Commonwealth of Pennsylvania

PENNSYLVANIA ENERGY DEVELOPMENT AUTHORITY

ANNUAL REPORT

FOR FISCAL YEAR 1987-88

July 1, 1987 - June 30, 1988

Issued
October, 1988

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PENNSYLVANIA ENERGY DEVELOPMENT AUTHORITY

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INTRODUCTION

The Pennsylvania Energy Development Authority's Annual Report for Fiscal Year 1987-88 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, 1987 and ended on June 30, 1988.

The report provides detailed information on the fiscal status of the Energy Development Fund. Additionally, it describes projects awarded allocations in FY 1987, as well as projects which received financial assistance in previous fiscal years that were completed or continued during this period.

PEDA concluded its fourth year of operation at the close of FY 1987-88. The Board of Directors has diligently attempted to further the Authority's mission of providing financial assistance to a wide range of energy projects, throughout the Commonwealth, during FY 1987-88. The Authority allocated approximately $1.7 million to 18 energy development projects. Furthermore, the Board passed inducement resolutions for three revenue bond transactions totaling $38 million to finance cogeneration and small power production facilities. The Authority also supported four projects under consideration for funding by the U.S. Department of Energy's Innovative Clean Coal Technology Program.

PEDA promulgated its revised Energy Development Plan on January 19, 1988. The three central points in the plan set the Authority's direction:

- 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 plan, 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

- o to maximize use of other 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 and revenue bond financing.

PEDA's approach to providing opportunities for financial assistance is (1) to develop a comprehensive Financial Assistance Program Prospectus and application package; and (2) to establish application deadlines throughout the fiscal year. For FY 1987-88, two application deadlines were designated: November 30 and March 8. Application deadlines and financial assistance opportunities were published in the Pennsylvania Bulletin on October 17, 1987.

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 - 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

The Authority has allocated nearly $7.5 million to 76 projects (Table 1). PEDA has disbursed or committed approximately $6.7 million to 67 projects.

PEDA 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 1) and Non-Coal Development. As illustrated in Figure 1, 38% 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. Eleven, or sixteen percent, of PEDA's projects have addressed anthracite development. Monetarily, the Authority has allocated the majority, $2.7 million or 41% of its total allocation, to Clean Coal Technology (Figure 2). Allocations to coal projects equal $5.8 million, or 87% of PEDA's energy development effort.

PEDA's impact on energy research, development and demonstration activity is reflected in Figure 3. The Authority's $6.7 million allocation has engendered an additional $16.5 million investment from other sources, for a total of $23.2 million in energy development effort in Pennsylvania. Clearly, PEDA has been most influential in development of clean coal technologies. The Authority's $2.7 million allocation has generated an additional $11.6 million investment in this area by parties interested in advancement of clean coal technologies; each Authority dollar has

been matched by $4.30 from project co-participants. Cost sharing figures by contractors and co-participants per each PEDA dollar for general coal development, anthracite development and non-coal development are $0.80, $1.06 and $2.22, respectively.

PEDA received 53 applications for financial assistance in FY 1987-88, with a stated total value of approximately $18.8 million; the corporate request for Authority funds was about $7.6 million. The Board allocated $1,719,817 to 18 projects worth roughly $9.5 million.

For FY 1987-88, the majority of PEDA's funding was oriented toward clean coal technology development, both categorically and financially (Figures 4-6). This fact is reinforced by looking at total project costs (Figure 8) - clean coal technology projects account for roughly 75% of PEDA-induced energy development effort. FY 1987-88 anthracite development projects will combine $300,000 in PEDA funds with $800,000 from other sources to foster $1.1 million in anthracite-associated activity; this arrangement is a roughly two-fold improvement from historical anthracite development cost sharing relationships (Figures 2 and 3). In FY 1987-88, five non-coal development projects were funded, the greatest number since the Authority's first year of operation. The preceding data suggest the Board has been successful in implementing its energy development priorities.

The distribution of PEDA project costs is presented graphically in Figures 7 and 8. FY 1987-88 was the most successful one to date in terms of attracting contractor and co-participant financial participation in projects funded by the Authority. Contractor and co-participant contributions versus each Authority dollar allocated to projects funded in FY 1987-88 were $4.50, as opposed to $2.66 in FY 1986-87 and $2.50 through the four year existence of the Authority's financial assistance program. In FY 1987-88, contractors and co-participants have committed to bear 82% of total project cost versus FY 1986-87 when they carried 73% of costs associated with projects. Overall, contractors and co-participants have been responsible for 71% of the costs related to projects funded by the Authority. In FY 1987-88, PEDA continued to improve its ability to attract contractor and co-participant financial commitment in energy-related projects. This participation has come from industry, utilities, universities, equipment vendors, local and federal agencies, non-profit groups and other interested parties.

PEDA PROJECT HIGHLIGHTS

Introduction

The Authority's energy development drive continued to build momentum in FY 1987-88. (This drive is summarized in the following paragraphs.) Synoptic data for PEDA projects are supplied in Table 1. For detailed discussion of Authority projects, refer to Appendices A and B. Table 2 presents summary information on PEDA's four revenue bond projects.

Commercial Projects

The Authority is involved in four coal-related commercial scale energy projects via $200 million in PEDA revenue bonds (Table 2). 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). The three fluidized bed combustion projects being developed by Babcock and Wilcox Company and Rubenstein Engineering, P.C. in western Pennsylvania will consume at least 500,000 tons of bituminous coal waste annually. Continental Cogeneration Associates' Humboldt Energy Center, an integrated gasification combined cycle facility near Hazleton, will use gas produced from anthracite refuse. The Humboldt Energy Center should be in commercial operation by early 1989. Jointly, these projects will employ approximately 500 workers during peak construction; permanent employment will be provided to roughly 75 persons. The $309 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.

Clean Coal Technology Projects

Categorically, PEDA's 25 clean coal technology projects are distributed as follows: pre-combustion, 15 (60%); emissions reduction during combustion, 5 (20%); flue gas clean-up, 3 (12%); and conversion of coal to a cleaner fuel, 2 (8%). Generally, the Authority's clean coal technology projects deal with 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 open gradient magnetic separation. Heyl & Patterson's micro-bubble flotation project and Florence Mining Company's oil agglomeration enhancement project are two pre-combustion coal beneficiation technologies at or near commercial scale. Three demonstration projects are focused on capturing or reducing noxious products from coal during combustion: Coal Tech Corporation's advanced

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 sorbent-catalyst 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 and the Anthracite Industry Association's planned 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. Low volatile bituminous 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 of low volatile bituminous coal, anthracite and anthracite/bituminous coal blends, thus enabling utility officials to make informed choices regarding fuels for their coal-fired power plants.

BCR National Laboratory's low volatile bituminous 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 low volatile bituminous coal utilization project. Results from this research will enable officials of these utilities to make a decision regarding full-scale test burns of low volatile bituminous coal by the end of 1988. If one of these utilities decides to fire at least one of its boilers with low volatile bituminous coal, hundreds of thousands of tons of Pennsylvania low volatile bituminous coal would be required to fuel this unit.

Coal and Waste Co-Firing Projects

Good Samaritan Hospital's project to dispose of pathologic and infectious hospital waste in an anthracite-fired circulating fluidized bed combustor is a novel means of disposing hazardous material. Anthracite will provide the heat necessary to destroy harmful byproducts associated with combustion of hazardous waste.

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 emissions of sulfur oxides. 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.

USDOE Innovative Clean Coal Technology Program

Two projects were supported by the Authority under Round 1 of the U.S. Department of Energy's Innovative Clean Coal Technology Program (ICCTP): Coal Tech Corporation's advanced cyclone coal combustor demonstration and M.W. Kellogg Company's Appalachian Coal Gasification Combined Cycle Power Generation Project, a demonstration of second-generation integrated gasification combined cycle power production technology.

Coal Tech Corp.'s combustor demonstration is now in its final phase. Though some difficulties developed with the refractory lining of the combustor, they have been resolved and the project remains on schedule. Data to assess the combustor's ability to reduce emissions of sulfur and nitrogen oxides are now being collected during hundreds of hours of testing.

Although Commonwealth officials have diligently attempted to assist the Appalachian Project, its developers have been unable to secure the revenue stream necessary to support its cost. Lately, interest in the Appalachian Project has been expressed by New York State Electric and Gas Company (NYSEG). NYSEG may repower one of its power plants with M.W. Kellogg's gasification technology. Pennsylvania coal is a strong candidate as the feedstock at the prospective NYSEG site.

Developers of four projects either funded, recommended or under consideration by PEDA have applied for funding under the second phase of USDOE's ICCTP. Through Bechtel National Inc., Pennsylvania Electric Company is pursuing demonstration of an in-duct injection flue gas clean-up technology at Seward Station. Rubenstein Engineering, P.C. is developing a modular, circulating fluidized bed combustion power plant (nominally 17.5 MW) at Homer City that will consume bituminous coal waste. Duquesne Light Company and the Electric Power Research Institute propose to build, test and operate an advanced technology coal preparation plant at Duquesne's Warwick Mine to provide fuel for its Cheswick Power Station; the station would be retrofitted with a select flue gas clean-up technology. Coal Dynamics Corporation intends to demonstrate controlled burnout technology on, and power production from, the Plummer-Puritan underground mine fire in Fayette County. The approximate cost of these clean coal technology demonstrations is $110 million.

