

SECTION VI

Improved Environmental Control

IMPROVED ENVIRONMENTAL CONTROL

II. STATUS OF TECHNOLOGY

A. Present Status

1. Demonstration of specific flue gas sulfur control techniques are underway. Demonstration of technical performance capabilities are highly advanced. The demonstration of long-term performance reliability is under study and new processes are in the bench scale and development stage.

Development of improved particulate control and identification of the hazardous pollutant problem have been initiated.

Major conversion technologies are in, or entering into, a pilot-scale development stage. Environmental problems associated with these conversion technologies are presently being identified and quantified.

Physical and chemical coal cleaning research and development is presently underway at laboratory scale. Design of a pilot-scale unit is underway with initiation of construction possible by February 1974.

Fluidized-bed combustion for environmentally acceptable utilization of high-sulfur refinery residue has been successfully operated in a pilot plant facility.

B. Barriers to Technology Implementation

1. Research is necessary to development of basic data that would result in: improved systems, reduced energy requirements, improved waste disposal, and waste and by-product utilization.

Basic specific research is required to provide fundamental knowledge on coal conversion and shale oil technology problems and on alternative methods for insuring the environmental integrity of large-scale facilities. Continued basic research is needed to examine and optimize the degree of environmental control and cost reductions achievable with coal cleaning (physical and chemical). Basic research is also required to identify major conversion process and scrubbing technology by-product recoveries and uses.

2. Development of specific processes related to flue gas control techniques will be required prior to implementation. Development of required conversion process controls will be needed whenever existing technology is inappropriate for use. The compatibility and optimal degree of control achievable in fuel conversion facilities with effluent treatment technologies will require development. Effort must be applied to develop the feasibility of integrated, large-scale continuous operation of coal cleaning technologies. Indicated directions from the basic waste/by-product scientific research must be developed through large-scale application on operating conversion systems. Technology for the recovery of energy from coal cleaning and refinery wastes and for the adequate reclamation of strip-mine areas must be developed to achieve highly efficient operation while minimizing environmental problems.

3. Implementation of fuel conversion technologies will be restricted due to the limited number of sites capable of supplying the materials requirements of the technologies. Implementation of flue gas cleaning

will be limited both by problems associated with retrofit on existing facilities and by the costs of application to small-scale facilities.

C. On-Going R&D Efforts to Overcome Barriers

1. Large funding levels in the multi-million dollar range are being expended in research, development and demonstration areas. The majority of funds (80-90%) is based on federal government operations or support.

2. In demonstration or first commercial operations of processes, the federal/industry support is generally 50/50.

3. There has been continuous as well as major efforts to exchange information with foreign efforts. These efforts have varied from visits, formal meetings, and contractual arrangements to official agreements (e.g., protocol with U.S.S.R. in environmental areas) with foreign governments.

III. RATIONALE FOR FEDERAL INVOLVEMENT

A. Government funding of the pollution control area is required in view of the need for development, implementation, and enforcement of strong pollution control standards and of the requirement for a cohesive, well-directed R&D program to support environmental quality control. Private industry cannot be relied upon to develop the broad R&D program which is needed.

Increases in the cost of naturally clean fuels (oil and gas), restrictions upon fuel switching, and implementation of emission standards should produce a more favorable industrial attitude toward application of pollution control technologies.

The development of processes for conversion of coal to high-grade fuels or liquids requires and will continue to require increasingly larger financial support. Such levels of funding required for accelerated or even minimum programs appear to be beyond the capabilities of industry. To achieve these developments successfully in a near-term period, requires a multi-prong attack. Only federal support could achieve this goal.

B. Financial support by the federal government will be required to reduce research and development barriers due to lack of profit motive to industrial users and to technical expertise centered in federal agencies. Federal financial assistance will also be required to accelerate the implementation of the developed technology due to the higher risk involved and the capital required. This assistance

support could be in several forms: direct funding, low interest loans, tax reduction incentives or even a federally supported and operated industry.

IV. OBJECTIVES, CRITERIA

A. The Pollution Control research area objective is to develop to commercial application technologies for environmentally acceptable domestic energy resource utilization and energy self-sufficiency.

B. Criteria for setting priorities among programs should include:

1. Public acceptance of program output
2. Government cost/benefit
3. Environmental acceptability
4. Related cost/manpower requirements
5. Resource extension
6. Efficiency enhancement

V. ALTERNATIVE R&D PROGRAMS

A. Schedule and Costs of R&D Program at Alternative Funding Levels

Pollution control-related energy R&D major milestone charts and federal obligation summaries are attached as Form A and Form B, respectively, for each of the program alternatives: (a) accelerated/ orderly; (b) maximum (crash); and (c) minimum.

B. Criteria Employed by the Subpanel in Constructing the Proposed R&D Program

1. N/A
2. The program was based upon:
 - a. Utilization of dirty fuels to supply clean energy.
 - b. Increasing supplies of liquid and gaseous fuel (increasing freedom from foreign sources).
 - c. Reducing environmental degradation to a minimum.
 - d. Conservation of energy.

C. Relationship of Other R&D

1. No dependency upon other R&D areas is envisioned. The degree of implementation of conversion system control and enhancement is dependent upon continued conversion technology development and future application.

2. At the time of commercialization of technologies for pollution control the beneficial impact of program output will define and be defined by the degree of implementation of other technologies.

D. Acceptability of R&D Program

Very few problems are envisioned regarding acceptability of the pollution control area program outputs. Environmental impact statements will be required for all demonstration projects as well as for subsequent commercial applications.

E. Other Costs and Benefits

The achievement of expanded coal utilization will provide capabilities for more optimal programming of existing domestic fuel resources. Fuel switching (to oil) requirements could be avoided and fuel self-sufficiency attained.

Widespread technology application should produce economic benefits associated with new technology developments and expanded coal utilization.

Program failure will result in loss of approximately 50% of major capital expenditures.

Program termination will produce major user sector concern regarding program co-sponsorship as well as problems in overall domestic fuel utilization impact and enhanced environmental quality attainment.

VI. IMPLEMENTATION PLAN

A. Direct Benefits

1. Implementation of the overall Environmental Control area R&D output will involve the extraction, refining and conversion, transportation, and central station conversion areas. Utility, industrial, and residential/commercial energy users would all comprise the ultimate technology utilization sectors. Supply sectors would encompass the pollution control equipment and construction industries.

2. The Pollution Control area technologies in the flue gas cleaning and fuel cleaning/conversion areas could ultimately impact upon the entire industrial, residential/commercial, and utility market. Flue gas environmental control capabilities could be achieved on $10-16 \times 10^{15}$ Btu by 1985 and $20-40 \times 10^{15}$ Btu by 2000. By the year 2000 synthetic gas from coal may provide $5.4-16.2 \times 10^{15}$ Btu/year. Also, yields of $2-6 \times 10^{15}$ Btu/year and $1.1-3.0 \times 10^{15}$ Btu/year of usable energy by 2000 could be obtained by fuel cleaning and shale oil industries, respectively. Ultimate application of Pollution Control area technologies will enable achievement of air quality criteria from fuel combustion and, thus, continued use of "dirty" domestic fuels.

3. Implementation of the Pollution Control area R&D will be a major factor in reducing U. S. dependence upon importation of fuels to supply domestic energy requirements. The utilization potential of coal and shale oil as a result of achievement of objectives will contribute to energy self-sufficiency. Process technology implementation will be independent of foreign resource or material supplies.

4. Program implementation will maximize usage of domestic energy supplies, thus precluding U. S. energy system vulnerability associated with strong dependence upon foreign fuel sources. Major security problems and accident impacts from technology implementation will not occur. Adequate environmental safeguard development will insure minimal risk associated with domestic energy supply.

5. The optional recovery elements of the Pollution Control R&D program will aid in increasing the efficiency of energy utilization from extracted domestic fuel resources. Development and refining of selective fuel cleaning technology will result in a maximum of useful fuel value recovery from coal. Strategies for central power station control and for conversion system control will be optimized to provide for the maximum possible net energy recovery.

B. Proposed Schedule for Implementation

1. Pollution control technology developments will initiate commercial market penetration in 1980 and progress as expanded fuel demands and public demands for environmental control necessitate.

2. The rate of technology implementation will be restricted by the availability of capital and the lack of trained manpower to undertake technology application. The ability of vendors to supply needed control equipment and control equipment guarantees will also be an implementation constraint.

3. The national energy system would be favorably affected through the expanded use of the vast domestic coal reserves which would be attained from achievement of program objectives.

4. Geographical/siting requirements will be major consideration in the application of fuel conversion technologies. The economics of retrofit applications will limit the degree of implementation of flue gas cleaning technologies.

5. The application potential of Pollution Control area technologies will be most favorably realized through optimum process economics. This will occur through enhanced by-product recovery and utilization and/or disposal techniques.

C. Economic Impact

Assuming a raw coal energy cost of $\$0.55/10^6$ Btu, the clean fuel product from fuel cleaning (physical and chemical) will cost $\$0.55-$
 $\$0.65/10^6$ Btu. Technology for the environmentally sound recovery of oil from shale will produce fuel at a cost of $\$1.00-\$1.50/10^6$ Btu. Major product fuels from coal liquefaction and coal gasification technologies are expected to cost $\$0.75-\$0.80/10^6$ Btu and $\$1.00-\$1.30/10^6$ Btu, respectively.

On the basis of a delivered electrical energy cost of $\$2.00/10^6$ Btu (6.75 mills/kwhr) from conventional coal-fired power plants the final energy cost with the addition of flue gas cleanup would amount to $\$2.35-$
 $\$2.80/10^6$ Btu (7.95-9.55 mills/kwhr). This electrical energy will of course be completely clean at the point of use and has a high "end use value."

VII. IMPACTS OF IMPLEMENTATION

A. Natural Resources Required

In addition to the quantities of energy which have been estimated to be attainable from technology implementation, flue gas cleaning and fuel cleaning (chemical + physical) are each expected to consume approximately 6% of the clean energy which they produce. Approximately 15%-25% of the fuel resources fed to coal-to-gas and coal-to-liquid conversion systems will be required to meet process fuel requirements.

B. Compatibility with Existing Energy System

The major fuel conversion and fuel cleaning technology developments should be compatible with existing fuel combustion facilities with little, if any, modifications required.

C. Environmental Impacts of Implementation

The technologies being developed in the Environmental Control R&D area will reduce atmospheric emissions from fuel combustion to levels which comply with environmental regulations. The impact of liquid, solid, and thermal effluents from developed technologies will be reduced to acceptable levels through development and implementation of the required control measures.

