Commonwealth of Pennsylvania

PENNSYLVANIA ENERGY DEVELOPMENT AUTHORITY

ANNUAL REPORT

FOR FISCAL YEAR 1988-89

July 1, 1988 - June 30, 1989

Issued
October, 1989

Robert P. Casey
Governor

Mark S. Singel
Lieutenant Governor

Anthony T. Sossong
Chairman

Flynt Tucker
b10

Commonwealth of Pennsylvania

PENNSYLVANIA ENERGY DEVELOPMENT AUTHORITY

TECHNICAL ADVISORY COMMITTEE

Joseph G.

James T. Cobb, Jr., Ph.D., Director
Energy Resources Program
University of Pittsburgh
Pittsburgh

Frederick P. DeWeese, President
Carbon Sales, Inc.
Wilkes-Barre

Gilbert M. Freedman
Allegheny Electric Cooperative, Inc.
Harrisburg

William R. Gillis, Director
Center for Rural Pennsylvania
Harrisburg

James D. Hervol, Assistant Manager
EPRI Coal Quality Development Center
Homer City

Lance J. Hoch
Narberth

Robert P. Johnson, Manager
Energy Utilization Research
Pennsylvania Power & Light Company
Allentown

Flynt Kennedy, Ph.D., Vice President
Research and Development
Consolidation Coal Company
Library

Edward K. Levy, Ph.D., Director
Energy Research Center
Lehigh University
Bethlehem

Harold G. Lorsch, Ph.D., Director
Center for Insulation Technology
Drexel University
Philadelphia

D. Scanlon

Peter T. Luckie, Ph.D.
Associate Dean for Research
Pennsylvania State University
University Park

John E. Notestein, Senior Scientist
Office of the Director
US Department of Energy
Morgantown Energy Technology Center
Morgantown, West Virginia

Thomas A. Sarkus, Esquire
Clean Coal Technology Task Force
US Department of Energy
Pittsburgh Energy Technology Center
Pittsburgh

Alfred A. Slowik, Director
Research and Development
Pennsylvania Electric Company
Johnstown

STAFF

Dane C. Bickley, Director
John M. Memmi, Associate Director
Cristina S. Papson, Esquire, Counsel
Barbara A. Yuricich, Asst. Secretary

Roderick A. Fletcher, P.E., Project Manager
Susan K. Summers, Project Manager
Robert E. Young, Project Manager

Staff services provided by the Pennsylvania Energy Office.

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

APPENDIX B -- PEDA RD&D PROJECTS IN PROGRESS (Continued)

INTRODUCTION

The Pennsylvania Energy Development Authority's Annual Report for Fiscal Year 1988-89 (FY 1988) is presented to the Governor and General Assembly pursuant to the Pennsylvania Energy Development Authority and Emergency Powers Act of 1982, P.L. 1213, No.280. The Annual Report is for the fiscal year that began on July 1, 1988 and ended on June 30, 1989.

The report provides detailed information on PEDA's revenue bond financing activity, and the fiscal status of the Energy Development Fund. Additionally, it describes projects awarded allocations in FY 1988, as well as projects which received financial assistance in previous fiscal years that were completed or continued during this period.

PEDA concluded the fifth year of its financial assistance program at the close of FY 1988. In this period, the Board of Directors diligently attempted to further the Authority's mission of providing financial assistance to a wide range of energy projects, throughout the Commonwealth. In the commercial energy project arena, the Authority concluded a $4.4 million bond transaction, enabling construction of the approximately $105 million Ebensburg Cogeneration Plant in Cambria County. Additionally, PEDA committed approximately $770,000 to ten energy research, development and demonstration (RD&D) projects worth $8.6 million.

To improve PEDA's technical capabilities, the board established its Technical Advisory Committee (TAC). TAC comprises individuals with expertise in fossil fuel resources, renewable energy resources and energy efficiency technologies. TAC's functions are to review applications for financial assistance received by the Authority and to furnish input to the board on energy issues pertinent to Pennsylvania.

PEDA's Energy Development Plan (EDP) contains three central points which set the Authority's direction in FY 1988:

- funding emphasis will be given to energy conservation or development technologies that show the greatest likelihood of near-term implementation;
- initiatives to provide opportunities for financial assistance to renewable resources and energy conservation projects shall be a priority; and,
- pursuit of projects that promote clean use of Pennsylvania coal shall be a priority.

As stated in the EDP, PEDA was created to finance projects that develop, promote, or more efficiently use Pennsylvania's energy resources. The Authority's primary goals are: to increase Pennsylvania coal production; to increase use of renewable fuels; to increase energy efficiency in

buildings and industry; and, to maximize use of available federal, local and/or private financial resources. The Authority has developed a multi-faceted financial assistance program to achieve these goals. This program includes grants, venture capital, loans, loan guarantees, interest reduction and revenue bond financing.

PEDA's approach to affording opportunities for financial assistance in FY 1988 was (1) to develop a comprehensive Financial Assistance Program Prospectus and application package; and, (2) to establish application deadlines throughout the fiscal year. Two application deadlines were designated: November 30 and March 8. Applications received attendant to these deadlines were deliberated on January 19 and May 18 respectively. Application deadlines and financial assistance opportunities were published in the Pennsylvania Bulletin on October 15, 1988.

The prospectus approved by the board established the criteria and constraints for review of applications and allocation of financial assistance. The primary constraint focused on the location of projects, namely, they must be conducted entirely or largely within Pennsylvania. Technical, financial and project-related criteria were used by the board to make allocation decisions.

SUMMARY OF FINANCIAL ASSISTANCE FOR ENERGY PROJECTS

PEDA has issued approximately $167 million in revenue bonds to three commercial energy ventures (Table 1): Humboldt Energy Center, Ebensburg Cogeneration Plant and the Clarion Project. The Authority has allocated nearly $8.2 million to 87 RD&D projects (Table 2). PEDA has disbursed or committed approximately $6.8 million to 70 RD&D projects.

PEDA RD&D projects are separable into four categories: Clean Coal Technology, Anthracite Development, General Coal Development (includes Bituminous Coal Development category of FY 1984 and FY 1985 in Table 2) and Non-Coal Development. As illustrated in Figure 1, 37% of the Authority's projects have focused on technologies that make coal a cleaner fuel. General coal development projects comprise the second largest number of projects, followed closely by non-coal development projects. Twelve, or seventeen percent, of PEDA's projects have addressed anthracite development. Monetarily, the Authority has committed the majority, $2.7 million or 41% of its total energy RD&D commitment, to Clean Coal Technology (Figure 2). Commitments to coal projects equal $5.8 million, or 86% of PEDA's energy RD&D effort.

PEDA's impact on energy RD&D in the Commonwealth is reflected in Figure 3. The Authority's $6.8 million commitment has engendered an additional $23.2 million investment from other sources, for a total of $30 million in energy RD&D effort in Pennsylvania. Clearly, PEDA has been most influential in developing clean coal technologies. The Authority's $2.7 million commitment has generated an additional $18.3 million investment in this area by parties interested in advancing clean coal technologies; each Authority dollar has been matched by roughly $6.80 from project co-

TABLE 1

PEDA REVENUE BOND PROJECTS

Project Number	Name	Developer	Rev Bond Issue
84061	Humboldt Energy Center	Continental Energy Asso	39,000,000
85033	Clarion Project	Babcock & Wilcox Co	45,650,000
85034	Ebensburg Cogen Plant	Babcock & Wilcox Co	77,600,000
87048	Ebensburg Cogen Plant	Babcock & Wilcox Co	4,400,000
		TOTAL	$166,650,000

