The original documents are located in Box 24, folder "Synthetic Fuels (2)" of the Loen and Leppert Files at the Gerald R. Ford Presidential Library.

MARCH 1976

PROPOSED SYNTHETIC FUELS COMMERCIAL DEMONSTRATION PROGRAM

FACT BOOK

UNITED STATES
ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION
WASHINGTON, D.C. 20545

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Synthetic Fuels Commercial Demonstration Program

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Introduction

The United States dependence on foreign sources of oil and gas continues to grow. Domestic production of oil and natural gas has been declining since the early 1970's. Even with the development of Alaskan and Outer Continental Shelf oil and gas, improved energy conservation, expansion of nuclear power capacity, and greater direct burning of coal can buy time, our dependence on foreign sources of oil and gas will continue to grow after 1990 if synthetic fuels are not produced in substantial quantities.

The Administration has proposed and is taking where possible a number of actions to deal with the near-term problem of our growing dependence on foreign supplies of oil and gas. These include:

- proposed development of the Naval Petroleum Reserves;
- phased decontrol of domestic oil and proposed price deregulation of interstate gas;
- conversion of selected oil and gas burning power generating stations to coal;
- incentives for conservation through home insulation, auto fuel economy standards, car pooling, energy efficienct appliances, etc.;
- proposed Energy Independence Authority to encourage greater domestic production of supplies; and
- the development of a strategic oil storage system and emergency preparedness measures to deal with potential embargoes.

Successful implementation of these initiatives will, in the short term, help minimize our growing dependence on foreign oil and gas. However, this dependence will continue to grow particularly after 1990. For this important reason, the President continues to propose that we now undertake the first important step toward the development of a synthetic fuels industry--a Federally sponsored Synthetic Fuels Commercial Demonstration Program.

The Proposed Program

The proposed program would encourage the private sector to construct and operate "first-of-a-kind" commercial-scale synthetic fuel plants. These initial plants include:

- shale conversion to synthetic petroleum;
- coal conversion to gas and clean boiler fuels;
- waste conversion to gas, oil and other fuels.

The major objectives of the Synthetic Fuels Commercial Demonstration Program are:

- to gain early information and to initiate development of industry infrastructure by:
  - investigating financing, environemntal, economic, institutional, technical, and other potential problems; and
  - promoting a limited amount of private sector synthetic fuels experience.
- to supplement existing and planned domestic energy production by:
  - reducing reliance on imports; and
  - providing less expensive energy if world oil prices rise.
- to improve U.S. international position in energy matters by:
  - demonstrating U.S. capability to tap its vast resources (see Exhibit A); and
  - establishing U.S. leadership among consuming nations in energy development.

The President is requesting early Congressional enactment of the Program and is requesting supplemental FY 1976 funding for Federal loan guarantees to initiate the first phase of a synthetic fuels commercial demonstration program designed to achieve about 350,000 barrels/day of oil equivalent production by the early 1980's.

This is the first phase of a possible two-phase program which could ultimately encourage up to 1 million barrels equivalent daily production of synthetic fuels in the 1985 time frame. The President has designated ERDA to administer the first phase, 350,000 bbl/day program since it is a commercial demonstration program. When it is enacted, the President's proposed Energy Independence Authority would assume the financing responsibilities for the synthetic fuels program and similar energy programs involving Federal financial incentives.

The remainder of this fact book provides information on the size and content of the proposed program, its scope and method of implementation as well as a discussion of the potential environmental, socio-economic and other impacts of the program, and the measures recommended to limit their impacts.

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Need for Early Commercial Demonstration

A program should be initiated now to encourage the construction and operation of a limited number of first-of-a-kind synthetic fuel commercial demonstration plants. This program is necessary because of the large projected demand for synthetic fuels in the 1990's, the lead time (10-15 years minimum) required to build a new industry, and the present financial and other risks associated with investments in first-of-a-kind commercial-scale synthetic fuel plants. Each of these three points is discussed separately.

- Domestic supplies of oil and gas are projected to decline beginning in the late 1980's. Production of domestic oil and natural gas has already fallen in the last several years and even with deregulation and decontrol, domestic oil and gas supplies would only be sufficient to limit further growth in imports for another 5-10 years. Even using advanced oil and gas recovery techniques and extensive production from the Outer Continental Shelf and Alaska, imports would continue to rise substantially if synthetic fuels were not available in substantial quantities by 1990's.

- The projection that synthetic fuels will be needed in substantial quantities in the 1990's is based on realistic estimates of domestic production of oil and gas and also assumes substantial growth in nuclear power as well as optimistic projections of the contributions from energy conservation and from alternative supply sources such as solar and geothermal. If any of these domestic energy supplies fails to provide its expected contribution, then the need for synthetic fuels could be more than the currently estimated demand for 1995 (5 million barrels per day).

- Initiating a synthetic fuels industry to be financed in the private sector and capable of providing about 5 million equivalent barrels/day of production capacity (i.e., about 100 major plants) by 1995 will require an early "commercial demonstration program" to resolve a number of uncertainties related to regulation, environment, financing, labor, economics, and transportation. These uncertainties must be resolved by the middle 1980's in order to enable adequate plant investment in the late 1980's. Thus, the lead times involved require the construction and operation over the next 5 to 10 years of a representative mix of synthetic fuels plants to obtain all the necessary data and information needed prior to a major industry expansion.

- There are at the present time a number of serious impediments to private sector commercialization of synthetic fuels. The uncertainty in the future prices of world oil is an important factor discouraging

private investment. If world oil prices were to fall substantially, forcing synthetic fuel prices down with them, large plant investments could not be paid off from revenues of low price, but initially high cost, synthetic fuels. In addition to the large plant capital risks, there are numerous environmental uncertainties, regulations that must be met, and uncertainties concerning the adequacy of available labor and materials. Federal Government involvement is needed to reduce the risks posed by these uncertainties.