FORM A

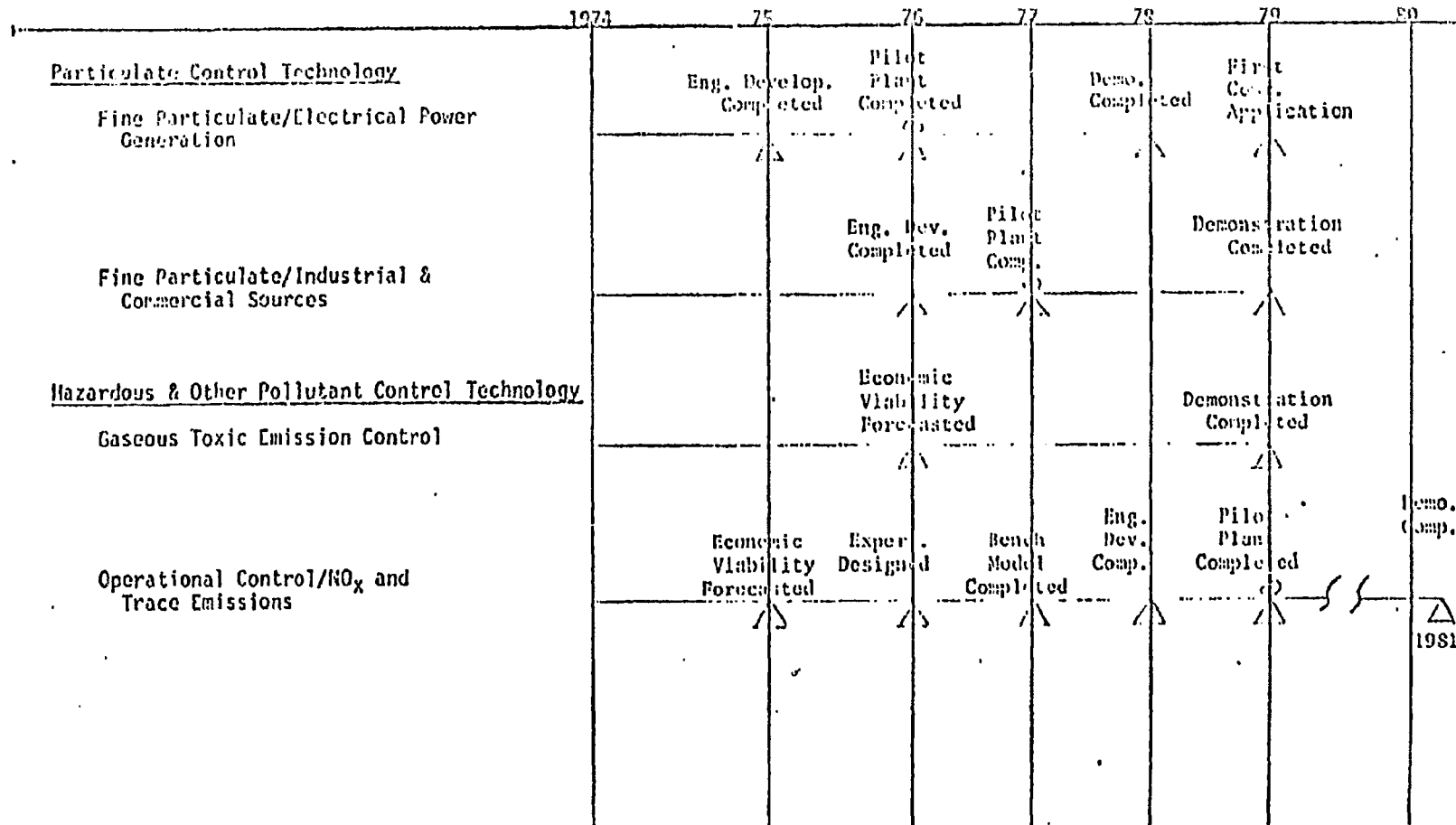
ENERGY R&D PROGRAM FLOW CHART

PROGRAM NAME: Improved Environmental Control

PROGRAM ALTERNATIVE: Accelerated

KEY DECISION POINT: ○

MAJOR MILESTONE OR CRITICAL PATH JUNCTURE △



FORM A

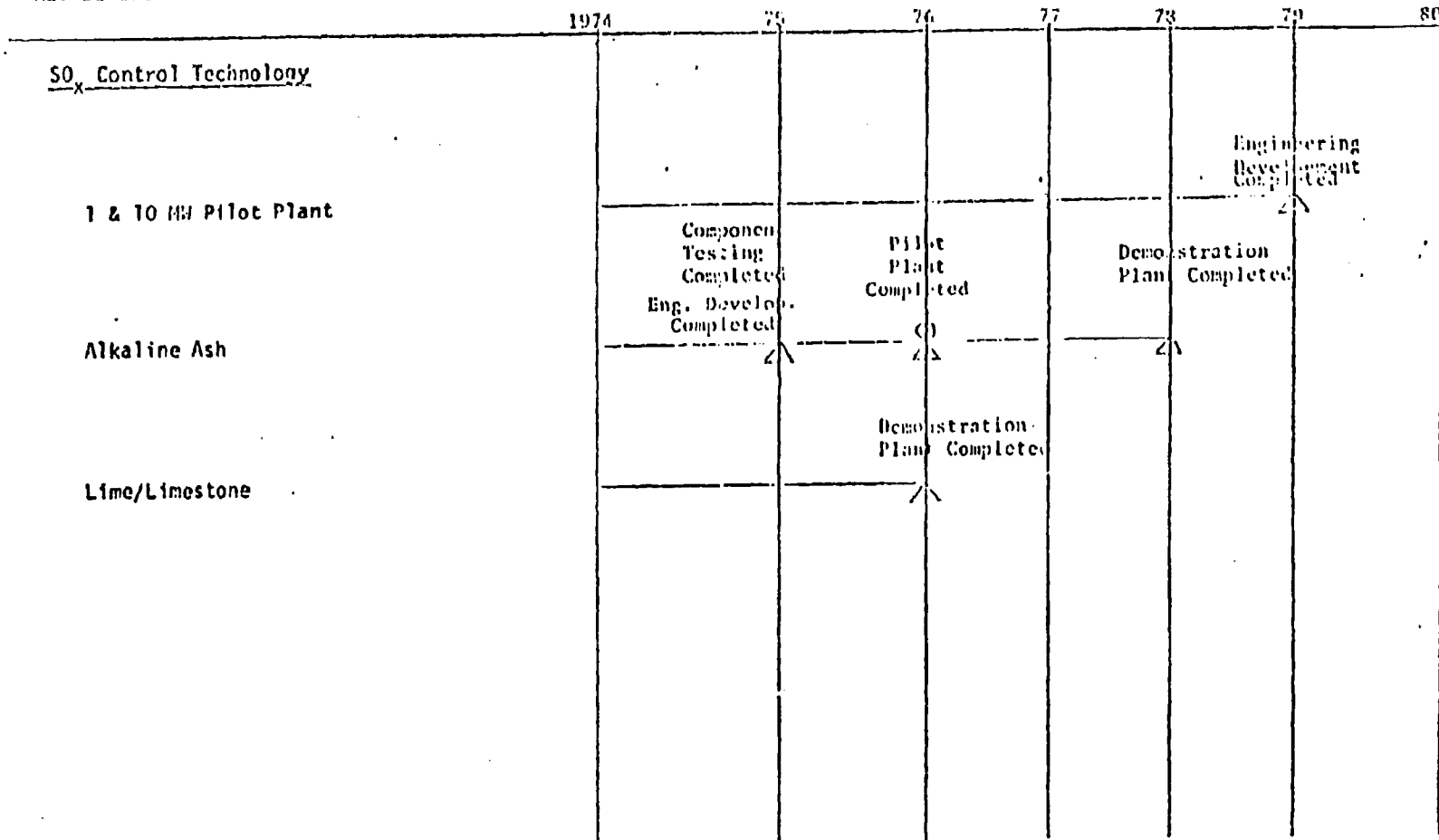
ENERGY R&D PROGRAM FLOW CHART

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Accelerated

KEY DECISION POINT: ○

MAJOR MILESTONE OR CRITICAL PATH JUNCTURE Δ



FORM A

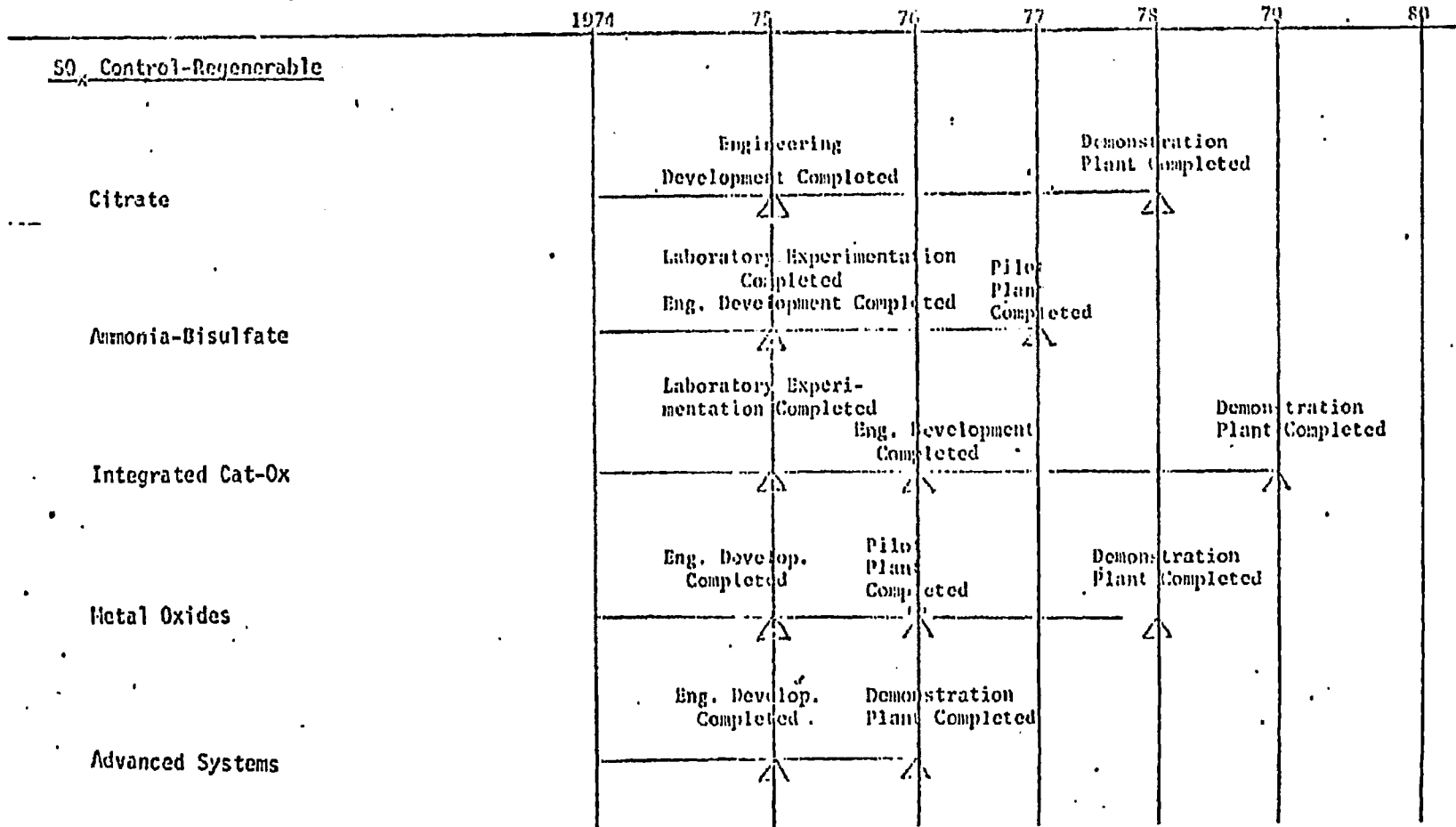
ENERGY R&D PROGRAM FLOW CHART

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Accelerated

KEY DECISION POINT: ○

MAJOR MILESTONE OR CRITICAL PATH JUNCTURE ▲



FORM A

ENERGY R&D PROGRAM FLOW CHART

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Accelerated

KEY DECISION POINT: ○

MAJOR MILESTONE OR CRITICAL PATH JUNCTURE ▲

	1974	75	76	77	78	79	80
<u>SO_x Control-Regenerable (continued)</u>		Eng. Develop. Completed	Pilot Plant Completed			Demonstration Plant Completed	
Industrial Boiler		▲	▲			▲	
		Eng. Develop. Completed	Demonstration Plant Completed				
Wellman-Lord/Allied		▲		▲			
<u>Fuel Cleaning</u>		Pilot Plant Completed			Demonstration Plant Completed	First Commercial Application	
Chemical Treatment of Coal		▲			▲	▲	
						Completion R&D	
Physical & Chemical Removal of Sulfur						▲	
		Laboratory Experimentation Completed		Pilot Plant Completed			
High Gradient Magnetic Separation		▲		▲			

FORM A

ENERGY R&D PROGRAM FLOW CHART

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Accelerated

KEY DECISION POINT: ○

MAJOR MILESTONE OR CRITICAL PATH JUNCTURE ▲

	1974	75	76	77	78	79	80
<u>Fuel Conversion and Process Control</u>		Experiment Designed	Component Testing Completed			Pilot Plant Completed	
Development and Demonstration of Control Components		▲	▲			▲	
Development and Demonstration for Shale Oil Control		Experiment Designed		Laboratory Experimentation Completed		Engineering Development Completed	
		▲		▲		▲	
Control of Fine Particulates from Fuel Extraction Processing Plants		Experiment Designed	Component Testing Completed			Laboratory Experimentation Completed	Eng. Develop. Completed
		▲	▲			▲	▲
Recovery of Petroleum Refining Hydrocarbon Losses		Lab. Experi. Completed	Eng. Develop. Completed	Pilot Plant Completed	Demo. Plant Completed	Demo. Plant Completed	
		▲	▲	▲		▲	

FORM A

ENERGY R&D PROGRAM FLOW CHART

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Accelerated

KEY DECISION POINT: ○

MAJOR MILESTONE OR CRITICAL PATH JUNCTURE ▲

	1974	75	76	77	78	79	80
<u>Fuel Conversion and Process Control (cont'd)</u>		Lab. Experi. Completed	Eng. Develop. Completed				
Utilization and Disposal of Conversion Plant Wastes		▲	▲				
Improved gas-solid-liquid Separation						Completion R&D	
<u>Waste Disposal and By-Products</u>		Lab. Experi. Completed	Eng. Develop. Completed				
Disposal of High Sulfur Refinery Waste by CFB		▲	▲			Demonstration Plan Completed	
Alternate Reductants from Regen. Flue Gas Cleaning Systems		Eng. Develop. Completed	Pilot Plant Completed				

FORM A

ENERGY R&D PROGRAM FLOW CHART

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Accelerated

KEY DECISION POINT: ○

MAJOR MILESTONE OR CRITICAL PATH JUNCTURE ▲

	1974	75	76	77	78	79	80
<u>Waste Disposal and By-Products (continued)</u>		Experiment Designed			Lab. Completed	Experi. Completed	
Lime-Sludge Waste Utilization		▲			▲		
		Eng. Develop. Completed	Pilot Plant Completed			Demonstration Plant Completed	
Waste By-Product from Gasification		▲	▲			▲	
		First Commer. Application				Completed	
Fly-Ash Strip Mining Reclamation		▲				▲	
		Eng. Develop. Completed	Demonstration Plant Completed			Completed	
Use of Sulfur as Asphalt Substitute		▲	▲			▲	
		Eng. Develop. Completed				Demonstration Plant Completed	
High Sulfur Combustor Demonstration			▲			▲	

FORM A

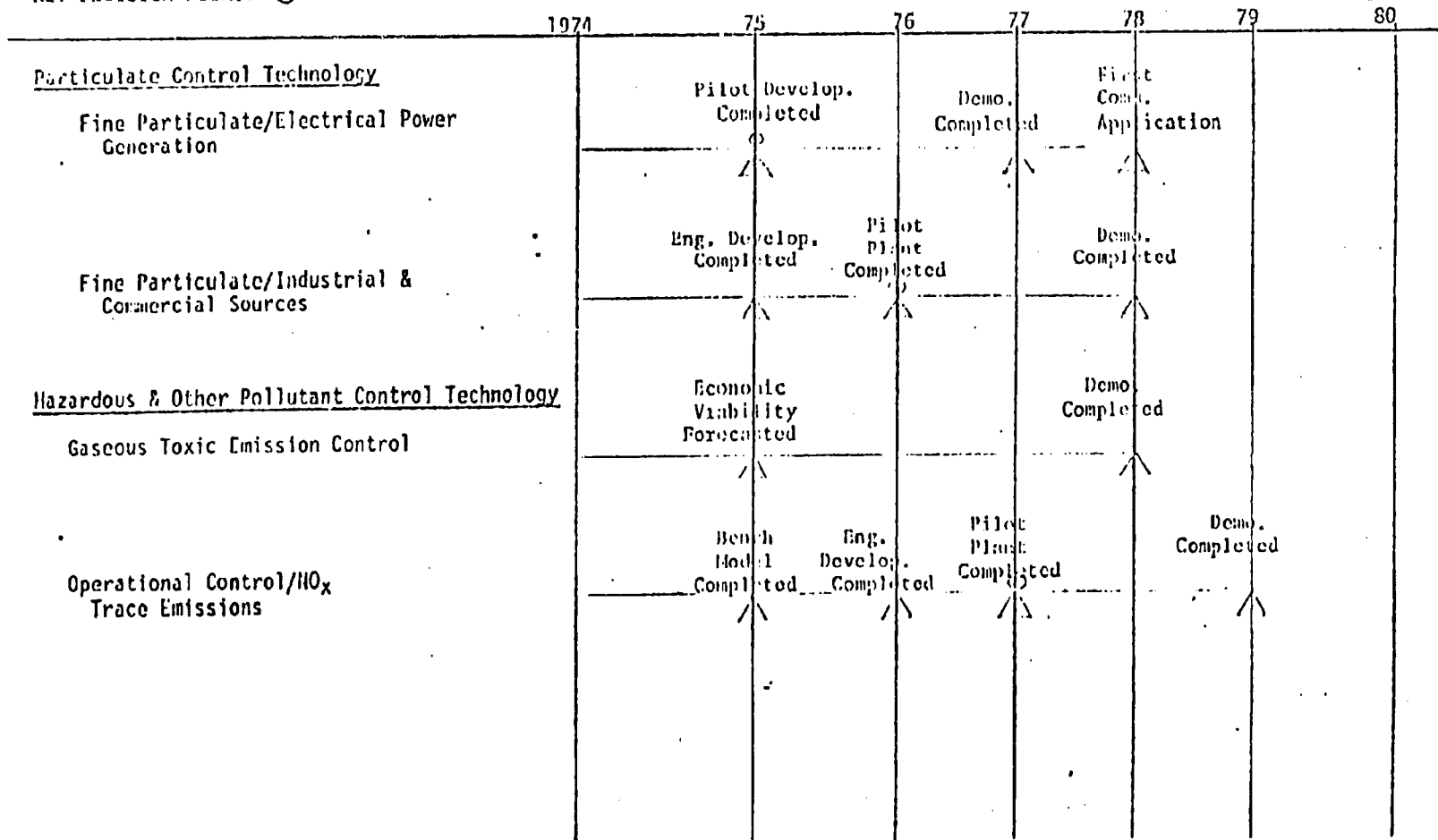
ENERGY R&D PROGRAM FLOW CHART

PROGRAM NAME: Improved Environmental Control

PROGRAM ALTERNATIVE: Crash

KEY DECISION POINT: ○

MAJOR MILESTONE OR CRITICAL PATH JUNCTURE ▲



FORM A

ENERGY R&D PROGRAM FLOW CHART

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Crash

KEY DECISION POINT: ○

MAJOR MILESTONE OR CRITICAL PATH JUNCTURE ▲

	1974	75	76	77	78	79	80
<u>SO</u> Control Technology						Lab. Experi. Completed	
1 & 10 MW Pilot Plant		Component Testing Completed	Pilot Plant Completed	Demonstration Plant Completed		▲	
Alkaline Ash		Eng. Develop. Completed					
Lime/Limestone			Demonstration Plant Completed				

FORM A

ENERGY R&D PROGRAM FLOW CHART

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Crsash

KEY DECISION POINT: ○

MAJOR MILESTONE OR CRITICAL PATH JUNCTURE

	1974	75	76	77	78	79	80
<u>SO_x Control-Regenerable</u>							
Citrate		Eng. Develop. Completed		Demonstration Plant Completed			
Ammonia-Bisulfate		Lab. Experi. Completed Eng. Develop. Comp.		Pilot Plant Completed			
Integrated Cat-Ox		Eng. Develop. Completed		Pilot Plant Completed			
Metal Oxides		Eng. Develop. Completed	Pilot Plant Comp.	Demonstration Plant Completed			
Advanced Systems		Eng. Develop. Completed	Demonstration Plant Completed				