Non-Coal Development Projects

PEDA allocated approximately $200,000 to five non-coal development projects in FY 1987-88. These projects focus on increased energy efficiency in row houses, industry, transportation and agriculture, and renewable resources development. The Board is optimistic that funding of these projects is the initial step in creating balance between the Authority's coal and non-coal initiatives.

FISCAL STATUS

PEDA ended FY 1987-88 with a net available balance of $862,981. Though the Authority has total assets of $4,161,644, $3,298,663 are committed to energy development projects ($3,213,413) and operations ($85,250), but not yet spent.

For FY 1987-88, costs of administration, including personnel, operating and fixed assets expenses, totaled $191,455. However, the Authority received $303,339 in interest from funds invested by the State Treasurer. The Board is pleased to report the Authority's operations imposed no costs to taxpayers, and the full amount of Commonwealth funds was available for PEDA's Financial Assistance Program.

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 1

PEDA FUNDED PROJECTS SUMMARY

Proj. No.	Contractor	Purpose	Proj. Cat.	PEDA All.	All. Type	Stat.
84002	PA Coal Min. Assn.	Improve Bituminous Marketability	BD	411,000	G	C
84003	Francis Miller	Coal Prep. Tech. Seminars	BD	16,500	G	C
84006	PA Coke Tech., Inc.	Improve Non-Recovery Coking Process.	BD	67,965	G	C
84007	Anthracite Ind. Assn.	Anthracite Mktg. and Demonstrations	AD	453,780	G	C
84016	Lehigh University	Improve Coking via Ionic Hydrogen.	CC	25,000	G	C
84017	Lehigh University	Fluidized Bed Coal Cleaning	CC	80,530	G	C
84020	Coal Tech Corp.	Adv. Cyclone Combustor - Stage II	CC	150,000	G	C
84024	Erie School Dist.	Enhanced Natural Gas Recovery	NC	37,500	V	C
84025	Johnstown Corp.	Coal & Coal-MSW Cogen. Feasibility	NC	28,715	G	C
84026	St. Francis College	Coal and MSW Cogen. Feasibility	NC	7,500	G	C
84034	Coun. for Lab. & Ind.	Conservation Improvements	NC	15,000	G	C
84035	Ad Peary Vo-Tech Sch	Cogeneration Feasibility	NC	6,287	G	R
84038	CDA Int., Inc.	Hosp. Oper. Rm. Energy Conservation	NC	35,000	G	C
84041	Bellefield Plant	Cogeneration Feasibility	NC	21,000	G	C
84042	BCR National Lab.	Reactive Gas CDS - Phase I	CC	120,241	G	C
84043	BCR National Lab.	Reichert Spiral Evaluation	CC	50,000	G	T
84044	Williams & Broome	Hydroelectric Power Barge Demo.	NC	200,000	V	C
84047	Enerco Associates	Pyrolysis of Waste Tires	NC	302,268	V	C
84049	Allegheny Elec. Coop.	Energy Storage in Buildings	NC	35,000	G	R
84050	Control Techtronics	Advanced Combustion Controller Demo	NC	15,000	G	C
84060	Babcock & Wilcox Co.	CWF Conversion, Open Hearth Furnace	BD	69,000	V	R
85003	Antrim Mining Co.	FBC Power Plant Feasibility	BD	10,000	G	C
85004	Norton Hambleton Inc.	Reverse Column Flotation CDS	CC	200,000	V	T
85005	Penn. State Univ.	CDS via Steam/Methane Pyrolysis	CC	35,000	G	C
85006	R.A. Systems	Water Jet Assisted Coal Shearer	BD	27,000	V	I
85007	SEDA-Coun. of Gov.	Primer on Domestic Anthracite Use	AD	29,000	G	C
85009	PA Coal Min. Assn.	Low-Vol in Util. Boil. - Ph. I	BD	58,783	G	C
85010	Anthracite Ind. Assn.	Anthracite Mktg. and Conversions	AD	259,380	G	C
85011	Cont. Cogen. Corp.	Anthracite Gasification	AD	35,000	G	C
85015	Hess & Fisher Eng.	Acid Mine Drainage Control	BD	31,475	G	I
85016	Univ. of Pittsburgh	Liquid CO2 CDS	CC	84,908	G	I
85020	SEDA-Coun. of Gov.	Conversion Feasibility	AD	10,000	G	C
85024	Kipin Ind., Inc.	Coal and Waste Co-Processing	BD	200,000	V	I
85025	Meadville Ind. Comm.	Cogeneration Feasibility	BD	10,000	G	C
85026	PA Coke Tech., Inc.	Non-Recovery Coke Production	CC	350,000	G	R
85027	Coal Tech Corp.	Adv. Cyclone Combustor - Stage III	CC	200,000	G	I
85028	Penn. State Univ.	SO_2 Sorbent Evaluation	CC	25,000	G	C
85030	EXPORTech Co., Inc.	Magnetic CDS - Phase I	CC	15,934	G	C
85031	Lehigh University	Microbial CDS	CC	50,000	G	I
85032	Penn. State Univ.	Surface Mining Software Development	BD	43,447	G	C
85035	Anth & Comm Dev Inst	Anthracite Operators' Assistance	AD	154,685	G	I

TABLE 1
(Continued)

PEDA FUNDED PROJECTS SUMMARY

Proj. No.	Contractor	Purpose	Proj. Cat.	PEDA All.	All. Type	Stat.
86002	BCR National Lab.	Reactive Gas CDS - Phase II	CC	114,983	G	C
86004	Univ. of Pittsburgh	Controlled Burnout of Refuse Piles	GC	149,931	G	I
86006	Penn. State Univ.	Mechanical CDS Efficiency	CC	33,727	G	I
86007	BCR National Lab.	Low-Vol in Util. Boil. - Ph. II	GC	198,340	G	I
86008	PA Electric Co.	Low NOx Burner Demonstration	CC	400,000	G	I
86009	PA Electric Co.	CZD S Reduction Demo. - Phase I	CC	100,000	G	C
86014	BCR Nat. Lab.	Ultrasonic Dewatering of Coal	GC	40,367	G	T
86018	Anthracite Ind. Assn.	Anthracite Mktg. and Conversions	AD	210,500	G	I
86022	Heyl & Patterson Inc.	Micro-Bubble Flotation CDS	CC	150,000	V	I
86026	BCR Nat. Lab.	Coal/Biomass Pyrolysis	GC	73,255	G	C
86028	Anthracite Ind. Assn.	Anthracite Trade Show	AD	26,505	G	C
86031	Humenick Wood Prod.	Wood Waste Combustion & Heat. Sys.	NC	24,108	G	C
86033	GRASP	Biothermal Composting Greenhouse	NC	33,960	V	R
86035	Econ Dev Coun NE PA	Anthracite Development & Promotion	AD	15,810	G	I
86041	PA Anth. Dev. Corp.	Anth. Explor. with Radio Imaging	AD	30,000	V	R
86043	Penn. State Univ.	Acid Mine Drainage Model	GC	142,175	G	I
86046	EXPORTech Co., Inc.	Magnetic CDS - Phase II	CC	18,996	V	I
87001	Lehigh University	Fluid Bed Coal Cleaning - Phase II	CC	86,405	G	D
87003	GE Trans. Systems	CWF Powered Diesel Elec. Loco.	CC	200,000	V	D
87005	CEEP, Inc.	Gasoline Vapor Recovery System	NC	44,959	V	P
87006	PA ELectric Co.	CZD S Reduction Demo. - Phase II	CC	250,000	V	P
87010	PA Electric Co.	CWF Combustion Tests	CC	182,800	G	P
87016	Lehigh University	Catalyst-Sorbent Optimization	CC	72,912	V	D
87022	Anthracite Ind. Assn.	Anthracite Promotion to Utilities	AD	230,000	G	D
87023	Coal Dynamics Corp.	Controlled Burnout, Deep Mine	GC	162,454	V	D
87024	Control Tech., Inc.	Combustion Control SW Modification	CC	25,000	V	D
87030	Penn State Univ.	Coal Quality Database Update	GC	18,028	G	D
87033	Rodale Research Ctr.	Reduced Tillage System Trial	NC	55,067	G	I
87037	Florence Mining Co.	Coal Cleaning (Agglom. Enhance.)	CC	35,000	V	D
87038	Good Samaritan Hosp.	CFBC Hosp. Waste Incin. w/ Anth.	AD	60,000	G	P
87045	EXPORTech Co., Inc.	Magnetic Cleaning of Fine Coal	CC	21,134	V	D
87047	Energy Develop. Serv.	Wind Data Acquisition	NC	14,000	V	D
87052	Somerset Rural Elec	Improved Indust. Energy Conserv.	NC	44,934	L	D
87053	BCR National Lab.	CDS in Rotary Kiln Combustor	CC	172,124	V	P
87055	GRASP	Energy Eff. Improve. in Row Homes	NC	45,000	G	D