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Need for Federal Assistance

Although there are many commercial-scale synthetic fuel plants in various stages of planning and design, none has yet proceeded to construction or has even obtained firm financing. The general reason for this is that there are, at the present time, large financial risks associated with constructing these "first-of-a-kind" commercial demonstration plants even though in some cases the fuels produced from these plants are expected to be competitive (e.g., shale oil) or are in great need (e.g., synthetic gas).

Specifically, the major reasons why industry has not, and is not likely in the next few years to make large synthetic fuel plant investments are:

- The present uncertainties about the future costs of synthetic fuels. Although in almost all cases, the technologies that would be included in this program are well known and have either been domestically demonstrated at the pilot plant scale or at larger scale outside the U.S., there are still uncertainties about the product costs due to inflation, timely availability of labor, equipment and raw materials and potential scale-up problems that may arise in constructing a "first-of-a-kind" plant.

- Uncertainty in the future competitive price of world oil. The product of a large synthetic fuel plant, such as an oil shale plant, must compete in a managed market against world oil. If the investor in a $1 billion plant does not have good assurance that the product of his plant can be sold at a price which will allow amortization of his debt plus a reasonable return on investment, then no investment will be made. If the OPEC producers drop the world oil price, even if temporarily, this could cause a default on plant debt. Thus, even though shale oil may be priced at 13-14/bbl. which is competitive with today's world oil price, there is no assurance to the investor that it will be competitive over the next 5-10 years. As world oil supplies decrease in the late 1980's to the point where world oil price will be governed by supply/demand relationship and not by cartel pricing policies, it is expected that synthetic fuels will become increasingly competitive.

- Large capital risks relative to company assets. The net worth of many of the companies which might sponsor synthetic fuels plants are not large compared to the investments required for the plants. This is especially the case for gas pipeline

companies, the largest of which has a net worth of less than $1 billion which is less than required capital investment for a $1 billion synthetic gas plant. Even for large companies such an investment is significant and would be made only if there were reasonable assurance of a favorable return on investment. For the largest companies, raising the required capital for a project which is sound is not a problem, the problem with synthetic fuels ventures is they are relatively more risky than other potential energy and non-energy investments.

- Risk of major project delays. Another reason industry is reluctant to make large synthetic fuel plant investments is the risk of major project delays during construction or start-up due to environmental, regulatory or other reasons. Since no synthetic fuel project has been completely through the regulatory processes, there is uncertainty about the nature and extent of potential delays.

In summary, without Federal financial incentives, it is unlikely that significant quantities of synthetic fuels will be produced by 1985. Without such production, many uncertainties associated with the viability of synthetics cannot be resolved, thus permitting large scale private investment for production capacity by the middle 1990's.

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Information Gained from the Synthetic Fuels Program

Since the early 1950's, U.S. efforts related to synthetic fuels development concentrated on pre-commercial R&D efforts concerned primarily with coal conversion and surface retorting of shale. Over the past five years a number of refinements to these technologies have taken place. These evolutionary developments, however, still remain untested at commercial scale in the U.S. Because of the significant capital costs involved, the regulatory uncertainties and the unknowns concerning OPEC cartel pricing policies, investors are reluctant to assume the large risk associated with first-of-a-kind commercial-scale synthetic fuel plants. The proposed Synthetic Fuel Commercial Demonstration Program is designed to reduce the risk to investors in the initial plants while at the same time providing valuable information on the environmental, economic, institutional and other factors which will influence the initiation of a synthetic fuels industry. This information is vital in formulating U.S. energy policy since a determination should be made in the next 5 to 10 years as to whether synthetic fuels can, in fact, offer a significant alternative to foreign sources of oil and gas beginning in the later 1980's.

If, as projected, a U.S. synthetic fuels industry capable of providing about 5 million equivalent barrels/day of production capacity (i.e., about 100 major plants) will be needed by 1995, the proposed commercial demonstration program is required in the immediate future. This is due to the need to resolve the economic, environmental, regulatory and other uncertainties by the middle 1980's in order that adequate plant captial investment can be made in the later 1980's to achieve significant synthetic fuel produciton levels prior to the turn of the century. Thus, the lead times involved require the construction and operation within the next 10 years of a representative mix of commercial-scale synthetic fuel plants to obtain the necessary data and information related to commercial viability.

The first phase of the program would involve the construction and operation of about 12-17 commercial demonstration plants using different energy resources (e.g., coal, oil shale, municipal wastes) and technologies that would result in a total synthetic fuel production capacity of an equivalent of about 350,000 barrels/day of oil. Specifically, the information to be gained and deemed to be necessary to facilitate the commercial introduction of either first or second generation synthetic fuels technologies includes:

1. Engineering Plant Operations Data

The main differences expected in terms of information obtained from commercial-scale operations as opposed to demonstration/pilot program levels include:

- Continuous plant operations

  Commercial-scale plants involve continuous plant operation which provide information on integrated component durability and lifetimes; whereas, pilot and demonstration operations are characterized by many short runs that test the technology. Also, continuous commercial-scale operations will verify product quality and uniformity which is particularily significant for liquid products such as oil from shale.

- System reliability/operability

  A commercial-scale plant is typically operated by crews largely composed of skilled or semi-skilled workers -- not engineers. A pilot or demonstration plant is usually more extensively instrumented to obtain technical and engineering data and is operated by a crew that has an unusually large percentage of technical and professional skills. The reliability of a commercial plant as an ongoing system can be more confidently estimated from data gained during typical commercial plant operations than from the atypical testing procedures and personnel used in pilot and demonstration plant operation.

- Occupational health and safety data

  Normal operating procedures of a commercial-scale plant will give realistic information that could not be gained from small-scale pilot or demonstration operations.

2. Environmental and Socio-Economic Information

A pilot or demonstration plant allows for estimating pollutants emitted from larger size plants. Yet, it is only through the construction of commercial size facilities that reliable information can be obtained about the combination of environmental impacts. Such facilities would demonstrate the combined impacts of the plant itself, large population migrations (with attendant demands on air, water, and community services), as well as providing the opportunity to formulate effective measures for controlling these impacts to acceptable levels.