FORM A

ENERGY R&D PROGRAM FLOW CHART

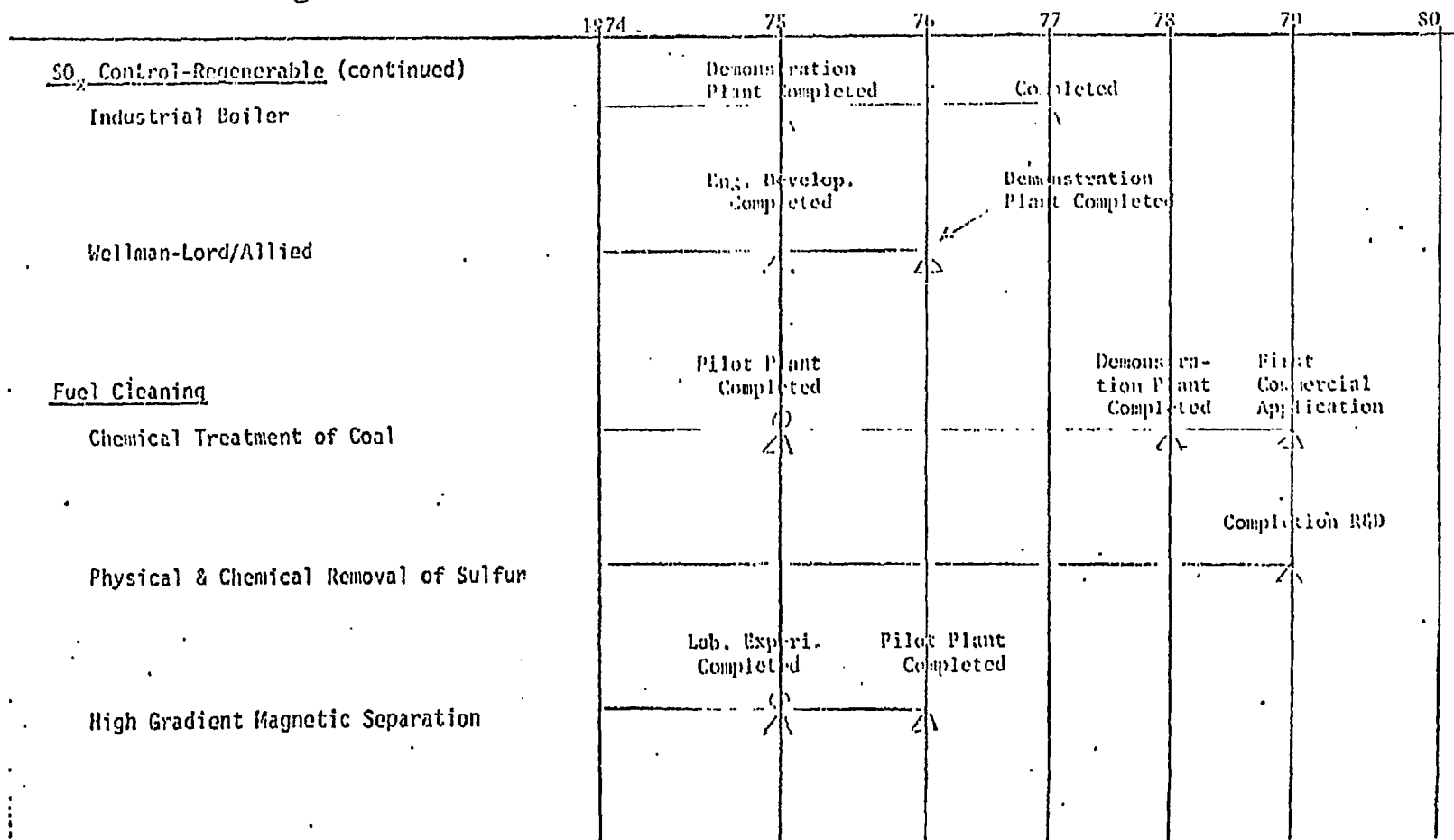
PROGRAM NAME: _____

PROGRAM ALTERNATIVE: _____

Crash

KEY DECISION POINT: ○

MAJOR MILESTONE OR CRITICAL PATH JUNCTURE ▲



ENERGY R&D PROGRAM FLOW CHART

FORM A

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Crash

KEY DECISION POINT: ○

MAJOR MILESTONE OR CRITICAL PATH JUNCTURE ▲

	1974	75	76	77	78	79	80
<u>Fuel Conversion and Process Control</u>		Experiment Designed	Component Testing Completed			Pilot Plant Completed	
Development and Demonstration of Control Components		▲	▲			▲	
		Experiment Designed	Lab. Completed	Experi. Completed		Eng. Develop. Completed	
Development and Demonstration for Shale Oil Control		▲	▲			▲	
		Component Testing Completed			Lab. Experi. Completed		
Control of Fine Particulates from Fuel Extraction Processing Plants		▲			▲		
		Lab. Experi. Completed			Demonstration Plant Completed		
Recovery of Petroleum Refining Hydrocarbon Losses		▲			▲		
		Eng. Develop. Completed					

FORM A

ENERGY R&D PROGRAM FLOW CHART

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Crash

KEY DECISION POINT: ○

MAJOR MILESTONE OR CRITICAL PATH JUNCTURE ▲

	1974	75	76	77	78	79	80
<u>Fuel Conversion and Process Control (cont'd)</u>		Experiment Designed	Eng. Develop. Completed				
Utilization and Disposal of Conversion Plant Wastes		▲	▲				
Improved gas-solid-liquid Separation				Completion R&D			
				▲			
<u>Waste Disposal and By-Products</u>		Eng. Develop. Completed					
Disposal of High Sulfur Refinery Waste by CAFB		Demo. Plant Completed		Completion			
		▲		▲			
Alternate Reductants from Regen. Flue Gas Cleaning Systems		Demo. Plant Completed	Completed				
		▲	▲				

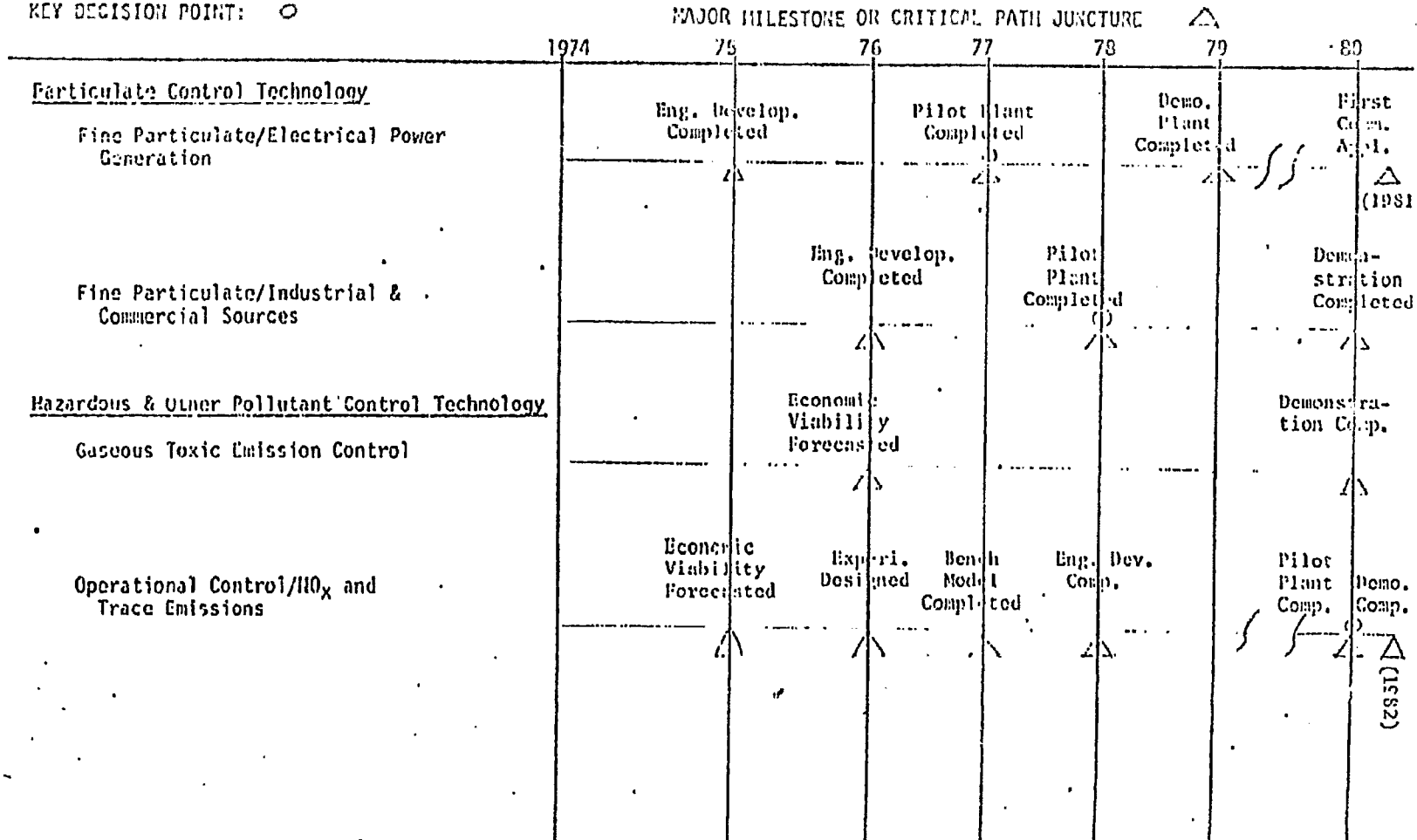
FORM A

ENERGY R&D PROGRAM FLOW CHART

PROGRAM NAME: Improved Environmental Control

PROGRAM ALTERNATIVE: Minimum

KEY DECISION POINT: ○



FORM A

ENERGY R&D PROGRAM FLOW CHART

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Minimum

KEY DECISION POINT: 0

MAJOR MILESTONE OR CRITICAL PATH JUNCTURE Δ

	1974	75	76	77	78	79	80
<u>SO_x Control Technology</u>							
1 & 10 MW Pilot Plant							Lab. Experi. Completed
Alkaline Ash			Component Testing Completed		Pilot Plant Completed		Demo Plant Completed
Lime/Limestone			Eng. Develop. Comp.				
			Complete				

FORM A

ENERGY R&D PROGRAM FLOW CHART

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Minimum

KEY DECISION POINT: ○

MAJOR MILESTONE OR CRITICAL PATH JUNCTURE ▲

	1974	75	76	77	78	79	80
<u>SO_x Control-Regenerable</u>							
Citrate			Eng. Develop. Comp.				Demo. Plant Completed
Ammonia-Bisulfate			Lab. Experi. Completed Eng. Develop. Comp.		Pilot Plant Completed		
Integrated Cat-Ox			Lab. Experi. Completed	Eng. Develop. Completed			Demo. Plant Completed
Metal Oxides			Eng. Develop. Completed	Pilot Plant Completed			Demo. Plant Completed
Advanced Systems		Demonstration Plant Completed			Complete		

(1981)

FORM A

ENERGY R&D PROGRAM FLOW CHART

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Minimum

KEY DECISION POINT: ○

MAJOR MILESTONE OR CRITICAL PATH JUNCTURE ▲

	1974	75	76	77	78	79	80
<u>SO_x Control-Regenerable (continued)</u>			Eng. Develop. Completed	Demo Plant Comp		Complete	
Industrial Boiler			▲	▲		▲	
		Eng. Develop. Completed		Demo. Plant Completed			
Wellman-Lord/Allied		▲		▲			
<u>Fuel Cleaning</u>		Pilot Plant Comp.	Demo. Plant Completed				Complete
Chemical Treatment of Coal		▲	▲				▲ (1981)
						Completion R&D	
Physical & Chemical Removal of Sulfur							
		Lab. Experl. Completed		Pilot Plant Completed			
High Gradient Magnetic Separation		▲		▲			

FORM A

ENERGY R&D PROGRAM FLOW CHART

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Minimum

KEY DECISION POINT: ○

MAJOR MILESTONE OR CRITICAL PATH JUNCTURE △

	1974	75	76	77	78	79	80
<u>Fuel Conversion and Process Control</u>		Experiment Designed	Component Testing Completed			Pilot Plant Completed	
Development and Demonstration of Control Components		△	△			△	
		Experiment Designed		Lab. Experi. Completed		Eng. Develop. Completed	
Development and Demonstration for Shale Oil Control		△		△		△	
		Experiment Designed	Component Testing Completed		Lab. Experi. Completed		Eng. Develop Completed
Control of Fine Particulates from Fuel Extraction Processing Plants		△	△			△	△
			Eng. Develop. Completed		Demo. Plant Completed		Complete
Recovery of Petroleum Refining Hydrocarbon Losses			△		△		△

ENERGY R&D PROGRAM FLOW CHART

FORM A

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Minimum

KEY DECISION POINT:

MAJOR MILESTONE OR CRITICAL PATH JUNCTURE \triangle

	1974	75	76	77	78	79	80
<u>Fuel Conversion and Process Control (cont'd)</u>			Lab. Experi. Completed		Eng. Develop. Completed		
Utilization and Disposal of Conversion Plant Wastes							
Improved gas-solid-liquid Separation						Complete \triangle	
<u>Waste Disposal and By-Products</u>			Lab. Experi. Completed	Pilot Plant Completed			Complete R&D
Disposal of High Sulfur Refinery Waste by CAFB							\triangle (1981)
Alternate Reductants from Regen. Flue Gas Cleaning Systems		Demo. Plant Completed	Completed				

FORM A

ENERGY R&D PROGRAM FLOW CHART

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Minimata

KEY DECISION POINT: ○

MAJOR MILESTONE OR CRITICAL PATH JUNCTURE △

	1974	75	76	77	78	79	80
<u>Waste Disposal and By-Products (continued)</u>						Lab. Experi. Completed	
Lime-Sludge Waste Utilization		Initiation					
			Lab. Experi. Completed	Eng. Develop. Completed			Demo. Plant Completed
Waste By-Product from Gasification			△	△			△
		First Commercial Application				Complete	
Fly-Ash Strip Mining Reclamation		△				△	
		Eng. Develop. Completed		Demo. Plant Completed			Completed
Use of Sulfur as Asphalt Substitute			△	△			△ (1981)
				Eng. Develop. Completed			Demo. Plant Comp.
High Sulfur Combustor Demonstration					△		△ (1982)

ENERGY R&D PROGRAM BUDGET SUMMARY

FORM B

PROGRAM NAME: Improved Environmental Control

PROGRAM ALTERNATIVE: Accelerated

FEDERAL OBLIGATIONS

\$X10⁶

PROGRAM ELEMENT	1975	1976	1977	1978	1979	1980-1989
<u>Particulate Control Technology</u>						
Fine Particulate/Electrical Power Generation ⁴	3.600	4.850	3.500	3.500	3.500	
Fine Particulate/Industrial & Commercial Sources ⁴	2.300	2.500	2.7667	2.7667	2.7667	
<u>Hazardous & Other Pollutant Control Technology</u>						
Gaseous Toxic Emission Control ⁴	1.850	3.000	0.6185	0.6185	0.6185	
Operational Control/NO _x and Trace Emissions ⁴	0.460	0.810	1.070	1.070	1.070	

* Federal obligations assume at least 50% demonstration co-funding by the private sector.

ENERGY R&D PROGRAM BUDGET SUMMARY

FORM B

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Accelerated

FEDERAL OBLIGATIONS

PROGRAM ELEMENT	\$X10 ⁶						
	1975	1976	1977	1978	1979	1980-1989	1990
<u>SO₂ Control Technology</u>							
1 & 10 MW Pilot Plant	2.025	1.935	1.135				
Alkaline Ash *	1.1	0.6	1.25	1.25			
Line/Limestone *	3.0	1.5					
<u>SO₂ Control - Miscellaneous</u>							
Citrate *	1.0	8.0	1.5	1.5			
Ammonia-Bisulfate	0.6	0.6	0.25				
Integrated Cat-Ox *	10.0		0.3	0.3	0.3		
Metal Oxides *	0.43	1.41	1.3	1.3			
Advanced Systems *	5.75	3.25					
Industrial Boiler *	0.85	0.5	0.167	0.167	0.167		
Hellman-Lord/ Allied *	4.5	8.7	.5				
<u>Fuel Cleaning</u>							
Chemical Treatment of Coal *	2.581	4.15	2.0	2.0	2.0		
Physical & Chemical Removal of Sulfur	1.0	1.0	1.0	1.0	1.0		
High Gradient Magnetic Separation	0.25	0.65	2.0				
* Federal obligations assumed at least 50% demonstration co-funding by the private sector.							

ENERGY R&D PROGRAM BUDGET SUMMARY

FORM B

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Accelerated

FEDERAL OBLIGATIONS

PROGRAM ELEMENT	\$X10 ⁶					
	1975	1976	1977	1978	1979	1980-1989
<u>Fuel Conversion and Process Control</u>						
Development and Demonstration of Control Components	6.1	10.1	4.334	4.334	4.334	
Development and Demonstration for Shale Oil Control	1.45	2.5	3.899	3.899	3.899	
Control of Fine Particulates from Fuel Extraction Processing Plants	1.25	1.0	1.433	1.433	1.433	2.0
Recovery of Petroleum Refining Hydrocarbon Losses ^a	2.45	2.2	0.717	0.717	0.717	
Utilization and Disposal of Conversion Plant Wastes	0.5	0.5				
Improved gas-solid-liquid Separation	2.9	2.85	1.983	1.983	1.983	

* Federal obligations assume at least 50% demonstration co-funding by the private sector.

FORM B

ENERGY R&D PROGRAM BUDGET SUMMARY

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Accelerated

PROGRAM ELEMENT	FEDERAL OBLIGATIONS						
	1975	1976	1977	1978	1979	1980-1989	1990
<u>Waste Disposal and By-Products</u>							
Disposal of High Sulfur Refinery Waste by CAFB *	3.25	1.25	0.5	0.5	0.5		
Alternate Reductants From Regen. Flue Gas Cleaning Systems	0.7	0.2					
Use of sulfur as Asphalt Substitute*	0.5	0.5	0.667	0.667	0.667		
High Sulfur Combustor Demonstration**	6.4	8.3	4.0	4.0	4.0		
Lime sludge Waste Utilization	0.163	0.18	0.22	0.22			
Waste By-Product from Gasification*	1.5	2.0	2.599	2.599	2.599	2.599 (1980)	
Fly-Ash Strip Mining Reclamation	1.0	1.5	1.353	1.353	1.353		
- assume at least 50% demonstration co-funding by the private sector.							