TABLE 2

PEDA FUNDED RD&D PROJECTS SUMMARY

Project Number	Contractor	Purpose	Project Category	PEDA Alloc	Alloc Type	Status
84002	PA Coal Mining Association	Coal Quality and Marketability Database	Bit Dev	411,000	Grant	Complete
84003	Francis Miller	Coal Preparation Technology Seminars	Bit Dev	16,500	Grant	Complete
84006	PA Coke Technology Inc	Non-Recovery Coking Process	Bit Dev	67,965	Grant	Complete
84007	Anthracite Industry Assn	Anthracite Marketing and Demonstrations	Anth Dev	453,780	Grant	Complete
84016	Lehigh University	Improved Coking via Ionic Hydrogenation	CC Tech	25,000	Grant	Complete
84017	Lehigh University	Fluidized Bed Coal Cleaning - Phase I	CC Tech	80,530	Grant	Complete
84020	Coal Tech Corporation	Advanced Cyclone Combustor - Stage II	CC Tech	150,000	Grant	Complete
84024	Erie School District	Enhanced Natural Gas Recovery	Non-Coal	37,500	Ven Cap	Complete
84025	Johnstown Corporation	Coal and Coal-MSW Cogen Feasibility	Non-Coal	28,715	Grant	Complete
84026	St Francis College	Coal and MSW Cogeneration Feasibility	Non-Coal	7,500	Grant	Complete
84034	Council for Labor & Ind	Conservation Improvements	Non-Coal	15,000	Grant	Complete
84035	Admiral Peary Vo-Tech Sch	Cogeneration Feasibility	Non-Coal	6,287	Grant	Rescinded
84038	CDA International Inc	Hospital Oper Rm Energy Conservation	Non-Coal	35,000	Grant	Complete
84041	Bellefield Boiler Plant	Cogeneration Feasibility	Non-Coal	21,000	Grant	Complete
84042	BCR National Laboratory	Reactive Gas Coal Desulfurization - I	CC Tech	120,241	Grant	Complete
84043	BCR National Laboratory	Reichert Spiral Evaluation	CC Tech	50,000	Grant	Terminated
84044	Williams & Broome	Hydroelectric Power Barge Demonstration	Non-Coal	200,000	Ven Cap	Complete
84047	Enerco Associates	Pyrolysis of Waste Tires	Non-Coal	302,268	Ven Cap	Complete
84049	Allegheny Electric Coop	Energy Storage in Buildings	Non-Coal	35,000	Grant	Rescinded
84050	Control Techtronics Inc	Advanced Combustion Controller Demo	Non-Coal	15,000	Grant	Complete
84060	Babcock & Wilcox Company	CWF Conversion, Open Hearth Furnace	Bit Dev	69,000	Ven Cap	Rescinded

TABLE 2
(Continued)

PEDA FUNDED RD&D PROJECTS SUMMARY

Project Number	Contractor	Purpose	Project Category	PEDA Alloc	Alloc Type	Status
85003	Antrim Mining Company	FBC Power Plant Feasibility	Bit Dev	10,000	Grant	Complete
85004	Norton Hambleton Inc	Reverse Column Flotation Coal Cleaning	CC Tech	200,000	Ven Cap	Terminated
85005	Penn State University	CDS via Steam/Methane Pyrolysis	CC Tech	35,000	Grant	Complete
85006	R.A. Systems	Water Jet Assisted Coal Shearer	Bit Dev	27,000	Ven Cap	In Progress
85007	SEDA-COG	Primer on Domestic Anthracite Use	Anth Dev	29,000	Grant	Complete
85009	PA Coal Mining Association	LV Coal in Utility Boilers - Phase I	Bit Dev	58,783	Grant	Complete
85010	Anthracite Industry Assn	Anthracite Marketing and Conversions	Anth Dev	259,380	Grant	Complete
85011	Continental Cogen Corp	Anthracite Gasification	Anth Dev	35,000	Grant	Complete
85015	Hess & Fisher Engineering	Acid Mine Drainage Control Structures	Bit Dev	31,475	Grant	In Progress
85016	University of Pittsburgh	Liquid CO2 (LICADO) Coal Cleaning	CC Tech	84,908	Grant	In Progress
85020	SEDA-COG	Heating Systems Conversion Feasibility	Anth Dev	10,000	Grant	Complete
85024	Kipin Industries Inc	Coal and Waste Co-Processing	Bit Dev	200,000	Ven Cap	Terminated
85025	Meadville Industrial Comm	Cogeneration Feasibility	Bit Dev	10,000	Grant	Complete
85026	PA Coke Technology, Inc	Non-Recovery Coke Production	CC Tech	350,000	Grant	Rescinded
85027	Coal Tech Corporation	Advanced Cyclone Combustor - Stage III	CC Tech	200,000	Grant	Complete
85028	Penn State University	SO_2 Sorbent Evaluation	CC Tech	25,000	Grant	Complete
85030	EXPORTech Company Inc	Magnetic Coal Cleaning - Phase I	CC Tech	15,934	Grant	Complete
85031	Lehigh University	Microbial Coal Desulfurization	CC Tech	50,000	Grant	Complete
85032	Penn State University	Surface Mining Software Development	Bit Dev	43,447	Grant	Complete
85035	Wilkes College ACDI	Anthracite Operators' Assistance	Anth Dev	154,685	Grant	Complete
86002	BCR National Laboratory	Reactive Gas Coal Desulfurization - II	CC Tech	114,983	Grant	Complete
86004	University of Pittsburgh	Controlled Burnout - Coal Refuse Piles	Gen Coal	149,931	Grant	In Progress
86006	Penn State University	Mechanical Coal Cleaning Efficiency	CC Tech	33,727	Grant	Complete
86007	BCR National Laboratory	LV Coal in Utility Boilers - Phase II	Gen Coal	198,340	Grant	In Progress
86008	PA Electric Company	Low NOx Burner Demonstration	CC Tech	400,000	Grant	In Progress
86009	PA Electric Company	CZD SO2 Reduction Demo - Phase I	CC Tech	100,000	Grant	Complete
86014	BCR National Laboratory	Ultrasonic Dewatering of Coal	Gen Coal	40,367	Grant	Terminated
86018	Anthracite Industry Assn	Anthracite Marketing and Conversions	Anth Dev	210,500	Grant	Complete
86022	Heyl & Patterson Inc	Micro-Bubble Flotation Coal Cleaning	CC Tech	150,000	Ven Cap	Terminated
86026	BCR National Laboratory	Coal/MSW Pyrolysis	Gen Coal	73,255	Grant	Complete
86028	Anthracite Industry Assn	Anthracite Trade Show	Anth Dev	26,505	Grant	Complete
86031	Humenick Wood Products	Wood Waste Combustion and Heat System	Non-Coal	24,108	Grant	Complete
86033	GRASP	Biothermal Composting Greenhouse	Non-Coal	33,960	Ven Cap	Rescinded
86035	EDCNP	Anthracite Development and Promotion	Anth Dev	15,810	Grant	Complete
86041	PA Anthracite Dev Corp	Anth Exploration with Radio Imaging	Anth Dev	30,000	Ven Cap	Rescinded
86043	Penn State University	Acid Mine Drainage Model	Gen Coal	142,175	Grant	In Progress
86046	EXPORTech Company Inc	Magnetic Coal Cleaning - Phase II	CC Tech	18,996	Ven Cap	Complete

TABLE 2
(Continued)

PEDA FUNDED RD&D PROJECTS SUMMARY

Project Number	Contractor	Purpose	Project Category	PEDA Alloc	Alloc Type	Status
87001	Lehigh University	Fluidized Bed Coal Cleaning - Phase II	CC Tech	86,405	Grant	In Progress
87003	GE Transport Systems	CWF-Fired Diesel Elec Locomotive - I	CC Tech	200,000	Ven Cap	In Progress
87005	CEEP Inc	Gasoline Vapor Recovery System	Non-Coal	44,959	Ven Cap	Rescinded
87006	PA Electric Company	CZD SO2 Reduction Demo - Phase II	CC Tech	250,000	Ven Cap	Provisional
87010	PA Electric Company	CWF Combustion Tests and Demonstration	CC Tech	182,800	Grant	Dr Contract
87016	Lehigh University	FGC Catalyst-Sorbent Optimization	CC Tech	72,912	Ven Cap	In Progress
87022	Anthracite Industry Assn	Anthracite Promotion to Utilities	Anth Dev	230,000	Grant	In Progress
87023	Coal Dynamics Corp	Controlled Burnout - Deep Mine	Gen Coal	162,454	Ven Cap	Rescinded
87024	Control Techtronics Inc	Combustion Control Software Mod	CC Tech	25,000	Ven Cap	In Progress
87030	Penn State University	Coal Market/Quality Database Update	Gen Coal	18,028	Grant	In Progress
87033	Rodale Research Center	Reduced Tillage for Energy Efficiency	Non-Coal	55,067	Grant	In Progress
87037	Florence Mining Company	Coal Cleaning (Agglomeration Enhance)	CC Tech	35,000	Ven Cap	Rescinded
87038	Good Samaritan Hospital	Hosp Waste Incin in Coal-Fired CFBC	Anth Dev	60,000	Grant	Dr Contract
87045	EXPORTech Company Inc	Magnetic Cleaning of Fine Coal	CC Tech	21,134	Ven Cap	In Progress
87047	Energy Devel Services	Wind Data Acquisition	Non-Coal	14,000	Ven Cap	Rescinded
87052	Somerset Rural Elec Coop	Improved Industrial Energy Conserv	Non-Coal	44,934	Loan	In Progress
87053	BCR National Laboratory	Coal Desulfur in Rot Kiln Combustor	CC Tech	172,124	Ven Cap	Dr Contract
87055	GRASP	Energy Efficiency Gains in Row Homes	Non-Coal	45,000	Grant	In Progress
88001	GE Transport Systems	CWF-Fired Diesel Elec Locomotive - II	CC Tech	200,000	Ven Cap	Dr Contract
88003	PA Farmers' Association	Technical Assistance - Ag Energy Appl	Non-Coal	50,000	Loan	Rescinded
88007	Renewable Energy Inst	Wind Data Acquisition	Non-Coal	18,000	Ven Cap	Dr Contract
88009	Penn State University	Short Longwall Feasibility	Gen Coal	36,902	Grant	In Progress
88015	Coal Tech Corporation	Advanced Cyclone Combustor Demo	CC Tech	50,000	Ven Cap	In Progress
88024	PA Electric Company	Weathered Coal Combustion Performance	Gen Coal	70,000	Grant	Provisional
88025	Lehigh University	FGC Catalyst-Sorbent Pilot Testing	CC Tech	40,152	Ven Cap	Provisional
88030	Penn State University	Mining Permit Review Software	Gen Coal	69,546	Grant	Provisional
88033	Good Samaritan Hospital	Hosp Waste Incin in Coal-Fired CFBC	Anth Dev	98,682	Grant	Dr Contract
88034	Drexel University	RDF Combustion Characterization	Non-Coal	107,054	Grant	Provisional
88036	US Department of Energy	Anthracite R&D Needs Assessment	Anth Dev	20,000	Grant	In Progress