- Air Quality

  Commercial scale plants are required to design and test effective control measures to minimize air pollution and meet applicable air quality control standards. Furthermore, commercial-scale plants will be needed to provide a sound basis for determining new source performance standards.

- Water Quality

  It is currently expected that synthetic fuels plants will contain total water reuse systems and will have zero discharge to surface or ground waters. A full scale commercial facility is necessary to see if, in fact, this system can be implemented. Additionally, for oil shale operations there are many uncertainties concerning the impacts on water quality of mining and reclamation. The small scale tests that have already been carried out have not resolved these uncertainties because the size of the effected region is too small to model a large-scale operation realistically.

- Land Disturbance

  Huge spoil piles that result from coal surface mining operations can be regraded to approximate the original contour and vegetative cover can be reestablished. The revegetation steps, however, are presently at an experimental stage. Commercial scale synthetic fuel facilities requiring coal and oil shale mining operations will provide opportunities for extensive, realistic field experiments to confirm the results of research already being sponsored on a small scale by the U.S. Environmental Protection Agency and the U.S. Department of Agriculture.

- State and Local Socio-Economic Impact

  A commercial size coal gasification or oil shale plant might require a total worker and family population of about 20,000 during the construction period and about 10,000 during normal operations. Should this population have to move into a remote area, additional investments in community facilities for increased water supply, sewage and solid waste treatment, fire service, recreation, police and health services, etc. would be required. Since the Synthetic Fuels Commercial Demonstration Program would contain community planning and impact assistance provisions, valuable experience would be gained in effectively dealing with these impacts in the future at a minimum risk to the affected community.

3. Plant and Mining Facility Economic Data

Small scale pilot or demonstration projects are designed mainly to answer questions associated with the "workability" of the technology. In general, economic data related to final product costs are of lesser importance in such sub-commercial scale operations. Large scale (commercial) projects, on the other hand provide a basis for obtaining a range of economic information:

- Capital Investment Costs

  The construction of a commercial scale plant and its associated ancillary facilities (i.e., mine, product distribution system, etc.) will provide reliable information on capital costs thus enabling preliminary rate-of-return estimates based on smaller scale projects to be validated or improved.

- Operating and Maintenance Costs

  Operating commercial scale plants on a continuous basis as opposed to a pilot/demonstration plant which typically operate intermittently, allows ongoing operating and maintenance schedules to be examined in order to establish the most efficient (least cost/technological and environmentally sound) procedures. Potential cost reductions in operations will have a significant impact on the eventual competitiveness of synthetic fuels.

- Economies of Scale

  In general, large industrial plants experience decreasing costs per unit of output as plant size increases. These economies are usually related in a non-linear fashion to the level of production. The magnitude and range of output over which these economies of scale pertain to synthetic fuels plants can only be accurately determined by commercial-scale operations.

- Comparative Economies of Competing Technologies

  Significant differences in final product prices among competing technologies (e.g., Tosco, Union or Paraho oil shale retorting technologies) can be established only as the price relationships are verified in scaling up to commercial plant sizes.

- Overall Economics of Venture

  In addition to information on the direct cost of construction and plant operation, other cost information essential to product pricing can be obtained from commercial-scale operations, e.g., transportation costs, reclamation costs, marketability of by-products, impact of regulation etc., can be examined. Information on these costs cannot adequately be obtained from small-scale pilot or demonstration projects since the plants are not designed to examine the economic viability of an integrated industrial complex.

- Advanced Mining and Feed Systems

  Related to economies of scale is the adoption or development of more sophisticated, higher output mining and feed systems most especially in the area of oil shale mining. Gaining operational information on advanced mining operations on a commercial scale for synthetic fuel plants will make future adaption periods much smoother, reducing costs and the time to attain efficient plant capacity utilization.

4. Project Financing Information

   - Investment Uncertainty

     Commercial demonstration projects will provide much of the information necessary to remove or mitigate uncertainties that presently inhibit investment in synthetic fuels plants. Removal of these uncertainties will most likely result in establishing the commercial viability of the processes involved. This will resolve financial community (equity investors and lenders) uncertainties and will permit the private sector in the mid 1980's to analyze more accurately investment risks and to make better investment decisions regarding synthetic fuels. Without realistic commercial scale operations, it is doubtful the financial community would be convinced that synthetic fuels technologies represent reasonable investment opportunities.

   - Private Sector Financing Experience

     Unlike pilot and demonstration plants which are financed as R&D investments either entirely with Federal funds or through a combination of Federal and participating company funds, the plants to be constructed under the ERDA commercial demonstration program would be financed in the private sector although partially guaranteed by the Federal government. The essential difference, however, is that valuable experience in financing these new projects will be gained both by the lenders involved and by the project sponsors.

5. Product Distribution and Marketing Information

   - Product Substitution

     Commercial demonstration projects should be designed, in part, to assist in the establishment of the acceptability of the projects, including determintion of their competitive posture in the marketplace, and to expose any anomalous marketing characteristics. This information will arise

from the requirement that the large commercial quantities being produced by the plants will have to be marketed and sold in markets where they must compete with their naturally derived counterparts and other proposed substitutes. This is typically not the case for smaller quantities of products produced through pilot and demonstration plants.

6. Regulatory Information

- Federal and State Requirements

  One of the major information benefits of the synthetic fuels commercial demonstration program will be derived from having synthetic fuels projects complete the applicable Federal and state regulatory processes. Although many regulatory requirements apply to smaller demonstration plants, such realistic regulatory issues as Indian lands and resources, rate proceedings before the Federal Power Commission and state regulatory authorities will only be examined with commercial-scale plants. Finally, substantial questions regarding the implications of state regulations will require early resolution before commercial investments will be made.