ENERGY R&D PROGRAM BUDGET SUMMARY

FORM B

PROGRAM NAME: Improved Environmental Control

PROGRAM ALTERNATIVE: Crash

PROGRAM ELEMENT	FEDERAL OBLIGATIONS \$X10 ⁶					
	1975	1976	1977	1978	1979	1980-1989
<u>Particulate Control Technology</u>						
Fine Particulate/Electrical Power Generation*	10.140	4.200	4.200	4.200		
Fine Particulate/Industrial & Commercial Sources *	4.162	4.162	3.320	3.320		
<u>Hazardous & Other Pollutant Control Technology</u>						
Gaseous Toxic Emission Control *	2.850	1.542	1.542	1.542		
Operational Control/10% and Trace Emissions *	1.067	1.284	1.284	1.284		

* Federal obligations assume at least 50% demonstration co-funding by the private sector.

ENERGY R&D PROGRAM BUDGET SUMMARY

FORM B

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Crash

FEDERAL OBLIGATIONS

\$X10⁶

PROGRAM ELEMENT

	1975	1976	1977	1978	1979	1980-1989	1990
<u>SO₂ Control Technology</u>							
1 & 10 MW Pilot Plant	2.025	1.955	1.135				
Alkaline Ash [#]	1.265	2.128	1.438				
Lime/Limestone [#]	3.0	1.5					
<u>SO₂ Control-Nonregenerable</u>							
Citrate [#]	1.15	9.2	3.45				
Ammonia-Bisulfate	0.6	0.6	0.25				
Integrated Cat-Ox [#]	11.5	0.345	0.345	0.345			
Metal Oxides [#]	2.116	1.495	1.495				
Advanced Systems [#]	5.75	3.25					
Industrial Boiler [#]	0.978	0.767	0.384				
Wellman-Lord/ Allied [#]	8.7	0.5					
<u>Fuel Cleaning</u>							
Chemical Treatment of Coal [#]	7.74	2.3	2.3	2.3			
Physical & Chemical Removal of Sulfur	1.0	1.0	1.0	1.0	1.0		
High Gradient Magnetic Separation	1.035	2.3					
[#] Federal obligations assumed	at least 50% demonstration co-funding by the private sector.						

ENERGY R&D PROGRAM BUDGET SUMMARY

FORM B

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Cash

FEDERAL OBLIGATIONS
\$X10⁶

PROGRAM ELEMENT	1975	1976	1977	1978	1979	1980-1989	1990
<u>Fuel Conversion and Process Control</u>							
Development and Demonstration of Control Components	9.15	20.2	13.002	13.002	13.002		
Development and Demonstration for Shale Oil Control	4.35	7.5	11.697	11.697	11.697		
Control of Fine Particulates from Fuel Extraction Processing Plants	2.587	1.648	1.648	1.648	2.3		
Recovery of Petroleum Refining Hydrocarbon Losses *	5.348	0.825	0.825	0.825			
Utilization and Disposal of Conversion Plant Wastes	0.5	0.5					
Improved gas-solid-liquid Separation	3.0	5.0	5.0				
* Federal obligations assume at least 50% demonstration co-funding by the private sector							

ENERGY R&D PROGRAM BUDGET SUMMARY

FORM B

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Crash

FEDERAL OBLIGATIONS

\$X10⁶

PROGRAM ELEMENT

	1975	1976	1977	1978	1979	1980-1989	1990
<u>Waste Disposal and By-Products</u>							
Disposal of High Sulfur Refinery Waste by CAFB *	3.738	2.013	1.15				
Alternate Reductants From Regen. Flue Gas Cleaning Systems	0.7	0.2					
Use of sulfur as Asphalt Substitute*	1.15	0.767	0.767	0.767			
High Sulfur Combustor Demonstration *	16.905	4.6	4.6	4.6			
Line sludge Waste Utilization	0.163	0.18	0.22	0.22			
Waste By-Product from Gasification*	4.025	2.989	2.989	2.989	2.989		
Fly-Ash Strip Mining Reclamation	2.0	3.0	2.666	2.666	2.666		

* Federal obligations assume at least 50% demonstration co-funding by the private sector.

ENERGY R&D PROGRAM BUDGET SUMMARY

FORM B

PROGRAM NAME: Improved Environmental Control

PROGRAM ALTERNATIVE: Minimum

PROGRAM ELEMENT	FEDERAL OBLIGATIONS					
	\\$x10 ⁶					
	1975	1976	1977	1978	1979	1980-1989
<u>Particulate Control Technology</u>						
Fine Particulate/Electrical Power Generation*	2.500	2.975	2.975	3.500	3.500	3.500
Fine Particulate/Industrial & Commercial Sources**	2.000	2.000	2.000	2.000	2.000	2.000
<u>Hazardous & Other Pollutant Control Technology</u>						
Gaseous Toxic Emission Control*	1.500	2.000	.750	.750	.750	.750
Operational Control/NO _x and Trace Emissions**	.460	.500	.500	1.000	1.000	1.000

* Federal obligations assume at least 50% demonstration co-funding by the private sector.

ENERGY R&D PROGRAM BUDGET SUMMARY

FORM B

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Minimum

FEDERAL OBLIGATIONS

\$X10⁶

PROGRAM ELEMENT

	1975	1976	1977	1978	1979	1980-1989			
<u>SO₂ Control Technology</u>									
1 & 10 MW Pilot Plant	0.849	0.849	0.849	0.849	0.849	0.849			
Alkaline Ash*	0.7	0.7	0.7	0.7	0.7	0.7			
Lime/Limestone*	3.0	1.5							
<u>SO₂ Control-nonrenewable</u>									
Citrate*	0.5	2.0	4.0	2.5	2.5	0.5			
Ammonia-Bisulfate	0.363	0.363	0.363	0.363					
Integrated Cat-Ox*	1.0	3.0	3.0	3.0	0.3	0.6			
Metal Oxides*	0.74	0.74	0.74	0.74	0.74	0.74			
Advanced Systems*	2.25	2.25	2.25	2.25					
Industrial Boiler*	0.425	0.25	0.167	0.167	0.167				
Wellman-Lord/ Allied*	4.5	8.7	0.5						
<u>Fuel Cleaning</u>									
Chemical Treatment of Coal*	1.819	1.819	1.819	1.819	1.819	3.638			
Physical & Chemical Removal of Sulfur	0.5	0.5	0.5	0.5	0.5				
High Gradient Magnetic Separation	0.125	0.325	.25						
* Federal obligations assume at least 50% demonstration co-funding by the private sector.									

ENERGY R&D PROGRAM BUDGET SUMMARY

FORM B

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Minimum

FEDERAL OBLIGATIONS
\$X10⁶

PROGRAM ELEMENT	1975	1976	1977	1978	1979	1980-1989			
<u>Fuel Conversion and Process Control</u>									
Development and Demonstration of Control Components	1.0	3.0	2.0	2.0	2.0	19.2			
Development and Demonstration for Shale Oil Control	0.29	0.5	0.78	0.78	0.78	12.517			
Control of Fine Particulates from Fuel Extraction Processing Plants	0.625	0.5	0.717	0.717	0.717	1.0			
Recovery of Petroleum Refining Hydrocarbon Losses*	0.45	2.0	2.2	.717	.717	.717			
Utilization and Disposal of Conversion Plant Wastes	0.25	0.25	0.25	0.25					
Improved gas-solid-liquid Separation	0.725	0.713	0.496	0.496	0.496				

* Federal obligations assume at least 50% demonstration co-funding by the private sector.

ENERGY R&D PROGRAM BUDGET SUMMARY

FORM B

PROGRAM NAME: _____

PROGRAM ALTERNATIVE: Minimum

FEDERAL OBLIGATIONS

\$x10⁶

PROGRAM ELEMENT	1975	1976	1977	1978	1979	1980-1989
<u>Waste Disposal and</u> <u>By-Products</u>						
Disposal of High Sulfur Refinery Waste by CAFD*	1.0	2.0	1.25	0.25	0.25	0.5
Alternate Reductants From Regen. Flue Gas Cleaning Systems	0.35	0.2				
Use of sulfur as Asphalt Substitute*	0.429	0.429	0.429	0.429	0.429	0.858
High Sulfur Combustor Demonstration*		1.0	3.0	4.4	6.3	12.0
Lime sludge Waste Utilization	0.157	0.157	0.157	0.157	0.157	
Waste By-Product from Gasification*	1.985	1.985	1.985	1.985	1.985	3.97
Fly-Ash Strip Mining Reclamation	0.5	0.75	0.666	0.666	0.666	

* Federal obligations assume at least 50% demonstration co-funding by the private sector.

SECTION VII

Support Research to Achieve Coal and Shale Processing
and Combustion Program Objectives

Program: Coal & Shale Processing and Combustion

Sub-program: Supporting Research to Achieve Coal and
Shale Processing and Combustion Program Objective

II. Status of the Technology

A. Present Status of the Technology

1. Equipment, materials and processes for simple coal gasifiers, for example, fixed bed Lurgi gasifiers, and first generation oil shale plants are in the development stage. None of these are currently in commercial use in the U.S. Research on fluid bed coal gasifiers and various coal liquification processes is being actively pursued in the U.S., supported primarily by the U.S. Department of Interior with some support from private sources. Currently supporting research is funded at a very low level.

B. Barriers to Implementation of the Technology

1. Research Barriers

First generation plants producing gas and oil from coal and shale could at high cost be made to operate now. Improvement of the reliability of the components and development of first and second generation plants requires research on materials which are more resistant to erosive wear and corrosive environment, better catalysts, easier production of hydrogen and better data on processes and materials.

2. Development Barriers

Present equipment, such as valves, operate sufficiently well

to provide the possibility of operation of first generation plants. However, reliability and economy of operation could be greatly improved by a planned program in component development and process development.

3. Implementation Barriers

The building of commercial units requires that cost of present processes be on a level that can be supported by normal market operations, with possible guarantees supplied by the government. The effect of the technology development sub-program might play a significant role in reducing costs and thus in increasing the potential for actual creation of a commercial industry.

C. Ongoing R&D Efforts to Overcome Barriers

1. Present level planned for FY 74 is \$12M funded by the U.S. government.
2. Private funding is restricted mainly to pilot plant development rather than technology development and supporting research.
3. Foreign results on Lurgi gasifiers may be of marginal use but the main effort must come from U.S.

III. Rationale for Federal Involvement

- A. Federal involvement is warranted because the national interest requires that the U.S. not become dependent on foreign sources

of gas and oil. Both national defense strategy and economic balance of payments considerations are important here. Market forces at present allow individual companies more profit from importing gas and oil than by domestic production from coal and oil shale, so Federal involvement is needed.

- B. Because of the broad application to many processing schemes of the research of this sub-program, industry will probably look to the government to support this area.
- C. Attitude of industry toward applied research will not be greatly altered by external factors. Levels are relatively low.
- D. Manpower training programs might be useful. If part of the work on this sub-program were carried out at universities, a manpower training aspect would be inherently included.

IV. Objectives, Criteria, and Priorities

- A. The supporting research sub-program is divided into six areas. For further details see Item 6 of energy research and development fact sheet for this sub-program. The objectives are:
 - 1. Equipment Development
To develop, independent of pilot and demonstration plants, new reliable coal injection systems for high pressure, char and ash withdrawal systems, solids monitoring instruments, valves and other key components required for coal processing.
 - 2. Materials
To develop methods for service life prediction, test methods

for materials and improved materials for coal processing equipment

3. Data compilations, handbooks and analyses

To advance the development of coal processing by developing a technical, design and economic information data base.

4. Catalysis and Chemical Kinetics

To develop improved catalysts for methanation, coal gasification and liquefaction and to develop the chemical kinetics necessary for the development of improved coal processing systems.

5. Process Development

To advance the development of coal processing by research on the unit operations of coal processing (i.e., fluidized bed technology) and by developing new processes for producing hydrocarbons from coal.

6. Hydrogen Production

To develop low-cost on-site processes for producing hydrogen-rich gases from non-petroleum sources for near and mid-term coal and oil shale processing.

- B. The program on coal and shale processing and development contains a number of expensive development projects such as pilot plants and demonstration plants. To support these plant development sub-programs, a technology development and supporting research sub-program equal in cost to 10% of the total program cost is

justified according to the consensus of opinion of consultants interviewed by the sub-panel.

V. A.1.a

Milestones

It is doubtful that meaningful milestones can be developed for the bulk of the projects in the supporting category. It is, therefore, suggested that in place of milestones, decision points be established for continued funding. Major criteria would be the progress that has been made and the likelihood of the ultimate success in applying the technology. The suggested decision point for all categories is July 1977 (beginning of FY 78).

At the end of the five year period, only those programs should be carried forward which hold promise of contributing to the development of second and third generation coal processing.

V. A.2

(a) Cost and Budget Projections (Millions)

<u>Accelerated/Orderly Program</u>	FY 75	FY 76	(Avg.) FY 77-79	Total
Equipment Development	\$8.4	\$5.8	\$7.9	\$37.9
Materials	6.8	7.7	8.4	39.7
Data Compilation				
Handbooks and Analyses	2.7	3.5	4.2	18.8
Catalysis and Chemical Kinetics	13.3	17.2	22.4	97.9

Cost and Budget Projections (Billions) (cont.)

<u>Accelerated/Orderly Program</u>	FY 75	FY 76	(Avg.) FY 77-79	Total
Process Development	20.8	26.8	28.4	132.8
Hydrogen Production	4.0	8.2	8.5	37.7
Total*	\$55	\$70	\$80	\$365
*Rounded				
<u>Maximum Program Total</u>	\$110	\$140	\$160	\$730
<u>Minimum Program Total</u>	\$12	\$12	\$12	\$60

(b) Negligible contribution from the public sector is anticipated.

(c) See (a) above.

V. A.3

(a) No new major manpower needs are envisioned. Overall 250 new professionals would be involved and 500 new nonprofessional supporting staff would be required.

(b) No major new facilities would be required. A number of small scale test facilities would be required, none requiring significant new construction.

4. Management Plan

(a) The research will be performed at a number of different government, industrial and university laboratories having existing competence. An appropriate organization should be charged with overall coordination of the program with the

major organizations funding the development work. Industrial liaison should be established for individual programs.

V. B. Criteria Employed in Constructing the Proposed R&D Program

1. Alternative Funding Approaches Considered:

Industry could fund all research and development work including supporting research. Considering the economic structure of private profit making companies, it is improbable that this research would be carried out on the scale necessary to develop a coal processing industry in an accelerated orderly manner.

2. There are many technological options available, none of which have been developed to the point where a single option can be selected. Therefore, the recommended program supports those considered to be technically sound and furthering the objective of improved coal processing.

C. 1. In general, the program is not starting from a zero technological base. Many of the technologies have been applied in other areas (i.e., fluidized bed technology) and it will be extremely beneficial to apply this expertise to coal technology.

2. Attempts to solve major technological problems in pilot and demonstration plants are extremely expensive. Every effort should be made to minimize the costs of development by having

parallel efforts independent of the pilot and demonstration plants.

V. D. Acceptability of Program

There are no acceptability problems for the program other than those associated with the general program of coal conversion.

E. Other Costs and Benefits of the R&D Program

1. The program focuses upon coal conversion process. Some of the technologies have the potential for transference to oil shale processing. The production of hydrogen rich gases will have a direct bearing upon shale-oil hydrogenation.
2. Failure to develop reliable key components of equipment independent of plant operations results in large expenditures at the plant level.
3. Orderly termination costs would be small.

I and VII. Implementation Plan to Follow Completion of Successful R&D Phases of Implementation

These sections are not applicable to the coal and oil shale supporting research program. All of the factors involved are discussed in other sub-program elements of the coal and oil shale processing report.

SUBPANEL 5

COAL AND SHALE PROCESSING AND COMBUSTION

APPENDIX C

BUDGET FACT SHEETS

ENERGY RESEARCH & DEVELOPMENT
FACT SHEET

1. IDENTIFICATION
 MANPOWER
 ORDERLY
 MINERAL

1. IDENTIFICATION
05-93-03-03-12-7

2. a. PROGRAM	Coal & Oil Shale Processing		
b. SUBPROGRAM	Pipeline Quality Gas from Coal		
3. a. FUNDING AGENCY	Department of the Interior		
b. DEPARTMENT	Office of Coal Research - Bureau of Mines		
4. CONTRACTOR AND SITE <small>(No more than 12 characters and spaces for contractor name and up to 15 characters and spaces for county.)</small>	NAME OF CONTRACTOR	Office of Coal Research - Institute of Gas	
	Site where work will be performed	State: Illinois	County: Chicago
	NAME OF CONTRACTOR	Office of Coal Research - Consolidated Coal	
	Site where work will be performed	State: S. Dakota	County:
	NAME OF CONTRACTOR	Bureau of Mines, Lummus, Rust Engineering	
Site where work will be performed	State: PA	County: Allegheny	
NAME OF CONTRACTOR	Office of Coal Research - Bituminous Coal Re		
Site where work will be performed	State: PA	County: Homer City	
NAME OF CONTRACTOR	Bur. Mines, Battelle Mem Inst., Chem System		
Site where work will be performed	State:	County:	

5. BRIEF DESCRIPTION OF PROPOSAL
(No more than 24 lines of text and no more than 70 characters and spaces per line)
Briefly outline nature and scope of work to be undertaken, including any new facilities which may have to be acquired or constructed.