CATEGORICAL DISTRIBUTION OF PROJECTS
(through five years of program)

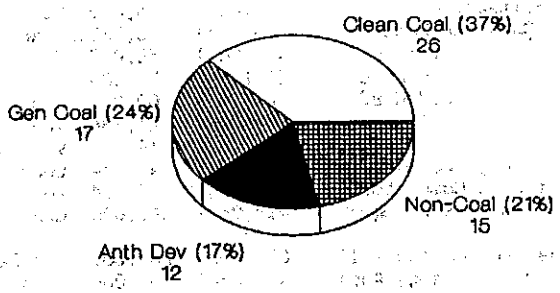

Figure 1

CATEGORICAL DISTRIBUTION OF PROJECTS
(FY 1988)

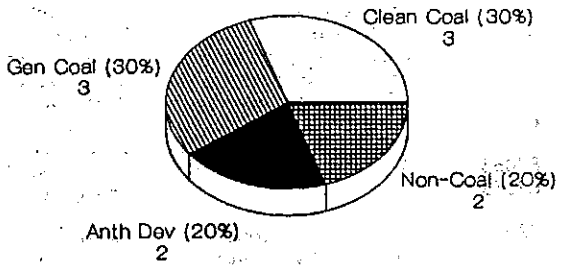

Figure 4

DISTRIBUTION OF PEDA FUNDS
(through five years of program)

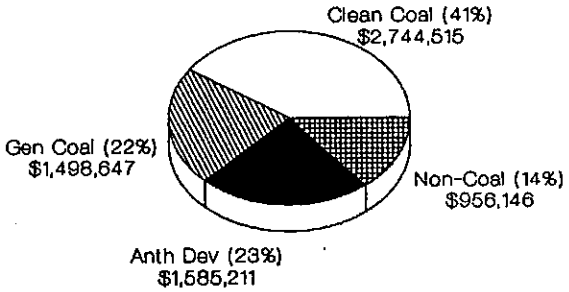

Figure 2

DISTRIBUTION OF PEDA FUNDS
(FY 1988)

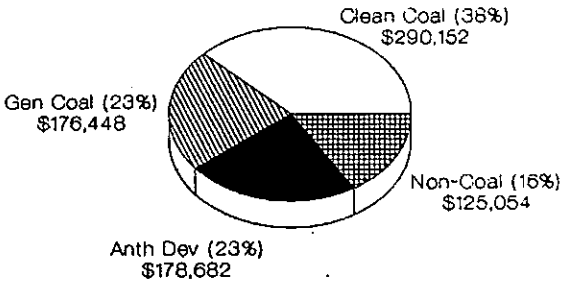

Figure 5

TOTAL COST
(through five years of program)

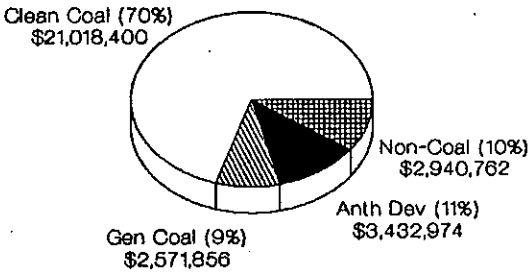

Figure 3

TOTAL COST
(FY 1988)

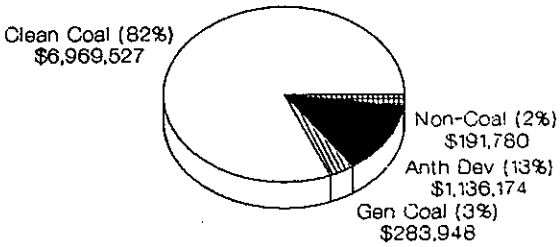

Figure 6

participants. Cost sharing figures by co-participants per each PEDA dollar for general coal development, anthracite development and non-coal development are $0.73, $1.13 and $2.06, respectively.

In FY 1988, PEDA received 35 applications for energy RD&D-related financial assistance, with a stated total value of approximately $14.4 million; the aggregate request for Authority funds was about $4.4 million. The board committed $770,336 to 10 projects worth roughly $8.6 million.

The majority of PEDA's funding was oriented toward clean coal technology development in FY 1988 (Figures 4-6). This fact is reinforced by looking at total cost (Figure 6) -- clean coal technology projects account for roughly 80% of PEDA-sponsored energy RD&D effort. Anthracite development projects will combine $180,000 in PEDA funds with $960,000 from other sources to foster $1.4 million in anthracite-associated activity. Interestingly, the distribution of PEDA funds to FY 1988 projects mirrors the historical distribution (compare Figures 2 and 5).

The composition of PEDA RD&D project costs is presented graphically in Figure 7. FY 1988 was the most successful one to date in terms of attracting co-participant financial participation in projects funded by the Authority. The co-participant contribution versus each Authority dollar committed to FY 1988 projects ratio is $10.13, as opposed to $4.65 in FY 1987 and $3.42 through the five year history of the Authority's financial assistance program. Over the last two years, GE Transportation System's multi-year, multi-million dollar effort to develop and demonstrate a coal-water fuel fired diesel electric locomotive has been a significant factor in the growth of co-participant cost sharing.

In FY 1988, co-participants in PEDA-funded energy RD&D projects have committed to bear 91% of total project cost whereas in FY 1987 they carried 82% of costs associated with projects (Figure 8). Overall, co-participants have been responsible for 77% of the costs related to projects supported by the Authority. PEDA continued to improve its ability to attract co-participant financial commitment to energy-related RD&D projects in this fiscal year. This participation has come from industry, utilities, universities, equipment vendors, local and federal agencies, non-profit groups and other interested parties.

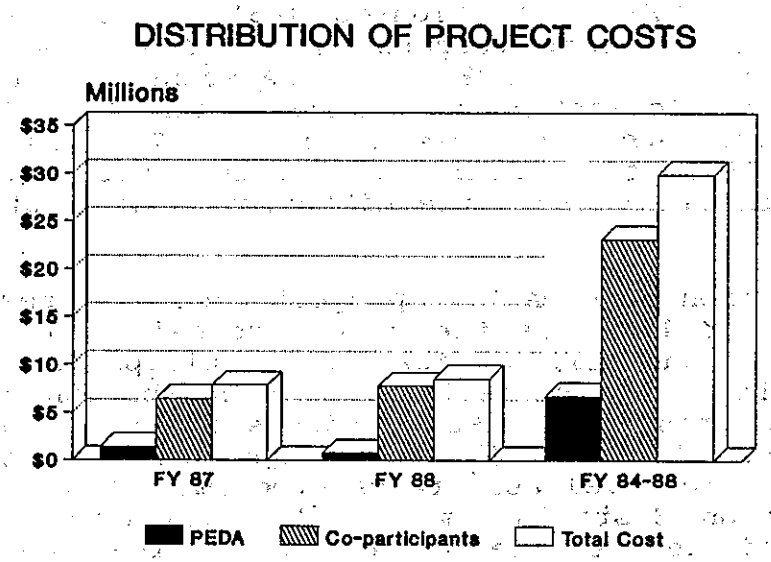

Figure 7

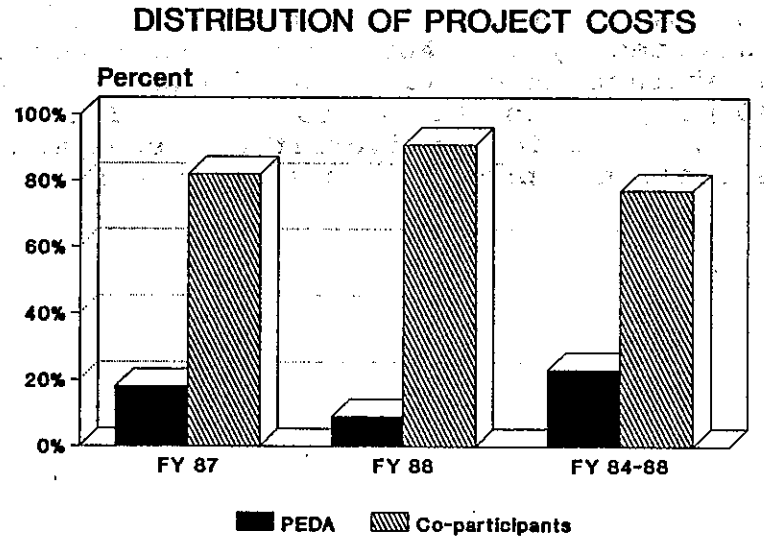

Figure 8

PEDA PROJECT HIGHLIGHTS

Introduction

The Authority's energy development and conservation program is summarized in the following paragraphs. Table 1 presents concise information on the three commercial energy projects for which PEDA has issued revenue bonds. Synoptic data for PEDA RD&D projects are supplied in Table 2. For discussion on Authority RD&D projects completed in FY 1988, refer to Appendix A; RD&D projects in progress are described in Appendix B.

