APPENDIX A

COMMERCIAL ASPECTS
OF THE PRODUCTION OF
CLEAN FUELS FROM COAL

January 11, 1974

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I. INDUSTRIAL VIEWPOINTS AND RECOMMENDATIONS TOWARD A GOVERNMENT-INDUSTRY CLEAN-FUELS-FROM-COAL PROGRAM

General

Industry is in favor of government-industry cooperation in implementing clean fuels from coal. This includes both demonstration of candidate processes at the coal resource center and commercial production despite anticipation of increased governmental control. This attitude is a recent corporate change for many firms. Until recently many companies preferred to do their own R and D, demonstration projects and commercial ventures without Federal assistance. Now the belief is that the funds required to get significant quantities of clean fuel from coal into the economy is too large for industry to handle alone. Directly or indirectly, government funding must be provided.

Recommendations

Good management is essential if the demonstrations projects are to be successfully, quickly, and cost-effectively designed, built and operated, and management has, in fact, been a matter of concern to many companies contacted. Rigidity and overmanagement of many government-sponsored programs has been repeatedly mentioned. The statement is made that rigid control by committee may be good politics but is poor management. It is therefore recommended that a single company be selected to be overall project manager for each demonstration project and should be given flexibility to get the job done. The company may subcontract for design and construction of the demonstration plant but would be expected to operate the plant and market the products. Financing should be in part by the project managing company, so there is adequate incentive for efficient design and operation. It is believed that this kind of management would provide the flexibility for on-the-spot decisions that would be necessary in such new processes.

Selection of the companies could be by competitive bid, using as criteria: the process the bidder proposes to demonstrate, the site proposed for the demonstration, the proposed coal feed stock, the patent position proposed, and the amount of funding to be supplied by the bidder.

It is also recommended that each demonstration project maintain its own analytical facilities, shop facilities, maintenance and repair facilities for operation of the demonstration trains. Down time in a demonstration project is unavoidable. It must be minimized and the way to do this is for the projects to have in-house diagnosis and repair capability.

II. GOVERNMENT INCENTIVES AND POLICIES NECESSARY TO IMPLEMENT COMMERCIALIZATION OF COAL-BASED FUEL

General

Governmental policies and attitudes can often be vital to an industry's vigor and even survival. Investment tax credits and depletion allowances, for example, stimulate the production of oil, gas and minerals and therefore have a positive effect. Governmental actions in regulating the wellhead price of natural gas considerably lower than the cost of other fossil fuels have had a very negative effect in the last few years on the finding and production of natural gas. In this section we consider some of the possible governmental policies and incentives that would aid in implementing a clean-fuels-from-coal industry.

As mentioned earlier, government support of demonstration projects is required. These are high risk projects and industry is reluctant to fund them unless they are well-protected by a firm patent position and a guaranteed market. This often is not the case in coal conversion technology, partly due to government support of many projects, making the patents available to all; and partly due to the plethora of patents in the energy field. Government support will be required to minimize the risks. Even so, industry will likely establish consortia for their part of the financing to minimize individual company risks.

Government policies and incentives have particular impact in the following areas:

- Tax Preferences
- Guaranteed Loans
- Low-Cost Loans
- Low-Cost Government Energy Leases
- Guaranteed Rates of Return
- Guaranteed Price
- Import Quotas
- Variable Import Tariffs
- Allocation of Scarce Resources (Manpower, steel, etc.)
- Cost Sharing
- Phase Out of Price Controls on Energy Equipment
- Performance Bids for Government Energy Leases
- Streamlining of Licensing and Environmental Legislation
- Revised Patent Procedures

Many of these policies and incentives will be discussed in detail in the following paragraphs.

Tax Preferences

A good incentive would be one which effectively stimulates the energy industry, yet does not require considerable government machinery to manage. Tax preferences for energy development and for energy R and D are suggested as an effective way to do this. Examples of tax preferences include the existing intangibles expensing, depletion allowances, and investment tax credit. A new tax preference worth considering would be tied to the expected new excess profits tax. The excess profits could be partially refundable if the money were reinvested in energy

<u>Loans</u>

Capital availability is recognized as a potential stumbling block to future energy production. Direct or indirect government loans may well be required. Possibilities include government guarantees of private loans, low-cost government loans, or even a bid situation in which industrial firms bid on the interest they are prepared to pay for a government loan for an energy plant

<u>Cost Controls</u>

Gas utility companies are presently regulated and as such operate with a guaranteed rate of return. It is significant that coal <u>gasification</u> is being developed today, rather than coal liquefaction and methanol. The lack of price protection inhibits development of coal liquefaction today. Thus, special regulatory treatment of coal conversion should be considered. A guaranteed price is another possible technique. The government could offer to buy the product at a given minimum price and therefore set a floor to the market value of the product.

