

An Overview of the U.S. Department of Energy's Federal Energy Technology Center

Richard R. Schehl¹, Sharon K. Marchant¹ and Richard E. Hucko¹

Abstract: In December 1996, two of the U.S. Department of Energy's (DOE) research and development (R&D) centers were consolidated. The Morgantown Energy Technology Center, located in Morgantown, West Virginia, and the Pittsburgh Energy Technology Center, located in Pittsburgh, Pennsylvania, were combined to create the Federal Energy Technology Center, or FETC.

FETC is one of the Department of Energy's major field organizations reporting to DOE's Office of Fossil Energy. A total of approximately 600 Federal employees and a similar number of support service contractor employees are at the Pittsburgh and Morgantown sites. FETC manages the majority of the U.S. Fossil Energy research and development programs, valued at nearly \$920 million in FY 1997.

The Role of FETC

The role of FETC is to reinforce and advance DOE's commitment to helping the private sector research and test new technologies, as well as emerging fossil fuel products—products that allow utilities and manufacturers to produce the energy we need while lowering emissions. The research we pursue at FETC enhances and expands our knowledge — the Federal Government's and private industry's. And from this pool of knowledge comes the tools that help protect our environment as we generate energy to meet demands that grow and change every year.

FETC continues to pursue R&D on advanced coal projects, through government and private sector partnerships. These partnerships bring out the best in each of us technologically. An example of this partnership is the Low-Emissions Boiler System, or LEBS, program which would never have been created by private industry alone, nor by the government alone. Together, though, we have forged a new breed of technology composed of existing environmental-control equipment and systems. Combined, these individual technological components introduce a highly efficient method of utilizing coal. Reliability is increased while emissions overall are greatly decreased. This technology can be particularly attractive in a growing international market for coal-fired power plants as well as in the United States.

Given the major impact of fossil energy on the economy and the environment, the Federal Government has a legitimate role to play in establishing and implementing policy. FETC's role is to provide two major products to decision makers in the Administration and Congress.

- The first product is accurate information on the technical, economic, and environmental implications of various policy alternatives. To establish rational policy, decision makers need accurate information. We supply them this information, such as determining the real cost and performance implications of removing and sequestering CO₂.
- The second product is advanced technology. To implement rational policy, advanced technologies need to be ready to be deployed by the private sector. The private sector must be ready to commercially offer highly efficient technologies to use coal, or any fossil fuel, before the government can implement a policy that regulates its use.

¹ Dr. Richard Schehl, Sharon K. Marchant, CPA, MBA and Dr. Richard E. Hucko. U.S. Department of Energy, 626 Cochrans Mill Road, P.O. Box 10940, Pittsburgh, PA USA 15236-0940

FETC is carrying out DOE's mission through the implementation of national energy and environmental programs that are addressed through a broad spectrum of nearly 600 research, development, and demonstration projects. These technology development projects are carried out through partnerships with:

- industrial organizations in the private sector,
- universities and colleges,
- not-for-profit research labs, and
- national laboratories.

Our projects range in size from R&D grants of a few thousand dollars to a college or university, to a \$1 billion cost-shared project with Geneva Steel Company in Provo, Utah, to demonstrate a combined steel- and power-production technology.

FETC manages R&D projects located in nearly every state in the United States. FETC also has a staff of nearly 300 researchers, federal employees and support contractors conducting an in-house research program that supports our external projects and identifies new areas of research.

Technology Programs Managed by FETC

Research, Development, and Demonstration programs are focused on supporting development of advanced technologies necessary to meet the U.S. energy and environmental needs for the 21st century. FETC's R&D projects span four major program areas:

- The first is coal- and natural gas-fueled advanced power generation.

Three examples of our power generation technologies, starting with Integrated Gasification Combined Cycle or IGCC, follow.

IGCC systems have two major advantages. First, their coal-to-electricity efficiency is 25 percent or more higher than that of conventional coal-fired power plants. Higher efficiencies mean that greenhouse gas emissions like CO₂ are held to a minimum and fuel costs are lower — which translates to lower electricity costs for the consumer. IGCC's second advantage is a dramatic reduction in environmental emissions. SO₂ emissions can be reduced in excess of 99 percent.

The Low-Emissions Boiler System program, mentioned before, is another approach to coal-fired power generation. LEBS integrates innovative pollution control technologies into a new design for pulverized coal power plants. This new design avoids many of the performance trade-offs that are made when pollution controls are retrofitted to older boilers. LEBS is an evolutionary step in the development of conventional pulverized-coal power plants.

- FETC's second major program area is R&D on converting coal and natural gas to liquid transportation fuels and chemicals through coal liquefaction, coal-water slurries, and natural gas-to-liquids technologies.

In the long-term, in the face of rising oil imports, knowing how to produce liquid fuels contributes to our nation's energy security. In the near-term, liquid fuel production may be economically attractive in some niche markets. On off-shore oil platforms, large quantities of natural gas are co-produced with the oil. EPA no longer allows the gas to be flared. Converting the gas to a liquid is an attractive option because the liquid can be transported to shore with the oil.