The research area concerns the production of pipeline gas from coal. The objectives are to: a) develop the technology necessary for the establishment of a commercial coal to pipeline quality gas industry with due regard to environmental considerations b) accelerate demonstration at a commercial scale by constructing and operating one or more coal to pipeline gas plants.

The work involves the acceleration of the present Office of Research - American Gas Association program and the Bureau of Mines program to produce high Btu gas from coal. The proposed program is for operation of four pilot plants (Hygas, CO₂-Acceptor, S Bigas; each producing 1 to 2 million scf/day). Two of the pilot plants are operating (Hygas and CO₂-Acceptor) and two will be operating by early 1975. A program for a stirred-fixed bed plant is also planned. The maximum program involves the design and construction of three commercial (250 million cubic feet per day) plants. Construction would begin July 1, 1975. This would replace the demonstration plant program as described in the accelerated/orderly program. This program would also be in conjunction with industry.

R&D on new gasification processes and supporting research equipment/materials development will be carried out concurrently with the construction of the commercial plants.

6. JUSTIFICATION (Use a separate sheet(s). See Item 6. on Instruction Sheet.)

		7. MAJOR RESOURCE REQUIREMENTS			
		F			
RESOURCE	FISCAL YEAR	1975	1976	1977	1978
a. MANPOWER <small>(in man years)</small>	(1) Scientific	50	1600	30	25
	(2) Technical	130	4800	50	75
	(3) Support				
	(4) Other	30	1600	20	20
b. RAW MATERIALS <small>(List materials and units of measure below, such as tons of coal, barrels of oil, kilograms of uranium, etc. Show amount of each in columns at right.)</small>		Each pilot plant will use about 75 tpd of coal Each demonstration plant will consume about 5,000 tpd of coal and 3,000 acre-ft of water. Each commercial plant will consume 15,000-20,000 tpd of coal and about 10,000 acre-ft of water. (See #8. Schedule)			
c. LAND AREA REQUIRED <small>(in acres)</small>	(1) Government	Pilot plant will require about 20 acres.			
	(2) Government	Commercial facility will require about 200 acres including			
	(3) Private-owned	coal mine which feeds the plant.			
	(4) Other				
d. OTHER RESOURCES NEEDED <small>(Specify item and unit of)</small>					

DEVELOPMENT

Level of Effort
 MAXIMUM
 ORDERLY
 MINIMAL

1. IDENTIFICATION NUMBER

05-03-00-03-12-78-3-01

Coal & Oil Shale Processing

Pipeline Quality Gas from Coal

Department of the Interior

Office of Coal Research - Bureau of Mines

NAME OF CONTRACTOR: Office of Coal Research - Institute of Gas Technology

Site where work will be performed: State: Illinois County: Chicago

NAME OF CONTRACTOR: Office of Coal Research - Consolidated Coal - Stearns

Site where work will be performed: State: Dakota County: Rogers

NAME OF CONTRACTOR: Bureau of Mines, Lummus, Rust Engineering

Site where work will be performed: State: PA County: Allegheny

NAME OF CONTRACTOR: Office of Coal Research - Bituminous Coal Research

Site where work will be performed: State: PA County: Homer City

NAME OF CONTRACTOR: Bureau of Mines, Battelle Mem Inst., Chem Systems

Site where work will be performed: State: County:

The research area concerns the production of pipeline quality gas from coal. The objectives are to: a) develop the technology necessary for the establishment of a commercial coal to pipeline quality gas industry with due regard to environmental consideration, b) accelerate demonstration at a commercial scale by constructing and operating one or more coal to pipeline gas plants.

The work involves the acceleration of the present Office of Coal Research - American Gas Association program and the Bureau of Mines program to produce high Btu gas from coal. The proposed plan calls for operation of four pilot plants (Hygas, CO₂-Acceptor, Synthana, Bigas; each producing 1 to 2 million scf/day). Two of the pilot plants are operating (Hygas and CO₂-Acceptor) and two will be operating by early 1975. A program for a stirred-fixed bed pilot plant is also planned. The maximum program involves the immediate design and construction of three commercial (250 million cf/day) plants. Construction would begin July 1, 1975. This would be in place of the demonstration plant program as described in the accelerated/orderly program. This program would also be in conjunction with industry.

R&D on new gasification processes and supporting research on equipment/materials development will be carried out concurrently with the construction of the commercial plants.

See sheet(s). See Item 6. on Instruction Sheet.)

7. MAJOR RESOURCE REQUIREMENTS

	1975	1976	1977	1978	1979
	50	1600	30	25	30
	130	4800	50	75	40
	30	1600	20	20	20

Each pilot plant will use about 75 tpd of coal
 Each demonstration plant will consume about 5,000 tpd of coal and 3,000 acre-ft of water.

Each commercial plant will consume 15,000-20,000 tpd of coal and about 10,000 acre-ft of water. (See #8. Schedule)

Pilot plant will require about 20 acres.

Commercial facility will require about 200 acres including coal mine which feeds the plant.

2

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State where work will be performed

State: PA County: Allegheny Rogers

NAME OF CONTRACTOR: Bureau of Mines, Lummus, Rust Engineering

State: PA County: Allegheny

NAME OF CONTRACTOR: Office of Coal Research-Bituminous Coal Research

State: PA County: Homer City

NAME OF CONTRACTOR: Bureau of Mines, Battelle Mem Inst., Chem Systems

State: PA County: Homer City

5. BRIEF DESCRIPTION OF PROPOSAL

List more than 2 lines of text and more than 70 characters and space per line

Briefly outline nature and scope of work to be performed, including any new facilities which may have to be designed or constructed.

The research area concerns the production of pipeline quality gas from coal. The objectives are to: a) develop the technology necessary for the establishment of a commercial coal to pipeline quality gas industry with due regard to environmental consideration; b) accelerate demonstration at a commercial scale by constructing and operating one or more coal to pipeline gas plants.

The work involves the acceleration of the present Office of Coal Research - American Gas Association program and the Bureau of Mines program to produce high Btu gas from coal. The proposed plan calls for operation of four pilot plants (Hygas, CO₂-Acceptor, Synthane, Bigas; each producing 1 to 2 million scf/day). Two of the pilot plants are operating (Hygas and CO₂-Acceptor) and two will be operating by early 1975. A program for a stirred-fixed bed pilot plant is also planned. The maximum program involves the immediate design and construction of three commercial (250 million cf/day) plants. Construction would begin July 1, 1975. This would be in place of the demonstration plant program as described in the accelerated/orderly program. This program would also be in conjunction with industry.

R&D on new gasification processes and supporting research on equipment/materials development will be carried out concurrently with the construction of the commercial plants.

6. JUSTIFICATION (Use a separate sheet(s). See Item 6. on Instruction Sheet.)

7. MAJOR RESOURCE REQUIREMENTS

RESOURCE	FISCAL YEAR	1975	1976	1977	1978	1979
a. MANPOWER (in man years)	(1) Scientific	50	1600	30	25	30
	(2) Technical	130	4800	50	75	40
	(3) Support					
	(4) Other	30	1600	20	20	20
b. RAW MATERIALS (List materials and units of measure below, such as tons of coal, barrels of oil, kilograms of uranium, etc. Show amount of each in columns at right.)		Each pilot plant will use about 75 tpd of coal Each demonstration plant will consume about 5,000 tpd of coal and 3,000 acre-ft of water. Each commercial plant will consume 15,000-20,000 tpd of coal and about 10,000 acre-ft of water. (See #8. Schedule)				
c. LAND AREA REQUIRED (in acres)	(1) Government	Pilot plant will require about 20 acres.				
	(2) Government	Commercial facility will require about 200 acres including coal mine which feeds the plant.				
	(3) Private land					
	(4) Other					
d. OTHER RESOURCES NEEDED (Specify item and unit of measure below. Show quantity of each in columns at right.)	(1)					

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

Level of Effort

- MAXIMUM
- ORDERLY
- MINIMUM

IDENTIFICATION

05-03-20-03-12-

6 JUSTIFICATION—State the specific energy problem or objective, and specify how the proposal will contribute to the solution of the problem or attainment of the objective. Include reasons for selecting the recommended approach over other alternatives. Also include the benefits expected to be derived from meeting the objective, or solving the problem for which the project is proposed. Outline the risks/uncertainties (R/U), plan to minimize R/U, and basis for proceeding in face of R/U. Quantitative data should be used to the fullest extent.

Current domestic supplies of natural gas cannot meet demand and both pipel. gas (Canada) and liquid natural gas, LNG, (Algeria) are being imported. Imports are expected to rise sharply over the next 10-15 years as a result of a continuing increase in the demand for natural gas, but imports will fall far short of the demand. Large imports are undesirable both from a political/military standpoint and because of contribution to the balance of trade deficit.

Although the U.S. domestic supplies of petroleum and natural gas cannot meet supply, U.S. reserves of coal are immense with a projected lifetime of 400-600 years at present consumption rates. The proposed plan is designed to help alleviate the shortages of natural gas by developing a commercial process for the production of pipeline quality gas at reasonable cost.

The proposed plan involves the acceleration of the present OCR-AGA program and present Bureau of Mines program for the production of high Btu-gas as well as research programs for development of new gasification processes. In addition, the plan includes a program of supporting research and development (submitted and outlined in a separate sub-program proposal) for equipment/materials research and development and for studies of gasification chemistry.

This plan includes the operation of the Hygas process pilot plant and the Acceptor process pilot plant and completion of the construction and operation of pilot plants for the Synthane process and for the Bi-Gas process. In addition other projects will be supported. This includes but is not limited to: construction and operation of a pilot plant to test the Bureau of Mines Hydrane process, development of the B. Memorial Institute's Self-Agglomerating Ash process, Chem Systems Liquid Phase process and Bituminous Coal Research's Combined Shift and Methanation Process.

In addition to all of the above projects, the maximum rate program includes immediate design and construction of 3 250 million cf/day commercial plants. The pilot programs, therefore, would be occurring concurrently with commercial plant construction and operation. Construction of the commercial plants would begin July 1, 1975.

Because the commercial plants will be built and operated before the beneficial pilot plant operation can be obtained, the technical risks and uncertainties will be over those encountered in the accelerated/orderly program.

Non-technical uncertainties will exist for the maximum program as for the orderly programs. These include: prices of foreign petroleum, Federal, State, and local strip-mine regulations, source of large amounts of capital needed for gasification plants and Federal Power Commission action on pricing of synthetic natural gas and coal.

AND DEVELOPMENT FACT SHEET (Continued)

Level of Effort

- MAXIMUM
- ORDERLY
- MINIMUM

IDENTIFICATION NUMBER

05-03-20-03-12-78-56-01

Describe the specific energy problem or objective, and specify how the proposal will contribute to the solution of the problem. Include reasons for selecting the recommended approach over other alternatives. Also include the benefits from meeting the objective or other conditions for which the project is proposed. Outline the risks/uncertainties of R/U, and basis for proceeding in face of R/U. Quantitative data should be used to the fullest extent.

domestic supplies of natural gas cannot meet demand and both pipeline natural and liquid natural gas, LNG, (Algeria) are being imported. Imports are projected to increase sharply over the next 10-15 years as a result of a continuing increase in demand for natural gas, but imports will fall far short of the demand. Large scale imports are undesirable both from a political/military standpoint and because of the impact on the balance of trade deficit.

The U.S. domestic supplies of petroleum and natural gas cannot meet the demand for these resources at current rates. The proposed plan is designed to help alleviate the critical shortage of natural gas by developing a commercial process for the production of pipeline-quality gas at reasonable cost.

The proposed plan involves the acceleration of the present OCR-AGA program and the expansion of the Bureau of Mines program for the production of high Btu-gas as well as research and development of new gasification processes. In addition, the plan includes supporting research and development (submitted and outlined in a separate proposal) for equipment/materials research and development and for basic gasification chemistry.

The plan includes the operation of the Hygas process pilot plant and the CO₂-free process pilot plant and completion of the construction and operation of pilot plants for the Synthane process and for the Bi-Gas process. In addition other research and development is being conducted. This includes but is not limited to: construction and operation of pilot plants to test the Bureau of Mines Hythane process, development of the Battelle Columbus Laboratories' Self-Agglomerating Ash process, Chem Systems Liquid Phase Methanation process, and the Bureau of Mines' Luminous Coal Research's Combined Shift and Methanation Process. In addition to all of the above projects, the maximum rate program includes immediate construction of 3 250 million cf/day commercial plants. The pilot plant program, therefore, would be occurring concurrently with commercial plant construction. Construction of the commercial plants would begin July 1, 1975. If the commercial plants will be built and operated before the benefit of the pilot plant operation can be obtained, the technical risks and uncertainties will increase and will be countered in the accelerated/orderly program.

Technical uncertainties will exist for the maximum program as for the other programs. These include: prices of foreign petroleum, Federal, State, and local tax regulations, source of large amounts of capital needed for gasification, Federal Power Commission action on pricing of synthetic natural gas from

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

SCHEDULE *(Include major facilities and major equipment. Indicate dates by Fiscal Year and Quarter).*

a. DEVELOPMENT MILESTONES *(number each consecutively)*

(Limit Title of Milestone to 60 characters and spaces)

b. DATES

	Start		Complete	
	FY	Q	FY	Q
	Begin design of 3 commercial (250 million cf/day) plants	75	1	76
Begin operation of Synthane pilot plant	75	1	76	4
Begin operation of Bi-Gas pilot plant	75	3	76	4
Begin construction of commercial plants	76	1	78	3
Design pilot plant for novel gasification processes	77	3	78	3
Operate pilot plant for novel processes	78	3	80	3
Operate commercial plants	78	3	Continued	

(Continue to next column)

- MAXIMUM
- ORDERLY
- MINIMUM

IDENTIFICATION NUMBER

05-03-20-03-12-78-56-01

b. DATES

Start		Complete	
Y	Q	FY	Q
5	1	76	1
5	1	76	4
5	3	76	4
6	1	78	3
7	3	78	3
3	3	80	3
3	3	Continuing	

a. DEVELOPMENT MILESTONES (continued)

(Limit Title of Milestone to 60 characters and spaces)

b. DATES

Start		Complete	
FY	Q	FY	Q

2

(Continue on separate sheet)

Page of

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

9. SUMMARY OF FUNDING REQUIREMENTS—Federal Government Only (in millions of dollars)

Requirement	(1)		(2)		(3)		(4)		O:
	FY 1974 (Non-Add)		FY 1975		FY 1976		FY 1977		
	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	
a. OPERATING (See p. for detail) Total Operating Requirements (from Detail Sheet)									
b. CONSTRUCTION (See p. for detail) Total Construction Requirements (from Detail Sheet)									
c. EQUIPMENT (See p. for detail) Total Equipment Requirements (from Detail Sheet)									
d. GRAND TOTAL—OBLIGATIONS									
e. GRAND TOTAL—OUTLAYS		27.3		30.2		848.7*		23.5	

* Include three commercial-scale plants at \$275 million each with industry contribution

NOTE: If cooperative programs are proposed, indicate the amount by year of both private and Federal government funding. A brief description of responsibilities should be separately provided in the above format.