<u>Import Restrictions</u>

Imports should be limited both as to their sale price and in the amount allowed into the U. S. It is possible though perhaps not probable that some time in the future foreign oil, LNG or methanol prices could undercut domestic sources. This could, for example, ruin firms that would have invested billions of dollars in coal liquefaction only to be undersold by foreign oil. This possibility has been described as an important factor in hindering both coal liquefaction and oil shale development. Imports underselling domestic sources could be prevented by a variable import levy, set so the imported price of any energy source would always be higher than the corresponding domestic product. In addition, it makes sense to limit imports to some small fraction of our total energy supply to prevent "oil blackmail."

Leasing Policies

Streamlining of procedures for obtaining coal and water leases appears to be necessary. The present freeze on Western Coal leasing must be removed. Low-cost leases would greatly expedite coal production and concomitant production. It is suggested that the cost of the leases be factored into the production schedules of the bidder. This would maximize energy production from the leases. The British government, for example, leased their North Seas properties at low cost but with specified development schedules, in order to accelerate production from this area.

Allocation of Scarce Resources

It is anticipated that limited availability of manpower and steel may hinder development of the clean-fuels-from-coal industry. Allocation of these and other resources potentially in short supply can be considered. A policy of "highest use" of resources should be adopted; it makes little sense to expedite a coal conversion industry on a crash basis by allocating manpower and steel if such action, for example, cuts deeply into oil and gas drilling and oil refinery construction.

Cost Sharing and Price Controls

Present Phase Four price controls are slowing production of energy equipment and must be modified if a coal-based fuel industry is to be accelerated.

Cost sharing probably will not be required for commercial development but almost certainly will be required for the demonstration projects. Probably the simplest and best procedure is for government and industry to share in the capital investment for the projects. Operating costs would be borne by industry, but the government could buy the products at a given price to take some of the risks out of this area. One of the solutions mentioned is for joint government-industrial corporations. Government cost sharing might include donation of coal, water leases, or land, instead of outright funding.

Legislation and Policy

The streamlining of legislative approval for energy projects appears to have a high priority. In this connection, the time period for permission to construct coal gasification plants could be shortened from the present two years to a year or less. Definition of responsibilities, due process for approvals of energy projects and agency responsibilities and procedures for writing of environmental impact statements are required.

It should be emphasized that there appears to be no reason that strict environmental controls cannot be maintained in a coal-based fuels industry. The impact of population, societal and aesthetic issues can also be controlled. See Section VIII for analysis of environmental impact. Some judgement should be exercised, especially in new projects, where some experimental impacts are difficult to estimate. The prototype or demonstration unit may be required to actually determine the eventual environmental impact.

A rational and final settlement of strip mining and land reclamation law is now being widely urged. The present uncertain situation makes planning quite difficult.

Patents and Proprietary Information

Introduction. The Government's role in the rapid construction of demonstration and production facilities includes pulling together necessary manpower and material resources, bearing some of the cost of the demonstration plant, and possibly also funding of subsidiary R and D to fill gaps in the available technology. Within this larger task, patent and proprietary data problems may arise because the resources for the project include a substantial body of privately-owned technology whose inclusion and compensation requires special consideration. There appears to be no fundamental reason why a cooperative relationship between Government and industry should not materialize. It is clear that, as a result of Government's commitments, this technology can be hastened to bear early fruit, to the substantial benefit of its owners. It is also clear that the present availability of relevant private technology promises an earlier solution of the problem, to the substantial benefit of the nation.

Problem Areas. There are, however, possible dangers which come to mind. One of these is that visions of eventual industry profits motivate the Government negotiators to drive a hard bargain. Indeed, industry suspicion and fear of a tough Government position on rights and control may be the first barrier to getting talks started in a cooperative spirit. Factors which may influence industry's thinking are: prior experiences in tough background rights negotiations, increasing general acceptance of the concept of compulsory licensing, and recent voices urging commercialization of energy production by the Government itself. The pre-negotiation environment could be significantly improved if the Administration clarified its position on these issues.

