 3) post-combustion CO₂ capture with increased efficiencies and decreased costs; and 4) geologic storage site characterization.

Large Scale Testing of Advanced Gasification Technologies– \$312 million

The Department is awarding \$312 million from the Recovery Act for expanding three advanced projects to accelerate the development of industrial carbon capture and storage technologies at large-scale. These projects support the Department's goal of developing industrial facilities with near-zero emissions by reducing the cost and improving the efficiency of capturing CO₂. The projects will accelerate the technology development by conducting tests at larger prototype, engineering scales. Following successful completion, these advanced technologies will be ready for scale-up to commercial size.



- **Air Products & Chemicals, Inc. (Allentown, PA) - Development of Ion Transport Membranes (ITM) Oxygen Technology for Integration with Advanced Industrial Systems**

Air Products will accelerate commercial manufacture of ion transport membranes modules and initiate the development of a 2,000 tons per day (TPD) pre-commercial scale facility ahead of schedule, enabling this technology to enter the marketplace at least two years earlier than previously projected. The ITM technology will produce oxygen at higher efficiencies and at lower capital and operating costs than state-of-the-art cryogenic oxygen production systems, benefitting domestic oxygen-intensive industrial processes in terms of cost, efficiency, and productivity improvements, such as those involved in the making of aluminum, glass, and steel via the use of this advanced technology. Successful development of ITM will also lower the cost of oxy-combustion configurations, enabling lower cost CO₂ capture. This project will receive \$71,700,000 in funding.

- **Eltron Research & Development, Inc. (Boulder, CO) – Scale-Up of Hydrogen Transport Membranes**

Eltron is developing a Hydrogen Transport Membrane (HTM) technology to cost-effectively separate hydrogen from shifted coal derived syngas. ARRA funds will decrease the development time until the expected release of this technology to the marketplace by about three years by accelerating the construction and testing of the 12-lb/day and 250-lb/day units, and the construction and testing of the 4- 10 TPD Pre-Commercial Module (PCM). Eltron HTM technology will produce pure hydrogen at temperatures approaching commercial water-gas-shift reaction conditions, allowing process intensification via integrated reaction-separation system, with the potential to improve the efficiency of numerous industrial applications including: refineries, production of chemicals and plastics, and iron ore reduction. This project will receive \$71,377,413 in funding.

- **Research Triangle Institute (Research Triangle Park, NC) – Scale-up of High Temperature Syngas Cleanup Technology**

The Research Triangle Institute will design, build, and test a warm gas cleanup system integrated with CCS at pre-commercial scale (30-50 megawatt electric equivalent [MWe]). RTI's warm gas cleanup system will remove multiple contaminants (sulfur, mercury, arsenic and selenium) from coal syngas, building on successful field tests at pilot scale (0.3 MWe) using real syngas from Eastman Chemical Company's gasifier. This project also includes: (1) optimization of sour water gas shift for CCS applications, (2) integration of CO₂ capture using activated Methyl Diethanolamine solvent with warm gas cleanup to produce a sequestration-ready CO₂ stream, (3) CO₂ compression and drying, (4) deep well injection of CO₂ for long-term geological storage, and (5) measurement, monitoring, and verification of the CO₂ storage. Successful warm gas cleanup combined with CCS has the potential to provide high-purity syngas from which up to 90% of the carbon has been removed, at significantly lower costs than current technologies. A number of industrial applications can benefit from this technology, including the production of hydrogen for use in petroleum refineries and petrochemical



U.S. DEPARTMENT OF
ENERGY

plants, production of chemicals and plastics, and for iron ore reduction. This project will receive \$168,824,716 in funding.

Advanced Turbo-Machinery to Lower Emissions from Industrial Sources – \$123 million

These four projects will develop turbo-machinery and engines that will help improve carbon capture and storage when applied to industrial processes. The projects will integrate with carbon capture in industrial-based systems to optimize CCS.