7. Water Requirements Data

- Water requirements for coal and oil shale mining operations are almost exclusively for dust control and land reclamation. Many synthetic fuel plants will also require substantial quantities of water as a feed stock or raw material. While supplying large quantities of water may not present serious problems in the East, water is scarce in many parts of the West. Commercial operations in the West will, in many instances, require deep well drilling to obtain the necessary water from acquifers, whereas from small scale pilot or demonstration plants enough water can be obtained from surface sources. The effect of such water withdrawals on aquifer recharge rate presently is unknown.

8. Information Concerning Public Acceptance

- An important category of information for potential future investors in synthetic fuels plants is whether such plants will be publicly acceptable. Experience in the electric power area has demonstrated that this issue is an important determinant in utility decision making. By constructing and operating a variety of commercial-scale plants, significantly better information will be obtained concerning the likely outcome of the public acceptance issue as it applies to the various synthetic fuel categories.

9. Manpower & Equipment Needs

- Pilot or small scale demonstration projects operate at levels for which unique equipment or non-professional skilled manpower requirements are minimal. On the other hand, a commercial demonstration project generally requires a wider range of equipment and a large number of non-technical and engineering manpower skills. For example, to produce 50,000 bbls/day, a shale oil complex will mine some 65 to 70 thousant tons of shale per day utilizing current technology. This is more than three times the output of present day large scale coal mines. The scaling-up of the equipment, general operational reliabilities, and magnitude of the operation required to extract, transport, and process this amount of shale can only be verified by actually developing a commercial-size operation. Similarily, the technical skills to operate a large, integrated and first-of-a-kind industrial complex can only be developed gradually and under commercial scale conditions.

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Description of Proposed Program

The President has proposed a goal of assuring the production of up to 1 million barrels/day oil equivalent of synthetic fuels by 1985. This goal has led to the development of a contingent two-phased program.

The first phase of the program is designed to demonstrate the technical, economic and environmental feasibility of commercial-scale plants using available technologies. This phase involves the construction and operation of about 12-17 commercial-size plants using different energy resources and technologies and resulting in a total capacity of about 350,000 oil equivalent barrels/day. The President recommended proceeding with this phase and is requesting the Congress to permit its implementation.

Decision to proceed to a second phase of the program is not anticipated until the 1979/1980 time frame and will depend on:

- more information on environmental and other impacts;
- results of ERDA's second generation technology R&D efforts in terms of modifications permitting lower cost production.
- better information on the world energy situation; and
- industry response to Phase I.

The first phase of the synthetic fuels program includes:

- providing on a competitive basis, limited financial incentives to the private sector for commercial demonstration plants to overcome existing financial uncertainty;
- expediting, through administrative action, the necessary Federal regulatory permits and clearances;
- providing financial guarantees or assistance to localities for needed socio-economic infrastructure planning and development;
- ensuring rigorous environmental protection through an environmental protection strategy; and
- assuring that the technology utilized in the initial commercial demonstration plants will be made available to all interested firms at a reasonable cost.

The commercial demonstration program would include a mix of plants and technologies designed to provide maximum information on the operation of synthetic fuel plants. A possible plant technology/resource mix and production capacity for the program is:

Type of Plant	Possible Number	Est. Production Capacity-Each Plant (bbl/day oil equivalent)	Affected Industry
• High BTU Coal	3	up to 40,000	Pipeline gas
• Oil shale Conversion	2-3	up to 50,000	Petroleum
• Substitute Fuels Utility/Industrial	4-6	up to 25,000	Utilities/ Industrial Users
• Biomass Conversion (Gas/Liquid)	3-5	up to 6,000	Various
Totals	12-17	up to 350,000	

The actual plant sizes and number of plants may vary somewhat depending on the proposals received from interested firms and the estimated environmental impacts.

Recommended Financial Incentives

The proposed approach is to encourage the construction and operation of these plants by providing limited financial incentives to the private sector. The government would also administratively assist firms in securing Federal regulatory permits and clearances required for synthetic fuel plants.

The form of financial assistance to be provided under the program varies by the type of plant and whether the affected industry is regulated or nonregulated. The basic proposed forms of financial assistance to be offered are loan guarantees, price guarantees and construction grants. For each type of synthetic fuel plant, a specific type of incentive(s) will be provided to at least partially remove the financial and market risks associated with plant construction and operation. The proposed approach is to share the underlying risks between the developer, the government, and the consumer. The risk sharing approach is designed to minimize, to any single party, the catastrophic financial effects entailed in failure of a plant which may cost in excess of a billion dollars. A competitive award process is planned. The evaluation of offers to build a synthetic fuels commercial demonstration project will include consideration of the amount of Federal assistance required by the offerer.

The following table summarizes the incentives identified as appropriate for each plant type:

Plant Technology	Affected Industry Regulated/Nonreg.	Construction Incentive	Operating Incentive
• High Btu Gasification (pipeline gas)	Regulated	Non-Recourse loan guaranty of up to 75% of estimated project cost	Not necessary if regulatory ruling permits cost of service recovery
• Oil Shale and Unregulated Utility/ Industrial Fuels Conversion	Nonregulated	Non-Recourse loan guaranty of up to 50% of estimated project cost	Price guaranty
• Utility/Industry Substitute Fuels	Regulated	Construction grant of up to 50% of estimated project cost	Not necessary if regulatory ruling permits cost of service recovery
• Biomass Conversion	Nonregulated	Non-Recourse loan guaranty of up to 75% of estimated project cost	None

Each incentive combination is designed to provide enough Federal assistance to encourage plant development. Each combination also requires considerable financial commitment by a private firm.

E

Relationship of RD&D Program to Commercial Demonstration Program

ERDA has, as a major aspect of its non-nuclear energy activities, the development of alternative technologies to reduce America's dependency on diminishing domestic supplies of oil and gas. Such technologies would make use of coal and oil shale, as well as organic wastes, and would result in the conversion of these materials into clean synthetic fuels including gas and oil. The demand for synthetic fuels in the U.S. for the middle 1990's is projected to be about five million equivalent barrels/day of production capacity. If synthetic fuels are not available in such quantities by the 1990's, imports would continue to rise substantially.