It is worthwhile to list possible disasters. (1) First among these, and most painful in the short run, would be the inability to obtain participation of important private contributors. (2) To a lesser extent, penalties would be incurred by delays in reaching agreement on participation, which would, in turn, delay the demonstration and production program. (3) It may also be possible to conclude contracts on terms excessively favorable to government and to the public. This may still be disadvantageous in the long run if rewards to the owners of private technology are inadequate because private effort and foresight are not encouraged. Failure to provide appropriate rewards could also seriously impair our ability to import foreign technology in the future. Since Western Europe is harder hit by the energy crisis, its efforts toward a solution of this problem are likely to be substantial, and the future results of this effort may be of benefit to us also. (4) On the other hand, it would obviously not be acceptable to the Government and the public if the technology which was brought to the point of practical application largely as a result of the heavy Government contribution would not be available to willing and able industrial users and competitors in the commercialization phase.

Conclusions and Recommendations. From the patent and proprietary data viewpoint, commercialization and demonstration phases are difficult to separate. But it is obvious that the proprietary technology questions should be resolved in the course of the demonstration phase preparations. Our recommendation for a basic government position is as follows:

1. The participants would retain ownership of their previously-developed technology, as well as independent control over their proprietary technology, except for a commitment to grant non-exclusive licenses at reasonable royalties to all potential users of the technology. This commitment would be imposed as a condition to participation.

2. Background rights to be granted to the Government should be appropriately limited to exclude the possibility of Governmental royalty-free sublicensing for commercial use.

3. Cooperative R and D contracts would be subject to AEC Type C patent clauses, with similar limitations on Government rights as in Item 2 above.

The basic position for this project, then, should be that it is a fair exchange if, for its contribution of public funds, the Government obtains an industry contribution of effort which will speed comercial production of fuels by these methods, plus the assurance that commercialization can ultimately take place in a non-monopolistic, competitive, free enterprise environment largely free of government involvement. It is believed that present regulations provide sufficient authority to assume the recommended position in view of the cooperative nature of the proposed projects; i.e., projects in which participants contribute funds as well as resources. It is thus very important that the Government leaders of the project remain closely involved in the patent aspects of the negotiation in order to ensure that a goal-oriented approach not be impeded by conservative patent interpretations of relevant laws and regulations.

Government Incentives and Polices: Conclusion and Recommendations

1. We recommend a jointly-funded government-industrial program of demonstrations of clean fuels from coal at one or more coal resource centers. We recommend that one company be designated project manager for each demonstration project. The company would have overall responsibility for the demonstrations, would co-fund the demonstrations, and would operate the process and market the projects. It is further recommended that each demonstration project maintain its own analytical, maintenance and repair facilities.

2. We recommend immediate design and construction of one or more processes to make methanol from coal synthesis gas.

3. We recommend design and construction of one or more coal gasification processes when definitive results from modern U. S. pilot plants are available, or if feasible, a pressurized Koppers-Totzek or slagging Lurgi process.

4. Further, it is recommended that design of modern coal liquefaction processes be begun as part of the demonstration program. Then, when pilot plant data are available, construction of the demonstration processes can start immediately. It is believed that this procedure can cut from one to two years off development of coal liquefaction.

5. We recommend that companies participating in the joint demonstration program be entitled to a percentage of patent rights and royalties commensurate to their percentage contribution to the project.

6. Recommend government incentives and policies that may be required to stimulate the coal conversion industry include:

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

b. Guaranteeded or low-cost government loans

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

d. Accelerated leasing of Federal energy and water sources with both grants, costs and royalties tied to production schedules, along with streamlining and better definition of responsibilities for approvals of plans and the writing of environmental impact statements.

e. We do <u>not</u> recommend dropping of government environmental standards. We believe that the new clean-fuels-from-coal industry can maintain high environmental standards while producing significant quantities of clean energy for the U. S. economy.

III. TRANSPORTATION, MARKETING AND END USES

Transportation

When coal-based fuels become commercial, it will be necessary to minimize the costs of transporting them to market. Transportation costs are summarized in the table below. The costs are approximate because, for example, pipeline transportation costs depend on terrain traversed and pipeline diameter. The cost of transporting oil by 24" pipeline is about half that by 10" pipeline.