Commercial Projects

The Authority is involved in three coal-related commercial scale energy projects -- Humboldt Energy Center, Ebensburg Cogeneration Plant and the Clarion Project -- via approximately $167 million in PEDA revenue bonds (Table 1). These projects will dispose of refuse from historic coal mining activity which is an environmental hazard (for example, source of acidic run-off and site of spontaneous combustion fires). Jointly, the projects will employ about 400 workers during peak construction; permanent employment will be provided to roughly 65 persons. The $258 million corporate project cost suggests an initial influx of millions of dollars into Pennsylvania's economy, with sustained monetary and tax revenue flows for many years thereafter.

Humboldt Energy Center

The Humboldt Energy Center (HEC) is a 135 megawatt, anthracite refuse-fueled integrated gasification combined cycle cogeneration plant located in the Humboldt Industrial Park near Hazleton. The plant is fully constructed and in its final commissioning stage. HEC has been selling 100 megawatts of power to Pennsylvania Power & Light Company since March 1989. Due to this facility, additional tenants have been attracted to the industrial park, resulting in a doubling of employment.

Ebensburg Cogeneration Plant

Construction of the Ebensburg Cogeneration Plant (ECP), a 52 megawatt bituminous coal refuse fired fluidized bed combustion installation, is underway, with the facility currently 10% complete. Engineering, procurement and construction activities are proceeding generally on schedule. Preparation of the Revloc refuse site (source of feedstock for the plant) continues, with creation of discharge ponds and widening of the access road to the site.

Clarion Project

Proceeds of the PEDA bond issue for the Clarion Project, a bituminous coal refuse fired fluidized bed combustion small power production facility, are being held in escrow pending completion of Clarion Power Company's plans to increase the generating capacity of the plant from 26 to 30 megawatts. Supplemental tax-exempt financing for this project, through the Clarion County Industrial Development Authority, is expected to be completed early in 1990.

Clean Coal Technology Projects

Categorically, PEDA's 26 clean coal technology projects are distributed as follows: pre-combustion, 12 (46%); emissions reduction during combustion, 7 (27%); flue gas clean-up, 4 (15%); and conversion of coal to a cleaner fuel, 3 (11%). Generally, the Authority's clean coal technology projects center on research and development, with only limited demonstration. However, several projects will benefit the environment by reducing pollutants at commercial sites.

Promising pre-combustion coal cleaning projects at the research level include Lehigh University's fluidized bed approach, the University of Pittsburgh's LICADO (Liquid Carbon Dioxide) process, and EXPORTech Company Inc.'s inquiries into magnetic separation. The LICADO process shows commercial promise; it has attracted the interest of the US Department of Energy and Westinghouse Electric Corporation. Three demonstration projects are focused on capturing or reducing noxious products from coal during combustion: Coal Tech Corporation's advanced slagging cyclone coal combustor, Pennsylvania Electric Company's low NO_x burner and BCR National Laboratory's rotary kiln combustor. Pennsylvania Electric Company's Confined Zone Dispersion demonstration and Lehigh University's research into a catalyst-sorbent for treating flue gas are examples of post-combustion clean-up projects.

Two projects aimed at coal-fired utilities, BCR National Laboratory's ongoing work to market low volatile bituminous coal (LV coal) and the Anthracite Industry Association's effort to promote anthracite and anthracite/bituminous coal blends, though not strictly in the realm of clean coal technology, do have a place in an emissions reduction strategy. LV coal and anthracite are inherently low in sulfur; however, other characteristics, such as combustion performance, heretofore have made them unattractive to coal-fired utilities. The objective of these projects is to provide current insight into the combustion behavior and handling of LV coal, blends of LV coal and higher volatile bituminous coal, anthracite, and anthracite/bituminous coal blends. This work should enable utility officials to make informed choices regarding fuels for their coal-fired power plants.

BCR National Laboratory's LV coal utilization project has been successful thus far. Three utilities, New England Power Service Company, United Illuminating Company, and Pennsylvania Electric Company have cooperated with, and committed information to, the technical

research component of the project. Results from this research have been presented to officials of these utilities. Decisions regarding full-scale test burns of LV coal should be known by the end of 1989. If one of these utilities decides to fire at least one of its boilers with LV coal, hundreds of thousands of tons of Pennsylvania LV coal would be required to fuel this unit. The anthracite promotion effort has also been successful so far; New York State Electric and Gas Company has agreed to participate in research related to firing anthracite at Jennison Station, a stoker plant near Binghamton.

Coal and Waste Co-Firing Projects

Good Samaritan Hospital's project to dispose of pathologic and infectious hospital waste in a coal-fired circulating fluidized bed combustor (CFBC) is a novel means of disposing hazardous material. Coal will supply the heat necessary to destroy harmful byproducts associated with combustion of hazardous waste. Initial results from this project indicate incinerating hospital waste in a CFBC is technically feasible.

BCR National Laboratory's rotary kiln combustor project will involve co-firing coal and waste in a rotary kiln for waste disposal and steam production. This project's innovative feature is introduction of limestone into the kiln to reduce SO_2 emissions. Historically, coal-fired kilns have been used in basic industry (e.g. cement manufacturing); however, they were not employed with concern for emissions. This project is a new application of existing technology.

Non-Coal Development Projects

Currently, five non-coal projects are part of the Authority's energy RD&D program. These projects deal with increased energy efficiency in rowhouses, industry and agriculture, and renewable resources assessment and utilization. As an example, the Grass Roots Alliance for a Solar Pennsylvania, a Philadelphia-based non-profit organization, is making progress in developing treatments for rowhouses which will result in lower utility bills and greater comfort for their occupants. The board is optimistic these projects, as well as future ones, will result in balance between the Authority's coal and non-coal initiatives.

FISCAL STATUS

PEDA ended FY 1988 with a net available balance of $2,352,382. Though the Authority has total assets of $5,004,987, $2,652,606 are committed to projects ($2,605,714) and operations ($46,892), but not yet spent. Administration costs, including personnel, operating and fixed assets expenses, totaled $226,928. However, the Authority received $426,892 in interest from funds invested by the State Treasurer. The board is pleased to report PEDA's operation imposed no costs to taxpayers, and the full amount of Commonwealth funds was available for financial assistance. Summaries of the Authority's fiscal status are presented in Tables 3, 4, 5 and 6. These statements were prepared by the Comptroller's Office, Commonwealth of Pennsylvania.

TABLE 3

PENNSYLVANIA ENERGY DEVELOPMENT AUTHORITY

STATEMENT OF FUNDS AVAILABLE

INCEPTION OF FUND TO JUNE 30, 1989

RECEIPTS		
Transfer from General Fund	$8,800,000.00	
Interest on Investments	1,508,233.58	
Commitment Fees	100,750.00	
Application Fees	16,600.00	
Venture Capital Repayments	1,126.99	
Reimbursement - Operating Expenditures	5,000.00	
AVAILABLE FOR DISBURSEMENT		$10,431,710.57
DISBURSEMENTS		
Grants/Venture Capital	$4,447,520.26	
Operating Expenses	979,203.26	
Total Disbursements	$5,426,723.52	
TOTAL FUNDS AVAILABLE		$5,004,987.05

TABLE 4

PENNSYLVANIA ENERGY DEVELOPMENT AUTHORITY

BALANCE SHEET

JUNE 30, 1989

ASSETS			
Cash			$ 18.74
Short Term Investments			4,964,000.00
Accrued Interest			40,968.31
TOTAL ASSETS			$5,004,987.05
LIABILITIES & NET WORTH			
LIABILITIES			
TOTAL LIABILITIES			$ 0.00
NET WORTH			
General Fund Appropriations	$8,800,000.00		
Grant Disbursements	4,447,520.26		
		$4,352,479.74	
Net Earnings from Operations		652,507.31	
			$5,004,987.05
TOTAL LIABILITIES AND NET WORTH			$5,004,987.05

