Sixteen Phase I Fossil Energy Projects Chosen by DOE's Small Business Innovative Research (SBIR/STTR) Program

Washington, D.C. — The Department of Energy has selected sixteen new projects under the Small Business Innovative Research/Small Business Technology Transfer (SBIR/STTR) Program.

Taken as a whole, the Department of Energy's (DOE) Fossil Energy (FE) Research and Development (R&D) activities help ensure that as the nation strives to reduce its reliance on imported energy sources, new technologies and methodologies will be in place to promote the efficient and environmentally sound use of America's abundant fossil fuels.

The selections will provide research grants in seven topic areas — advanced coal research, advanced fossil energy research, climate control technologies for fossil energy applications, coal gasification technologies, advanced turbine technologies for IGCC power plants, fuel cell technologies for central power generation with coal, and oil & gas technologies — and will be funded at a maximum of $150,000 for 9 months. The projects are managed by the DOE's Office of Fossil Energy and its National Energy Technology Laboratory (NETL).

The selections mark the 31st round of the Department's SBIR program. Over the 26 years of its existence, the DOE SBIR Program has evolved significantly. DOE has issued 25 Phase I solicitations in SBIR, reviewed approximately 31,797 proposals, and selected for funding 4,413 Phase I projects and 1,816 Phase II projects valued in excess of $2 billion.

A summary of the topic areas and the selected projects follow.

Advanced Coal Research
Carbon Dioxide (CO_2) Conversion to Fuels and Chemicals

Utilization of carbon dioxide (CO_2) has become an important global issue due to the significant and continuous rise in atmospheric CO_2 concentrations, accelerated growth in the consumption of carbon-based energy worldwide, depletion of carbon-based energy resources, and low efficiency in current energy systems. Projects under this topic will develop novel concepts, based on the use of advanced catalysts, for the conversion of CO_2 from energy production and utilization systems to value-added fuels and industrial chemicals.

- **Eltron Research & Development, Inc.**, Boulder, CO — Eltron will develop novel electrocatalysts for effecting direct conversion of CO_2 directly to fuels fungible with existing transportation fuels. (DOE Share: $150,000)
- **Exelus, Inc.**, Livingston, NJ — The objectives of this project are to develop a novel, integrated photocatalysis process that enables the conversion of flue-gas CO_2 into methanol, a valuable commodity chemical. The project will develop a highly efficient, low-cost photocatalyst with an engineered structure that allows an exceptionally large portion of the solar spectrum to be utilized. The photocatalyst will be assisted by reactor

and process innovations that both enhance the overall performance of the system and allow it to be integrated into industrial sites readily. (DOE Share: $150,000)

- **Liquid Light, Inc.**, Monmouth Junction, NJ — Liquid Light, Inc will conduct research and development on electrocatalytic systems for selectively and efficiently converting CO_2 to butanol, a gasoline alternative, using a biomimetic process. The technology under development addresses the problems of energy security and climate change by allowing CO2 to be a feedstock for the chemical industry and for transportation fuels. (DOE Share: $149,691)

Advanced Coal Research
Solid Oxide Fuel Cell Cathode Enhancement through Infiltration

Research is sought that employs infiltration processing techniques to develop enhanced performance solid oxide fuel cell (SOFC) cathodes operating at 650o to 850oC.

- **Materials & Systems Research, Inc.**, Salt Lake City, UT — The proposed work aims to develop a vacuum-assisted infiltration technique to improve SOFC cathode performance and longevity through the impregnation of an inexpensive electrocatalyst precursor into a cathode backbone. Upon calcination at reduced temperatures, a thin but continuous network of nano-sized catalysts is formed and covered the cathode backbone with enlarged catalytic surface area and heterogeneous microstructure, thus enhancing both the oxygen exchange rate and oxygen ions transport rate on the cathode surface. Cathode stability will be greatly improved through the use of the reduced temperature calcination. (DOE Share: $150,000)

Advanced Coal Research
Self-Powered (energy harvesting) Wireless Sensors for High Temperature Environments in Fossil Energy Power Systems

An engineered, self-powered wireless package with an integrated protective housing for commercial installations of new sensor technology in high temperature environments is sought for development. Primary applications where the sensors would be applied are Fossil Fuel-based power plants including coal-fired boiler systems, coal gasification systems, and turbines.