Energy Transportation Costs

Form	Mode	Cost (cents per million BTU per 100 miles)
Coal	Shuttle Train	2.5
Gas	Pipeline	1.7
Oil	Pipeline	0.9
Oil	Barge	0.6

The conclusion from Table 1 is that it is most economical to convert the coal to liquid or gaseous products as close to the mine as possible, and to ship the converted products. This is even more true because conversion processes are 60-80% efficient, and thus require transport of more coal energy than product energy.

Marketing and End Uses

1. Synthetic Crude Oil

No problems are anticipated in introducing synthetic crude oil, or products refined from it, into the marketing and distribution system of the United States.

It has been suggested that a heavy investment in syncrude facilities might be rendered obsolete by a sharp decrease in imported crude prices to the U. S. This is highly unlikely, since neither Western Europe or Japan have a capability for synthetic fuels and will compete with us for world oil.

2. Synthetic Natural Gas

The issues in marketing and use of synthetic natural gas are institutional: The Federal Power Commission must decide how to treat this product. Until they do, industrial time scales for coal gasification are unclear.

IV. IMPACT ON ENVIRONMENT

General

As previously noted, a typical commercial coal-conversion installat has been assumed to have a capacity of about 25,000 - 30,000 tons of coal per day, and will produce some 0.1%-0.3% of the nation's oil/gas requirements, i.e., fuel which can supply from about 2×10^{11} to 5 x 1(BTU per day. The environmental impacts of various plant and construction factors will be discussed under a number of specific headings such as construction, emissions, noise, etc. All impacts will be discussed on a per plant basis.

Impact of Construction

The construction of a typical plant will require about two one-half to three years. During the period of peak activity, up to 3000 personnel may be involved in the construction. An annual payroll of as high as $30 million may be involved. Due to the size of a typic plant site (about 1000 acres), there will be unavoidable damage to the local terrain and biota. All plant construction plans will have to include provisions for minimizing and mitigating the effects of both local and off-site construction-related damages.

The construction phase will require either that workers and their families will be attracted to the area, or that established work patte in the region will be altered. The estimated $30 million annual payrc during the construction period will represent a temporary economic ber fit to the area of the plant, but the termination of the construction phase could result in later economic disruption in surrounding communi

Water requirements during the construction phase should be on the order of 100,000 gallons per day for drinking, sanitation, and concrete batch plant purposes. Electrical power requirements will probably be about 5,000 kw. Air quality will be affected by particulates generated by construction activities. Water treatment will be used to upgrade the quality of waste water from the project construction, and construction practices will be modified so as to minimize dust generation. Construction impacts will probably be roughly proportional to plant size.

Resource Use

As previously noted, a typical plant will require 25,000 - 40,000 tons of coal per day. Also, each plant will use some 6,000-11,000 gallons of water per minute (10,000-18,000 acre-feet per year), of which essentially none will be returned to the water resources of the area. Power demands of each plant will be in the range of about 28 MW. Each proposed plant site will have to be studied to determine the effects of these new resource uses on the environment. Resource use will vary almost directly with plant capacity.

Atmospheric Emissions from Plant Operation

Irrespective of the coal treatment process used, potential atmospheric pollutants include sulfur compounds (such as H_2S and SO_2) and nitrogen compounds (such as nitrogen oxides and ammonia). Appropriate treatment processes can be utilized to reduce concentrations of these substances in effluent streams to levels consistent with local and national air quality standards.

In order to reduce amounts of H_2S released, the Claus process could be used to produce salable amounts of elemental sulfur. The SO_2 contained in the tail gas from this process could be controlled by scrubbing the gas through wet limestone. The release of ammonia can be minimized by condensation of the ammonia prior to recovery and sale of the resultant liquid gas. Nitrogen oxide emissions are only significant if ammonia is disposed of by combustion. If ammonia is recovered by liquefaction, the levels of NO_x in emissions are low and are easily controllable.

Additional atmospheric emissions will include principally water vapor (as much as 1 to 2 million pounds per hour, depending on the process used), and carbon dioxide (some 2 to 3 million pounds per hour). The processes under consideration should produce essentially no particulates, provided appropriate apparatus is employed. Atmospheric emissions will not necessarily scale with plant size, but will depend on equipment design and operational procedures.

<u>Noise</u>

Noise associated with plant processes can be maintained below the levels required by the <u>1971 Occupational Safety and Health Act</u> by means of appropriate equipment design and operational procedures.

<u>Solid Wastes</u>

Solid wastes created by plant operation will include ash, sludge, and possibly some spent catalyst. Of these, the ash represents by far the major constituent. Ash can represent on the order of one-fifth of the processed coal, with the result that 5,000-6,000 tons of ash per day can be produced by the typical plant.

