PROJECT facts

DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY

ADVANCED POWER SYSTEMS

ASSESSING THE TOXICS PRODUCED BY COAL COMBUSTION—THE PSI PROJECT

PRIMARY PROJECT PARTNER

Physical Sciences Inc.
Andover, MA

MAIN SITE

Physical Sciences Inc.
Andover, MA

TOTAL ESTIMATED COST

$4,345,000

COST SHARING

DOE	$3,381,000
Non-DOE	$964,000

Project Description

Of the 189 substances identified as hazardous air pollutants by Title III of the 1990 Clean Air Act Amendments, 37 species, including 11 metals, have been detected in the flue gases of pulverized-coal-fired utility boilers. The United States must expand its use of coal, its most plentiful energy resource, if it is to maintain its global position. Consequently, it must also expand its menu of innovative pollution-control options to deal with these pollutants.

Before electric utilities can implement strategies to eliminate toxics, they must be able accurately to predict the emissions produced by a broad range of fuels under a variety of operating conditions. Over the past decade, a large data base identifying the concentrations of several of these pollutants has been developed. The data define the general behavior of toxic species during combustion, and have been used to develop models of behavior. However, these models fail when extrapolated beyond their supporting data base, creating a critical gap in our knowledge. Over the next decades new fuels and new combustion systems will play an increasing role in our Nation's power-generation system, and we need to be able to predict and control the toxics they might emit. The current models do not give us the information we need.

Fundamental models for the formation, partitioning, and emissions of toxics from coal combustion can fill this gap. With support from the U.S. Department of Energy's field center in Pittsburgh, Physical Sciences Inc. (PSI) is carrying out a detailed research program. It has three objectives: (1) to elucidate the important mechanisms of toxics formation and partition; (2) to develop submodels for the appropriate trace toxic-species transformations; and (3) to incorporate these mechanisms into an engineering model to predict behavior, based on coal and combustion parameters. Initial work will focus on understanding trace metals and other toxic substances identified by the Clean Air Act Amendments. Bench and laboratory testing will identify and quantify the formation and partitioning of toxic species.

Program Goal

Tightening environmental standards require that U.S. coal-fired plants be much cleaner and more efficient by the year 2010. DOE plans to develop systems at least 10 times cleaner than current coal-fired power plants that comply with the Federal New Source Performance Standards. To minimize the release of toxic substances—by preventing their formation, destroying them, or converting them—utilities need to understand what causes their formation. The PSI project will quantitatively define the transformation processes by which substances present in coal are converted by combustion into potentially toxic emissions.

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CONTACT POINTS

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Project Partners

UNIVERSITY OF ARIZONA
Tucson, AZ
(subcontractor)

UNIVERSITY OF KENTUCKY RESEARCH FOUNDATION
Lexington, KY
(subcontractor)

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Cambridge, MA
(subcontractor)

UNITED STATES GEOLOGICAL SURVEY
Reston, VA
(interagency agreement with DOE)

ELECTRIC POWER RESEARCH INSTITUTE
Palo Alto, CA
(private sector partner)

TECHNICAL RESEARCH CENTER OF FINLAND
Espoo, Finland
(private sector partner)

Project Benefits

With regulations like the Clean Air Act Amendments strengthening air-quality requirements for power plants, advanced new technologies such as the Low Emission Boiler System and the High Performance Power System being developed by the Department of Energy are essential if we are to meet future environmental demands while generating sufficient power for economic growth. Developing ways to harness the energy found in our greatest resource—coal—without impacting the environment is critical to our survival as a world power. This project helps us to satisfy these environmental demands.

Before electric utilities can plan or implement strategies to control emissions of hazardous pollutants, they must develop an accurate and site-specific ability to predict these emissions in all effluent streams, using the broad range of fuels and operating conditions available to them. The development of a Toxics Partitioning Engineering Model will permit utility planners to predict the emissions of potentially toxic substances and plan accordingly.

New fuels, such as coal blends or beneficiated fuels; new combustion technology and operating conditions, such as low-NOx burners or staged combustion; and advanced new power systems—all create unique emissions conditions. A predictive model is essential to ensure that coal-fired power generation is environmentally benign.

Cost Profile (Dollars In Thousands)

	Prior Investment	FY95	FY96	FY97	Future Funds
Department of Energy *	—	—	$348	$325	$2,708
Private Sector Partners	—	—	$148	$140	$677

* Appropriated Funding

Key Milestones