TABLE 5

PENNSYLVANIA ENERGY DEVELOPMENT AUTHORITY

COMPARATIVE STATEMENT OF FUNDS AVAILABLE

FOR THE TWELVE MONTH PERIOD ENDING JUNE 30

	1988		1989	
TOTAL AVAILABLE FUNDS - July 1		$3,638,424		$4,161,643
RECEIPTS				
Transfer from General Fund	$1,300,000		$1,500,000	
Interest on Investments	303,339		426,892	
Commitment Fees	0		25,000	
Application Fees	5,650		3,700	
Venture Capital Repayments	0		73	
Reimbursement - Operating Expenditures	0		0	
Total Receipts		$1,608,989		$1,955,665
AVAILABLE FOR DISBURSEMENT		$5,247,414		$6,117,308
DISBURSEMENTS				
Grants/Venture Capital	$ 894,315		$ 885,392	
Operating Expenses	191,455		226,928	
Total Disbursements		$1,085,770		$1,112,320
GROSS FUNDS AVAILABLE		$4,161,644		$5,004,988 (a)
COMMITMENTS				
Grants/Venture Capital	$3,213,413		$2,605,714 (b)	
Operating	85,250		46,892	
Total Commitments		$3,298,663		$2,652,606
NET FUNDS AVAILABLE		$ 862,981		$2,352,382 (c)

(a) Cash, $20; Investments, $4,964,000; Interest, $40,968
(b) Encumbered, $975,535; Unencumbered, $1,630,179
(c) Unexpended/uncommitted funds at close of fiscal year

TABLE 6

PENNSYLVANIA ENERGY DEVELOPMENT AUTHORITY

RECONCILIATION OF COMMITMENTS

JUNE 30, 1989

M.E.	Contractor	Commitments	Disbursements	Balance
485-006	R.A. Systems	27,000.00	16,916.00	10,084.00
485-015	Hess & Fisher Engineers	31,475.00	15,589.00	15,886.00
485-016	University of Pittsburgh	84,908.00	59,102.83	25,805.17
485-027	Coal Tech Corporation	200,000.00	178,472.32	21,527.68
485-035	Wilkes College	125,000.00	76,883.92	48,116.08
*485-035	Wilkes College	29,685.00	0.00	29,685.00
486-004	University of Pittsburgh	149,931.00	74,487.05	75,443.95
486-007	BCR National Laboratory	271,715.00	237,354.59	34,360.41
486-008	PA Electric Company	400,000.00	0.00	400,000.00
486-043	Penn State University	142,175.00	86,992.45	55,182.55
487-001	Lehigh University	86,405.00	0.00	86,405.00
487-003	GE Transportation Sys	200,000.00	150,000.00	50,000.00
*487-006	PA Electric Company	250,000.00	0.00	250,000.00
*487-010	PA Electric Company	182,800.00	0.00	182,800.00
487-016	Lehigh University	72,912.00	43,252.66	29,659.34
*487-022	Anthracite Industry Assn	200,300.00	0.00	200,300.00
487-022	Anthracite Industry Assn	29,700.00	8,310.89	21,389.11
487-024	Control Techtronics Inc	25,000.00	10,004.46	14,995.54
487-030	Penn State University	18,028.00	2,373.41	15,654.59
487-033	Rodale Research Center	55,067.00	22,239.42	32,827.58
*487-038	Good Samaritan Hospital	60,000.00	0.00	60,000.00
487-045	Exportech Company Inc	21,134.00	16,824.00	4,310.00
*287-052	Somerset Rural Elec Coop	44,934.00	0.00	44,934.00
*487-053	BCR National Laboratory	172,124.00	0.00	172,124.00
487-055	GRASP	45,000.00	31,112.05	13,887.95
*488-001	GE Transportation Sys	200,000.00	0.00	200,000.00
*488-007	Renewable Energy Inst	18,000.00	0.00	18,000.00
488-009	Penn State University	36,902.00	0.00	36,902.00
488-015	Coal Tech Corporation	50,000.00	0.00	50,000.00
*8834-024	PA Electric Company	70,000.00	0.00	70,000.00
*8834-025	Lehigh University	40,152.00	0.00	40,152.00
*8834-030	Penn State University	69,546.00	0.00	69,546.00
*8834-033	Good Samaritan Hospital	98,682.00	0.00	98,682.00
*8834-034	Drexel University	107,054.00	0.00	107,054.00
*8834-036	US Department of Energy	20,000.00	0.00	20,000.00
	Total	$3,635,629.00	$1,029,915.05	$2,605,713.95

* Unencumbered Commitments

APPENDIX A

PEDA RD&D PROJECTS COMPLETED IN FISCAL YEAR 1988

Project 85027: Coal Tech Corporation (CTC) was a successful applicant in the first round of the U.S. Department of Energy's Innovative Clean Coal Technology Program for support of its advanced slagging cyclone coal combustor demonstration. This combustor is capable of being retrofit to oil/gas design industrial and utility boilers. The combustor is capable of controlling SO_2 and NO_x emissions to near New Source Performance Standards, while retaining and rejecting ash, sorbent and solid sulfur compounds as slag before combustion gases enter the boiler.

CTC's combustor was operated for nearly 400 hours in this project. Extensive parametric testing was performed and data collected on combustion efficiency, slag retention, NO_x and SO_2 reductions, effluent characteristics, and combustor durability. Accomplishments include: (1) testing of four Pennsylvania coals, with sulfur levels as great as 2.8%; (2) reduction in NO_x emissions to as low as 184 ppm; (3) consistent slag retention in the combustor in the 70-80% range; (4) determination that the slag is environmentally inert; (5) measurements of SO_2 which suggest a 90% reduction in this pollutant at an injected sorbent mole ratio (calcium/sulfur) of 3.

For discussion of additional activity relative to CTC's advanced coal combustor, please refer to Project 88015 in Appendix B.

Project 85031: Lehigh University conducted fundamental research on bioprocessing of coal. The initial focus of this project was to establish and evaluate the potential of *Sulfolobus acidocaldarius* in removing organically bound sulfur in coal. Although Lehigh scientists were unable to achieve much success with *S. acidocaldarius*, they were able to detect, isolate, and partially characterize soil bacteria with the capacity to desulfurize dibenzothiophene (DBT) - an organic compound containing sulfur. This research established that soil isolates which have the capacity to transform DBT, with or without desulfurization, are abundant; a quick, easy, positive, presumptive and reliable fluorescence-based assay has been developed to detect this capacity. The mechanism by which the desulfurization occurs is unknown but genetic analyses which will be informative about the basis of the activity have begun. Attempts to grow *S. acidocaldarius* in continuous culture continue.

Project 85035: The Anthracite and Community Development Institute of Wilkes College assisted small- and medium-size anthracite operations in northeastern Pennsylvania through its Coal Operators Assistance Program (COAP). The COAP provided marketing and technical aid, advice on compliance with state and federal mining regulations, and financial counseling. The COAP serviced 130 operators in Pennsylvania's anthracite region.

Activities during the project included marketing and(or) technical assistance in international trade development, government supply contract procurement, and residential heating system conversions; compilation of an Anthracite Producers Directory; guidance in meeting state and federal mining regulations; help with financing and bonding problems; and, conduct of training seminars and workshops.

Project 86006: Pennsylvania State University investigated the distribution of sulfur in the Upper and Lower Clarion coal seams, being mined by C & K Coal Company in Clarion County, as well as the potential for improving sulfur removal from these coals at Piney Tipple, the company's coal cleaning plant. The project involved (1) characterization of the sulfur forms, high temperature ash, total sulfur, and distribution of pyrite size and morphology in the coals; (2) determination of the modes of occurrence of pyritic sulfur; (3) evaluation of the efficiency of the washing procedure at the Piney Tipple; and, (4) suggestion of changes (if any) in the washing procedure at the Piney Tipple that might produce a cleaner coal product.

As a result of this study, three suggestions were offered to C & K Coal Company to enable production of cleaner product: (1) excluding portions of seams which contain a large proportion of disseminated pyrite during stripping operations; (2) crushing coal being fed to the cleaning plant to finer size (1 in, maximum) to free larger pyrite particles; and , (3) employing lower specific gravity liquids to affect better separation between coal and mineral matter.

Project 86018: The Anthracite Industry Association completed the following activities to promote anthracite: production of a video sales presentation; placement of radio news spots; conduct of preliminary tasks for an anthracite trade show; and, placement of trade journal advertisements. Additionally, several facilities had their heating systems converted to anthracite-fired equipment: Northumberland County Prison, Sunbury; Grace Lutheran Church, Shamokin; R.J. Glass Company, Altoona; West Snyder High School, Beaver Springs; West End Fire Company, Mahanoy City; and Tremont Community Center.

