2. Recommendations - Pioneer Plant Phase

(1) Companies participating in the joint demonstration program should be entitled to a percentage of patent rights and royalties commensurate to their percentage contribution to the project.

(2) Other government incentives and policies that may be required to promote constructing the first commercial scale coal conversion plants include:

a. Tax preferences, including a partially refundable excess profits tax.

b. Guaranteed or low-cost government loans.

c. Variable import tariffs to maintain imported energy prices higher than domestic.

A more comprehensive discussion of industry viewpoints, possible government actions to accelerate synthetic fuel development and possible constraints to growth rate of an expanding synthetic fuels industry is presented in Appendix A.

IV. Development of an Industry

A. General

The broad goal of the recommended synthetic fuels program is to have several commercial scale coal liquefaction and gasification plants operational by 1980. If this program were carried out, the United States would have to decide by the late 1970's whether to start actions aimed at the actual creation of a synthetic fuels industry. Table 1 indicated the eventual size of such an industry might have to be 5-10 million barrels/day oil equivalent to eliminate all fuel imports.

We can foresee many institutional and physical problems which might stand in the way of creating such an industry. The rapid build-up of industries for mining coal, gasifying or liquefying coal and marketing domestic synthetic oil or gas implies reallocation of resources on a national scale at an unprecedented rate. Even now it is not too early to identify these problems and estimate the time necessary to solve them. The country should be ready to start, when necessary, the long, slow processes of reconciling existing legal, environmental, industrial, social, financial, legislative and other institutional practices with the needs of a large synthetic fuels industry.

B. Constraints to Accelerated Growth

(1) Institutional Constraints

In the following passages we summarize a variety of opinions about the roles of various institutions in building a synthetic

fuels industry. Such viewpoints are typically delivered from the viewpoint of one faction. We cannot independently verify the accuracy of such statements and we do not necessarily endorse these ideas. They are included to stimulate further thought and review if warranted.

(a) Government Policy Constraints

There is general agreement that accelerated leasing of Federal energy and water sources with grants, costs and royalties tied to production schedules would be needed for a large synthetic fuels industry. Streamlining and better definition of responsibilities for approvals of plans and the writing of environmental impact statements are also required. Industry wants not so much abandonment of environmental protection, health and safety standards, etc., as stable definitive standards so long-range development plans can be made. Industry and lenders are reluctant to commit capital on a long-range basis if, for instance, plant siting, strip mining or power plant air pollution ground rules are constantly changing.

There is also concern at the sheer number of public hearings and permits that must be observed before construction of a project can start. Now 25 to 30 permits are required for a coal gasification plant and perhaps two years delay is involved in getting through this permit phase.

With proper streamlining to a minimum number of hearings and permits, it is felt only six months would be needed.

Government policy on the patent and royalty area is also of concern to industry. If data from Federally supported research is given away free, often no private parties will choose to utilize the data. No company has any proprietary "edge" over another company and competitors could jump in at any time. It has been suggested the government collect royalties from government research by competitiv bidding for use of this data. There has also been a general worry over the broad effect of government support of research and development. There is a claim that private enterprise cannot compete with the government and private research declines in those research and development areas where government [illegible]ers.

A broader question is the effect of "artificial" government controlled prices on the amount of capital available for investment in future energy production enterprises. This can appear in the form of ceilings in today's prices, or fear of unknown future price roll backs. The latter fear seems to be a factor in the hesitation of gas utilities to build coal gasification plants.

Government policy in the area of import quotas and tariffs is of crucial concern to potential developers of

a synthetic fuels industry. The fear of being undercut in price by cheap Arab oil imports, might stop the application of coal liquefaction.

The antitrust area is of particular concern to the oil industry. Perhaps a coal-based synthetic fuel industry would be more readily implemented if joint private research and development ventures and synthetic fuel projects were favored.

Naturally fiscal and taxation policies favoring development of indigenous energy sources are considered necessary for a coal based synthetic industry.

Further discussion of government tax, loan, leasing, legislation, patent cost sharing and import policy is included in Appendix A.

One underlying theme of comments about government policy was that there should be one focal point in the Federal government with the power to reconcile the conflicting policies of the many government agencies that would have jurisdiction over a synthetic fuels industry. The central Federal agency should also work to encourage uniform state and local policies across the country particularly in the case of land use.

