

# ADVANCED RESEARCH

THE FOUNDATION  
FOR INNOVATIVE  
SYSTEMS

materials



processes  
innovation

FORGING THE PATH  
FROM BASIC RESEARCH  
TO REALIZATION OF  
THE VISION 21 CONCEPT,  
ADVANCED RESEARCH  
CONCENTRATES ON  
TECHNOLOGIES AND  
PROCESSES THAT ENABLE  
INNOVATIVE SYSTEMS.

## PROGRAM AREAS

- Materials and Advanced Metallurgical Research
- Bioprocessing
- Coal Utilization Science
- University Coal Research
- Historically Black Colleges and Universities/Other Minority Institutions
- Small Business Innovation Research
- Advanced Clean Fuels Research

## INTRODUCTION

The major goal of the Advanced Research Program is to develop, by 2015, a series of advanced materials, subsystem technologies, and breakthrough process concepts that are essential to the success of Vision 21.

## MATERIALS AND ADVANCED METALLURGICAL RESEARCH

Program activities focus on developing a technology base in advanced materials synthesis, processing, life-cycle analysis, and performance characterization. The program funds exploratory research on new materials that could improve the performance or reduce the cost of existing fossil fuel technologies, and the development of materials for new systems. Partnering and cost-sharing with industry are central elements.

Research is currently being conducted by the Advanced Research and Technology Development Materials Program at Oak Ridge National Laboratory, the Advanced Metallurgical Research Program at Albany, Oregon, as well as materials-related activities at the Federal Energy Technology Center (FETC).

## BIOPROCESSING

Primarily fundamental research, this program area includes research into the chemistry, biochemistry, microbiology, and engineering of bioprocessing technologies and focuses on the biological production and processing of fossil fuels, wastes, and biomass.

## COAL UTILIZATION SCIENCE

The Coal Utilization Science (CUS) Program supports research to develop technologies for clean, efficient power generation from coal and other fossil fuels. Emphasis is placed on producing fundamental information by performing experimental research and theoretical investigations on processes and mechanisms that form technological barriers. Novel processes that address environmental issues as well as power generation are included.

AN ADVANCED RESEARCH SUCCESS STORY: NEW CERAMICS

A lightweight ceramic hot-gas filter material developed by the Advanced Research Program is now widely used to remove hot-gas particulates in fossil-fueled power generation and industrial systems, vastly improving their efficiency and productivity.

Developed as part of an industry-DOE cost-shared collaboration, the filter material is now sold commercially, with a potential international market of \$7 billion over the next 10 years. The U.S. market alone is forecast to reach \$200 million annually by the end of the century.



UNIVERSITY COAL RESEARCH

Grants are provided by the University Coal Research (UCR) Program to U.S. universities in order to support fundamental research and develop improved fossil energy technologies. Novel and innovative approaches are sought to solve national and global environmental and energy-related issues. This research sustains U.S. global pre-eminence in the areas of fossil fuel science and engineering by supporting fossil energy research at our Nation's universities. The result is a developing and expanding knowledge base in disciplines relevant to fossil fuels.

HISTORICALLY BLACK

COLLEGES AND

UNIVERSITIES/OTHER

MINORITY INSTITUTIONS

The Historically Black Colleges and Universities/Other Minority Institutions (HBCU/OMI) Program was established to provide a mechanism for cooperative research between historically black institutions and other minority institutions with U.S. industries and Federal agencies. This program strives to support the education of scientists and engineers and sponsors research in support of the Office of Fossil Energy's (FE's) product lines. The HBCU/OMI program has emphasized improving the environmental compatibilities of advanced coal, oil, gas, and environmental technology concepts.

SMALL BUSINESS

INNOVATION RESEARCH/

SMALL BUSINESS

TECHNOLOGY TRANSFER

FE's Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) programs make competitive grants to small businesses for fossil-related technology research projects that interest small businesses while advancing the mission of FE. Research supports FE goals of obtaining clean fuels and energy from fossil sources.

ADVANCED CLEAN FUELS

RESEARCH

Coal-derived substitutes for traditional petroleum products have the potential to provide the secure supply of transportation fuels that is critical to all sectors of our economy. Development of a synthetic fuels industry will positively affect our balance of payments and create high-paying jobs, while addressing the projected decline in petroleum production and the concomitant increase in demand after 2015. In addition, these fuels will be more environmentally friendly than any petroleum-based products, while using our vast domestic coal resources to provide a level of energy security not seen for decades.

This cutting-edge research program provides the basis for new technologies by serving as a bridge between basic and applied fuels research. The program is exploring novel concepts for the production of new fuels from coal and mixtures of coal and other resources. Research is done in concert with industry, academia, and other government agencies and laboratories at the national and State levels.

AN ADVANCED RESEARCH SUCCESS STORY: SUPER 9 CHROME ALLOY

Today Super 9 Chrome, an extremely strong steel alloy, is the worldwide industry standard for safer and more reliable coal-fired powerplants. Developed by the U.S. Department of Energy (DOE) advanced materials program, the new alloy is now used for superheater tubes, pipes, and forgings, allowing an increase in powerplant operating steam temperature from 1,005°F to 1,075°F.

The higher operating temperatures have allowed powerplants to boost efficiencies and to save on fuel costs. The greater reliability afforded by Super 9 Chrome parts and the improved stability of equipment incorporating the new alloy have also served to reduce maintenance charges, thereby improving the economic performance of the powerplant fleet overall.

BENEFITS TO THE NATION

**High-efficiency power.** Development of advanced materials will enable the production of advanced, high-efficiency power systems that better utilize fossil fuel resources.

**Domestic liquid fuels.** Production of non-petroleum-based liquid fuels with low environmental impact will give the U.S. an alternative source of transportation fuel.

**Energy security.** Maintenance of coal as the primary source of energy for electricity production will provide Americans with a dependable domestic source of power.

**Economic security.** Reductions in energy costs resulting from advanced technologies will ensure continued economic well-being for U.S. citizens.

**Environmental acceptability.** Advanced materials and processes are critical to meeting both tighter emissions standards and future restrictions on greenhouse gases. Reduction of emissions will improve human health and the environment.