Key AD: Anthracite Development, BD: Bituminous Coal Development, C: Complete, CC: Clean Coal Technology, CDS: Coal Desulfurization, CWF: Coal-Water Fuel, CZD: Confined Zone Dispersion, D: Draft Contract, G: Grant, GC: General Coal Development, I: In Progress, L: Loan, NC: Non-Coal Development, P: Provisional, R: Rescinded, S: Sulfur, V: Venture Capital

TABLE 2

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 Project	Babcock & Wilcox Co.	77,600,000
87028	Homer City Power Plant	Rubenstein Eng., P.C.	21,000,000*
87042	Clarion Project	Babcock & Wilcox Co.	12,350,000*
87048	Ebensburg Project	Babcock & Wilcox Co.	4,400,000*
		Total	$200,000,000

* In Process

TABLE 3

PENNSYLVANIA ENERGY DEVELOPMENT AUTHORITY

BALANCE SHEET

JUNE 30, 1988

ASSETS

Cash	$ 2,380.55
Short Term Investments	4,135,000.00
Accrued Interest	24,262.62
TOTAL ASSETS	**$4,161,643.17**

LIABILITIES & NET WORTH

LIABILITIES			
Accrued Expenses - Executive Office Costs			$ 2,535.99
TOTAL LIABILITIES			$ 2,535.99
NET WORTH			
General Fund Appropriations	$ 7,300,000.00		
Grant Disbursements	3,562,128.12		
		$3,737,871.88	
Net Earnings from Operations		421,235.30	
			$4,159,107.18
TOTAL LIABILITIES AND NET WORTH			**$4,161,643.17**

TABLE 4

PENNSYLVANIA ENERGY DEVELOPMENT AUTHORITY

COMPARATIVE STATEMENT OF FUNDS AVAILABLE

FOR THE TWELVE MONTH PERIOD
ENDING JUNE 30

	1987		1988		
TOTAL AVAILABLE FUNDS - July 1		$3,386,750		$3,638,424	
RECEIPTS					
Transfer from General Fund	$1,300,000		$1,300,000		
Interest on Securities	272,685		303,339		
Commitment Fees	50,000		0		
Application Fees	3,350		5,650		
Venture Cap. - Repayments	1,054		0		
Reimb. - Oper. Expenditures	5,000		0		
Total Receipts		$1,632,089		$1,608,989	
AVAILABLE FOR DISBURSEMENT		$5,018,839		$5,247,414	
DISBURSEMENTS					
Grants/Venture Capital	$1,168,763		$ 894,315	(a)	
Operating Expenses	211,651		191,455		
Total Disbursements		$1,380,414		$1,085,770	
GROSS FUNDS AVAILABLE		$3,638,424		$4,161,644	(b)
COMMITMENTS					
Grants/Venture Capital	$2,597,993		$3,213,413	(c)	
Operating	103,300		85,250		
Total Commitments		$2,701,293		$3,298,663	
NET FUNDS AVAILABLE		**$ 937,131**		**$ 862,981**	(d)

(a) Department of Commerce, $62,428; Executive Offices, $831,887
(b) Cash, $2,381; Investments, $4,135,000; Interest, $24,263
(c) Pre-encumbered, $55,000; Encumbered, $1,463,978; Unencumbered, $1,694,435
(d) Unexpended/uncommitted funds at close of fiscal year

TABLE 5

PENNSYLVANIA ENERGY DEVELOPMENT AUTHORITY

STATEMENT OF FUNDS AVAILABLE

INCEPTION OF FUND TO JUNE 30, 1988

RECEIPTS		
Transfer from General Fund	$7,300,000.00	
Interest on Securities	1,081,341.94	
Commitment Fees	75,750.00	
Application Fees	12,900.00	
Venture Capital Repayments	1,054.32	
Reimb. for Operating Expenditures	5,000.00	
AVAILABLE FOR DISBURSEMENT		$8,476,046.26
DISBURSEMENTS		
Grants/Venture Capital	$3,562,128.12	
Operating Expenses	752,274.97	
Total Disbursements		$4,314,403.09
TOTAL FUNDS AVAILABLE		**$4,161,643.17**

TABLE 6

PENNSYLVANIA ENERGY DEVELOPMENT AUTHORITY

RECONCILIATION OF COMMITMENTS

JUNE 30, 1988

M.E.	Contractor	Commitments	Disbursements	Balance
484-002	PA Coal Mining Assn.	$ 411,000.00	$ 397,525.04	$ 13,474.96
485-004	Norton, Hambleton Inc.	200,000.00	190,000.00	10,000.00
485-005	Penn State University	35,000.00	16,766.59	18,233.41
485-006	R.A. Systems	27,000.00	10,990.00	16,010.00
485-010	Anthracite Ind. Assn.	259,380.00	249,380.00	10,000.00
485-015	Hess & Fisher Eng.	31,475.00	14,034.00	17,441.00
485-016	Univ. of Pittsburgh	84,908.00	34,468.15	50,439.85
485-024	Kipin Industries, Inc.	200,000.00	57,786.32	142,213.68
485-027	Coal Tech Corporation	200,000.00	104,404.62	95,595.38
485-031	Lehigh University	50,000.00	22,566.97	27,433.03
485-032	Penn State University	43,447.00	26,068.72	17,378.28
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	Univ. of Pittsburgh	149,931.00	49,161.68	100,769.32
486-006	Penn State University	33,727.00	9,308.40	24,418.60
486-007	BCR National Laboratory	198,340.00	69,285.97	129,054.03
486-008	PA Electric Co.	400,000.00	0.00	400,000.00
486-009	PA Electric Co.	100,000.00	85,791.56	14,208.44
486-018	Anthracite Ind. Assn.	210,500.00	188,135.00	22,365.00
486-022	Heyl & Patterson Inc.	150,000.00	72,007.78	77,992.22
486-026	BCR National Laboratory	73,255.00	66,609.35	6,645.65
486-035	EDCNP	15,810.00	4,560.00	11,250.00
486-043	Penn State University	142,175.00	0.00	142,175.00
486-046	EXPORTech Co., Inc.	18,996.00	5,298.80	13,697.20
*487-001	Lehigh University	86,405.00	0.00	86,405.00
*487-003	GE Transportation Sys.	200,000.00	0.00	200,000.00
*487-005	CEEP, Inc.	44,959.00	0.00	44,959.00
*487-006	PA Electric Co.	250,000.00	0.00	250,000.00
*487-010	PA Electric Co.	182,800.00	0.00	182,800.00
*487-016	Lehigh University	72,912.00	0.00	72,912.00
*487-022	Anthracite Ind. Assn.	230,000.00	0.00	230,000.00
*487-023	Coal Dynamics Corp.	162,454.00	0.00	162,454.00
*487-024	Control Tech., Inc.	25,000.00	0.00	25,000.00
*487-030	Penn State University	18,028.00	0.00	18,028.00
487-033	Rodale Research Center	55,067.00	0.00	55,067.00
*487-037	Florence Mining Company	35,000.00	0.00	35,000.00
*487-038	Good Samaritan Hospital	60,000.00	0.00	60,000.00
*487-045	Exportech Company, Inc.	21,134.00	0.00	21,134.00
*487-047	Energy Development Serv.	14,000.00	0.00	14,000.00
*287-052	Somerset REC	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	0.00	45,000.00
	Total	$5,055,620.52	$1,897,207.39	$3,158,413.13