A second theme of industrial comment was that minimum government control and maximum operation of free enterprise was necessary for the most efficient development of domestic

energy resources.

(b) Constraints Imposed by Industrial Practices

The major constraints to energy industrial development of a synthetic fuels industry are naturally tied to considerations of profitability. If new domestic oil or gas, imported oil or gas, or shale oil is cheaper, a coal based synthetic fuels industry will not develop in the private sector.

In the coal production area, the conservative approach to expansion, the long delays in applying new technology, and the low level of effort to develop new technology would control the growth rate of a synthetic fuels industry. Resistance to increased productivity by coal mining unions might also prove to be a limiting factor in mining.

In some cases coal companies with relatively small capital for plant investment are owned by larger energy companies with considerably more investment capability. If a policy exists of letting each subsidiary operate financially independently, the coal company with relatively small profits cannot expand independently, although it might be able to if aided by the parent company.

Although there is a danger that if one proprietary liquefaction or gasification process were outstandingly better than all others, unilateral development of that process by the controlling company might slow the growth

of liquefaction, we believe the existing practice, prevalent in the energy industries, of leasing processes for royalties will solve this problem.

(c) Financial Constraints

We have heard repeatedly that early private growth of a synthetic fuels industry will be inhibited by a lack of capital availability. Lenders believe synthetic fuels plants are capital intensive with thin margins and have considerable operating leverage with resulting big swings in profit performance. Lenders will require comprehensive protection to insulate themselves against these business risks. It has been suggested that the Federal government may have to be a partner in any early consortium formed to build plants so that plant projects can get good credit ratings. These credit ratings would be essential to attract the massive amounts of capital required, since the bulk of United States' investment money only flows toward relatively low risk ventures.

(2) Physical Constraints

(a) Engineering and Construction Manpower Constraints

The engineering manhour requirement for a 250 million standard cubic feet per day coal gasification plant is about 1,300,000 manhours. At 1,750 working hours per year per man, this is over 700 manyears of effort. A 40,000 barrel per day (BPD)

coal liquefaction plant would require a similar effort. There are approximately 12,000 engineers employed in the engineering and construction industry in this country. In addition, there are another 8,000 designers and draftsmen. This total combined engineering force of approximately 20,000 results, on a straight time basis, at 1,750 working hours per year per man, in a total of 35 million manhours.

From these data it can be concluded that, as with steel, construction of a few coal conversion demonstration or production plants would not produce an engineering bottleneck. However, construction of ten production plants in conjunction with required expansion in other energy-related areas (refineries, electrical utilities, etc.) would introduce considerable engineering manpower problems. Construction labor bottlenecks are also indicated in preliminary studies.

If engineering design manpower were a critical bottleneck, an attempt might be made to modularize plant design to minimize design effort. This is admittedly difficult. The DOD has had problems in attempting to modularize ships, planes, etc. and the nuclear reactor industry is experiencing similar problems. However, it has been done successfully in the past.

(b) Mining Manpower Constraints

Another phase of the coal effort in commercializing coal-based energy sources would be the mining of the coal. Over the past 15 years, the coal mine labor force declined from 500,000 to 120,000 as a result of mechanization in the mines. The rising productivity through mechanization enabled the mines to produce nearly enough to satisfy the demand. Also, during the 1960-1970 period, for a variety of reasons, productivity in some underground mines declined by 20-30%. But the long-range problem has been the inability to attract new mine workers, or even to bring back those who have moved away into other industries.

For example, consider the problem of mining the 40,000 tons per day (TPD) of coal needed for a 100,000 BPD coal liquefaction plant. Strip mining for that quantity of coal would take about 600 miners. Deep mining for the same quantity would take about 2,200 men. These figures are based on current mining operations, in which the miners work 15 shifts a week, but only about 10 of those are productive shifts (the other 5 are spent in relocating and maintaining equipment). The present total mining labor force is 120,000 workers. If ten such coal conversion plants are built, the labor force must be expanded 5% if strip mining were employed and 20% if the coal were deep mined, so the effect is not negligible. However, new Western strip mines would have considerably less

overburden then existing Eastern strip mines and strip mining productivity is projected to increase. Industry estimates a 25% increase in strip mines could double strip mine production by 1980.