Because of the long lead times required to design, construct, and bring into operation commercial-scale synthetic fuel plants, and because of the need to have a substantial production capability for synthetic fuels in place in the 1990's, there is a need to proceed in parallel with two kinds of activity. The first is ERDA's Fossil Energy research, development, and demonstration program which is associated with advanced or second-generation synthetic fuels technologies. These second-generation technologies are not as yet sufficiently mature to be the basis for commercial-scale plants, although it is eventually expected that they will be economically superior to present technology. The second kind of activity is commercial-scale demonstration of first-generation or available technologies in order to gain early information and experience for the industry and investment community related to the commercial viability of synthetic fuel ventures. (See TAB C for a more complete discussion of the information to be gained from this program).

These two kinds of activity are very different: the first emphasizes scientific and technical feasibility of components and processes, while the second emphasizes resolving economic, environmental, regulatory, social and other uncertainties which inhibit early commercialization.

From an operational standpoint, the programs differ in the following respects:

- ERDA's Fossil Energy RD&D program will be funded on a cost-shared basis with industry and will result in the construction and operation of single module demonstration plants using advanced technology components near commercial scale. The cost-sharing approach is used because of the greater technical risk associated with advanced technology demonstration plants and the need for the government to reduce the costs to industry of such projects.

- The proposed Synthetic Fuels Commercial Demonstration Program would be operated primarily with loan and price guaranties and, in general, would result in the construction and operation of commercial plants with several modules of commercial-scale equipment. The guarantee approach is recommended because of the lower technical risk, although there are still substantial financial risks associated with first-of-a-kind commercial-scale plants. (See TAB B for a more complete discussion of these risks and TAB F for a discussion of the recommended financial incentives).

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Rationale for Recommended Incentives

The recommended financial incentives were arrived at after consideration of the overall goal and objectives of the commercial demonstration program. Specifically, the goal of accelerating synthetic fuel production in the 1976-1985 time frame can only be met with incentives that address the financial economic and regulatory uncertainties that currently constrain investment in synthetic fuels by private industry.

The financial incentives considered included loans, loan guaranties, purchase agreements, price guaranties, construction grants, government ownership, and tax changes including investment tax credit, construction expensing and accelerated depreciation. The criteria used to compare the incentives were:

- expected cost to the government;
- effectiveness in assuring target production;
- breadth of industry participation and competitiveness;
- minimizing Federal management involvement;
- complexity in administering the incentives;
- flexibility in program size and scope; and
- existence of necessary statutory authorities.

In general, it was concluded that:

- The price guaranty is the least costly and most effective way to overcome the uncertainty of future price competitiveness.
- The loan guaranty is the least costly and most effective way to share the front-end capital risk.
- The construction grant was needed in the electric utility sector because of debt financing restrictions.

For each synthetic fuel category, a consistent methodology was used to assess the economic barriers to investment and the associated need for financial incentives, to develop alternative incentives, to evaluate these alternatives and to select the optimum incentive. The following constraints to private sector investment in synthetic fuels were determined:

- Synthetic Oil. Except for the very largest firms (i.e., major oil companies, etc.), capital availability is a substantial barrier. Risk to capital or an inadequate or uncertain return on investment is a major concern for all potential producers. Note that only unregulated firms were determined to be viable potential producers of these synthetic fuel types (e.g., shale oil).

- Synthetic Natural Gas. All producers would be subject to price regulation by the Federal Power Commission. Accordingly, the ability to pass production costs through to consumers mitigates the constraint of return on investment. However, capital availability and exposure are significant barriers to investment for all potential project sponsors, most of which are regulated gas pipeline companies.

- Utility Fuels. Potential producers of these synthetic fuels are also regulated, and the return on investment barrier, again, is mitigated somewhat by the ability to pass costs through to the consumers. Synthetic utility fuels may in many cases cost more than the fuels they displace and the required consumer electric rate increases present potential problems with regard to regulatory approval of such projects. Capital availability has in the past been also a significant problem for potential producers of this synthetic fuel type.

- Industrial Fuels. Capital availability and exposure are major barriers to all except the very largest of these producers. The risk of inadequate return or profitability is also a constraining factor for potential producers in this sector.

Thus, the major financial risks are of two types:

- Front-end or capital risk associated with a plant failure or with a long delay which results in loan default and loss of capital.

- Price uncertainty associated with uncertain future price of world oil.

The overall assessments and the recommended incentives are shown by size of firm and by fuel type in the following table.

INDUSTRY CONCERNS AND INCENTIVE RECOMMENDED

Synfuel Category	Financial Needs: Capital Availability	Financial Needs: Capital Exposure	Financial Needs: Return on Investment	Recommended Incentive Competitively Awarded
Synthetic Oil	Not Regulated			Non-Recourse loan guaranty of up to 50% of estimated project cost.
• Major Firm	-	-	x	
• Middle Size Firm	x	x	x	
• Independent Venture	x	x	x	
• Small Firm	x	x	x	
Synthetic Natural Gas-Regulated Biomass-Not Regulated				Non-Recourse loan guaranty of up to 75% of estimated project cost.
• Major Firm	x	x	-	
• Middle Size Firm	x	x	-	
• Independent Venture	x	x	-	
• Small Firm	x	x	-	
Utility Fuels	Regulated			Construction grant of up to 50% of estimated project cost.
• Major Firm	x	-	-	
• Middle Size Firm	x	-	-	
• Independent Venture	x	x	-	
• Small Firm	x	x	-	
Industrial Fuels	Not Regulated			Non-Recourse loan guaranty of up to 75% of estimated project cost.
• Major Firm	-	-	x	
• Middle Size Firm	x	x	x	
• Independent Venture	x	x	x	
• Small Firm	x	x	x	

x serious constraint
- not a constraint

Illustrative Example - Competitive Bidding

The following example for an oil shale plant illustrates the use of the loan and price guaranty incentives and the competitive bidding approach envisioned under the proposed program.