* Unencumbered Commitments

Figure 1.
Categorical Distribution
of PEDA Projects

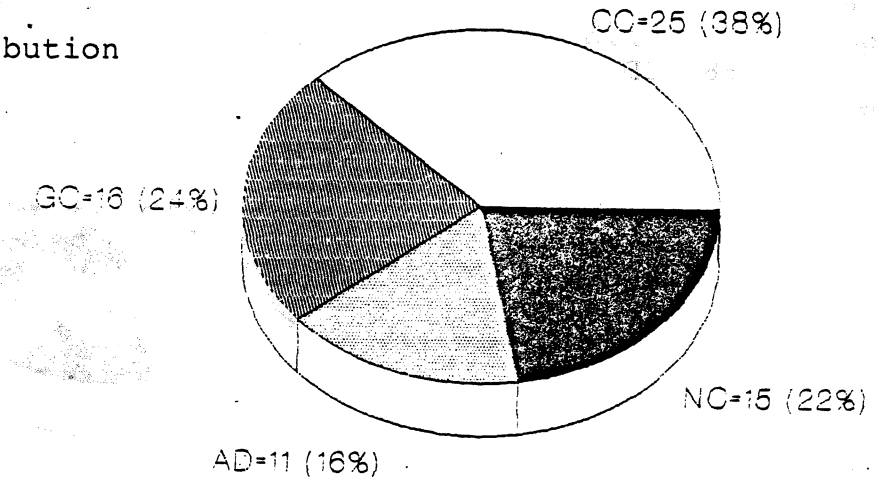


Figure 2.
Distribution of PEDA
Funds to PEDA Projects

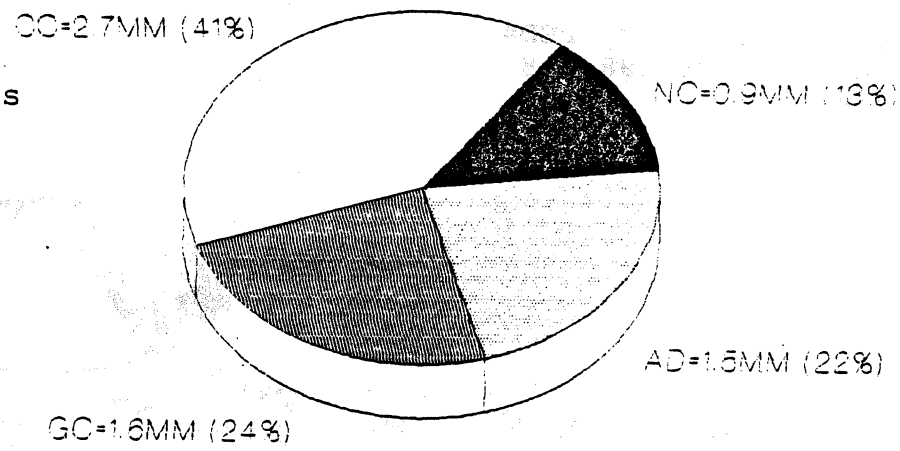
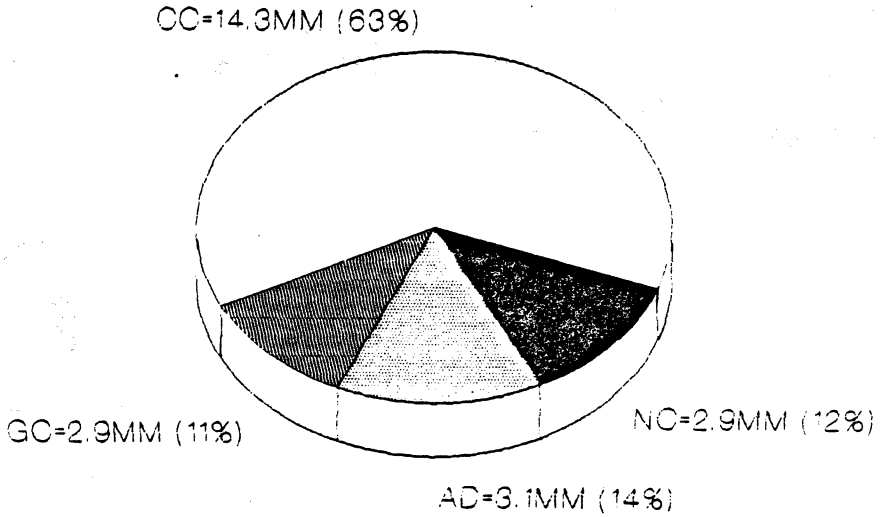


Figure 3.
Total Costs of
PEDA Projects



(AD: Anthracite Development, CC: Clean Coal Technology,
GC: General Coal Development, NC: Non-Coal Development)

Figure 4.
Categorical Distribution of FY 1987-88 PEDA Projects

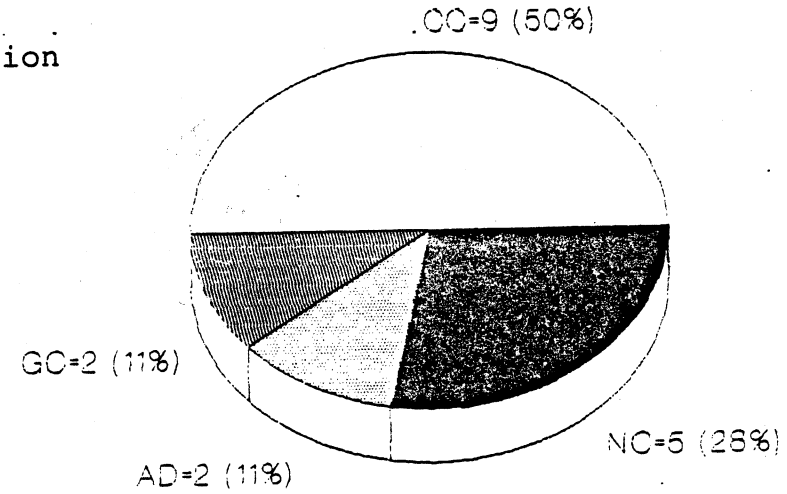


Figure 5.
Distribution of PEDA Funds to FY 1987-88 Projects

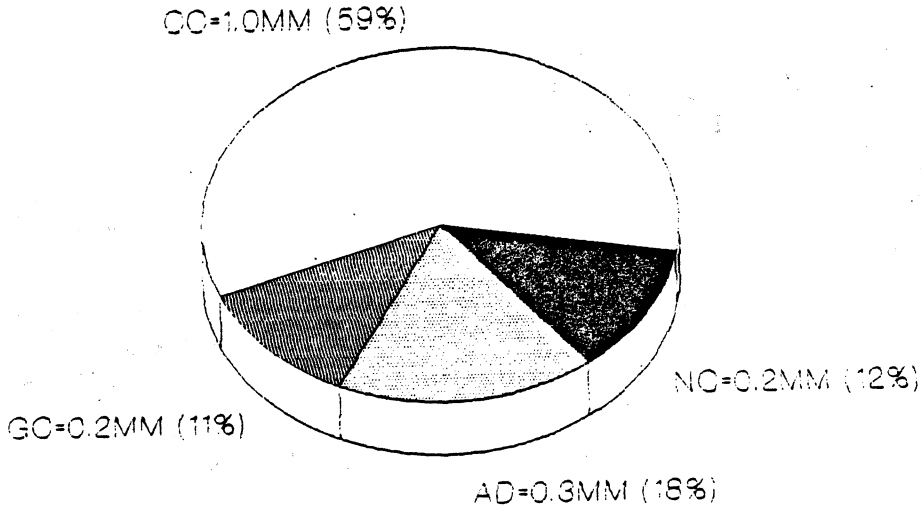
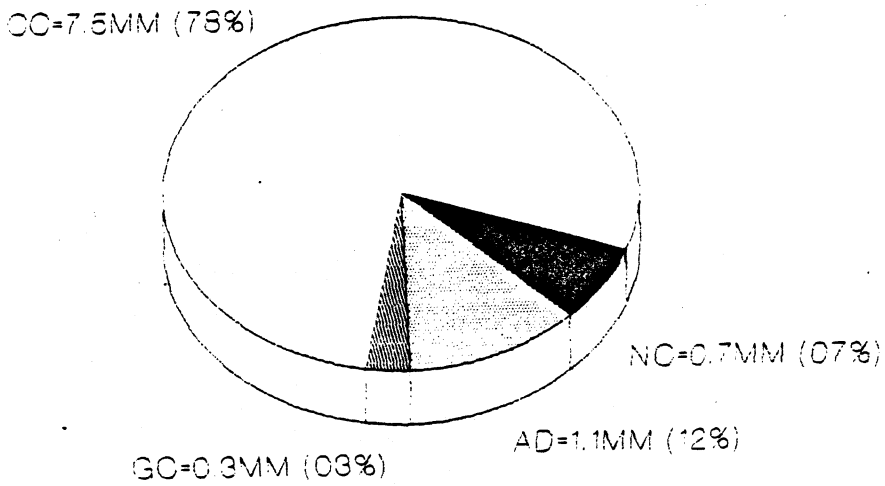


Figure 6.
Total Costs of FY 1987-88 PEDA Projects



(AD: Anthracite Development, CC: Clean Coal Technology, GC: General Coal Development, NC: Non-Coal Development)