The number of miners required for deep mining doubling would be greater. Developing new mining techniques which reduce the manpower requirements could aid a synthetic fuels industry by significantly reducing coal production costs. If advanced mining techniques are used, miner requirements could be lowered by a factor of 4.5 for strip mining, and lowered by a factor of 8 for deep mining.

(c) Constraints on Steel for Construction

The present shortage of steel in the U.S. has been brought on by many years of reduced production owing to strong foreign competition. Now that foreign demand has increased and foreign prices have risen, domestic production cannot keep pace with the sudden influx of orders. U.S. mills have been supplying distributors on an allocation basis since November 1973. Delivery times for such steel items as pipe may extend as long as three years, as shown in Table VIII.

TABLE VIII

Delivery Times

Cast Valves	6 months to 1 year
Pipe	2 years
Structural Shapes	1 to 2 years
Pressure Vessels	3 years

Impact of the demonstration and production plans compared to annual steel and construction figures is given in Table IX.

TABLE IX

COMPARISON OF DEMONSTRATION AND PRODUCTION PLANT REQUIREMENTS WITH CONSTRUCTION AND STEEL FIGURES FOR 1973

	1973	One 1,000 TPD Demonstration Plant	One 25,000 TPD Production Plant	Ten 25,000 TPD Production Plants
Heavy Construction (millions of dollars)	23,000	50	450	4500
Cost as a percentage of 1973 Heavy Construction	-	0.2%	2%	20%
Steel (millions of tons)	135	0.1	0.2	2.0
Steel Requirements as a Percentage of Total 1973 steel	-	0.007	0.15	1.5

From the foregoing data, it can be seen that the demonstration plant would have little impact on the total steel and construction picture. Construction of a limited number of production plants also would have limited impact. However, a large coal conversion industry (say, ten plants, increasing national energy production by about one percent) would have a significant impact. With the present expansion plans of the steel industry and with sufficient fuel allocation, however, it appears that sufficient steel can be made available for the coal conversion industry.

(d) Heavy Equipment Procurement Constraints

There is an interval of about 3 years between the time large strip mining equipment is ordered and the time it is operational in the field. A similar delay is typical in acquiring the large pressure vessels used in coal liquefaction plants. Funding and mine equipment production capacity could be geared up for a fast growing synthetic fuels industry in the 1980's. However, it takes considerable time, a large investment and more significantly, a reasonably assured market to expand this production capacity. Foundries in particular will need such assurance before new production lines are established.

(e) Energy Transportation Problems

We think that expanding transportation capacity will not be a growth limiting constraint on a synthetic fuels industry. The National Petroleum Council estimates $6 billion would be needed to build coal carrying railroad cars, if coal products were doubled by 1985, and believes that kind of money can be raised. However, if railroad capacity cannot expand fast enough, it has been pointed out that around 10,000 miles of new pipeline could carry all the slurry coal, synthetic oil or synthetic gas produced by a Western state synthetic fuel industry. The domestic oil and gas pipeline production in 1969 alone was over 10,000 miles.

(f) Impact on Environment

Environmental impact (on a per-plant basis) is shown in Table X.

TABLE X

ENVIRONMENTAL IMPACT

Aspects of Project	Impact
Construction Phase	No. of Personnel: About 300 per plant There will be damage to biota. Plans will include provision for minimizing and mitigating effects. Water requirements: 100,000 GPD Electrical Requirements: 5000 KW

TABLE X

(Cont'd)