- The third major FETC program area is R&D on natural gas exploration, production, processing, and storage technologies.
- Our final program area deals with technologies to clean up DOE sites used for nuclear weapons production.

FETC is developing environmental cleanup technologies that are faster, safer, and cheaper than those currently available. Our goal is to reduce the projected \$200 billion to \$300 billion needed to

clean up the radioactive and hazardous wastes at DOE sites, our national legacy from 50 years of nuclear weapons production.

International Projects

Working principally with the U.S. Agency for International Development (USAID), FETC carries out several energy and environmental projects in foreign countries. We work with American technology vendors to coordinate and implement projects in countries such as the following:

India: Since 1982, FETC has managed a USAID-funded project designed to help India use its indigenous coal and biomass energy resources for electric power generation while reducing its generation of greenhouse gases. FETC and USAID developed an Interagency Agreement for India in 1986 to promote new low-emission, low-cost, coal-based power generation systems and technologies for retrofitting older power plants for better fuel efficiency and pollution control. Through FETC's management and technical coordination, a state-of-the-art, pilot-scale combustion facility--the first of its kind in South Asia--was designed and erected in Tiruchirapalli, India.

Poland: As a result of a 1989 cooperative agreement between Poland and the United States, FETC is managing a \$20 million USAID program to reduce the air pollution in Krakow. A two-phase program was structured to address the main sources of sulfur dioxide emissions: coal-fired utility boilers and numerous small coal-fired furnaces and home stoves.

Ukraine: Again for USAID, we conducted an engineering analysis of the costs of repowering a power plant in Lugansk. This study will underpin Ukraine's submission of a \$200 million funding proposal to the World Bank, all with an eye toward weaning Ukraine away from the unstable nuclear generation option of Chernobyl.

Brazil: FETC is assisting the Brazilian government in creating an environmentally and fiscally sound energy policy so that domestic coal can be used to generate power as the hydro resources of the Amazon River near exhaustion. In addition, we organized a reverse trade mission on this topic for the U.S. Trade and Development Agency.

South Africa: FETC is assisting the Trade and Development Agency in developing a project that examines the extent of the coalbed methane resources on the Lebowa region. The project will then assess the feasibility of commercialization of this indigenous resource for electric power generation to spur development in this energy-deprived, economically depressed region.

South Korea: FETC is helping the Republic of Korea in its efforts to expand its electric generation capacity to 36 gigawatts over the next 14 years. This will be accomplished by constructing 25 coal-fired plants, 14 nuclear plants, and 12 liquid natural gas facilities. Some of the electric generation capacity expansion may be based on U.S. technology.

Fossil Fuels in the Future

Even with new and emerging technologies that use fossil fuels, the question still persists of whether there will be a domestic market for new fossil-based power generation technologies during the next 20 years.

Fossil fuels will continue to drive our economy. Today, fossil fuels supply 85 percent of the energy we consume in the United States. Our future economic growth depends heavily on having affordable energy — and fossil fuels provide the most affordable energy. Every credible energy expert says fossil fuels will continue to be the dominant energy source in the U.S. for the foreseeable future. DOE's Energy Information Agency — the EIA — projects that fossil fuel's market share will grow from its current 85 percent to 89 percent by 2015.

The United States has the largest fleet of power plants in the world — 767,000 megawatts of installed capacity — and EIA indicates that our electric consumption will grow by 1.5 percent per year.

Despite increased use of this existing fleet, our predicted demand growth means we must build new plants over the next 20 years. We must also replace some of our aging fossil plants — as well as nuclear plants that are being decommissioned at the end of their 40-year licensing period. EIA

projects that by 2015, the U.S. will need over 300,000 megawatts of new and replacement capacity. This is equivalent to more than a thousand 300-megawatt plants, and each of these plants is a several hundred million-dollar capital investment. According to EIA, natural gas will fuel most of these plants. However, 12 percent will use coal, 4 percent will be renewables, and 1 percent will be fuel cells.

This is the case in the United States. Globally, the need for energy is even more pressing. Worldwide energy demand is expected to rise dramatically over the next two decades, particularly in China, India, Indonesia, and Eastern Europe. EIA projects global electricity demand will grow by 50 percent between now and 2010. The only constraint is the availability of capital.

Over the next 20 years, the U.S. National Coal Council projects that the capital requirements for electrification projects around the world will be almost \$19 trillion. Half of the new plants will be fueled by coal.

Concluding Comments

The U.S. Government's investment in energy R&D provides a number of benefits, including the following:

- The information and the technologies to implement rational public policy.
- Lower cost energy.

Even small reductions in the cost of energy have enormous impact on our economy. For example, more efficient power generation systems could lead to cost savings of \$5 billion to \$15 billion per year by 2015 in the United States alone.

- A cleaner environment.

In the United States, by the 2000 to 2015 time frame, we will be able to reduce NO_x emissions and hazardous air pollutants from existing power plants by 70 percent to 90 percent. Also, increasing the efficiency of our coal-fired power plants from their current average of 34 percent to 50 percent will reduce CO₂ emissions by 40 percent. Solid waste production would be cut by one-third.