The United States Government (USG) would solicit offers from interested and qualified firms. The amount of loan guaranty and the market price guaranty level that each firm proposes is expected to vary. If an oil shale plant were estimated to cost $1.0 billion, a firm might propose a loan guaranty to 50% of project cost or $500 million and a market price guaranty level of $12 per barrel. Another firm may propose no loan guaranty but a market price guaranty level of $15 per barrel. The meaning of a price guaranty level of $15 is as follows: Should the market price of oil fall below $15 per barrel, say to $12, the USG would pay the firm $3 per barrel for each barrel produced. Should the market price rise to $17, then the USG would pay nothing and receive as revenue a portion of the $2 in excess of the agreed-to guaranty price.

An evaluation of the expected net present value (cost) to the USG when combined with other factors characterizing the proposals would indicate which was of greatest benefit to the nation. Under the arrangement for loan guaranties for part of the project cost arrangement, the private sector company has a substantial investment of its own resources. The USG would select the best offer(s) based on least cost and on the objectives of the program. Under the proposed incentives, the USG mainly guarantees against plant failure and market price uncertainty. The USG would pay only if the plant failed or the market price of oil remained below the guaranty price. The USG would have recourse to the plant assets should a default occur but not to the assets of any parent company. It is important to recognize that the private sector will have substantial investments in funds, personnel, technology and expertise in each plant that would be a loss should the plant fail.

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Program Budget Estimates - Synthetic Fuels Commercial

Demonstration Program

Estimating the exact expected cost and corresponding budgetary authority necessary for the commercial demonstration program is complicated by the long-term nature of the synthetic fuel plant construction and operation (25-30 years) and by other significant uncertainties including:

- the future foreign/domestic market prices of oil and gas;
- the cumulative effect of inflation over this time frame;
- the overall success/failure rate of the plants.

In view of these uncertainties and the need to develop "best possible" estimates for the program, a rigorous financial analysis effort has been completed. This analysis included:

- detailed plant cost estimates for the various technologies
- detailed social infrastructure development cost estimates based on estimated increases in population in a locality attributable to the synthetic fuel plants
- use of a series of computerized cost models for each plant type with flexibility to change plant mixes to evaluate differing programs and the capacity to estimate capital as well as operating phases for each plant
- the capability to alter key assumptions for future market prices, inflation rates, plant and operating costs and the cost of energy resources used by the conversion technologies.

In the process of developing budgetary estimates, numerous program cost scenarios were estimated by changing assumptions for the market price of oil, inflation rates, cost of coal resources. Extreme scenarios were calculated based on pessimistic assumptions, e.g., market price of oil $7 per barrel. As a result of the many differing calculations, recommended budgetary requests have been formulated that are adequate for the program and will be ample to cover most unforeseen contingencies. The estimates are for the full term of the program and unless extremely adverse developments occur, the authorizations will be adequate to complete the program. It must be recognized that the budgetary authorization estimates do not represent actual cost to the government but rather reasonable estimates of funding authority necessary to implement the program.

Authorizations

Exhibits 1 and 2 show the individual plant cost estimates by type of plant including social infrastructure costs and the estimated number to be included in the commercial demonstration program. The basic assumptions used in developing these estimates are enumerated on the Exhibits. The anticipated levels of funding authorizations for loan guarantees, price guarantees and construction grants are shown at the bottom of the Exhibits and derived directly from the plant cost and operating estimates.

The President is requesting an initial $2 billion in loan guaranty authorization for FY 1976 to initiate the program in ERDA. The remaining funding authorization for loan guarantees and for price guarantees is contained in the Administration's funding request for the Energy Independence Authority for FY 1977. In the event EIA is not enacted in 1976, ERDA would need an additional authorization of $4 billion in loan guarantees and would request price guarantee and grant authorization on a project by project basis. In that event, the following authorization levels will be needed to allow execution of Phase I of the Synthetic Fuels Commercial Demonstration Program:

Loan Guaranty.....	$6.0 billion
Price Guaranty.....	4.5
Construction Grants.....	.6
Total Budgetary Authority....	$11.1 billion

Up to $425 million of the $6 billion authorization might be needed for guaranty of debt service for municipal financing of necessary social infrastructure caused by substantial increases in local population because of a synthetic fuel plant. Under this proposal the ERDA Administrator would be given the authority to guaranty debt service of municipal bonds that are necessary to finance the construction of essential capital facilities (e.g., sewers, water, public safety) to service the influx of new population caused directly by the synthetic fuel plant. A detailed description of this proposal is contained in the Socio-economic Impact Assistance fact sheet. (Tab O)

In order for the government to proceed with the complete program, the requested authorizations are needed prior to the execution of any agreements with the private sector. However, certain plants can be initiated with only a loan guaranty authorization.

While the total authorizations requested for the program exceed $11 billion, the actual cost to the government of the program is expected to be a small fraction of the requested authorization because:

- most loan guarantees are expected to be repaid and at least a portion of any defaults will be covered by fees charged for the loan guaranty and sale of any project assets that are recovered.

- actual price guaranty payments are likely to be significantly lower than than the requested authorization if the world price of oil continues to increase, which is likely.

Costs to the government will be incurred for the construction grants up to $600 million and for expenses to administer the program estimated at $10-$15 million annually. The possible cost to the Government for the program over its 20 to 30 year life is about $2.1 billion (Exhibit 5).

Borrowing Authority/Appropriation Approach/Estimates

Although there is a good possibility that loan guarantees and a somewhat lesser possibility that price guarantees will never result in the expenditure of Federal funds, the ERDA Administrator must, in order to make the recommended guarantees credible and effective, have the full authority to outlay funds in the very unpredictable circumstances when they may become needed. To accomplish this purpose, it is proposed that the ERDA Administrator be provided with a limited, renewable authority to issue notes or other obligations to the Treasury should payments be required in connection with either loan or price guarantees.