Level of Effort:

- MAXIMUM
- ORDERLY
- MINIMUM

IDENTIFICATION NUMBER

05-03-20-03-12-78-56-01

(4)		(5)		(6)		(7)		(8)		(9)	
FY 1977		FY 1976		FY 1975		Subtotal FY 1975-79		Balance To Complete		Total Expend FY 1974 (Oct 7 5 3)	
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
	23.5		4.2		3.1						909.7

... contributing \$125 million each

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

9. DETAIL OF FUNDING REQUIREMENTS—Federal Government Only (in millions of dollars)

a. OPERATING

ITEM	(1)		(2)		(3)		C
	FY 1974 (Non-Add)		FY 1975		FY 1976		
	Obs.	Outlays	Obs.	Outlays	Obs.	Outlays	
TOTAL (Carry forward to summary sheet) ▶							
() Name of Performing Organization:							
MANPOWER							
MATERIALS							
MAJOR PROCUREMENTS							
ALL OTHER							
TOTAL FOR THIS PERFORMING ORGANIZATION							
() Name of Performing Organization:							
MANPOWER							
MATERIALS							
MAJOR PROCUREMENTS							
ALL OTHER							
TOTAL FOR THIS PERFORMING ORGANIZATION							
() Name of Performing Organization:							
MANPOWER							
MATERIALS							
MAJOR PROCUREMENTS							
ALL OTHER							
TOTAL FOR THIS PERFORMING ORGANIZATION							
() Name of Performing Organization:							
MANPOWER							
MATERIALS							
MAJOR PROCUREMENTS							
ALL OTHER							
TOTAL FOR THIS PERFORMING ORGANIZATION							

(Continue on

Level of Effort:

- MAXIMUM
- ORDERLY
- MINIMUM

IDENTIFICATION NUMBER

05-03-20-03-12-70-5

	(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) - SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL BY FY 1974
	Days	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

9. DETAIL OF FUNDING REQUIREMENTS- Federal Government Only (in millions of dollars)

B. CONSTRUCTION

ITEM	(1) FY 1974 (Non-Add)		(2) FY 1975		(3) FY 1976		Obi						
	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays							
TOTAL (Carry forward to summary sheet) ▶													
<p>Title of project, Location (State and County) and Total Estimated Cost (TEC) (in millions) (non-contractible). Every project costing one million dollars or more should be separately identified with a brief statement of why it is required.</p>													
TITLE OF PROJECT (Not to exceed 30 characters and spaces.) ()													
<table border="1"> <tr> <td>State</td> <td>County</td> <td>TEC (in millions)</td> </tr> <tr> <td colspan="3">Statement:</td> </tr> </table>	State	County	TEC (in millions)	Statement:									
State	County	TEC (in millions)											
Statement:													
TITLE OF PROJECT (Not to exceed 30 characters and spaces.) ()													
<table border="1"> <tr> <td>State</td> <td>County</td> <td>TEC (in millions)</td> </tr> <tr> <td colspan="3">Statement:</td> </tr> </table>	State	County	TEC (in millions)	Statement:									
State	County	TEC (in millions)											
Statement:													
TITLE OF PROJECT (Not to exceed characters and spaces.) ()													
<table border="1"> <tr> <td>State</td> <td>County</td> <td>TEC (in millions)</td> </tr> <tr> <td colspan="3">Statement:</td> </tr> </table>	State	County	TEC (in millions)	Statement:									
State	County	TEC (in millions)											
Statement:													

(Continue on Sep

Level of Effort:

- MAXIMUM
- ORDERLY
- MINIMUM

IDENTIFICATION NUMBER

05-03-20-03-12-78-56-01

77 Durta	(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL EXCLUDING FY 1975-79	
	Outlays	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays	

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

2. DETAIL OF FUNDING REQUIREMENTS—Federal Government Only (in millions of dollars)

c. EQUIPMENT

ITEM <i>(Each item not to exceed 80 characters and spaces)</i>	(1) FY 1974 (Non-Add)		(2) FY 1975		(3) FY 1976		C
	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays	
	For each major performing organization, show total equipment funds, with a separate sub-allocation of each item of equipment costing one-half million dollars or more.	TOTAL (Carry forward to summary sheet) >					

(Continue on 5)

Level of Effort:
 MAXIMUM
 ORDERLY
 MINIMUM

IDENTIFICATION NUMBER
 05-03-00-03-22-78-57-01

4) 977	(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1978-79		(8) BALANCE TO COMPLETE		(9) TOTAL EXCLUDING FY 1978 (O. & O.)	
	Outlays	Obls.	Outlays	Obls.	Obls.	Outlays	Obls.	O. & O.	Obls.	O. & O.

2

ENERGY RESEARCH & DEVELOPMENT
FACT SHEET

Level of Effort

- MAXIMUM
 MODERATE
 MINIMUM

1. IDENTIFICATION NUMBER
705-03-20-03-17-10-51

2. a. PROGRAM	Coal & Oil Shale Processing
b. SUBPROGRAM	Pipeline Quality Gas From Coal
3. a. PROJECT AGENCY	Department of the Interior
b. SOURCE	Office of Coal Research-Bureau of Mines
4. CONTRACTOR ADDRESS <i>(No more than 12 characters and spaces for name of contractor; use standard abbreviation for state up to 16 characters and spaces for county.)</i>	NAME OF CONTRACTOR: Office of Coal Research-Institute of Gas Tech. Site where work will be performed: State: Illinois County: Chicago
	NAME OF CONTRACTOR: Off. Coal Research-Consol. Coal-Stearns & Rope Site where work will be performed: State: S. Dakota County:
	NAME OF CONTRACTOR: Bureau of Mines, Lummus, Rust Engineering Site where work will be performed: State: PA. County: Allegheny
	NAME OF CONTRACTOR: Office of Coal Research-Bituminous Coal Resea Site where work will be performed: State: PA. County: Plover City
NAME OF CONTRACTOR: Bur. Mines, Battelle Mem. Inst., Chen Systems Site where work will be performed: State: County:	
5. BRIEF DESCRIPTION OF PROPOSAL <i>(No more than 24 lines of text and no more than 70 characters and spaces per line)</i> Briefly outline nature and scope of work to be undertaken, including any new facilities which may have to be acquired or constructed.	<p>The research area concerns the production of pipeline quality gas from coal. The objectives are to: a) develop the technology necessary for the establishment of a commercial coal to pipeline quality gas industry with due regard to environmental considerations b) accelerate demonstration at a commercial scale by construct and operating one or more coal to pipeline gas plants.</p> <p>The work involves the acceleration of the present Office of Coal Research - American Gas Assn. program and the Bureau of Mines program to produce high Btu gas from coal. The proposed plan for operation of four pilot plants (Hygas, CO₂-Acceptor, Synth Bigas; each producing 1 to 2 million scf/day), followed by the construction and operation of two demonstration plants (50-150 million cf/day, also in conjunction with industry). The demonstration plants will be spaced about two years apart. The second demonstration plant will provide facilities for testing newer developments and processes. The demonstration program will be followed by design and construction of commercial-scale plants (250 million cf/day).</p> <p>R&D on new gasification processes and supporting research equipment/materials development will be carried out concurrent with the pilot plant/demonstration plant program.</p>

6. JUSTIFICATION (Use a separate sheet(s). See Item 6. on Instruction Sheet.)

7. MAJOR RESOURCE REQUIREMENTS

RESOURCE	FISCAL YEAR	1975	1976	1977	1978	1
a. MANPOWER <i>(in man years)</i>	(1) Scientific	50	400	30	400	30
	(2) Technical	130	1300	50	1300	40
	(3) Support					
	(4) Other	30	300	20	300	20
b. RAW MATERIALS <i>(List materials and units of measure where, such as tons of coal, barrels of oil, kilograms of uranium, etc. Show amount of each in columns at right.)</i>		Each pilot plant will use about 75 tpd of coal Each demonstration plant will consume about 5,000 tpd of coal and 3,000 acre-ft of water. Each commercial plant will consume 15,000-20,000 tpd of coal and about 10,000 acre-ft of water. (See #8. Schedule)				
c. LAND AREA REQUIRED <i>(in acres)</i>	(1) Govt-owned	Pilot plant will require about 20 acres.				
	(2) Govt-leased	Commercial facility will require about 200-acres including				
	(3) Privately-owned	coal mine which feeds the plant				
	(4) Other					
d. OTHER RESOURCES NEEDED <i>(Specify item and unit of</i>						

DEVELOPMENT

Level of Effort

- MAXIMUM
- ORDINARY
- MINIMUM

1. IDENTIFICATION NUMBER

05-07-20-03-17-10-54-01

	Coal & Oil Shale Processing	
	Pipeline Quality Gas From Coal	
	Department of the Interior	
	Office of Coal Research-Bureau of Mines	
and	NAME OF CONTRACTOR: Office of Coal Research-Institute of Gas Technology	
State	Site where work will be performed	State: Illinois County: Chicago
es for	NAME OF CONTRACTOR: Off. Coal Research-Consol. Coal-Stearns & Rogers	
	Site where work will be performed	State: S. Dakota County:
	NAME OF CONTRACTOR: Bureau of Mines, Lummas, Rust Engineering	
	Site where work will be performed	State: PA. County: Allegheny
	NAME OF CONTRACTOR: Office of Coal Research-Bituminous Coal Research	
	Site where work will be performed	State: PA. County: Pomeroy City
	NAME OF CONTRACTOR: Bur. Mines, Battelle Mem. Inst., Chem Systems	
	Site where work will be performed	State: County:

The research area concerns the production of pipeline quality gas from coal. The objectives are to: a) develop the technology necessary for the establishment of a commercial coal to pipeline quality gas industry with due regard to environmental consideration, b) accelerate demonstration at a commercial scale by constructing and operating one or more coal to pipeline gas plants.

The work involves the acceleration of the present Office of Coal Research - American Gas Assn. program and the Bureau of Mines program to produce high Btu gas from coal. The proposed plan calls for operation of four pilot plants (Hygas, CO₂-Acceptor, Synthane, Bigas; each producing 1 to 2 million scf/day), followed by the construction and operation of two demonstration plants (50-150 million cf/day, also in conjunction with industry). The demonstration plants will be spaced about two years apart. The second demonstration plant will provide facilities for testing newer developments and processes. The demonstration program will be followed by design and construction of commercial-scale plants (250 million cf/day).

R&D on new gasification processes and supporting research on equipment/materials development will be carried out concurrently with the pilot plant/demonstration plant program.

2

rate sheet(s). See Item 6. on Instruction Sheet.)

7. MAJOR RESOURCE REQUIREMENTS

LR▶	1975	1976	1977	1978	1979
	50	400	30	400	30
	150	1300	50	1300	40
	30	300	20	300	20
	Each pilot plant will use about 75 tpd of coal				
	Each demonstration plant will consume about 5,000 tpd of coal and 3,000 acre-ft of water.				
	Each commercial plant will consume 15,000-20,000 tpd of coal and about 10,000 acre-ft of water. (See #8. Schedule)				
	Pilot plant will require about 20 acres.				
	Commercial facility will require about 200-acres including coal mine which feeds the plant.				
D					

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up to 16 characters and spaces for county.

Site where work will be performed	<input checked="" type="checkbox"/>	State: S. Dakota	County:
NAME OF CONTRACTOR:	Bureau of Mines, Lummaus, Rust Engineering		
Site where work will be performed	<input checked="" type="checkbox"/>	State: PA.	County: Allegheny
NAME OF CONTRACTOR:	Office of Coal Research-Bituminous Coal Research		
Site where work will be performed	<input checked="" type="checkbox"/>	State: PA.	County: Homer City
NAME OF CONTRACTOR:	Bur. Mines, Batelle Mem. Inst., Chem Systems		
Site where work will be performed	<input checked="" type="checkbox"/>	State:	County:

5. BRIEF DESCRIPTION OF PROPOSAL
 (No more than 24 lines of text and no more than 70 characters and spaces per line)
 Briefly outline nature and scope of work to be undertaken, including any new facilities which may have to be acquired or constructed.

The research area concerns the production of pipeline quality gas from coal. The objectives are to: a) develop the technology necessary for the establishment of a commercial coal to pipeline quality gas industry with due regard to environmental considerations; b) accelerate demonstration at a commercial scale by constructing and operating one or more coal to pipeline gas plants.

The work involves the acceleration of the present Office of Coal Research - American Gas Assn. program and the Bureau of Mines program to produce high Btu gas from coal. The proposed plan calls for operation of four pilot plants (Hygas, CO₂-Acceptor, Synthan Bigas; each producing 1 to 2 million scf/day), followed by the construction and operation of two demonstration plants (50-150 million cf/day, also in conjunction with industry). The demonstration plants will be spaced about two years apart. The second demonstration plant will provide facilities for testing newer developments and processes. The demonstration program will be followed by design and construction of commercial-scale plants (250 million cf/day).

R&D on new gasification processes and supporting research equipment/materials development will be carried out concurrently with the pilot plant/demonstration plant program.

6. JUSTIFICATION (Use a separate sheet(s). See Item 6. on Instruction Sheet.)

7. MAJOR RESOURCE REQUIREMENTS

RESOURCE	FISCAL YEAR	1975	1976	1977	1978	1979
a. MANPOWER (in man years)	(1) Scientific	50	400	30	400	30
	(2) Technical	130	1300	50	1300	40
	(3) Support					
	(4) Other	30	300	20	300	20
b. RAW MATERIALS (List materials and units of measure below, such as tons of coal, barrels of oil, kilograms of uranium, etc. Show amount of each in columns at right.)		Each pilot plant will use about 75 tpd of coal Each demonstration plant will consume about 5,000 tpd of coal and 3,000 acre-ft of water. Each commercial plant will consume 15,000-20,000 tpd of coal and about 10,000 acre-ft of water. (See #8. Schedule)				
c. LAND AREA REQUIRED (in acres)	(1) Govt-owned	Pilot plant will require about 20 acres.				
	(2) Govt-leased	Commercial facility will require about 200-acres including				
	(3) Privately-owned	coal mine which feeds the plant.				
	(4) Other					
d. OTHER RESOURCES NEEDED (Specify item and unit of measure below. State quantity of each in columns at right.)	(1)					

3

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

Level of Effort:

- MAXIMUM
 ORDERSLY
 MINIMUM

IDENTIFICATION

05-03-20-03-12-

6. JUSTIFICATION- State the specific energy problem or objective, and specify how the proposal will contribute to the solution of the problem or attainment of the objective. Include reasons for selecting the recommended approach over other alternatives. Also include the benefit expected to be derived from meeting the objectives or solving the problem for which the project is proposed. Outline the risks/uncertainty (R/U), plan to minimize R/U, and basis for proceeding in face of R/U. Quantitative data should be used to the fullest extent.

Current domestic supplies of natural gas cannot meet demand and both pipeline gas (Canada) and liquid natural gas, LNG, (Algeria) are being imported. Imports are predicted to rise sharply over the next 10-15 years as a result of a continuing increase in the demand for natural gas, but imports will fall far short of the demand. Further large scale imports are undesirable both from a political/military standpoint and of the contribution of the unfavorable balance of trade.

Although the U.S. domestic supplies of petroleum and natural gas cannot meet supply, U.S. reserves of coal are immense with a projected lifetime of 400-600 years at present consumption rates. The proposed plan is designed to help alleviate the current shortages of natural gas by developing a commercial process for the production of pipeline quality i.e., high Btu gas from coal at reasonable cost.

The proposed plan involves the acceleration of the present OCR-AGA program and present Bureau of Mines program for the production of high-Btu gas from coal as well as research programs for development of new gasification processes. In addition, this includes a program of supporting research and development (submitted and outlined as separate sub-program proposal) for equipment/materials research and development and basic studies of gasification chemistry.

This plan includes the operation of the Hygas process pilot plant and the CO Acceptor process pilot plant, completion of the construction and operation of pilot plants for the Synthane process, for the Bi-Gas process and for a stirred-fixed bed gasifier and the construction and operation of two 50-150 million cf/day demonstration plants. In addition other research will be supported. This includes but is not limited to: construction and operation of a pilot plant to test the Bureau of Mines Hydr process, development of a) Battelle Memorial Institute's Self-Agglomerating Ash process, b) Chem Systems Liquid Phase Methanation process, and c) Bituminous Coal Research Combined Shift and Methanation Process.

This approach was selected because it provides a flexible research program to examine the merits of a number of promising processes before a demonstration plant is constructed. It is aimed at developing a process to produce a product gas at lowest price with the least amount of harm to the ecology. Other processes which were considered were ultimately decided to be too complicated or too costly.

It is expected that as a result of the proposed program, full scale (250 million cf/d) gasification plants will be operating by 1980. Present estimates point to 1 trillion cf/year of synthetic natural gas from coal by 1985 and 3 trillion cf/year by 1990.

Risks and uncertainties have been minimized by a comprehensive pilot plant to establish and solve technical problems before the demonstration plant stage. Ongoing research will be carried out concurrent with the pilot program to aid in the solution of technical problems and to further improve the processes.

Non-technical uncertainties consist of: prices of foreign petroleum, Federal and local strip-mine regulations, source of large amounts of capital needed for demonstration plants and Federal Power Commission action on pricing of synthetic natural gas from coal.

RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

Level of Effort:

- MAXIMUM
 ORDINARILY
 MINIMUM

IDENTIFICATION NUMBER

05-03-20-03-12-80-56-01

State the specific energy problem or objective, and specify how the proposal will contribute to the solution of the problem or objective. Include reasons for selecting the recommended approach over other alternatives. Also include the benefits derived from meeting the objectives or solving the problems for which this project is proposed. Outline the risks/uncertainties minimize R/U, and basis for proceeding in face of R/U. Quantitative data should be used to the fullest extent.

domestic supplies of natural gas cannot meet demand and both pipeline natural and liquid natural gas, LNG, (Algeria) are being imported. Imports are projected to increase sharply over the next 10-15 years as a result of a continuing increase in demand for natural gas, but imports will fall far short of the demand. Furthermore, imports are undesirable both from a political/military standpoint and because of the contribution of the unfavorable balance of trade.