Aspects of Project	Impact
Operational Phase •Resource use (per plant)	Coal: 25-30,000 tons/day Water: 6,000-10,000 GPM Electric Pwr: 30MW
•Atmospheric Emissions	Sulfur Compounds: (H_2S and SO_2) Nitrogen Compounds: (NO_x and NH_3) Other: H_2O and CO_2 Particulates: Nil if appropriate apparatus is used Sulfur and nitrogen compounds can be reduced to acceptable levels by present technology methods. New health and industrial hygiene procedures may have to be developed for control of carcinogenic particulates.
Noise	Can be maintained within 1971 Occupational Safety and Health Act levels.
Solid Wastes	Types: Ash, sludge, and possibly, spent catalyst. Ash: One fifth of processed coal (5000-6000 TPD per plant) Fate: Disposal by burial in strip mines
Aqueous Effluent	Waste water may contain NH_3 and phenols. Can be held within federal levels by treatment
Water Supply System Impact	Will require systems study
Aesthetic Factors	Possible problem areas: (1) land clearing and (2) plant structures
Socio-economic Impact	Full time employees: 500-1000 Annual Payroll: $6 to $13 million Indirect Support: 2500-5000 persons Local, state and national tax revenues: $10 to $20 million/year
Product Transportation Impact	Needs systems study

From this table it appears that, in general, strict environmental controls can be maintained in a coal-based fuels industry. The impact of population, societal and aesthetic issues needs further study. Some judgement should be exercised, especially in new projects, where some impacts are difficult to estimate. Observation of prototype or demonstration units may be required in order to actually determine the eventual environmental impact.

g. Mining and Plant Siting Constraints

In a preliminary survey, the American Gas Association has identif 176 sites in the lower 48 states where there is sufficient local water and uncommitted coal reserves to supply a 250,000,000 standard cubic feet per day (SCFD) coal gasification plant. The same sites could support a coal liquefaction plant of about 50,000 bbl/day capacity. Thus, there are already known sites to support a coal liquefaction and gasification industry with output equivalent to over 8 million barrels of oil per day. However, numerous constraints exist which may eliminate some sites from consideration or delay their acquisition for a synthetic fuels industry. Some major constraints are listed below. The time delays involved in creating operating mines of the scale required to feed a synthetic fuel plant suggest we should begin siting studies now.

The establishment of a commercial-scale surface mining operation capable of producing 25,000 tons of coal per day is a considerable undertaking. It requires 5 to 7 years to complete under normal circumstances and would cost between 50 to 60 million dollars. It is therefore clear that careful analysis of the technological, regulator and environmental problems associated with any plants and mines planr in the early 1980's should start now. The processes of site selectic land acquisition, mine design, equipment acquisition, and environment review may have to be expedited if acquisition planning is not initi soon.

The problems of site selection may be especially difficult in the East, where coal companies may encounter serious difficulties in acquiring continguous reserves adequate to support commercial-scale operation. In the West, large tracts are already controlled by government and private interests. In either case, a firm contract for coal supply must be obtained before the planning, review, and development phases can begin. Gov: ment participation to the extent of an early lease grant may be necessary to assure early site selection. Consideration should also be given to the elimination, modification, or streamlining (on a special-case basis) of existing permit and environmental review procedures.

We feel that it would be wise to consider a program for "stockpiling" potential synthetic fuel plant sites, as is being considered in the nuclear reactor industry. In this approach the environmental and legal permit phase of site acquisition for locales with sufficient coal and water reserves, would be carried out well in advance of plant construction. Then if unforeseen delays were encountered, they would not become the limiting path to plant operation.

C. Government Role

It should be evident from the above that the Federal Government will play a decisive role in the development of coal liquefaction and gasification. Since even now immediate government actions are needed to shape the course of this industrial growth in the 1980's government,

policy making should begin soon. It is improbable that either a laissez faire or crash approach will be taken, and some ground rules should be set for the extent and type of government involvement. For instance, should the government enter the development field for a few years and withdraw upon attainment of full-scale engineering data? Should the government participate in jointly or solely owning a few commercial scale plants, to "keep industry honest" by obtaining its own cost data a-la TVA?

In any case, if government maintains an interest in guiding the new industry, it should develop a strong in-house systems analysis capability. We have found today how difficult it is to equitably allocate refinery production between two distillate fuels - gasoline and heating oil. If in the interests of using our coal resources optimally the government must choose to influence the relative use of coal as a utility fuel, an industrial fuel, a gasoline feedstock or a natural gas feed stock, the government should create a strong internal capability to forecast the results of its actions. Such a capability will be needed to determine whether synthetic fuel plants are best sited mine mouth, at energy demand centers or at some intermediate location. It is also important to decide if energy is best shipped from the Western coal regions as coal, oil, gas or electricity. In a broader sense systems analysis might help in rationally allocating, say, a limited steel supply between coal conversion reactor vessels or drill hole casing for new oil production.