The authority to borrow from the Treasury to make payment, if required, for guarantees, was selected in favor of no specific appropriation authority or an advance appropriation arrangement for several reasons including:

- Credibility. It is important for the ERDA Administrator to have, in advance, a clear-cut authority to make payments in the event of either default or on account of the requirements of price guarantees. Such authority is necessary to remove the uncertainty on the part of investors about the timeliness of payment and/or the USG intent to pay.

- Continuity. Default or price guaranty payments are not likely to occur for a number of years.

- Surety. The precise amount of such payments are difficult to estimate and may not occur if favorable conditions result in the future.

In view of these factors, giving the ERDA Administrator limited authority to issue debt, if and when the need arises, is the most expeditious and efficient means of financing the program. Repayment of ERDA's obligations held by the Treasury would be accomplished through subsequent specific Congressional appropriations.

The Administration will transmit to the Congress separate appropriation requests for the borrowing authority consistent with the terms of the Budget Reform Act.

The following basic factors were considered in assessing the amount of borrowing authority needed:

- Time-phasing of project starts over the 1977-1979 period.
- Likelihood of projects simultaneously defaulting on loan guarantees and likely cost of default to the government.
- The expected future market price of oil and gas and any indicated price guaranty disbursements.
- The 20 to 30-year economic life of the synfuel projects.
- The need for flexible and credible program administration as well as periodic accountability to the Congress.

After analyzing these factors, it is recommended that $1.5 billion in loan guaranty borrowing authority be provided to cover possible loan default costs. ERDA debt outstanding under this authority could not exceed $1.5 billion at any time. Outstanding debt would be repaid by the ERDA Administrator by obtaining specific appropriations. This amount is 25% of the gross Federal loan guaranty liability of $6 billion (Exhibit 3). Although default costs could exceed 25%, it is very unlikely that this would occur before Congress had the opportunity to repay ERDA's debt to the Treasury. The $1.0 billion borrowing authority recommended for price guarantees will provide for about 3 years of price guaranty payments under the very pessimistic assumption that oil prices fall to $7 per barrel. Should recent trends continue for the price of oil, it is unlikely that any price guaranty payments will be made.

Construction grants are different from loan and price guarantees because they will require budgetary expenditures. A straightforward appropriation request will be made for this incentive. Consequently, even though construction grant outlays are not anticipated during FY 1976 because of the lead time in incurring construction costs, the full authorization of $600 million in grants is expected to be needed to enter into contractual agreements during FY 1977 even though outlays will be spread over a number of subsequent years.

In the event EIA is not enacted and the program were funded in ERDA, the following borrowing authorities and appropriations would be needed:

Loan Guaranty.....	$1.5 billion
Price Guaranty.....	1.0
Total Borrowing Authority.....	$2.5 billion
Construction Grants.....	$ .6 billion
Total Appropriations.....	$3.1 billion

The program's five-year projections for construction grants, administrative costs, and guaranty fees are shown in Exhibit 4.

Exhibit 1
Phase I Program Budget Authorizations
($ million, statistics include 7% annual inflation)

Plant Type	Number Scheduled for 1976-1978	Total Capital Invested	Construction Phase		Operation Phase
			Loan Guaranty	Construction Grant	Price Guaranty
High BTU Gas (regulated)	3	2,700	2,000	-	-
Shale Oil (unregulated)	2	2,100	1,050	-	900
Utility/Industrial Fuel (unregulated)	2	1,300	650	-	3,600
Utility Industrial Fuel (regulated)	2	1,000	-	500	-
Biomass (regulated & unreg.)	5	1,200	900	-	-
Social/infrastructure asst.			425		
CONTINGENCY			975	100	-
TOTAL BUDGET AUTHORIZATION REQUESTED			6,000	600	4,500

Specific Key Assumptions:

- Assumes recommended incentives of 50% loan guaranty for unregulated utility/industrial fuel, and oil shale plants; 75% loan guaranty for biomass and high-BTU gas plants; and price guaranties for shale oil and unregulated utility/industrial fuel. Should higher than recommended percentages for loan guaranties be necessary, the Contingency Reserve could accommodate.
- All statistics include 7% annual inflation rate for capital and operating costs.
- Total project investment is based on a 7-year development schedule for all plants, except for biomass conversion which are expected to be completed in a 3-year period. Plants are assumed to have a 20-year operating life.
- Investment totals do not include costs of such auxiliary developments as coal mines, roads, pipelines, etc., which, if they occur, could be accommodated by the Contingency Reserve.
- Loan guaranty statistics refer to the gross Federal commitment. The cost of an actual default will be less depending on the number of defaults if any, the timing of the default and the amount of recoverable assets.
- The contingency amount for loan guaranties and construction grants provides for construction delays, extraordinary inflation, different plant mixes, increased incentives, etc.
- The price guaranty statistics were calculated assuming that the market price for shale oil rises at 7% per year from a 1976 base of $7 per barrel, and for utility/industrial fuels, the price rises from a base of $9 per barrel. The statistics further assume that no revenues accrue to the government even if market prices exceed the guaranty level.

Synthetic Fuels Commercialization Program Budget

Exhibit 2 - Individual Project Statistics 1/

Plant Type	Size (bbl/d)	Investment 2/	Loan 3/ Guaranty	Construction Grant	Price 4/ Guaranty
Shale Oil	50,000	1000	500	-	450
High-Btu Gas	40,000	870	650	-	-
Utility/Industrial Fuel Regulated	25,000	460	-	230	-
Unregulated	25,000	610	300	-	1800
Biomass	6,000	230	170	-	-

1/ Data are rounded and a detailed cost analysis is available in the Synthetic Fuels Commercialization Task Force Report, Volume III.

2/ The 7% annual inflation rate is included, and the projects are all assumed to start in 1976.