- **GE Energy (Schenectady, NY) – Advanced Hydrogen Turbine Development for Industrial Applications**

Advanced hydrogen fueled gas turbine technology will be developed applicable to industrial processes that have the potential to separate and capture carbon dioxide. Industrial opportunities are likely to include pet coke gasification, polygeneration and other industrial process that produce hydrogen and require on site power. The turbine advancements will focus on increased efficiency at the lowest possible system costs. This project will receive \$31,315,237 in funding.

- **Siemens Energy (Orlando, FL) – Advanced Hydrogen Turbine Development for Industrial Applications**

Advanced hydrogen fueled gas turbine technology will be developed applicable to industrial processes that have the potential to separate and capture carbon dioxide. Industrial opportunities are likely to include pet coke gasification, polygeneration and other industrial process that produce hydrogen and require on site power. The turbine advancements will focus on increased efficiency at the lowest possible system costs. This project will receive \$32,330,423 in funding.

- **Clean Energy Systems, Inc. (Rancho Cordova, CA) – Oxy-Fuel Turbo Machinery Development for Energy Intensive Industrial Applications**

A first-of-a-kind commercial scale oxy-fuel turbine will be designed, developed, and tested. The oxy-fuel turbine can use a diverse set of industrial fuels including refinery off gases, gasified pet coke, and natural gas and capture >99% of the produced CO₂. This project will receive \$30,000,000 in funding.

- **Ramgen Power Systems (Bellevue, WA) - Ramgen Supersonic Shock Wave Compression and Engine Technology**

This additional project expansion will focus on incorporating the supersonic compression technology into an engine. By following a dual track development on the compressor for applications of CO₂ compression only and incorporation into an engine that can run with oxygen and fuel, producing a high concentration of CO₂ for subsequent supersonic compression, the technology risk is greatly reduced leading to a higher potential of success for the base compressor design and its ability to be used in industrial CCS applications. Thus, this project will demonstrate the compression technology in an engine



U.S. DEPARTMENT OF
ENERGY

versus a conventional CO₂ compression process. Because this technology has more than one purpose, we are able to gain valuable knowledge about scaling up this compression technology. This project will receive \$30,000,000 in funding.

Post-Combustion CO₂ Capture with Increased Efficiencies and Decreased Costs – \$90 million

Five projects will develop advanced technologies for carbon dioxide capture for industrial systems and also application to power plants. These projects will advance state-of-the-art CO₂ capture technologies with increased efficiencies and decreased costs that can be applied as part of an integrated carbon capture and storage system. The Department is developing these advanced CO₂ capture technologies to ensure that CCS can be an affordable and efficient greenhouse gas emission mitigation strategy for both the industrial and utility sectors.

- **ADA-ES, Inc. (Littleton, CO) Evaluation of Solid Sorbents as a Retrofit Technology for CO₂ Capture**

ADA-ES and partners will design, construct and operate a 1 MWe equivalent gas flow pilot-scale test unit to evaluate the performance and cost of an advanced solid sorbent CO₂ capture technology. Results will be used to prepare detailed designs and cost estimates for industrial- and utility-scale CO₂ capture applications. This advanced solid sorbent-based process has the potential to dramatically reduce the energy penalties and costs associated with CO₂ capture from dilute gas streams found in industrial process applications. The pilot-scale test unit will be constructed and operated at one of the cost-share participant's plant sites for at least two continuous months. The pilot tests and process modeling will provide the information necessary to complete a technical and economic analysis of the process. This project will receive \$15,000,000 in funding.

- **Alstom Power (Windsor, CT) Oxy-Combustion Technology Development for Industrial-Scale Boiler Applications**

Alstom Power will perform oxy-combustion pilot testing at its 5 MWe equivalent gas flow Boiler Simulation Facility (BSF). The results from these pilot tests will be used to perform detailed engineering designs and cost estimates supporting efficient, low-cost oxy-combustion CO₂ capture solutions for the industrial and utility sectors. The oxycombustion system designs will incorporate advanced oxy-firing systems, advanced process controls and CO₂ purification. The R&D instrumentation, measurements and data acquisition for the pilot-scale tests will be established to refine and validate simulation tools in order to optimize new and retrofit oxy-combustion boiler applications. The project is relevant to the retrofit of the over 40 percent of the world's installed base of industrial and utility boilers. This project will receive \$10,000,000 million in funding.