The industrial answer would of necessity always be via the cheapest route. The government answer should further take into consideration the total impact of alternate routes to developing a coal synthetic fuels industry. The government should be prepared to identify those areas where the most economic route and the optimum total impact route differ and set policy guidelines for resolving any such conflicts between public and private interests.

V. Suggested Future Action

A. Near-Term Management

If Project Independence is vigorously pursued, it is evident that development of coal liquefaction and coal gasification must be a key part of the program for energy independence. Even though synthetic fuels may not provide major relief for imports by 1980, they offer the promise of sustained oil and gas production at significant levels after 1985, when domestic oil and gas production will probably be decreasing. We have pointed out that action is required now if the industry is to emerge in the 1980's However, we have also itemized a number of basic problems that must be resolved before a joint government-industry national development program can be launched with the sense of commitment required for success.

In the interim, before a formal program is finalized, we strongly recommend contingency action be taken. This action would involve overall planning for synthetic fuel development as soon as the government begins working toward Project Independence. If necessary, the interim management could be temporary in nature and would not commit any follow-on organization to specific plans. The main purpose of the interim group would be to minimize the inevitable transitional disorganization in getting a new effort started.

We think the program we have suggested in this report and its appendices is specific enough that we do not have to present at this point the detailed schedule of pilot plant, demonstration plant and industrial development as a course of "action." The action we recommend is getting the country to the "time zero" or starting point in this schedule. Specifically, we recommend simply assigning the responsibility for Project Independence to one person or group with a goal oriented mission of "action." Their initial action will be to review our suggestions and others. The responsible party will then have to quickly find groundrules acceptable to all concerned parties for accelerating on-going research in coal mining, liquefaction and gasification, much of which is currently performed in private industry.

The primary goals in this early effort will be to (1) issue as soon as possible some form of request for proposals to industry that will bring substantive response aimed at starting development of synthetic fuel production, and (2) to assure that a sufficient level of the federal funds forthcoming for attacking the energy crisis are allocated to the synthetic fuels area of Project Independence. Given the long lead times we have cited in this report, the processes of organization formation, policy making, proposal requesting and funding decisions should be completed in

time to spend substantial amounts of fiscal 1975 federal funds for coal based synthetic fuel development projects.

B. Long-Term Management

We received a number of suggestions concerning the type of formal industry-government joint organization which would handle development of a synthetic fuels industry. The structure of the organization was thought to be less important than the degree of mutual commitment of both parties to the goal of increased domestic fuel production.

Several characteristics of the lead organization were thought by our contacts to be necessary if the program were to succeed. The lead group should have the authority necessary to do the job. It must be able to recommend the full gamut of incentives available to the federal government, i.e., land leasing, product subsidies, tax preference, priority allocation of strategic materials, etc. The organization must be independent and goal oriented and it must not be constrained to respond only to outside proposals. It should be temporary — that is, it should terminate when the Project Independence goals are achieved or abandoned. Fiscal flexibility is a must since the lead group must be able to respond quickly to solve unforeseen technical problems in any of its projects. Formation of a fund financed by energy taxes analogous to the

time to spend substantial amounts of fiscal 1975 federal funds for coal based synthetic fuel development projects.

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Highway Trust Fund was one suggested mechanism for maintaining the fiscal fluidity.

Though each party with equity in the organization should have a voice in guiding overall program policy, the line management for each individual project should have great independence of operation. Several consultants favored giving one party complete responsibility for coordinating design, construction, and operation of each project, an approach which has worked well in industry. Financial experts also supported the concept of setting up a separately financed and managed entity for each enterprise.

An often expressed viewpoint was that line technical management and project siting should not be solely governmental. A synthetic fuels industry is not analogous to a Manhattan Engineering District where there was no prior technical base or economic incentive for private industry. The bulk of knowledge about hydrocarbon processing resides in private industry and unilateral government sponsored, managed, and implemented projects would result in federal R and D money simply "rediscovering the wheel."

In order to establish national priorities among alternative options, there was universal agreement that energy systems should be modeled and the resultant systems analysis should be used for guidance.