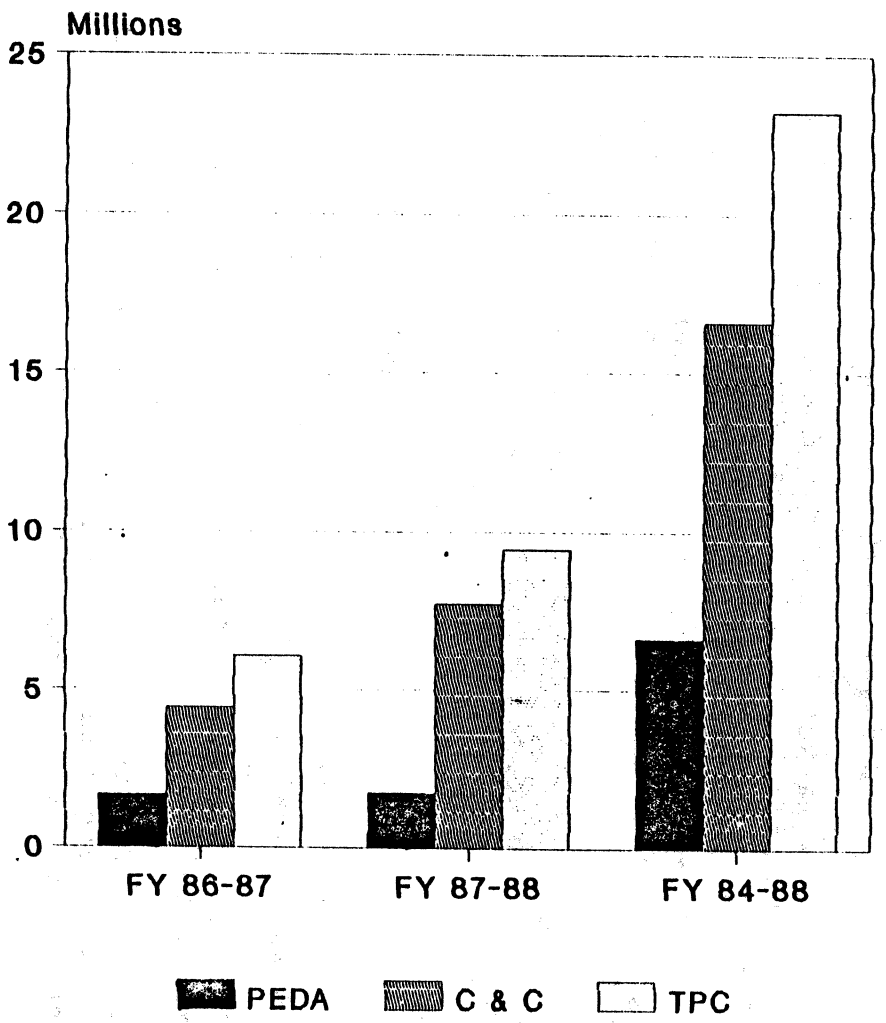


Figure 7: Distribution of PEDA Project Costs, in Millions of Dollars, by Fiscal Year and through Four Years of Operation (C&C: Contractor and Co-participant Contributions, PEDA: Authority Funds, TCP: Total Project Cost)

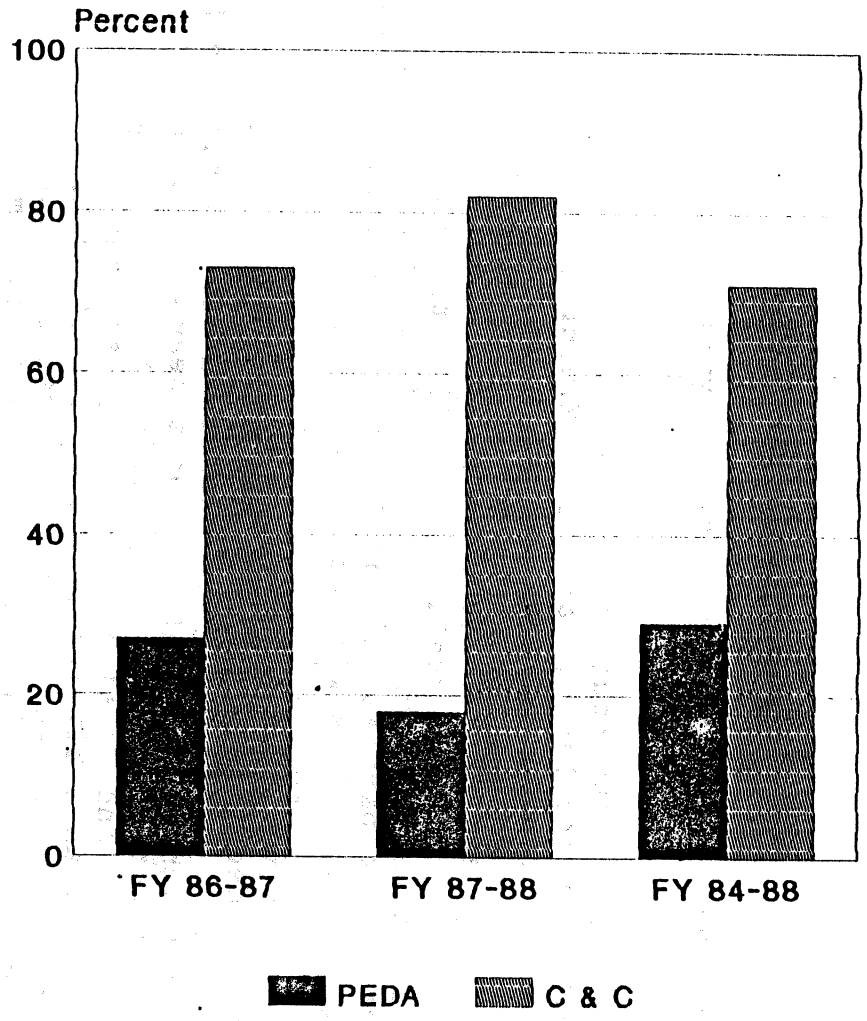


Figure 8. Distribution of PEDA Project Costs, on a Percentage Basis, by Fiscal Year and through Four Years of Operation (C&C: Contractor and Co-participant Contributions, PEDA: Authority Funds)

APPENDIX A

PEDA PROJECTS COMPLETED IN FISCAL YEAR 1987-88

Project 84002: The bituminous coal marketability improvement project directed by the Pennsylvania Coal Mining Association (now part of the Pennsylvania Coal Association) had three major phases: (I) to define the market potential for Pennsylvania bituminous coals; (II) to develop correlations between explored coal quality and mined coal quality; and (III) to establish a coal resource database for use by the coal industry, utilities and other interested parties that includes an automated procedure for matching coal suppliers with potential consumers.

Phase I documented the market potential for existing and improved (i.e. better cleaned) Pennsylvania bituminous coals. Major elements of Phase I were: (1) survey of coal characteristics for Pennsylvania's bituminous coal fields on a seam-by-seam basis; (2) survey of market coal quality specifications, especially industrial, utility and foreign markets; (3) assessment of the ability of Pennsylvania bituminous coals to meet market specifications using current or advanced coal cleaning techniques; and, (4) overall "mines-to-market" economic assessment (a) to evaluate the potential of each seam (by county) to serve individual markets, and (b) to establish the potential for expanded market opportunities through coal beneficiation.

General conclusions from Phase I are:

- o significant new markets can be obtained economically through application of present coal preparation technologies;
- o low volatile coals show the greatest potential for meeting low sulfur (less than 1%) markets, with minimum cleaning;
- o costs associated with advanced coal cleaning are not competitive for upgrading coal quality for today's markets;
- o utility and industrial coal users represent the greatest potential for growth in Pennsylvania coal sales;
- o metallurgical or coking coal opportunities are greatest among companies without major captive coal supplies; and,
- o metallurgical markets represent the greatest potential for export sales.

The overall goal of Phase II was to predict raw coal washability from borehole-derived data. Phase II objectives were: (1) to develop correlation between explored coal quality and mined coal

quality, (2) to develop a predictive model for projecting coal characteristics from core hole and channel sample analyses via geostatistics, and (3) to validate statistically the preceding predictive model.

Spatial correlation between explored coal quality and mined coal quality was examined via analysis of sixty-six channel samples taken from the perimeter of a longwall mining panel in the Lower Kittanning Seam, Indiana County. The channel samples were analyzed for spatial correlation of seam height, total sulfur as measured by the Eschka method, total sulfur as measured by the High Temperature Combustion method, pyritic sulfur, organic sulfur and sulfate sulfur. Of the preceding six parameters, only seam height, organic sulfur and sulfate sulfur exhibit spatial correlation, with only seam height being statistically significant at the 5% level. For those Pennsylvania coals where the majority of the pyritic sulfur can be removed, while the organic cannot, the inference is total sulfur of cleaned coal may be spatially correlated. None of the measured parameters showed any spatial correlation beyond 2,000 ft. Therefore, at least in this instance, a standard exploration drilling program for a coal deposit would not provide sufficient information for application of geostatistical techniques.

Sixty-three channel samples from the previously mentioned longwall panel were subjected to washability analyses to provide input for geostatistical modeling. The samples were split into two fractions: 8x20 mesh and 20x100 mesh. The coal in each of these splits was washed at three specific gravities, namely, 1.30, 1.45 and 1.60, yielding four float/sink fractions: 1.30F, 1.30S-1.45F, 1.45S-1.60F and 1.60S. These samples did not show any spatial correlation; therefore, at least for these data, geostatistics provides no better information than averaging neighboring samples. Furthermore, prediction of run-of-mine coal washability necessitates washability analyses of floor and roof material to account for dilution effects.

This project's final phase involved creation of a computerized coal resource database. This database incorporates information compiled and/or generated in Phases I and II. The database includes coal characteristics, washability data, mining costs, market potential information, transportation data and mine data.

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.

Maintenance and updating of the database are being performed under Project 87030 in Appendix B.

Project 84016: Lehigh University conducted research on ionic hydrogenation, a process to beneficiate coal and increase its fluidity for coking. Ionic hydrogenation is a selective chemical reaction that splits bonds between aromatic carbon, and sulfur and oxygen. Experiments indicated coal desulfurization and increased fluidity via ionic hydrogenation are attainable only with low rank Pennsylvania bituminous coals. However, significant desulfurization occurs with BF_3:H_2O, though this acid system destroys coking properties. Room temperature treatment of bituminous coal with BF_3:H_2O for one hour resulted in removal of 33% of the sample's total sulfur content.