Disposal of this material will probably be by burial in the strip mine associated with each plant. During the mine reclamation operations, the ash will be covered by a layer of earth. The ash itself will be hard and cinderlike, with the general appearance of fine gravel. The trace elements contained in the ash are generally insoluble, and no ground water contamination problems are anticipated.

The relatively small amounts of sludge and spent catalyst generated in the course of plant operations can be disposed of along with the ash. The amount of solid waste to be disposed of will vary with the plant size and capacity.

Aqueous Effluents

Some waste water may contain objectionable materials, such as phenols and ammonia. This liquid waste will have to be subjected to purification before it can be released to the environment; total volumes which could need such treatment are as yet undetermined. Other effluents which will be produced by plant operation will include those which can be treated to make them suitable for recycling as makeup, as well as those which may have to be disposed of in evaporation ponds. In any case, no effluents will be released off-site which do not meet local and national water quality standards; hence, there will be no adverse effects to ground water aquifers or local biota. Total effluent volume should be about proportional to plant size.

Impact of Water Supply System

Other competing uses for plant water requirements will have to be considered and the impact of water diversion from these uses will have to be quantified. The environmental impacts of any needed dams, canals, or pipelines will have to be studied, as will the effects of required reservoir and water treatment plant construction.

Finally, the effect of this water diversion on the source of water supply will have to be studied; for instance, use of a fraction of the total flow in a particular watershed could have significant impact on downstream water quality. This impact on water quality will be approximately proportional to plant size.

Aesthetic Factors

The most significant adverse aesthetic impacts of a typical plant will be (1) land clearing for construction and rights-of-way, (2) the construction itself, and (3) possibly contrasting scenic values (depending on the plant environs). The latter consideration will be especially significant in the case of large cooling towers, stacks, and process towers. These impacts will be relatively independent of plant size.

Socio-Economic Impacts

The economic impact of plant operation will be immediate and significant. Each plant will have about 500-1000 full-time employees, with an annual payroll of some $6 million to $13 million. This employment will indirectly support 2500-5000 persons, who will have to be absorbed into existing communities in the region surrounding the plant, or who will have to be housed in specially built communities. Service-type businesses will have to be developed or expanded to serve this incremental population; an appreciable impact on local schools and utilities may also be expected.

Development (or improvement) of a network of roads converging on the plant area will be inevitable.

Local, state, and national tax revenues from each plant will probably be in the range of $10 - $20 million annually.

Socio-economic impacts should be proportional to plant size.

Product Transportation Impacts

Irrespective of plant type, it is likely that the product will be transported to user areas by means of pipeline. The impacts of pipeline construction must be evaluated, and a route chosen which will minimize these impacts without unduly increasing construction costs. Environmental effects of pipeline construction are essentially independent of plant size.

In some cases, it is possible that rail transportation of plant products will be required, thus necessitating either the construction of a new rail line (or spur), or an increase in traffic on existing lines. The impacts of these needs will have to be evaluated, and facilities will be designed to minimize undesirable effects. Again, environmental effects of rail transportation requirements will be essentially independent of plant size.

V. SUPPORTING ENERGY RESEARCH AND DEVELOPMENT PROGRAMS

During design, construction and operation of the demonstration plants and the commercial process plants on-going energy R and D programs should be expanded, particularly in the pilot plant stage. Pilot plant failures are due to a number of causes, but often are not due to the inherent nature of the processes being tested. Failure of standard items, such as flanges, seals, valves, piping, compressors, pumps and heat exchangers under severe environmental conditions are often the cause of pilot plant downtime. Since many of the demonstration processes will operate under similar environmental conditions to that of proposed new processes, successful operation of the demonstration plants will prove out such standard equipment for pilot plant usage or well. Pilot plant test runs should be longer and afford a more objective evaluation of the processes.

In addition, the demonstration processes will offer proven and different perspectives on unit operations such as heat exchange, multiphase flow, purification, solids handling, catalysis, recycle, environmental controls and others. Should the new processes contain a deficiency in one or more areas but offer significant improvements in others, proven unit operations will be available to incorporate into the new process.

Basic operating data, such as reaction rates and products, fluid mechanics in complex systems, turbulent mixing, and materials strength and compatibility, will be an important product of the demonstration units, probably more important than the energy they produce.