- **MesoScribe Technologies, Inc.**, St. James, N.Y. — MesoScribe will develop self-powered, passive wireless, high-temperature sensors for in situ measurement of temperature, strain and pressure inside gas turbines for power generation systems. (DOE Share: $150,000)

Advanced Fossil Energy Research
High Performance Materials for Long Term Fossil Energy Applications

New materials, ideas, and concepts are required to significantly improve performance and reduce the costs of existing fossil energy power generation systems or to enable the development of new systems and capabilities especially under harsh conditions including high temperatures, elevated pressures, and corrosive environments (reducing conditions, gaseous alkali).

- **QuesTek Innovations, LLC**, Evanston, IL — QuesTek will implement a systems-based approach to design and develop novel cost-effective oxidation- and creep-resistant alloys for thick-section components of coal-fired power plants. QuesTek will investigate and assess two well-defined, novel microstructural concepts and use their proprietary computational models to design novel new compositions. QuesTek will have prototype ingots manufactured to demonstrate the ability of the new materials to address creep strength, weldability, oxidation resistance and other properties. (DOE Share: $149,986)

Advanced Fossil Energy Research
Other Applications

- **Makel Engineering, Inc.**, Chico, CA — The focus of the proposed Phase I program is to develop an integral package to enable operation of MEMS sensors in the harsh environment associated with advanced power systems. The packaging will support chemical sensors such as the planar thick film high temperature sensors developed for CO and CO_2 monitoring by Makel's team and research partners. The integral design enables upgrading systems as newer sensor options become available, without having to re-develop new packaging solutions for other types of high temperate sensors with multi-conductors. (DOE Share: $149,949)

Climate Control Technologies for Fossil Energy Applications
Advanced Solvents for CO_2 Capture from Existing Coal-fired Power Plants

Applications are sought to develop solvent based technologies that can substantially lower the cost of CO_2 capture from flue gas
produced by existing coal-fired power plants.

- **Green Technology Ltd Co.,** Louisville, OH — This project will study the feasibility of a novel contaminant-tolerant solvent/stripping chemical hybrid process for post-combustion CO_2 capture from utility flue gas. The process will use a proprietary solvent technology to achieve DOE's goal of 90% or greater CO_2 emissions reduction at existing coal-fired power plants with no more than a 30% increase in cost of energy services. (DOE Share: $100,000 STTR)

Climate Control Technologies for Fossil Energy Applications
Dense Carbon Dioxide Transport Membranes

Applications are invited for dense CO_2 transport membranes. Studies involving novel dense CO_2 transport membrane material formulation, synthesis, characterization, and proof-of-principle scale permeation tests are included. Computational methods offer a cost-effective technique to engineer novel materials and computational approaches to design novel dense CO_2 perm-selective membranes are encouraged. Dense CO_2 transport membranes are expected to operate at WGS reactor outlet conditions.

- **Tda Research, Inc.**, Wheat Ridge, CO — Proposes to develop a dense membrane that can separate CO_2 from coal derived synthesis gas at temperatures well above the dew point of the synthesis gas. High operating temperature of the membrane ensures high cycle efficiency. (DOE Share: $150,000)

Climate Control Technologies for Fossil Energy Applications
CO_2 Utilization for Chemicals and Solid Products

Applications to develop novel technologies for the use of captured CO_2 as a feedstock for chemical synthesis into valuable products (excluding algae and fuels which are addressed elsewhere).