Project 84017: Fluidized bed coal cleaning at Lehigh University involved material separation by density. Crushed run-of-mine Pennsylvania bituminous coal was introduced into a fluidized bed chamber, atop a layer of magnetite. At conditions close to minimum bubbling velocity, solids stratified in the vessel. Specifically, clean coal segregated at the top of the bed, while pyrite was distributed throughout the bed. Material was removed from the bed in layers, yielding clean coal, middling and reject fractions; magnetite was recovered from the coal with a magnetic separator.

Coal beneficiation experiments investigated the effects of superficial gas velocity, magnetite particle size and coal-to-magnetite fuel weight ratio on pyritic sulfur removal efficiency. Single-stage cleaning yielded marked reductions in pyritic sulfur content (as much as 50% at 70 weight percent coal yield); multi-stage processing of selected coal fractions resulted in additional beneficiation. Results suggest this dry coal cleaning technique may be more economical than conventional wet cleaning techniques such as concentrating tables and cyclones.

For discussion of continued research on fluidized bed coal cleaning, please refer to Project 87001 in Appendix B.

Project 84038: CDA International, Inc. tested a retrofittable, microprocessor controlled heating-ventilation-air conditioning (HVAC) system that it has developed for operating rooms in hospitals. Operating rooms are extremely energy intensive due to

continuous 100% outside air ventilation. Projections by CDA suggested $2,000/yr savings per typical operating room through reducing ventilation during unoccupied times, while maintaining code compliance. Lock Haven Hospital was the site for this project.

The project involved instrumentation of the environmental and mechanical systems which control operating room conditions. The monitoring system measured energy consumption prior to and after HVAC modifications. Comparative analysis substantiated the projected energy savings of $2,000/yr per operating room.

Findings from this project have been sent to appropriate officials of Pennsylvania's 350 hospitals.

Project 85005: Research to develop a new process to reduce coal's sulfur content was completed at Pennsylvania State University. The process involved low temperature pyrolysis of coal using steam/methane mixtures. This treatment was expected to remove sulfur selectively, through reaction with hydrogen, while suppressing coal gasification.

Well-characterized char prepared from a high sulfur, medium volatile Pennsylvania bituminous coal was subjected to experimental study. Chars treated with steam/methane mixtures were analyzed for sulfur reduction, gasification, specific surface area, reactivity and pore size distribution as functions of temperature, gas composition, and in cases, time of exposure. Results show this chemical process can desulfurize coal, to a limited extent, without appreciable gasification and structural change to carbon; char reactivity was essentially unaffected.

Project 85009: Pennsylvania Coal Mining Association (now part of the Pennsylvania Coal Association) and BCR National Laboratory are engaged in a two-phase project to introduce low volatile and generally low sulfur Pennsylvania bituminous coal into utility boilers. Low volatile coal may be a viable emissions reduction strategy for coal-fired utilities, particularly in the northeastern United States. Accomplishments in Phase I were (1) selection and contact of candidate utilities, (2) development of technical marketing materials, and (3) conduct of presentations to representatives of candidate utilities.

As a result of Phase I efforts, two utilities committed to further exploration of low volatile bituminous coal: United Illuminating Company and New England Power Service Company. Additionally, Pennsylvania Electric Company committed to further studies of low volatile coal at Seward and Conemaugh stations where emissions specifications are causing plant operators to look outside of Pennsylvania for low sulfur coal.

For discussion of Phase II of this project, please refer to Project 86007 in Appendix B.

Project 85010: The Anthracite Industry Association (AIA) has spearheaded several projects to promote anthracite as a clean, efficient, dependable and modern fuel source. This project involved:

- execution of a publicity campaign through broadcast media and newsletters;
- provision of responses to inquiries regarding anthracite stemming from the above publicity campaign;
- provision of technical support to AIA's anthracite marketing effort;
- provision of technical support to parties interested in using anthracite-fired systems to meet their heating needs; and,
- completion of a feasibility study on the potential of using an anthracite-fired heating/steam system versus an oil-, natural gas- or electric-based one at the proposed federal penitentiary in Schuylkill County.

Project 85011: Continental Cogeneration Corporation (CCC) completed a project aimed at increasing the efficiency and commercial feasibility of making producer gas from anthracite refuse.

The technical objectives of this effort were (1) to survey all possible sources of anthracite waste; (2) to fire a range of anthracite refuse in full scale gasification tests, and characterize problem causing processes; (3) to develop advanced analytical techniques to predict gasification problems and compare them with full scale test results; (4) to correlate data from objectives 1-3 to develop quality control and operating parameters that will ensure economic and trouble free gasifier operation; and, (5) to identify fuel ash constituents to obtain an ash disposal permit.

All objectives have been met. CCC has taken options on two waste piles. Three waste fuels were tested at full scale. A bench scale gasification unit has been developed and used to test gasification performance of anthracite refuse. The main problem encountered when gasifying anthracite refuse is the increased amount and variety of minerals in waste versus premium anthracite; a laboratory analytical technique has been devised to predict problems and to isolate bad acting mineral constituents so that they can be removed from refuse prior to its shipment to

the cogeneration facility. Fuel ash from gasification has been approved for sale as an anti-skid material.

Project 85028: Pennsylvania State University assessed the performance of different limestones and dolomites (sorbents) in reducing SO_2 emissions during atmospheric fluidized bed combustion (AFBC) of Pennsylvania high sulfur bituminous coal. Effects of sorbent residence time, sorbent particle size, and bed temperature on sulfur capture efficiency were investigated for different sorbents.

Results show several sorbent properties can be used to select suitable sorbents for AFBC applications. Balance between large pore diameter and high surface area is requisite to achieving high calcium utilization. The rate at which pore blockage occurs depends on the impurity level within the sorbent's structure. From this standpoint, impure sorbents are better than high purity limestones for reducing SO_2 emissions from fluidized bed combustors.

Project 85032: Thousands of acres of abandoned coal mined lands occur in Pennsylvania. The estimated cost to reclaim these lands is $15 billion. One way to deal with orphaned mined lands is to provide an incentive for the coal mining industry to remine some of these areas. Credit for water quality and land improvements by mining operations, at no governmental expense, is one such incentive. Consistent with this approach is the need to reduce an operator's liability for preexisting discharges that may be improved by remining.

Engineers at Pennsylvania State University have attempted to lessen a mine operator's liability for preexisting discharges by providing an automated procedure to predict cost and productivity for competitive surface mine schemes on remining sites. These investigators modified PSU's computerized Open Pit Materials Handling Simulator and Surface Coal Mine Cost Model. These programs have been integrated into a surface mining simulation software package, REMINE, that operates on a microcomputer.

Project 86002: Phase II of BCR National Laboratory's reactive gas coal desulfurization project continued examination of pyrite/ozone kinetics begun in Phase I (for additional details on Phase I of this work, please refer to Project 84042 in Appendix A of the Annual Report for Fiscal Year 1986-87). In addition to the previously studied variables (pH, time, temperature), variables including sample size consist, particle surface area and surface characteristics were assessed in Phase II. Phase II's primary goal was optimization of pyrite/ozone reaction conditions. Studies of coal-derived pyrite and run-of-mine coal to determine their susceptibility to reactive gas desulfurization were a secondary goal.

Phase II studies yielded the following conclusions:

- optimum reaction conditions for the desulfurization of coal in aqueous suspension appear to be pH of 1.00, temperature of 30 deg C, reaction time of at least 4 hrs;
- small differences were observed in the reactivity of pyrite samples obtained from different coals, presumably due to differences in morphology and degree of liberation of pyrite;
- reaction of pyrite with ozone becomes negligible above pH of 4.00; decreasing pH from 1.00 to 0.00 results in only marginal increases in reactivity;
- pyrite reactivity increases with decreasing particle size and, consequently, with increasing surface area;
- attempts to improve oxidation of pyrite in ozone, with ultraviolet radiation or auxiliary oxidants such as hydrogen peroxide, proved ineffective;
- at pH of 1.00, coal desulfurization is more effective in the presence of hydrochloric acid than in the presence of sulfuric or nitric acid; and,
- the ozonation process is apparently capable of removing organically bound sulfur from coal - in one set of experiments, reductions in organic sulfur ranging from 45 to 59 percent were achieved with four Pennsylvania coals.

Project 86009: Pennsylvania Electric Company conducted a project to demonstrate and optimize Confined Zone Dispersion (CZD), a retrofittable SO_2 reduction technology, on one-half of the flue gas emanating from its 140 MW coal-fired furnace (Unit 15) at Seward Generating Station. CZD, which involves in-duct injection of lime slurry, has the potential to reduce SO_2 emissions by 50% to 70% from their present level at this power plant.

Results from this project include:

- SO_2 and NO_x removals up to 20% and 17% respectively are possible with the current CZD test system;
- injection of atomized lime slurry in a large duct can be controlled in a confined zone dispersion, which minimizes duct deposition while enhancing SO_2 removal; and,

- high lime utilization (greater than 50%) is possible, particularly at low lime concentrations; utilization is inversely related to lime concentration.

Please see Project 87006 in Appendix B for further information on the CZD demonstration at Seward Station.