Project 86035: The Economic Development Council of Northeastern Pennsylvania (EDCNP) finished a project aimed at furnishing technical assistance to small producers and exporters seeking to market anthracite to Korea and other Far Eastern countries. To complete this project, EDCNP (1) reviewed existing specifications of the Korean anthracite market and made recommendations on reasonable specifications that are consistent with this market; and, (2) sampled and analyzed selected anthracite silt ponds, anthracite refuse banks and processed anthracite, and thereafter offered recommendations to achieve effective quality control. The second task included evaluating the mixing ratio of different anthracite and anthracite waste feeds to meet calorific value requirements, and assessing mixing methods to ensure uniform quality.

EDCNP concluded Pennsylvania anthracite can meet the specifications of Far Eastern markets, with the exception of moisture content. To benefit

both buyer and seller, the basic moisture requirement should be raised from 7% to 10%, and the limit from 13% to 15%. In order to reduce discrepancies between buyer and seller as a result of differing test procedures, the current air dry basis heat value criterion should be changed to a dry basis measure.

In parallel to this project, EDCNP conducted a comprehensive study of foreign markets for anthracite under contract to the US Department of Energy.

Project 86046: EXPORTech Company, Incorporated's (ETCi) project continued its initial inquiry, under Project 85030 (see Appendix A of Annual Report for Fiscal Year 1986-87), into dry magnetic separation (DMS) as a physical coal cleaning method. In this project, ETCi extended its earlier work by beneficiating Lower Kittanning coal fractions ranging from 30 mesh to 8 mesh topsize. The ability to beneficiate larger sizes of coal is integral to commercialization of DMS as a beneficiation process.

As an example of the effectiveness of ETCi's magnetic separation process, a 30x50 mesh coal fraction, containing 11.49% ash and 4.98% sulfur, was cleaned to a product containing 6.04% ash and 2.39% sulfur, at 84% weight recovery. Reductions in ash and sulfur were approximately 50% from initial values. The results of this research suggest beneficiation of coarse coal sizes via DMS is limited by liberation of mineral matter during crushing, not magnetic separator technology.

APPENDIX B

PEDA RD&D PROJECTS IN PROGRESS

Project 85006: R.A. Systems (RAS) is developing a cutting drum with built-in pressure intensifier for water-jet assisted cutting on a longwall shearer. A pressure intensifier located in the cutting drum, and powered by it, solves the current technical problem of distributing high pressure water to the cutting drum of coal winning machines. Water-jet assisted cutting significantly reduces the mechanical forces on cutting tools and enhances mine safety by lowering dust levels in underground mines.

Project objectives are: (1) to solve technical problems through bench testing of selected components to assess the feasibility of intensifying pressure in a cutting drum; (2) to build a cutting drum equipped with a water pressure intensifier that is retrofittable on existing longwall shearers; (3) to determine optimum parameters (e.g. water pressure) for the drum from step 2, with surface tests; and, (4) to install the modified cutting drum on a shearer and use it to excise coal from a longwall face. Currently, RAS is seeking a host for final tests, underground, on a longwall panel.

Project 85015: Hess & Fisher Engineers, Inc. is evaluating alternative sediment and erosion control methods. This study's main objective is to obtain quantifiable data to provide regulatory agencies with documentation to justify use of innovative sediment control techniques. Results from this study will be disseminated to Pennsylvania's surface mining industry.

Data collection has been completed. Initial data analysis indicates the innovative ripped zone works at least as well at controlling sediment runoff as the area with conventional ditches. The Final Report on this project is imminent.

Project 85016: The University of Pittsburgh's LICADO (liquid CO_2) coal cleaning study is in its second phase. The LICADO process, invented by the University of Pittsburgh, uses liquid CO_2 as a medium to beneficiate ultra-fine coal (-200 mesh).

Phase I work focused on the mechanism of the LICADO process and its effectiveness in producing clean coal. Phase I experiments were conducted in a batch reactor. Salient results from Phase I work are: (1) change of coal/water slurry concentration (from 3% to 17%) has only a minor effect on clean coal ash content and product yield; (2) clean coal quality is favored by using a low liquid CO_2 injection rate, without significantly decreasing product yield or Btu recovery; (3) mixing in the water phase improves product yield (Btu recovery), while mixing in the liquid CO_2 phase has an opposite effect on yield; and, (4) significant sulfur reduction occurs during the cleaning process, for example, Pennsylvania's Upper Freeport bituminous coal containing 23.4%

ash and 1.30% total sulfur was cleaned to a product containing 3.8% ash and 0.74% total sulfur, with 75% Btu recovery and minimal moisture content in single-stage processing.

Phase II studies are in progress. Phase II comprises three tasks: equipment development, testing of continuous operation, and engineering and economic analysis. A 10 lb/hr continuous contact LICADO circuit is currently being operated to examine factors that affect clean coal quality and yield as functions of operating conditions, and to provide a database for commercial development of the LICADO process. Tests with Upper Freeport coal have yielded high clean coal values, with good separation between coal and mineral matter.

Project 86004: The University of Pittsburgh is involved in a project focused on energy production from controlled burnout of coal refuse piles in Pennsylvania. Burnout Control is a technique that employs ventilation and suction to accelerate combustion of a waste coal pile until extinction. These refuse deposits possess calorific values ranging between 2,000 and 6,000 Btu/lb; they are both an unused potential energy source and an environmental hazard. Laboratory research has included characterizing and evaluating properties of coal waste piles in Pennsylvania for suitability to Burnout Control, and correlating thermal energy potential to properties of waste coal piles.

Project objectives are: (1) to provide the background required for selecting suitable coal refuse sites within Pennsylvania for energy production via Burnout Control; (2) to gain a basic understanding of potential emissions necessary for preliminary design of environmental control technology and development of environmental permits; and, (3) to establish commercialization criteria for Burnout Control, to serve as guidelines for sampling for laboratory studies and commercial energy development.

Initial commercialization criteria for the Burnout Control process have been completed. A 25 MW site with a 32 yr burn life is economically feasible if $.05/kwh of generated electricity can be obtained; a 5 MW plant with a 32 yr burn life requires an avoided cost of $.07/kwh to be financially viable. Tests of coal refuse samples in the simulated Burnout Control system are complete, as are studies of the ash resulting from these tests. The Final Report on this work is imminent.

Project 86007: As described under Project 85009 in Appendix A of the Final Report for Fiscal Year 1987-88, the Pennsylvania Coal Association initiated, and BCR National Laboratory is continuing, a three-phase project to introduce low volatile Pennsylvania bituminous coal (LV coal) into utility boilers. LV coals may be a technically and economically viable SO_2 emissions compliance option for utilities in the northeastern United States.

Phase II addressed the participating utilities' (New England Power Service Company, United Illuminating Company, Pennsylvania Electric Company) concerns relative to burning LV coal through (1) utilizing

previously published empirical data as well as combustion test results, coal experiences, laboratory combustion sensitivity tests, baseline coal characteristics investigations, and full scale LV coal demonstration burns for comparison with laboratory data developed in this phase; (2) performing laboratory tests directed toward understanding the handling, combustion, and emissions characteristics of the participating utilities' baseline coals, selected LV coals and chosen coal blends; (3) determining how selected LV coals would perform in the participating utilities pulverized coal boilers under potential worst case conditions (100% LV coal); (4) establishing correlations between full scale and laboratory empirical data which can be used to identify potential problems before they occur in a utility boiler; and, (5) assessing the cost competitiveness of LV coals for delivery to the participating utilities' target power plants.

Results from Phase II revealed no major problems with the combustion, emissions, and boiler operating characteristics of the tested LV coals, as related to the target boilers. This assessment holds under projected worst case conditions or when LV coals are blended with existing baseline coals. Economically, LV coals can be mined competitively and should maintain a distinct transportation advantage, over compliance coals from other states, for the participating utilities. Currently, the project team is awaiting a firm commitment from one of the participating utilities to begin Phase III -- conduct of an LV coal test burn program.

Project 86008: Pennsylvania Electric Company is hosting a project to demonstrate a low NO_x burner at its Homer City Generating Station in Indiana County, Pennsylvania. This demonstration is part of a program sponsored by the Electric Power Research Institute (EPRI) to evaluate the performance of low NO_x burner systems. The low NO_x burner will be retrofitted to a pre-1971 New Source Performance Standards boiler. Comparisons between data obtained before, immediately after, and well after burner conversion will accurately and conclusively assess performance of the selected low NO_x burner system. Low NO_x burners appear to be the simplest and cheapest means of achieving significant NO_x reductions in emissions from utility boilers.

Baseline testing was conducted by EPRI in Fall 1988. New air registers were installed in late 1988; preliminary measurements of NO_x emissions after this installation showed a 15-20% reduction from pre-installation levels. New burner barrels and tips await installation. EPRI will continue working on this project through 1991.

Project 86043: Pennsylvania State University is engaged in a project to develop a statistical model to predict acid mine drainage (AMD) from proposed coal mining sites. The goal is to produce a model that predicts AMD more accurately than current methods. The AMD model will be based on the correlative behavior among the amount and reactivity of pyrite in coal, the amount and form of carbonate components in overburden, and leachate data gathered from simulated weathering experiments.