- **Membrane Technology and Research, Inc. (Menlo Park, CA) - Pilot Testing of a Membrane System for Post-Combustion CO₂ Capture**



Membrane Technology and Research (MTR) and partners will demonstrate a membrane process to separate CO₂ from industrial- and utility-scale processes including boilers, cement manufacturing, steel and aluminum production and chemical refining. MTR will design, construct and test a 1 MWe equivalent gas flow membrane skid capable of 90 percent CO₂ capture from a slipstream of coal-fired flue gas. A six-month field test using the test skid will be conducted at Arizona Public Service's (APS) Cholla Power Plant. Additionally, a small slipstream test will be performed at the National Carbon Capture Center to validate membrane performance. This project will provide sufficient performance data to allow a thorough technical and economic evaluation of the membrane capture process and will verify the relative potential of this approach. This project will receive \$15 million in funding.

- **Praxair (Tonawanda, NY) Oxy-Combustion: Oxygen Transport Membrane Development**

Praxair will expand the development of the Praxair Oxygen Transport Membrane (OTM) module, partial oxidation reactor hardware development and system demonstration that will accelerate commercial deployment of ceramic membrane technology in industrial processes such as synthesis gas generation and oxy-fuel combustion. Development of an OTM combustion system will dramatically reduce the cost associated with operating a CO₂ capture ready oxy-boiler as it would reduce the power cost associated with producing the oxygen by approximately 75percent. Other combustion applications that would benefit from the development of an OTM combustion process include refinery process heaters, ethylene cracking furnaces, steam methane reformers and other process heaters in industrial/chemical plants that might ultimately be required to control CO₂ emissions.

- **Siemens Energy, Inc. (Pittsburgh, PA) Slipstream Development and Testing of Siemens POSTCAP Capture and Separation Technology**

Siemens Energy will design, install and operate an advanced CO₂ capture, solvent-based, pilot plant that has significant potential to provide an efficient, low-cost CO₂ capture solution for both industrial and utility-scale applications. The Siemens POSTCAP CO₂ capture process utilizes an amino acid salt as the solvent that offers cost and performance advantages when compared to state-of-the-art amine based solvents. The POSTCAP pilot plant will be installed at Tampa Electric Company's (TECO) Big Bend Station and will treat a flue gas slip stream equivalent to approximately 2.5 MWe. Although the CO₂ source for this slip stream pilot-scale testing is from a coal-fired power plant flue gas, it will provide an appropriate design and performance baseline for direct scale-up to many industrial applications. This project will receive \$15,000,000 in funding.



U.S. DEPARTMENT OF
ENERGY

Geologic Storage Site Characterization – \$50 million

The 10 projects previously selected under ARRA funding will be expanded to increase the scientific understanding and locations of geologic formations for safe and permanent carbon dioxide storage from industrial sources. With the added funding of \$50 million from the Recovery Act, these projects will support the goals of helping reduce U.S. greenhouse gas emissions, developing and deploying near-zero-emission coal technologies and making the U.S. a leader in mitigating climate change.

Projects in this category will collect data to determine the potential to store large volumes of CO₂ in geologic formations; provide support to augment the National Carbon Sequestration (NATCARB) database through support of state geologic surveys and other research institutions; and participate in technical working groups on best practices for site characterization and approving storage site selection.

One of the projects being funded is:

- **University of Texas at Austin (Austin, TX) - Gulf of Mexico Miocene CO₂ Site Characterization Mega Transect**

The University of Texas at Austin will conduct a regional evaluation of storage opportunities in Miocene aged formations with a focus on specific reservoirs once identified. The project will lease currently available regional 3D seismic data and acquire a new seismic acquisition system (P-Cable) that is optimized for ultra-high resolution 3D and 4D seismic imaging of shallow and mid-range depths to allow detection of shallow structural features. Both types of data will help to develop baseline assessments of the target formations to measure and monitor their characteristics and validate them for future industrial CCS injection operations. This project will receive \$5 million in funding.

For more information, contact:

- DOE Office of Public Affairs, 202-586-4940