- **Sustainable Innovations, LLC**, Glastonbury, CT — This project focuses on the development of an Electrochemical Polymer Precursor Generation (EPPG) system that will efficiently generate carboxylic acids which serve as precursors to polymer synthesis. When integrated with clean electricity sources such as renewables, this system can cost effectively transform waste CO_2 molecules into valuable products at the industrial scale. (DOE Share: $150,000)

Climate Control Technologies for Fossil Energy Applications
Advanced Solvents for CO_2 Capture from Existing Coal-fired Power Plants

- **TDA Research, Inc.**, Wheat Ridge, CO — Proposes to develop a low cost, high capacity sorbent to remove CO_2 from coal-fired power plant effluents. (DOE Share: $150,000)

Coal Gasification Technologies
CO_2 – Coal Slurry Preparation

Applications are sought to optimize the coal- CO_2 slurry process from slurry preparation to readiness for gasifier injection (at least 750 psi), including necessary rheological testing not available in the literature, process tests and/or needed equipment design and construction.

- **Iiax, LLC**, Lexington, MA — TIAX proposes to investigate the feasibility of a coal- CO_2 (liquid) slurry feed for coal gasification by conducting a bench-scale evaluation of critical parameters that influence the solids carrying capacity of the slurry and the resilience of high-moisture content coals. The proposed approach will enable the use of low-rank coal (LRC) feedstocks, increase the efficiency, and reduce the operating costs of coal gasification systems, thereby encouraging U.S. industry to implement environmentally superior gasification-based processes. (DOE Share: $149,952)

Advanced Turbine Technology for IGCC Power Plants
Rapid Manufacturing and Prototyping of Gas Turbine Components

Research and development is sought to explore innovative approaches to increase the density and mechanical properties of complex parts for high-temperature gas turbine applications. Applicants can also focus on the application of rapid prototyping methodology to current state of the art manufacturing processes to significantly reduce the overall time and cost to market, thereby reducing manufacturing energy usage and the associated carbon footprint.

- **Barber-Nichols, Inc.**, Arvada, CO — proposes development of combined novel rapid manufacturing process "Electron Beam Melting" EBM, with a rapid material removal process "Electro Chemical Machining" ECM, to provide a low-cost, high-quality alternative to the traditionally expensive and time consuming casting processes for industrial gas turbine engines. The combined process developed under this SBIR will enable significantly shorter engine development cycle times as well as provide a faster, lower cost approach for the manufacture of complex cast parts across multiple industries. (DOE Share: $149,366)

Fuel Cell Technologies for Central Power Generation with Coal
Low-Cost Megawatt-Scale High-Temperature Heat Exchangers for SOFC Applications

- **FuelCell Energy, Inc.**, Danbury, CT — FuelCell Energy, Inc is developing a novel catalytic heat exchanger to reduce the cost and increase the performance of solid oxide fuel cell (SOFC) power plants for the distributed generation market. The effort is based on a 300 kW SOFC plant fueled by renewable biogas, natural gas, or coal-based syngas. (DOE Share: $149,958)

Oil and Gas Technologies
Enhanced Recovery of Unconventional Resources

Grant applications are sought to develop innovative tools or methods to reduce geological and geophysical, environmental, processing, and field development costs – and/or improve recovery efficiency – associated with oil sands, tar sands, oil shale, and unconventional natural gas.

- **Sky Research, Inc**, Ashland, Oregon — Under this proposal Sky Research in collaboration with Idaho National Laboratory scientists will demonstrate the feasibility of a methodology to obtain oil shale retorting temperatures from geophysical data. If this proposal is successful, it would lead to commercial methods for spatiotemporal subsurface temperature monitoring. (DOE Share: $149,940)

Oil and Gas Technologies
Development of Petroleum and Natural Gas Fields

Grant applications are sought to develop innovative tools or methods to reduce cost and/or increase recovery efficiency associated with both conventional and unconventional oil and natural gas reservoir development.

- **Frac Biologics, Inc.**, Pittsburgh, OH — Researchers at Frac Biologics and Allegheny Singer Research Institute are testing an exciting new biotechnology to cost effectively remove hazardous contaminants from frac water. (DOE Share: $100,000)