In the U.S. domestic supplies of petroleum and natural gas cannot meet the needs. Reserves of coal are immense with a projected lifetime of 400-600 years at current consumption rates. The proposed plan is designed to help alleviate the critical shortage of natural gas by developing a commercial process for the production of pipeline-quality, high Btu gas from coal at reasonable cost.

The proposed plan involves the acceleration of the present OCR-AGA program and the continuation of the Bureau of Mines program for the production of high-Btu gas from coal as well as programs for development of new gasification processes. In addition, the plan includes a program of supporting research and development (submitted and outlined in a separate program proposal) for equipment/materials research and development and for development of gasification chemistry.

The program includes the operation of the Hygas process pilot plant and the CO₂-free process pilot plant, completion of the construction and operation of pilot plants for the Synthane process, for the Bi-Gas process and for a stirred-fixed bed process. In addition the construction and operation of two 50-150 million cf/day demonstration plants. In addition other research will be supported. This includes but is not limited to the construction and operation of a pilot plant to test the Bureau of Mines Hydrane process, development of a) Battelle Memorial Institute's Self-Agglomerating Ash process, b) the Liquid Phase Methanation process, and c) Bituminous Coal Research's Hydrogenation and Methanation Process.

This approach was selected because it provides a flexible research program designed to evaluate the merits of a number of promising processes before a demonstration plant is constructed. It is aimed at developing a process to produce a product gas at the lowest cost with the least amount of harm to the ecology. Other processes which were considered but were ultimately decided to be too complicated or too costly.

It is expected that as a result of the proposed program, full scale (250 million cf/day) demonstration plants will be operating by 1980. Present estimates point to 1.2 trillion cf/year of synthetic natural gas from coal by 1985 and 3 trillion cf/year by 1990.

The major uncertainties have been minimized by a comprehensive pilot plant program designed to identify and solve technical problems before the demonstration plant stage. Support activities will be carried out concurrent with the pilot program to aid in the solution of technical problems and to further improve the processes.

Other technical uncertainties consist of: prices of foreign petroleum, Federal, State, and local tip-mine regulations, source of large amounts of capital needed for gasification, and Federal Power Commission action on pricing of synthetic natural gas.

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

SCHEDULE (Include major facilities and major equipment. Indicate dates by Fiscal Year and Quarter).

a. DEVELOPMENT MILESTONES (number each consecutively)

(Limit Title of Milestone to 60 characters and spaces)

b. DATES

	Start		Complete	
	FY	Q	FY	Q
	Begin operation of Synthane pilot plant	75	1	76
Begin design of demonstration plant (50-150 million cf/day)	75	1	76	1
Begin operation of Bi-Gas pilot plant	75	3	76	4
Begin construction of demonstration plant	76	1	78	3
Begin design of second demonstration plant	77	1	78	1
Design pilot plant for novel gasification processes	77	3	78	3
Design commercial (250 million cf/day) plant	77	3	78	3
Begin construction of second demonstration plant	78	1	80	3
Operate pilot plant for novel processes	78	3	80	3
Operate demonstration plant	78	3	Continuing	
Construct commercial plant	78	3	81	1
Operate second demonstration plant	80	3	Continuing	
Operate commercial plant	81	1	Continuing	

(Continue to next column)

Level of Effort:

- MAXIMUM
- ORDERLY
- MINIMUM

a. DEVELOPMENT MILESTONES (continued)

(Limit Title of Milestone to 60 characters and spaces)

IDENTIFICATION NUMBER

05-03-30-03-12-80-56-03

b. DATES

Start		Completion	
FY	Q	FY	Q

ing
ing
ing

2

(Continue on separate sheet)

Page of

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

9. SUMMARY OF FUNDING REQUIREMENTS—Federal Government Only (in millions of dollars)

Requirement	(1)		(2)		(3)		(4)
	FY 1974 (Non-Fed)		FY 1975		FY 1976		FY
	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.
a. OPERATING (See p. for detail) Total Operating Requirements (from Detail Sheet)							
b. CONSTRUCTION (See p. for detail) Total Construction Requirements (from Detail Sheet)							
c. EQUIPMENT (See p. for detail) Total Equipment Requirements (from Detail Sheet)							
d. GRAND TOTAL—OBLIGATIONS							
e. GRAND TOTAL—OUTLAYS		27.3		30.2		223.7*	

* Includes \$200 million for demonstration plant.

** It is assumed that industry will build and operate the commercial plant.

NOTE: If cooperative programs are proposed, indicate the amount by year of both private and Federal government funding. A brief responsibilities should be separately provided in the above format.

Level of Effort:

- MAXIMUM
- ORDERLY
- MINIMUM

IDENTIFICATION NUMBER

05-03-20-03-12-80-56-01

1977	(5) FY 1978		(6) FY 1979		(7) Subtotal FY 1978-79		(8) Balance To Complete		(9) Total Excluding FY 1978 (Col 7 & 8)		
	Outlays	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays
.5	23.5		204.2		3.1						484.7

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

9. DETAIL OF FUNDING REQUIREMENTS—Federal Government Only (in millions of dollars)

a. OPERATING

ITEM	(1)		(2)		(3)	
	FY 1974 (Non-Add)		FY 1975		FY 1976	
	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays
TOTAL (Carry forward to summary sheet)						
() Name of Performing Organization:						
MANPOWER						
MATERIALS						
MAJOR PROCUREMENTS						
ALL OTHER						
TOTAL FOR THIS PERFORMING ORGANIZATION						
() Name of Performing Organization:						
MANPOWER						
MATERIALS						
MAJOR PROCUREMENTS						
ALL OTHER						
TOTAL FOR THIS PERFORMING ORGANIZATION						
Name of Performing Organization:						
MANPOWER						
MATERIALS						
MAJOR PROCUREMENTS						
ALL OTHER						
TOTAL FOR THIS PERFORMING ORGANIZATION						
() Name of Performing Organization:						
MANPOWER						
MATERIALS						
MAJOR PROCUREMENTS						
ALL OTHER						
TOTAL FOR THIS PERFORMING ORGANIZATION						

(Con)

Level of Effort:

- MAXIMUM
- ORDERLY
- MINIMUM

IDENTIFICATION NUMBER

05-03-20-03-12-80-50-01

76	(4) FY 1977		(5) FY 1978		(5) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL BY FISCAL YEAR	
	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

B. DETAIL OF FUNDING REQUIREMENTS—Federal Government Only (in millions of dollars)

B-1. CONSTRUCTION

ITEM:	(1) FY 1974 (Non-Add)		(2) FY 1975		(3) FY 1976		(4) FY 1977							
	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays	Obis.	Outl						
	TOTAL (Carry forward to summary sheet) >													
<p>TITLE OF PROJECT (Not to exceed 50 characters and spaces.) ()</p> <p><i>Title of project, Location (State and County) and Total Estimated Cost (TEC) must be entered from this point on. Every project requires one line. If more than one line is required, each line should be separately identified with a box number. Do not exceed 50 characters and spaces.</i></p> <p>Item No. ()</p> <table border="1" style="width:100%"> <tr> <td>State</td> <td>County</td> <td>TEC (in millions)</td> </tr> <tr> <td colspan="3">State funds:</td> </tr> </table>									State	County	TEC (in millions)	State funds:		
State	County	TEC (in millions)												
State funds:														
<p>TITLE OF PROJECT (Not to exceed 50 characters and spaces.) ()</p> <table border="1" style="width:100%"> <tr> <td>State</td> <td>County</td> <td>TEC (in millions)</td> </tr> <tr> <td colspan="3">State funds:</td> </tr> </table>									State	County	TEC (in millions)	State funds:		
State	County	TEC (in millions)												
State funds:														
<p>TITLE OF PROJECT (Not to exceed 50 characters and spaces.) ()</p> <table border="1" style="width:100%"> <tr> <td>State</td> <td>County</td> <td>TEC (in millions)</td> </tr> <tr> <td colspan="3">State funds:</td> </tr> </table>									State	County	TEC (in millions)	State funds:		
State	County	TEC (in millions)												
State funds:														

(Continue on Separate Sheet)

Level of Effort:

- MAXIMUM
- ORDERLY
- MINIMUM

IDENTIFICATION NUMBER

05-03-20-03-12-80-55-02

(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL EXCLUDING FY 1974 (Col 7 & 8)	
Obs.	Outlays	Obs.	Outlays	Obs.	Outlays	Obs.	Outlays	Obs.	Outlays	Obs.	Outlays

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

DETAIL OF FUNDING REQUIREMENTS—Federal Government Only (in millions of dollars)

c. EQUIPMENT

ITEM <i>(Each item not to exceed 60 characters and spaces)</i>	(1) FY 1974 (Non-Add)		(2) FY 1975		(3) FY 1976		(4) FY 1977	
	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays	Obis.	Outl.
	TOTAL (Carry forward to summary sheet) ▶							

to each major performing organization, develop equipment funds, with a separate fact sheet for each item of equipment costing one-half million dollars or more.

(Continue on Separate Sh

Level of Effort:

- MAXIMUM
- ORDERLY
- MINIMUM

IDENTIFICATION NUMBER

05-03-00-03-12-30-56-01

(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL EXCLUDING FY 1974 (Cols. 7 & 8)	
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays

2

ENERGY RESEARCH & DEVELOPMENT
FACT SHEET

1. IDENTIFICATION
 MAXIMUM
 ORDINARY
 MINIMUM

1. IDENTIFICATION #
05-03-20-03-12-81-

2. a. PROGRAM	Coal & Oil Shale Processing	
b. SUBPROGRAM	Pipeline Quality Gas From Coal	
3. a. PROPONENT AGENCY	Department of the Interior	
b. SUBUNIT	Office of Coal Research - Bureau of Mines	
4. CONTRACTOR AND SITE	NAME OF CONTRACTOR: Office of Coal Research-Institute of Gas Technol	
(No more than 12 characters and spaces for name of contractor; use standard abbreviation for state; up to 16 characters and spaces for county.)	Site where work will be performed	State: Illinois County: Chicago
	NAME OF CONTRACTOR: Coal Research Consol. Coal-Stearns & Ro	State: S. Dakota County:
	NAME OF CONTRACTOR: Bureau of Mines, Lummus, Rust Engineering	State: PA. County: Allegheny
	NAME OF CONTRACTOR: Office of Coal Research-Bituminous Coal Resea	State: PA. County: Homer City
	NAME OF CONTRACTOR: Bur. Mines, Battelle Me. Inst., Chem Systems	State: County:

5. BRIEF DESCRIPTION OF PROPOSAL
(No more than 24 lines of text and no more than 70 characters and spaces per line)
Briefly outline nature and scope of work to be undertaken, including any new facilities which may have to be acquired or constructed.

The research area concerns the production of pipeline quality gas from coal. The objectives are to: a) develop the technology necessary for the establishment of a commercial coal to pipeline quality gas industry with due regard to environmental considerations; b) accelerate demonstration at a commercial scale by constructing and operating one or more coal to pipeline gas plants.

The work involves the present Office of Coal Research - American Gas Association program and the Bureau of Mines program to produce pipeline quality gas from coal. The program involves the continued operation of two pilot plants, 1-2 million cf/day (the Hygas process and the CO₂-Acceptor process) and the continued construction and operation of pilot plants for the Synthane process and the Bi-Gas process. A stirred fixed-bed pilot plant will be constructed and operated. The pilot plant program will be followed by the construction of a demonstration plant (50-150 million cf/day) to test the best process or combination of processes. After the demonstration program, it is anticipated that sufficient design information will be available for design and construction of commercial (250 million cf/day) plants.

6. JUSTIFICATION (Use a separate sheet(s). See Item 6. on Instruction Sheet.)

7. MAJOR RESOURCE REQUIREMENTS

RESOURCE	FISCAL YEAR	1975	1976	1977	1978
a. MANPOWER (in man years)	(1) Scientific	60	400	40	25
	(2) Technical	180	1300	120	75
	(3) Support				
	(4) Other	30	300	30	20
b. RAW MATERIALS (List materials and units of measure below, such as tons of coal, barrels of oil, kilograms of uranium, etc. Show amount of each in columns at right.)		Each pilot plant will use about 75 tpd of coal Each demonstration plant will consume about 5,000 tpd of coal and 3,000 acre-ft of water. Each commercial plant will consume 15,000-20,000 tpd of coal and about 10,000 acre-ft of water. (See #8. Schedule)			
c. LAND AREA REQUIRED (in acres)	(1) Govt-owned	Pilot plant will require about 20 acres.			
	(2) Govt-leased	Commercial facility will require about 200 acres including			
	(3) Privately-owned	coal mine which feeds the plant.			
	(4) Other				

DEVELOPMENT SHEET

MAXIMUM
 ORDERLY
 MINIMUM

1. IDENTIFICATION NUMBER
 05-03-20-03-12-81-54-01

Coal & Oil Shale Processing
 Pipeline Quality Gas From Coal

NCY: Department of the Interior
 Office of Coal Research - Bureau of Mines

TITLE: NAME OF CONTRACTOR: Office of Coal Research-Institute of Gas Technology

State where work will be performed: State: Illinois County: Chicago

NAME OF CONTRACTOR: Off. Coal Research Consol. Coal-Stearns & Rogers
 State where work will be performed: State: S. Dakota County:

NAME OF CONTRACTOR: Bureau of Mines, Lummus, Rust Engineering
 State where work will be performed: State: PA County: Allegheny

NAME OF CONTRACTOR: Office of Coal Research-Bituminous Coal Research
 State where work will be performed: State: PA County: Homer City

NAME OF CONTRACTOR: Bur. Mines, Battelle Me. Inst., Chem Systems
 State where work will be performed: State: County:

OF

The research area concerns the production of pipeline quality gas from coal. The objectives are to: a) develop the technology necessary for the establishment of a commercial coal to pipeline quality gas industry with due regard to environmental consideration, b) accelerate demonstration at a commercial scale by constructing and operating one or more coal to pipeline gas plants.

The work involves the present Office of Coal Research - American Gas Association program and the Bureau of Mines program to produce pipeline quality gas from coal. The program involves the continued operation of two pilot plants, 1-2 million cf/day, (the Hygas process and the CO₂-Acceptor process) and the continued construction and operation of pilot plants for the Synthane process and the Bi-Gas process. A stirred fixed-bed pilot plant will also be constructed and operated. The pilot plant program will be followed by the construction of a demonstration plant (50-150 million cf/day) to test the best process or combination of processes. After the demonstration program, it is anticipated that sufficient design information will be available for design and construction of commercial (250 million cf/day) plants.

2

(separate sheets). See Item 6. on Instruction Sheet.)

7. MAJOR RESOURCE REQUIREMENTS

YEAR	1975	1976	1977	1978	1979
Electric	60	400	40	25	20
Water	180	1300	120	75	60
Land	30	300	30	20	20
of tons of coal	Each pilot plant will use about 75 tpd of coal Each demonstration plant will consume about 5,000 tpd of coal and 3,000 acre-ft of water. Each commercial plant will consume 15,000-20,000 tpd of coal and about 10,000 acre-ft of water. (See #8. Schedule)				
owned	Pilot plant will require about 20 acres.				
leased	Commercial facility will require about 200-acres including				
development	coal mine which feeds the plant.				

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up to 16 characters and spaces for county.

Site where work will be performed	State: S Dakota	County:
NAME OF CONTRACTOR:	Bureau of Mines, Lummus, Rust Engineering	
Site where work will be performed	State: PA	County: Allegheny
NAME OF CONTRACTOR:	Office of Coal Research-Bituminous Coal Resear	
Site where work will be performed	State: PA	County: Homer City
NAME OF CONTRACTOR:	Bur. Mines, Battelle Me. Inst., Chem Systems	
Site where work will be performed	State:	County:

5. BRIEF DESCRIPTION OF PROPOSAL
 (No more than 24 lines of text and no more than 70 characters and spaces per line)
 Briefly outline nature and scope of work to be undertaken, including any new facilities which may have to be acquired or constructed.

The research area concerns the production of pipeline quality gas from coal. The objectives are to: a) develop the technology necessary for the establishment of a commercial coal to pipe quality gas industry with due regard to environmental considerations b) accelerate demonstration at a commercial scale by constructing and operating one or more coal to pipeline gas plants.