The project comprises three tasks: (1) overburden characterization via (a) quantitative phase characterization based upon x-ray diffraction analysis, (b) grain-size distribution measurement of pyrite grains in selected samples with computer-controlled scanning electron microscopy, and (c) quantification of the reactivity and amount of pyrite and carbonate minerals by evolved gas analysis; (2) simulated weathering (leaching) experiments to study rates and quantities of acid production; and, (3) development of a predictive model based upon data collected from Tasks 1 and 2.

Six mine sites have been sampled as part of this project. This effort, which is now complete, resulted in collection of 316 samples. Progress has been made on overburden characterization and simulated weathering experiments. One result from this research has been the development of a simple and cheap modification to improve the current method of determining the acid neutralization potential of overburden.

Project 87001: Lehigh University has been investigating the application of fluidization to coal cleaning (refer to Project 84016 in Appendix A of the FY 1987-88 Annual Report). The second phase of this project is intended to develop fluidized bed coal cleaning to the point where field demonstration of the technology can be attempted. At least three Pennsylvania coals will be evaluated in the course of this project.

Objectives of the Phase II project are: (1) to obtain additional results on fluid bed coal cleaning system performance and use them to develop standardized performance measures for comparison with other coal cleaning methods; (2) to improve the understanding of particle stratification mechanisms to permit identification of optimum system design and operating conditions; (3) to develop data needed for refining system design and improving system performance; (4) to examine the fluid bed coal cleaning method's applicability to a wider range of coals; (5) to design and build a small continuously operating bench scale fluid bed coal cleaning unit; (6) to perform cleaning tests with the continuous system, under varying operating conditions and on different coals; (7) to characterize the continuous system's performance; and, (8) to develop a conceptual fluid bed coal cleaning plant layout and complete an economic evaluation of a commercial scale fluid bed coal preparation facility. Progress has been made toward attaining objectives 1-5 and 8. Work focusing on objectives 6 and 7 will begin in the coming year.

Project 87003: General Electric Transportation Systems has completed the first year of a five-year project to develop a diesel electric locomotive fired with coal-water fuel (CWF). Specific project objectives are: (1) to establish the conceptual commercial system design for a CWF-based diesel engine power system and to update this design as technical knowledge increases; (2) to conduct research needed to establish firmly the technology for the proposed system concept; (3) to develop technologies for control of hot gas contaminants potentially detrimental to the system; (4) to develop and test components and subsystems required for integrated testing of a CWF-fired diesel engine system under representative duty cycles; (5) to conduct integrated

system tests of a CWF-based diesel engine system, to analyze this system's performance and to predict the system's durability; and, (6) to assess the engine system's ability to meet functional, environmental, maintenance and other requirements for specific commercial applications and to identify further testing and development needs.

The main accomplishment for the period was development of the design in preparation for the integrated system test phase. These tests will enable the demonstration of the commercial potential of a coal fueled diesel engine in its actual operating environment. Modifications to the test locomotive, including replacing the 16 cylinder engine with a 12 cylinder engine, were completed. Second year work on this project is discussed under Project 88001 in this appendix.

Project 87006: Pennsylvania Electric Company (Penelec), and its subcontractor, Bechtel Corporation, continue to build on preliminary work to reduce SO_2 emissions at Seward Station using the Confined Zone Dispersion (CZD) flue gas clean-up process. Initial investigations of CZD were completed under Project 86009 (Appendix A of FY 1987-88 Annual Report). This project will attempt to increase the steady-state rate of SO_2 reduction from 20% to 50-70%. Penelec will incorporate a new duct configuration, new nozzle arrays, innovative downstream obstruction treatments, and improved injection methods to improve the CZD system's performance. This project is scheduled to run for three years. Penelec's CZD demonstration is currently under consideration as a project in the U.S. Department of Energy's Clean Coal Technology Program.

Project 87010: Pennsylvania Electric Company (Penelec) is spearheading a project to show the technical feasibility of cofiring coal-water slurry fuel (CWSF) and coal in pulverized coal (PC) boilers. The project involves firing CWSF at pilot (1.5 million Btu/hr) and demonstration (15 million Btu/hr) scales. CWSF will be produced from deep cleaned Freeport Seam coal and middling coal from the coal preparation process at Homer City Generating Station. The project comprises four phases: (1) CWSF formulation and characterization; (2) assessing the combustion behavior of CWSFs; (3) monitoring combustion behavior when cofiring PC and CWSF; and (4) CWSF demonstration tests. Pennsylvania State University's CWSF Combustion Test Facility will be used in Phase 4 to show that a boiler can perform per design when burning CWSF exclusively. The project is slated for completion in 18 months. This work will yield results necessary for Penelec to make a decision regarding a PC/CWSF testing program at Homer City Generating Station.

Project 87016: Lehigh University is developing a selected catalyst-sorbent's ability to capture NO_x and to concentrate SO_2 for subsequent removal from coal-derived combustion gases. To advance this technology, the project entails building a bench-scale test apparatus capable of operating continuously with flue gas generated from combustion of Pennsylvania bituminous coal. The results of this testing will allow design and cost analysis of a commercial installation. Project

objectives are: (1) to construct a bench-scale test apparatus which treats gases from coal combustion; (2) to optimize preparation and operation of the chosen catalyst-sorbent; (3) to life-test an optimal catalyst-sorbent to provide the necessary information for a scale-up design; and, (4) to design, and estimate the cost of, a pilot-scale (10 MM Btu/hr) unit to demonstrate this coal combustion gas clean-up technology.

Six catalyst-sorbents have been tested thus far. The immediate priority is to increase a select catalyst-sorbent's effectiveness in removing SO_2 and NO_x (to a level equal to or greater than 90%) by lengthening it. Thereafter, optimization testing and life-time testing will occur. The project's scheduled completion date is December 31, 1989.

Project 87022: The Anthracite Industry Association (AIA) is directing a project whose goal is to increase anthracite use by coal-fired utilities. Burning of anthracite may be a means of satisfying emissions requirements. In addition to identifying opportunities for exclusive anthracite use, development of blending and combustion technologies to allow safe firing of anthracite/bituminous coal blends in utility boilers may also stimulate increased anthracite utilization. AIA plans to demonstrate that anthracite and/or anthracite/bituminous coal blends can be burned economically in utility stoker boilers.

The project comprises two phases. Phase I involves procuring at least one utility's commitment to explore use of anthracite and/or anthracite/bituminous coal blends as feedstocks to utility boilers. Phase II will include a technical program to address the specific concerns raised by utility officials regarding firing of anthracite and/or anthracite/bituminous coal blends. Currently, New York State Electric and Gas Company has agreed to participate in Phase II studies related to its Jennison power plant, thus fulfilling Phase I requirements. Phase II of this project likely will begin in January 1990.

Project 87024: Control Techtronics, Inc. (CTI) completed a software package, with instruction manual, for a microprocessor-regulated combustion controller for application to the York-Shipley Division of Donlee Technologies' coal-fired fluidized bed combustor (FBC). The controller features the ability to change the FBC's operating parameters in response to levels of compounds such as SO_2 in emissions from the combustor. The software and controller have been shipped to York-Shipley where the controller will be installed and demonstrated.

CTI will develop the software for a combustion controller for application to the sludge-fired FBC to be constructed in Womelsdorf as part of a venture being developed by York Energy Systems. This installation will be a commercial demonstration of the combustion controller. Completion of the commercial application is expected by December 1990.

Project 87030: Pennsylvania State University has updated the demand information for the Pennsylvania Coal Database and Market Analysis On-Line Computer System. The database was created with PEDA support under Project 84002. Coal delivery and quality information for utilities in the Pennsylvania market area were revised, along with estimates of coal preparation and transportation costs. Remote access to the database through a bulletin board was maintained, and the contractor prepared and distributed a newsletter to publicize the system.

The database has an automated procedure to match coal suppliers with potential consumers. Available functions in this supply/demand system are (1) matching captured utility feedstock specifications to Pennsylvania bituminous coal seams; (2) matching input utility feedstock specifications to Pennsylvania bituminous coal seams; (3) listing captured power plant feedstock specifications; (4) listing future purchase plans for utilities on file; (5) matching coal seam quality (county basis) to feedstock specification of power plants, with no costs; (6) matching coal seam quality (county basis) to feedstock specifications of power plants, with estimated target mining costs; (7) matching input coal quality to captured feedstock specifications of power plants, without costs; and, (8) matching input coal quality to captured power plant feedstock specifications, with estimated target mining costs.

Project 87033: Rodale Research Center (RRC) initiated a long-term experiment in 1988 to assess the energy savings and energy efficiency of reduced tillage in low-input field crop production. The project's prime objective is to explore methods of crop production which reduce tillage and are environmentally sound, within cropping systems that will be profitable for farmers from both energy and economic standpoints.

