the ENERGY lab

PROGRAM FACTS

Strategic Center for Coal

Crosscutting Technology Research Program Innovative Energy Concepts Summary

This key technology explores the research and development (R&D) of innovative cost-effective transformational technologies that enhance the efficiency, environmental performance, and availability of advanced energy systems, as well as the creation of computational tools that shorten the development timelines of advanced energy systems. This area functions as an incubator by conducting fundamental and applied research in innovative concepts with a 10 to 25 year developmental horizon that offer the potential for technical breakthroughs and step change improvements in coal power systems with CCS and the removal of any environmental impacts from fossil energy-based power system. NETL is working to explore the following emerging research areas.

Conceptual Design of Power Generation Facility Utilizing Advanced Technologies

CONTACTS

Robert Romanosky
Deputy Director,
Office of Coal and Power R&D
Acting–Technology Manager,
Crosscutting Technology Research Program
304-285-4721
robert.romanosky@netl.doe.gov

Robie Lewis
Program Manager,
Crosscutting Technology Research
301-903-6166
robie.lewis@hq.doe.gov

Regis Conrad
Director,
Division of Advanced Energy Systems
301-903-2827
regis.conrad@hq.doe.gov

John Wimer
Director,
Office of Coal and Power R&D
304-285-4124
john.wimer@netl.doe.gov

Sean Plasynski
Director,
Strategic Center for Coal
412-386-4867
sean.plasynski@netl.doe.gov

NATIONAL ENERGY TECHNOLOGY LABORATORY

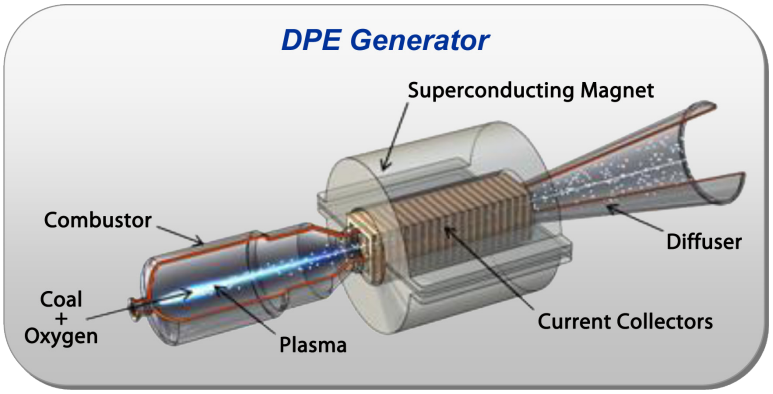
Albany, OR • Anchorage, AK • Morgantown, WV • Pittsburgh, PA • Sugar Land, TX

Website: www.netl.doe.gov

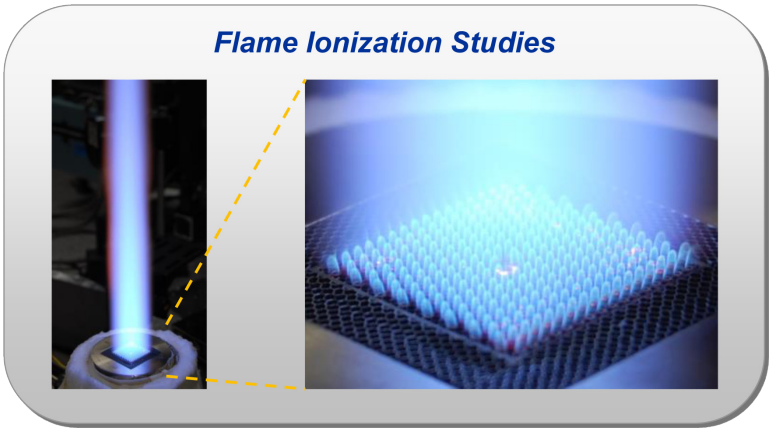
Customer Service: 1-800-553-7681

U.S. DEPARTMENT OF ENERGY

- **Advanced Power Generation Concepts**
  Current R&D is examining direct power extraction (DPE) technologies as topping cycles aimed at directly converting the thermal energy of a working fluid into electrical energy. This DPE technology can convert kinetic energy into electricity at conditions beyond the capabilities of existing materials used in boilers and combustion turbines. Fuel, used in the DPE generator, is burned via oxycombustion which greatly simplifies carbon capture and storage. The goal is to develop a near-zero emission power generation system with high efficiency (>50%) that meets cost of generation goals. The DPE system provides a topping cycle to more traditional power generation systems generating additional electricity that will offset the auxiliary power required for carbon capture and storage, yielding a more efficient power cycle.



- **Power Electronics and Energetic Materials**
  Energetic materials generate electricity when they are exposed to heat. This research is seeking opportunities to harness this capability by identifying cases where low levels of heat are sufficient to provide electric power. This technology can be used to provide electricity to power devices (e.g., self-powered sensors) inside equipment for external communication, for areas where continuous sources of low grade heat are available and the cost to provide grid power is expensive, or to enhance overall efficiency of existing power systems (e.g., thermoelectric generators).



Impacts and Benefits

The following impacts are possible through this proposed research:

- Perform the applied research needed to assess the technical and economic potential of innovative power generation concepts.
- Determination of the performance potential of high efficiency concepts like direct power extraction. Results will define the technical barriers that must be addressed to produce the desired benefits of the technology. Validation data is needed to insure that predicted performance is correct. If DPE technologies are proven viable, they offer the potential for power systems to operate at high efficiencies (> 50%).
- Investigation of new materials that may be useful in future power plant operation, or lower cost energy harvesting for wireless sensors and other applications.