The work involves the present Office of Coal Research - American Gas Association program and the Bureau of Mines program to produce pipeline quality gas from coal. The program involves the continued operation of two pilot plants, 1-2 million cf/d (the Hygas process and the CO₂-Acceptor process) and the continued construction and operation of pilot plants for the Synthane process and the Bi-Gas process. A stirred fixed-bed pilot plant will be constructed and operated. The pilot plant program will be followed by the construction of a demonstration plant (50-150 million cf/day) to test the best process or combination of processes. After the demonstration program, it is anticipated that sufficient design information will be available for design and construction of commercial (250 million cf/day) plants.

6. JUSTIFICATION (Use a separate sheet(s). See Item 6. on Instruction Sheet.)

		7. MAJOR RESOURCE REQUIREMENTS			
RESOURCE	FISCAL YEAR	1975	1976	1977	1978
a. MANPOWER (in man years)	(1) Scientific	60	400	40	25
	(2) Technical	180	1300	120	75
	(3) Support				
	(4) Other	30	300	30	20
b. RAW MATERIALS (List materials and units of measure below, such as tons of coal, barrels of oil, kilograms of uranium, etc. Show amount of each in columns at right.)		Each pilot plant will use about 75 tpd of coal Each demonstration plant will consume about 5,000 tpd of coal and 3,000 acre-ft of water. Each commercial plant will consume 15,000-20,000 tpd of coal and about 10,000 acre-ft of water. (See #8. Schedule)			
c. LAND AREA REQUIRED (in acres)	(1) Govt-owned	Pilot plant will require about 20 acres.			
	(2) Govt-leased	Commercial facility will require about 200 acres including coal mine which feeds the plant.			
	(3) Privately-owned				
	(4) Other				
d. OTHER RESOURCES NEEDED (Specify item and unit of measure below. Show quantity of each in columns at right.)					
(1)	(1)				

3

- MAXIMUM
- ORDERLY
- MINIMUM

6. JUSTIFICATION: State the specific energy problem or objective, and specify how the proposal will contribute to the solution of the problem or attainment of the objective. Include reasons for selecting the recommended approach over other alternatives. Also include the benefits expected to be derived from meeting the objective or solving the problem for which the project is proposed. Outline the risks/uncertainties (R/U), plans to minimize R/U, and basis for proceeding in face of R/U. Quantitative data should be used to the fullest extent.

Current domestic supplies of natural gas cannot meet demand and both pipeline gas (Canada) and liquid natural gas, LNG, (Algeria) are being imported. Imports are predicted to rise sharply over the next 10-15 years as a result of a continuing increase in the demand for natural gas, but imports will fall far short of the demand. Large-scale imports are undesirable both from a political/military standpoint and from the contribution to the balance of trade deficit.

Although the U.S. domestic supplies of petroleum and natural gas cannot meet demand, U.S. reserves of coal are immense with a projected lifetime of 400-600 years at present consumption rates. The proposed plan is designed to help alleviate the shortages of natural gas by developing a commercial process for the production of pipeline quality gas at reasonable cost.

This proposed minimum plan consists of the present Office of Coal Research Gas Association gasification program and the present Bureau of Mines gasification program. Specifically, this involves the continued operation of two pilot plants (Hydrane Acceptor process) and the construction and operation of an additional two (Synthane Bi-Gas). One demonstration plant will be built and the present schedule call for the construction of a 250 million cf/day commercial plant by 1981. This plan also includes the development of a stirred fixed-bed reactor.

Parts of the accelerated/orderly program which will not be supported with the minimum program are: new gasification processes, the Hydrane pilot plant, the Agglomerating process pilot plant, combined shift and methanation and a second demonstration plant. The minimum program will lag the accelerated program by about 10 years.

This program provides a flexible pilot program which will allow a choice of processes or a combination of processes for use in a commercial-scale demonstration plant. The ultimate benefits to be derived consist of a commercial pipeline gas from coal which will help alleviate the critical shortages of natural gas projected for the future. The present program is expected to result in 1.2 trillion cf/year of synthetic natural gas from coal by 1985 and 3 trillion cf/year by 1990.

The simultaneous operation of four pilot plants will aid in minimizing the risks and uncertainties. However, the lack of research on new processes and the lack of a second demonstration plant will increase technical risks as compared with the accelerated/orderly program. Non-technical uncertainties will still exist. These include: prices of foreign petroleum, Federal State and local strip-mine regulation, source of large amounts of capital needed for gasification plants and Federal Commission action on pricing of synthetic natural gas from coal.

Classification:
 MAXIMUM
 ORDERLY
 MINIMUM

IDENTIFICATION NUMBER
45-03-20-03-12-81-56-01

PROJECT
81-5

the specific energy problem or objective, and specify how the proposal will contribute to the solution of the problem. Include reasons for selecting the recommended approach over other alternatives. Also include the benefits from meeting the objectives or solving the problems for which the project is proposed. Outline the risks/uncertainties (R/U), and basis for proceeding in face of R/U. Quantitative data should be used to the fullest extent.

Domestic supplies of natural gas cannot meet demand and both pipeline natural and liquid natural gas, LNG, (Algeria) are being imported. Imports are projected to increase sharply over the next 10-15 years as a result of a continuing increase in demand for natural gas, but imports will fall far short of the demand. Furthermore, increased imports are undesirable both from a political/military standpoint and because of the contribution to the balance of trade deficit.

The U.S. domestic supplies of petroleum and natural gas cannot meet the demand. The reserves of coal are immense with a projected lifetime of 400-600 years at current consumption rates. The proposed plan is designed to help alleviate the critical shortage of natural gas by developing a commercial process for the production of pipeline gas at reasonable cost.

The proposed minimum plan consists of the present Office of Coal Research - American Coal Gasification program and the present Bureau of Mines gasification program. This involves the continued operation of two pilot plants (Hygas and CO₂-Synthane) and the construction and operation of an additional two (Synthane and Hygas). A demonstration plant will be built and the present schedule calls for operation of a 100 million cf/day commercial plant by 1981. This plan also includes research and development on a stirred fixed-bed reactor.

The accelerated/orderly program which will not be supported within the present program are: new gasification processes, the Hydrane pilot plant, the Self-Heating process pilot plant, combined shift and methanation and a second demonstration plant. The minimum program will lag the accelerated program by about one year. The accelerated program provides a flexible pilot program which will allow a choice of one or more combinations of processes for use in a commercial-scale demonstration plant. The benefits to be derived consist of a commercial pipeline gas from coal which will help alleviate the critical shortages of natural gas projected for the future. The present program is expected to result in 1.2 trillion cf/year of synthetic gas from coal by 1985 and 3 trillion cf/year by 1990.

The simultaneous operation of four pilot plants will aid in minimizing technical uncertainties. However, the lack of research on new processes and the lack of a demonstration plant will increase technical risks as compared with the accelerated program. Non-technical uncertainties will still exist. These include the effects of foreign petroleum, Federal State and local strip-mine regulations, the availability of capital needed for gasification plants and Federal Power Commission regulations on pricing of synthetic natural gas from coal.

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

SCHEDULE (Include major facilities and major equipment. Indicate dates by Fiscal Year and Quarter).

a. DEVELOPMENT MILESTONES (number each consecutively)

(Limit Title of Milestone to 60 characters and spaces)

b. DATES

	Start		Co
	FY	Q	FY
	Begin operation of Synthene pilot plant	75	1
Design of demonstration plant (50-150 million cf/day)	75	1	7
Begin operation of Bi-Gas pilot plant	75	3	7
Construct demonstration plant	76	1	7
Design commercial (250 million cf/day) plant	78	1	7
Operate demonstration plant	79	1	C
Construct commercial plant	79	1	8
Operate commercial plant	82	1	C

(Continue to next column)

Level of Effort:

- MAXIMUM
- ORDERLY
- MINIMUM

IDENTIFICATION NUMBER

05-03-20-03-12-81-74-01

a. DEVELOPMENT MILESTONES (continued)

(Limit Title of Milestone to 60 characters and spaces)

Date	Q	Milestone Description	D. DATES			
			FY	Q	FY	Q
4						
1						
4						
1						
1						
1						
1		Planning				
1						
1		Planning				

2

(Continue on separate sheet)

Page of

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

2. SUMMARY OF FUNDING REQUIREMENTS—Federal Government Only (in millions of dollars)

Requirement	(1)		(2)		(3)		(4)	
	FY 1974 (Non-Acid)		FY 1975		FY 1976		FY 1977	
	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
a. OPERATING (See p. for detail) Total Operating Requirements (from Detail Sheet)								
b. CONSTRUCTION (See p. for detail) Total Construction Requirements (from Detail Sheet)								
c. EQUIPMENT (See p. for detail) Total Equipment Requirements (from Detail Sheet)								
d. GRAND TOTAL—OBLIGATIONS								
e. GRAND TOTAL—OUTLAYS		27.3		29.0		219.5*		7.0

* Include \$200 for demonstration plant

** Assumes that industry will construct and operate commercial plant

NOTE: If cooperative programs are proposed, indicate the amount by year of both private and Federal government funding. A brief description of the cooperative programs should be separately provided in the above format.

Level of Effort:

- MAXIMUM
- ORDERLY
- MINIMUM

IDENTIFICATION NUMBER

05-03-23-03-12-S1-S6-01

(4) FY 1977	(5) FY 1978		(6) FY 1979		(7) Subtotal FY 1975-79		(8) Balance To Complete		(9) Total Excluding FY 1974 (Col. 7 & 8)	
	Outlays	Obs.	Outlays	Obs.	Outlays	Obs.	Outlays	Obs.	Outlays	Obs.
7.0		4.0		3.0***						262.5

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

DETAIL OF FUNDING REQUIREMENTS - Federal Government Only (In millions of dollars)

OPERATING

ITEM:	(1)		(2)		(3)		F
	FY 1974 (Non-Fed)		FY 1975		FY 1976		
	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays	
TOTAL (Carry forward to summary sheet)							
Name of Performing Organization:							
MANPOWER							
MATERIALS							
MAJOR PROCUREMENTS							
ALL OTHER							
TOTAL FOR THIS PERFORMING ORGANIZATION							
Name of Performing Organization:							
MANPOWER							
MATERIALS							
MAJOR PROCUREMENTS							
ALL OTHER							
TOTAL FOR THIS PERFORMING ORGANIZATION							
Name of Performing Organization:							
MANPOWER							
MATERIALS							
MAJOR PROCUREMENTS							
ALL OTHER							
TOTAL FOR THIS PERFORMING ORGANIZATION							
Name of Performing Organization:							
MANPOWER							
MATERIALS							
MAJOR PROCUREMENTS							
ALL OTHER							
TOTAL FOR THIS PERFORMING ORGANIZATION							

(Continue on Sep)

Level of Effort:

- MAXIMUM
- ORDERLY
- MINIMUM

IDENTIFICATION NUMBER

05-03-20-03-12-S1-56-01

(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL EXCLUDING FY 1975-79	
Ob's.	Outlays	Ob's.	Outlays	Ob's.	Outlays	Ob's.	Outlays	Ob's.	Outlays	Ob's.	Outlays

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

9. DETAIL OF FUNDING REQUIREMENTS - Federal Government Only (in millions of dollars)

B. CONSTRUCTION

ITEM	(1) FY 1974 (Non-Add)		(2) FY 1975		(3) FY 1976		(4) FY 1977
	Obs.	Outlays	Obs.	Outlays	Obs.	Outlays	Obs.
TOTAL (Carry forward to summary sheet)							
<p><small>Title of project, Location (State and County) and Total Estimated Cost (TEC) must be shown with consistency. Every project costing one or more dollars or more should be separately identified with a brief statement of why it is required.</small></p>							
<p>TITLE OF PROJECT (Not to exceed 30 characters and spaces.) ()</p> <p>State: _____ County: _____ TEC (in millions): _____</p> <p>Comments:</p>							
<p>TITLE OF PROJECT (Not to exceed 30 characters and spaces.) ()</p> <p>State: _____ County: _____ TEC (in millions): _____</p> <p>Comments:</p>							
<p>TITLE OF PROJECT (Not to exceed characters and spaces.) ()</p> <p>State: _____ County: _____ TEC (in millions): _____</p> <p>Comments:</p>				✓			

(Continue on Separate Sheet)

Level of Effort:

- MAXIMUM
- ORDERLY
- MINIMUM

IDENTIFICATION NUMBER

05-03-20-03-12-81-56-01

(4) FY 1977	(5) FY 1978		(6) FY 1979		(7) SUSTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL EXCLUS... FY 1974-79		
	Outlays	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

TAIL OF FUNDING REQUIREMENTS—Federal Government Only (in millions of dollars)

EQUIPMENT

ITEM <i>(Do not exceed 40 characters and spaces)</i>	(1) FY 1974 (Non-Add)		(2) FY 1975		(3) FY 1976		(4) FY 1977	
	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays
	TOTAL (Carry forward to summary sheet) >							
To include planning organization, the equipment funds, with a separate column of each item of equipment of cost of one million dollars or more.								

(Continued on Separate Sheet)

Level of Effort:
 MAXIMUM
 ORDERLY
 MINIMUM

IDENTIFICATION NUMBER
 05-03-20-03-12-81-56-01

	(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL EXCLUDING FY 1974 (Cols. 7 & 8)	
	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays

2

ENERGY RESEARCH DEVELOPMENT
FACT SHEET

UNCLASSIFIED
[] CONFIDENTIAL
[] SECRET

1. IDENTIFICATION
05-04-21-03-12-72

2. a. PROGRAM	Coal Processing
b. SUPPORT GRANT	Clean Burning Liquids
3. a. FUNDING AGENCY	Interior
b. SUBUNIT	CCR
4. CONTRACTOR AND SITE <i>(No more than 12 characters and spaces for name of contractor, use standard abbreviation for state up to 16 characters and spaces for county.)</i>	NAME OF CONTRACTOR: Various- 40 to 50
	Site where work will be performed: <input checked="" type="checkbox"/> State: County:
	NAME OF CONTRACTOR:
	Site where work will be performed: <input type="checkbox"/> State: County:
	NAME OF CONTRACTOR:
Site where work will be performed: <input type="checkbox"/> State: County:	
NAME OF CONTRACTOR:	
Site where work will be performed: <input type="checkbox"/> State: County:	
NAME OF CONTRACTOR:	
Site where work will be performed: <input type="checkbox"/> State: County:	
5. BRIEF DESCRIPTION OF PROPOSAL <i>(No more than 24 lines of text and no more than 70 characters and spaces per line)</i> Briefly outline nature and scope of work to be undertaken, including any new facilities which may have to be acquired or constructed.	Four (4) 100,000 BPD Plants are proposed employing (1) Direct hydrogenation, (2) Carbonization with hydrogenation and utilization of all char, (3) Extraction/hydrogenation, (4) Gasification Fischer Tropsch or related synthesis. These processes may various combinations.

6. JUSTIFICATION (Use a separate sheet(s). See Item 6. on Instruction Sheet.)

7. MAJOR RESOURCE REQUIREMENTS					
RESOURCE	FISCAL YEAR	1975	1976	1977	1978
a. MANPOWER <i>(in man years)</i>	(1) Scientific	300	300	300	200
	(2) Technical	300	300	300	300
	(3) Support	600	600	600	600
	(4) Other Const		200	1000	2000
b. RAW MATERIALS <i>(List materials and units of measure below, such as tons of coal, barrels of oil, kilograms of uranium, etc. Show amount of each in columns at right.)</i>		minor	minor	coal 1.0x10 ⁶ tns/yr.	coal 10.0x10 ⁶ tpy water 20,000 acre ft.
c. LAND AREA REQUIRED <i>(in acres)</i>	(1) Government				
	(2) Government	2560	2560		
	(3) Private owned				Same as 1975-1976
	(4) Other				No additional area required
d. OTHER RESOURCES NEEDED					

DEVELOPMENT

DESCRIPTION

FEDERAL

OTHER

STATE

1. IDENTIFICATION NUMBER

05-04-21-03-12-78-03-01

Y
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Coal Processing
Clean Burning Liquids
Interior
OCR
NAME OF CONTRACTOR: Various- 40 to 50
Site where work will be performed: State: County:
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Four (4) 100,000 BPD Plants are proposed employing (1) Direct hydrogenation, (2) Carbonization with hydrogenation and utilization of all char, (3) Extractive/hydrogenation, (4) Gasification with Fischer Tropsch or related synthesis. These processes may be in various combinations.

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operates sheet(s). See Item 6. on Instruction Sheet.)

7. MAJOR RESOURCE REQUIREMENTS

YEAR	1975	1976	1977	1978	1979
Electricity	300	300	300	200	200
Coal	300	300	300	300	300
Water	600	600	600	600	600
Land		200	1000	2000	1500
Other	minor	minor	coal 1.0x10 ⁶ tons/yr.	coal 10.0x10 ⁶ tpy water 20,000 acre ft.	coal 50.0x10 ⁶ tpy water 50,000 acre ft.
Area	2560	2560	Same as 1975-1976		
Notes	No additional area required				

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