Preliminary energy budgeting results support the basic premise of the research. Reducing tillage, herbicides and nitrogen-based fertilizers has been determined to be crucial for limited energy input on crops. The types of input have different basic energy sources which have varying degrees of scarcity. Differences in scarcity plus the amount of other expenditures, such as labor, suggest economic analysis will provide more general criteria for assessing the energy component of reduced tillage practices.

Project 87045: EXPORTech Company, Inc. (ETCi) is investigating the technical feasibility of a novel method for extending dry magnetic separation to the cleaning of -200 mesh coal. To this end, ETCi built a separation apparatus and processed fine coal in controlled gaseous atmospheres. Experimental work by ETCi has revealed the carrier gas is an unimportant factor relative to separating fine coal from mineral matter. The Final Report on this project is expected by October 31, 1989.

Project 87052: Somerset Rural Electric Cooperative (SREC) is using Authority funds to make loans to industrial firms for energy efficiency improvements related directly to conservation of Pennsylvania's energy

resources. This pilot project for the Authority highlights partnership between government and the private sector to foster energy-based economic development.

The Authority received a detailed energy audit for a lumber company, which has requested financing through the loan program to replace motors in its mill with high efficiency motors, and to install fixed capacitors for power factor correction, resulting in added energy efficiency. Financing details are underway. SREC has indicated that two other projects will be submitted to the Authority for review in the near future.

Project 87053: BCR National Laboratory will direct a project aimed at evaluating the efficacy of a modified rotary kiln combustor (RKC) in burning Pennsylvania coal and coal wastes, with limestone injection for control of SO_2 emissions. The project is expected to be completed within 20 months of start-up.

Project objectives are: (1) to prove the feasibility of burning (a) high-sulfur bituminous coal, (b) high-sulfur bituminous coal preparation waste, and (c) anthracite refuse cofired with bituminous coal as necessary for thermal augmentation, with limestone injection as necessary for control of SO_2 emissions in an RKC outfitted with a proprietary air distributor; (2) to discover the calcium/sulfur ratio necessary for operation of an RKC burning the preceding feedstocks; (3) to define the parameters for further limestone injection into the RKC's secondary combustion chamber; (4) to evaluate the technical and economic merits of a commercial scale RKC in comparison with atmospheric bubbling fluidized bed combustors and circulating fluidized bed combustors; and, (5) to ascertain the need for further testing of the RKC prior to its commercial deployment for burning either coal wastes exclusively or a combination of coal waste and high-sulfur coal.

Project 87055: The Grass Roots Alliance for a Solar Pennsylvania (GRASP) is investigating the role of thermal bypasses in the poor performance of attic insulation in rowhouses. Based on this inquiry, GRASP will generate recommendations on how to improve the energy efficiency of attic insulation in rowhouses. Project objectives are: (1) development and evaluation of a simple method for estimating size of thermal bypasses and unintentional roof venting; (2) evaluation of different methods and materials for treating thermal bypasses; (3) determination of the energy and moisture transfers resulting from thermal bypasses, attic ventilation and insulation types, under real conditions; (4) development and evaluation of a unified model of energy and moisture dynamics in attics; and, (5) creation of a simple, low cost contractor's guide for tailoring attic insulation and ventilation treatments to specific site conditions.

GRASP installed instrumentation in the attics of three rowhouses in Philadelphia. Data were collected for inside and outside air temperatures, moisture content, relative humidity, and pressure differences. GRASP used an innovative smoke bomb test to measure attic

ventilation rates. Data collection will continue throughout the winter of 1989 and 1990.

Project 88001: This project will cover second year activity for General Electric Transportation Systems' five-year project to develop a diesel electric locomotive fired with coal-water fuel (CWF). Specific project objectives are detailed in the report for Project 87003 in this appendix, which covers work done in the first year. During the second year, the contractor will (1) prepare detailed test plans for the applied R&D needed to firmly establish the technology for the proposed locomotive power system concept; (2) procure all materials and equipment necessary to modify the test facilities as described in the approved test plans, then conduct the tests in accordance with the approved test plans and analyze and interpret the test data with respect to the established goals; (3) conduct a subsystems component testing and development program based on the results; and (4) using the integrated system design, develop the test plan, procure and assemble the necessary test equipment, commission the test facilities, and conduct the integrated system test.

Project 88007: Renewable Energy Institute will install wind data acquisition equipment at an optimal site on Lake Erie's Pennsylvania shore. Data such as wind speed and direction will be collected every second for a twelve-month period. Upon reduction and analysis of these data, prospective developers of wind-based power generation systems will have high quality information on which to base decisions regarding wind energy potential along Lake Erie.

Project 88009: Pennsylvania State University will examine all aspects of a 200-foot longwall face. Ventilation, subsidence, coal handling, moves, productivity and development requirements will be studied. the long- and short-term effects of both standard and short longwalls on groundwater will be assessed. The results from the three-year effort will be used by the industry sponsor to decide on establishing an in-mine demonstration of the short longwall mining method.

Project 88015: Coal Tech Corporation (CTC) is continuing development and demonstration of its advanced slagging cyclone coal combustor through multi-day operation of the test unit. (See report under Project 85027 in Appendix A for additional background.) In one four-day test, the combustor was kept on-line for a period of 65 hours versus a total availability of 80 hours. In this project, CTC will study several operational and performance factors that require additional understanding before commercialization of this technology.

These factors include: (1) further parametric studies to fully optimize SO_2 and NO_x reduction, with capture of sulfur in the slag, in an environmentally safe form; (2) accumulation of additional operational data to clarify interactions among injected sorbent, gaseous sulfur compounds, and scrubber water; (3) conclusive establishment of the thermal and mechanical methods for blockage-free operation of the

combustor's slag tap; and, (4) demonstration of the combustor's durability through round-the-clock multi-day operation and testing.

Project 88024: Pennsylvania Electric Company is directing a project intended to increase the understanding of changes in physical and chemical properties of bituminous coal which is naturally weathered. As a result of weathering, this coal contains essentially no pyritic sulfur due to the oxidation of pyrite. Therefore, utilization of this coal may be a means to comply with SO_2 emissions standards. Combustion data will be collected during test burns of weathered coal blended with fresh coal, in a pulverized coal utility boiler, to confirm results of previous laboratory investigations.

Project 88025: Lehigh University plans to continue its work on developing a catalyst-sorbent for treating flue gas from coal-fired combustors (refer to Project 87016 in this appendix). The primary objective is to test an optimal catalyst-sorbent on a slip stream of flue gas from Pennsylvania Power and Light Company's Martins Creek Power Plant. The secondary objective is to substitute palladium in deference to more expensive rhodium as the catalytic metal. This project will enable (1) improved scale-up cost projections for this clean coal technology; and, (2) determination of the amount of rhodium that can be replaced by palladium without decreasing the catalyst's life expectancy.

Project 88030: Pennsylvania State University, will develop a comprehensive surface mining permit review software package. The first phase of this project will focus on Modules 3, 7 and 8 of the Pennsylvania Department of Environmental Resources' permit application package.

Project 88033: Good Samaritan Hospital is directing a project designed to expand the use of coal by utilizing a circulating fluidized bed combustor (CFBC) to provide an environmentally safe method for disposing of pathological and infectious hospital waste. The project comprises the following five tasks (1) evaluating CFBC incineration technologies and identifying principal organic hazardous constituents in hospital waste for selection of the surrogate compounds; (2) developing a waste handling system; (3) preparing a bench-scale combustor test plan; (4) conducting bench-scale combustion tests and establishing design specifications for a proof-of-concept unit; and, (5) determining the conceptual design and cost estimates of a full-scale, proof-of-concept facility.

The first three tasks of the project have been completed and the Authority will provide financial assistance for completion of task four. On-site combustion testing will be performed at York-Shipley's facility in York.

Project 88034: Drexel University intends to perform research aimed at removing technical barriers to commercial use of refuse derived fuel (RDF) in Pennsylvania as a feedstock for fluidized bed combustors. To this end, the objectives of this project include: (1) conducting

thermogravimetric analysis of RDF pellets; (2) identifying and measuring the concentrations of organic and inorganic chemicals which are released during pellet devolatilization; (3) examining the effect of pellet additives on devolatilization, combustion and emissions; (4) measuring and developing models of the rates of devolatilization, combustion and emissions of RDF pellets; and, (5) assessing the performance of sorbents in capturing chlorine, a major noxious constituent in emissions from RDF combustion.

Project 88036: The US Department of Energy, through its subcontractor, Eos Technologies, is analyzing the potential for increasing anthracite use by (1) investigating anthracite resources and their present uses; (2) assessing opportunities for expanding existing markets and developing new ones; and (3) defining specific R&D needs and applications of the results of such R&D. During this project, the state-of-the-art relative to end-use equipment will be examined, along with opportunities for improving their environmental performance, efficiency and operation. The Final Report on this study is expected by the end of 1989.