Project 86026: BCR National Laboratory completed a project aimed ultimately at employing currently idle coke ovens to pyrolyze solid combustible waste and coal, thereby producing enhanced Btu products for subsequent energy production as well as other usable materials. Project objectives were (1) to research and develop systems that combine various inexpensive Pennsylvania coals (e.g. high-sulfur bituminous coals, bituminous coal waste, anthracite refuse) and combustible solid waste into refuse derived fuels (RDF); (2) to conduct energy balance studies on the RDF from step 1 in a bench-scale coke oven; (3) to complete bench-scale tests on selected RDF from step 2 for production modeling purposes; and, (4) to evaluate test data and systems development information to ascertain the technical and economic merit of this coal/waste co-processing concept.

Key study findings include:

- Incorporation of Pennsylvania low-grade, high-sulfur and/or refuse coals enhances energy yields from biomass pyrolysis. Energy output increases 35-40% with 30% coal addition, and 60-80% with 40% coal addition.

- Based on estimated capital cost budget ranges used in this study, estimated total net biomass pyrolysis process costs with coke ovens in southeastern Pennsylvania appear competitive with current local landfill values, estimated at $60/ton (1987), at all capital cost scenarios. Approximately 1 million tons of biomass pyrolysis capacity exist in southeastern Pennsylvania.

- Bench- and pilot-scale pyrolysis tests demonstrated biomass, in the form of densified pellets, can be successfully pyrolyzed in coke making facilities.

- No activated carbon properties were observed in the pyrolyzed residue.

- A conceptual full-scale system would involve two-stage pyrolysis/oxidation treatment of municipal solid waste and/or municipal solid waste/coal pellets in a sequential process, while the densified pellets remain in the coke oven.

PEDA PROJECTS COMPLETED IN FISCAL YEAR 1987-88
(Continued)

Project 86028: The purpose of this project was to provide support for the Anthracite Industry Association's Second Annual Anthracite Trade Show.

Project 86031: Humenick Wood Products (HWP) installed an innovative wood waste burning and heat exchange system in its manufacturing plant. Formerly, HWP disposed of its wood wastes, and released heated air which had passed through particulate filters. The filters trap residues from wood finishing processes in which spray guns are used to apply stains, sealers and lacquers. One novel feature of the system is the flexible auger which feeds the combustor; it is capable of drawing fuel (in this instance, wood chips and sawdust) around turns and up inclines, thus minimizing fuel storage space problems. The system's firebox is lined with a plastic refractory, enabling high combustion temperatures to be maintained for extended periods and, consequently, consistent thermal output. In the event the bio-fuel supply is interrupted, an integrated oil back-up heating system is automatically brought into service. HWP's wood-fired system permits (1) heating of the Humenicks facility via burning of internally generated wood waste, and (2) heat recovery from clean air previously vented to the atmosphere.

APPENDIX B

PEDA PROJECTS IN PROGRESS

Project 85006: R.A. Systems 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.

Components of the cutting drum with built in pressure intensifier have been tested, with final surface tests to occur presently. Final tests, underground on a longwall panel, should follow shortly thereafter.

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.

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 product. 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-state 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 constructed to examine factors that affect clean coal product quality and yield as functions of operating conditions, and to provide a database for commercial development of the LICADO process.

Project 85024: Kipin Industries, Incorporated (KII) has developed the technology to combine liquid and solid hydrocarbon wastes such as tar and oil sludge with other waste materials or low-grade coal to produce a marketable commodity. The purpose of KII's project is to characterize waste materials and to evaluate to what extent they can be combined with coal to form acceptable feedstocks for coal-fired boilers.

Project objectives are:

1. to determine to what extent coal can act as a base for various wastes such as municipal garbage, organic acid sludges, trash/debris, tires, paint and resins, chemicals, railroad ties/wood, oil spill absorbents, sewage sludge and plastic;

2. to determine which products and blends from step 1 are best suited for stoker or pulverized coal boilers (handling characteristics, product and ash characteristics, and emission effects will be considered);

3. to determine which blends of processed waste oils can be shipped to coal mines for coal upgrading; and,

4. to evaluate if equipment can be installed at a power plant or industrial facility that permits waste-to-fuel processing for either on-site use or shipping to consumers.

Purchase and construction of coal/waste co-processing equipment for this demonstration are complete. The site to operate this mobile facility is under negotiation.

Project 85027: Coal Tech Corporation 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 cyclone combustor demonstration.

Though some difficulties developed with the refractory lining of the combustor, they have been resolved and the project remains on schedule. Data to assess the combustor's ability to reduce emissions of sulfur and nitrogen oxides are now being collected.

Project 85031: Lehigh University is engaged in fundamental research on bioprocessing of coal. The focus of this inquiry is to establish and evaluate the potential of Sulfolobus acidocaldarius as a means of removal of the organically bound sulfur in coal.

The technical objectives of the research are:

1. to demonstrate definitively that S. acidocaldarius is capable of non-destructive desulfurization of dibenzothiophene (DBT - an organic compound containing sulfur);

2. to measure stoichiometrically the specific product(s) formed during step 1;

3. to determine the role of permeability in the efficiency of DBT degradation;

4. to evaluate the role of cell aggregation and attachment in DBT degradation; and,

5. to initiate testing of the above parameters with coal.

This research has established that soil isolates which have the capacity to transform DBT, with or without desulfurization, are abundant; a fluorescence-based assay has been developed to detect this capacity. Attempts to grow S. acidocaldarius in continuous culture continue.

Project 85035: The Anthracite and Community Development Institute of Wilkes College is helping small and medium-sized anthracite operations in northeastern Pennsylvania. The Coal Operators Assistance Program provides marketing and technical help, advice on compliance with state and federal mining regulations, and financial counseling.

Specific activities engaged during this project have included:

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

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 will include characterization and evaluation of properties of coal waste piles in Pennsylvania for suitability to Burnout Control, and correlation of thermal energy potential to properties of waste coal piles.

Project objectives are:

1. to provide the basic knowledge required for selection of suitable coal refuse sites within Pennsylvania for energy production via Burnout Control;
2. to provide 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.

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. The simulated Burnout Control system is operational and tests with coal refuse samples are under way.

Project 86006: Pennsylvania State University is investigating the sulfur removal efficiency of C & K Coal Company's Piney Tipple. This coal preparation facility processes high-pyrite coal from the Upper and Lower Clarion seams.

The procedure being employed to evaluate the Piney Tipple is:

1. characterization of the sulfur forms, high temperature ash, total sulfur, and distribution of pyrite size and morphology in the Upper and Lower Clarion seams;

2. determination of the modes of occurrence of pyritic sulfur in cleaned Upper and Lower Clarion seam coals;

3. evaluation of the efficiency of the washing procedure at the Piney Tipple; and,

4. recommendation of changes (if any) to the washing procedure at the Piney Tipple that might produce a cleaner coal product.

Steps 1 and 2 are complete. The Final Report for this project is imminent.

Project 86007: As described under Project 85009 in Appendix A, Pennsylvania Coal Mining Association initiated, and BCR National Laboratory is continuing, a two-phase project to introduce low volatile Pennsylvania bituminous coal into utility boilers.

Phase II is to address the participating utilities' concerns through systems analysis, laboratory characterization of low volatile bituminous coals, development of standard laboratory tests, laboratory combustion analysis and satisfaction of safety requirements. A recommended program for full-scale combustion tests will be formulated for each power plant under consideration. The goal of Phase II is to secure at least one utility's commitment to a demonstration burn of low volatile Pennsylvania bituminous coal.

Currently, the project team is concluding its laboratory investigations, writing a Final Report for each of the utilities, and preparing presentations for utility officials.

Project 86008: Pennsylvania Electric Company is in the initial stage of 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 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 describe 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.

Extensive baseline measurements are slated to begin on August 1, 1988. New air registers, which are expected to reduce NO_x emissions by 30%, are to be installed in Fall 1988. New burner barrels and tips are scheduled to be installed in Spring 1990; this equipment is anticipated to reduce NO_x emissions by an additional 20-35%.

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 the Second Annual Anthracite Trade Show; and, placement of trade journal advertisements.
Additionally, several facilities have 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; and, West End Fire Company, Mahanoy City. The Tremont Community Center is currently under consideration for installation of an anthracite-based heating system.

Project 86022: Heyl & Patterson, Inc. is evaluating the amenability of the HeylPat-Miller Flotation System to micro-bubble flotation. Micro-bubble flotation is an advanced physical process for cleaning fine coal. Substantial improvements must be made in fine coal flotation selectivity if micro-bubble flotation is to perform effectively on Pennsylvania coal.

Project objectives are:

1. to establish the aeration capacity of the HeylPat-Miller aerator at various pressures and flows up to 60 psig inlet pressure;

2. to modify the inlet design of the aerator and to determine aeration capability with various inlet configurations and apex orifice sizes;

3. to quantify the bubble size distribution under the most attractive designs from steps 1 and 2;

4. to compare the size of bubbles from the modified flotation system to the size of bubbles generated under standard flotation conditions; and,

5. to test a Pennsylvania coal under standard and micro-bubble flotation conditions, using a standard frothing agent, and

to compare results in terms of product yield and product quality for five size fractions of that coal.

The test flotation system has been erected in the Heyl & Patterson Pilot Plant, and modified based on preliminary testing; the short term test program developed; requested patents received; baseline operating data developed; and aeration testing initiated. Bubble size measurements and flotation tests with coal are due to begin in mid-summer 1988.

Project 86035: The Economic Development Council of Northeastern Pennsylvania (EDCNP) has embarked on a project to furnish technical assistance to small producers and exporters seeking to market anthracite to Korea and other Far Eastern countries. EDCNP will perform two tasks:

1. Review existing specifications of the Korean anthracite market and make recommendations on reasonable specifications that are consistent with this market; and,

2. Sample and analyze some major anthracite silt ponds, culm banks and processed anthracite, and offer recommendations to achieve effective quality control. This task will include evaluation of the mixing ratio of different anthracite and anthracite waste feeds to meet calorific value requirements, and assessment of mixing methods to insure uniform quality.

Specification review and data collection are complete; sample analysis is nearly finished. The Final Report for this project is expected in late summer 1988.

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 between 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. Three tasks comprise the project: (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.

Progress has been made on overburden characterization and simulated weathering experiments.

Project 86046: EXPORTech Company, Incorporated's latest project continues its initial inquiry, under Project 85030 (see Appendix A of Annual Report for Fiscal Year 1986-87), into Open Gradient Magnetic Separation (OGMS) as a physical coal cleaning method. In this project, EXPORTech Co., Inc. seeks to extend its earlier work by beneficiating Lower Kittanning coal with 8 mesh topsize. The ability to beneficiate larger sizes of coal is integral to commercialization of OGMS as a beneficiation process.

The magnetic separator and ancillary equipment employed in this research have been modified to handle coarser coal sizes. The testing program is under way.

Project 87001: Lehigh University has been investigating the application of fluidization to coal cleaning (refer to Project 84016 in Appendix A). The second phase of this project is intended to develop this coal beneficiation technique 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:

- 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;
- to improve the understanding of particle stratification mechanisms to permit identification of optimum system design and operating conditions;
- to develop data needed for refining system design and improving system performance;
- to examine the fluid bed coal cleaning method's applicability to a wider range of coals;
- to design and build a small continuously operating bench scale fluid bed coal cleaning unit;
- to perform cleaning tests with the continuous system, under varying operating conditions and on different coals;
- to characterize the continuous system's performance; and,
- to develop a conceptual fluid bed coal cleaning plant layout and complete an economic evaluation of a commercial scale fluid bed coal preparation facility.

Project 87003: General Electric Transportation Systems has started a five-year project to develop a diesel electric locomotive fired with coal-water fuel (CWF). Specific project objectives are:

- to establish the conceptual commercial system design for a CWF-based diesel engine power system and to update this design as technical knowledge increases;
- to conduct research needed to establish firmly the technology for the proposed system concept;
- to develop technologies for control of hot gas contaminants potentially detrimental to the system;
- to develop and test components and subsystems required for integrated testing of a CWF-fired diesel engine system under representative duty cycles;
- 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,
- 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.

Project 87005: Consumers' Energy and Environmental Protection, Inc. (CEEP) plans to test a gasoline vapor recovery system prototype. This system may lead to more efficient refueling of automobiles. Upon completion of testing, CEEP will install the gasoline vapor recovery system at a commercial service station, for demonstration purposes.

Project 87006: Pennsylvania Electric Company (Penelec) continues to build on preliminary work to reduce sulfur 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).

This project will attempt to increase the steady-state rate of SO_2 reduction from 20% to 50-70%. Penelec will incorporate new nozzle arrays, innovative downstream obstruction treatments, and improved injection methods to improve the system's performance. Thereafter, the CZD system will be tested over a one-month period.

Penelec's CZD demonstration is currently under consideration as a

project in the U.S. Department of Energy's Innovative Clean Coal Technology Program.

Project 87010: Pennsylvania Electric Company (Penelec) is participating in demonstration of an integrated process in which -100 mesh coal is (1) cleaned to remove pyritic sulfur, (2) processed to produce coal-water fuel or CWF, (3) transported in slurry form to a utility site, and (4) co-fired with conventional comminuted coal in a pulverized coal boiler. The utility pulverized coal boiler to be employed in this demonstration is the 650 MW Unit 3 at the Homer City Power Station.

This project involves two series of CWF combustion tests. The first series of tests, at the 1 MM Btu/hr level, will help to demonstrate the feasibility of burning CWF and optimize the CWF type best suited for the Homer City Unit 3 boiler. The second series of larger scale (50 MM Btu/hr) combustion tests will incorporate an advanced CWF slurry burner. Both test series will require deep cleaned -100 mesh coal and production of various CWF slurries.

This project's technical objective is to show the feasibility of efficient combustion of CWF, in a phased manner. Results will lead to design of a 70 tph retrofit CWF burner system on the Homer City Unit 3 boiler.

Project 87016: Lehigh University engineers are demonstrating a selected catalyst-sorbent's ability to capture nitric oxides and to concentrate sulfuric oxides for subsequent removal from coal-derived combustion gases. To further develop this technology, this 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.

Project 87022: The Anthracite Industry Association (AIA) is conducting 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 both utility pulverized coal boilers and stoker boilers.

The project comprises two phases. Phase I involves procurement of 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. One or more utilities are hoped to conduct test burns of anthracite and/or anthracite/bituminous coal blends as a result of this project.

Project 87023: Coal Dynamics Corporation (CDC) will execute a project ultimately geared to harnessing heat from an abandoned underground mine fire, to produce steam for electrical power generation. The site for this effort is the Plummer-Puritan mine fire in Fayette County. The project will address engineering and environmental issues of import to commercial power production. Engineering issues include fire dynamics, ventilation and propagation; and location of equipment for commercial scale power generation. Environmental concerns are the effects of mine fire utilization on air, water and land quality.

CDC has submitted a proposal to develop its power production technology under the U.S. Department of Energy's Innovative Clean Coal Technology Program.

Project 87024: Control Techtronics, Inc. is developing software for a microprocessor-regulated combustion controller. The controller will be installed on a commercial fluidized bed combustor (FBC). The controller will feature the ability to change the FBC's operating parameters in response to levels of compounds such as sulfur dioxide in emissions from the combustor.

Project 87030: Penn State University is updating the demand information that is currently in the Pennsylvania Coal Database and Market Analysis On-Line Computer System. The database was created with PEDA support under Project 84002 (Appendix A). Coal delivery and quality information for utilities in the Pennsylvania market area will be revised, along with estimates of

coal preparation and transportation costs. Additionally, the remote-access capability of the database will be maintained, and counsel provided to database users.

Project 87033: Rodale Research Center (RRC) is conducting a project to assess the energy savings and energy efficiency of reduced tillage farming techniques versus conventional farming practices. Specifically, RRC's Low Input Reduced Tillage experiment will be evaluated from both an energy and economic standpoint.

The expected outcome of this study is increased energy efficiency on the farm. The project will provide information to farmers on the benefits of reduced tillage farming methods.

Project 87037: Florence Mining Company operates the first, and largest, oil agglomeration coal cleaning plant in the world. To enhance its oil agglomeration fine coal beneficiation process, the company will install experimental, high efficiency sieve bend screens developed by the Electric Power Research Institute. If effective, the screens will permit savings of as much as 40% in oil consumption.

The screens will be evaluated in two steps. First, preliminary testing with small scale sieve bend screens will be completed on a slip stream from the oil agglomeration circuit. Thereafter, and based on positive results from preliminary tests, full scale screens will be installed in the oil agglomeration circuit and tested for four months.

Project 87045: EXPORTech Company, Inc. (ETCi) will investigate the technical feasibility of a novel method for extending dry magnetic separation to the cleaning of -200 mesh coal. To this end, ETCi will build a separation apparatus and process fine coal in a controlled gaseous atmosphere.

Project 87047: Energy Development Services, Inc. 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 along Lake Erie.

Project 87052: Somerset Rural Electric Cooperative (SREC) is using PEDA funds to make loans to industrial firms for energy efficiency improvements related directly to conservation of Pennsylvania's native energy resources. This pilot project for the Authority highlights partnership between government and the private sector to foster economic development.

PEDA PROJECTS IN PROGRESS
(Continued)

Project 87053: BCR National Laboratory intends to direct a project comprising co-firing coal and waste, with limestone for capture of sulfur liberated during combustion, in a rotary kiln combustor. The project's objectives are:

- o to prove the feasibility of burning a mixture of high-sulfur coal and various wastes in a rotary kiln, with limestone injection;
- o to define the parameters for optimal operation of the rotary kiln; and,
- o to evaluate the technical and economic merits of a commercial-scale kiln combustor in comparison with atmospheric fluidized bed combustion.

Project 87055: The Grass Roots Alliance for a Solar Pennsylvania (GRASP) will investigate the role of thermal bypasses in the poor performance of attic insulation in row houses. Based on this inquiry, GRASP will generate recommendations on how to improve the energy efficiency of attic insulation in row houses.

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.