3/ Presumes recommended incentives of 50% loan guaranty for unregulated utility/industrial fuel, and oil shale plants; 75% loan guaranty for biomass and high-Btu gas plants; and price guaranties for shale oil and unregulated utility/industrial fuel.

4/ Contingent costs for price guaranties were estimated assuming that the price of shale oil rises at 7% per year from a 1976 base of $7/bbl and for utility/industrial fuels, the price rises from a base of $9/bbl; and further assuming that no revenues accrue to the government even if market prices exceed the guaranty level.

Synthetic Fuels Commercialization Program Budget

Exhibit 3 - Possible Outlay Schedule for Price Guaranty Payments [1]

($ millions)

	1982	1983	1984	1985	1986	1987	1988	1989	1990	Total Payments Thru 2005
Payments to Unregulated Utility/Industrial Fuel Plants [2]										
$9 Oil Scenario:	50	109	166	233	229	225	220	215	209	3600
$11 Oil Scenario:	34	71	106	144	134	123	111	98	84	1100
Payments to Oil Shale Plants										
$7 Oil Scenario: [3]	167	153	137	120	102	83	63	41	18	900
$9 Oil Scenario:	58	35	12	-	-	-	-	-	-	105
$11 Oil Scenario:	-	-	-	-	-	-	-	-	-	0

1/ Calculations assume 7% per year inflation in capital and variable operating costs; projects start according to the schedule of Exhibit I.

2/ No payments are assumed to accrue to the government even if oil and gas prices exceed the synthetic fuel price guaranty level.

3/ Oil and gas prices are presumed to rise at 7% per year from a 1976 base of $7 per barrel for oil and $1.65 per MMBtu for gas. The $9 and $11 scenario have proportionately higher bases, but same inflation rate.

Synthetic Fuels Commercial Demonstration Program Budget

Exhibit 4: Five-year Budget Projections for 350,000 bbl/day Program

($ in millions)

	FY 1976&TQ	FY 1977[1]/	FY 1978[1]/	FY 1979[1]/	FY 1980[1]/	FY 1981[1]/
Net Budget Outlays	3	12	26	37	55	91
Administration	3	10	15	15	15	15
Loan Guarantee[2]/	0	0	0	0	0	0
Price Guarantee[2]/	0	0	0	0	0	0
Grants	0	7	23	42	71	115
Loan Guarantee Fees Collected	(0)	(5)	(12)	(20)	(31)	(39)
New Budget Authority	503	2,610	15	15	15	15
Loan Guarantees	500	1,000	0	0	0	0
Price Guarantees	0	1,000	0	0	0	0
Grants	0	600	0	0	0	0
Administration	3	10	15	15	15	15
New Credit Authority	2,000	8,500	0	0	0	0
Loan Guarantees	2,000	4,000	0	0	0	0
Price Guarantees	0	4,500	0	0	0	0

1/ Funding for FY 1977 and beyond are shown for illustrative purposes as if these programs were funded in ERDA. If, however, EIA is created in FY 1977, the Synthetic Fuels Program would be transferred to it.

2/ No payments for either loan guarantee defaulst or price guaranties are anticipated during this period.

Exhibit 5
Possible Total Cost to Government (FY 76 thru 2005)
350,000 bbl/day Program
($ million)

Financial Incentive	Fiscal Years '76-'81	Fiscal Years 1982 - 2005	Total Cost of Program FY 76 - 2005
Loan Guarantees -Defaults (2 plants)/1	-	$ 1000	$ 1000
- Fee collected by Government (Revenue) (1% annually-debt outstanding) /2	$ (108)	(720)	(828)
Price Guarantees (assumes $11 oil scenario)	-	1,100	1,100
Construction grants	258	242	500
Administrative (assumes $10-$15 million annually)/3	74	240	314
TOTAL COST TO GOVERNMENT/4	$ 224	$ 1862	$ 2086

/1 From Exhibit 1, 12 plants require $6 billion in loan guarantees. If two plants default then, at most, $1 billion would be lost.
/2 See Exhibit 4 for Fiscal Years '76-'81. Calculation for 1982-2005 assumes average annual outstanding debt over the 24 years of $3 billion.
/3 FY 76-81 statistic from Exhibit 4, and FY 1982-2005 assumes $10 million/year for 24 years.
/4 Fees are subtracted from outlays.

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FACT SHEET

Status of Available Technologies

Introduction:

Technology is available that would allow construction to begin, early in 1977, on plants that could provide significant amounts of the synthetic fuels identified in this report. Operation of these plants would also lead to information that could be the basis for establishing commercial synthetic fuels industries.

Oil Shale Conversion:

The richest U.S. oil shale deposits and center of interest for current commercialization studies are in Utah and Colorado. Oil shale is a fine sedimentary rock rich in insoluble organic material called kerogen. Upon heating to 850 to 900°F, the kerogen is converted directly to liquid hydrocarbon vapors, gas and residual carbon. This heating or retorting is the key step in any propspective commercial oil shale operation. Based on the Bureau of Mines and industry research and development, several technologies recovering oil from shale are now considered ready for scale up to full size equipment. These include:

- Modified in-situ retorting in which low grade shale is mined to create a void in which to do the retorting.
- Underground room and pillar mining with surface retorting.
- Surface mining and retorting.

The surface retorting technologies that are most advanced and therefore of greatest interest to prospective U.S. oil shale operators are:

- The Oil Shale Company solid-to-solid heat transfer retort (TOSCO II).
- The Union Oil Company gas retort (Union Retort B).
- The Development Engineering Incorporated gas retort (Paraho).

Each of these has been tested at the semiworks scale (500-1000 tons/day/retort) providing a basis for commercial scale desings (10,000 tons/day/retort). Other important technologies evolving from Russian and Brazilian oil shale operations are being scaled up in these countries. The Superior Oil Company multimineral approach, now being tested at the pilot plant scale, may be of great importance to recover all mineral values in the mineral rich Piceance Creek Basin shales of Colorado.

Other steps in recovering oil from oil shale are mining, crushing, upgrading the shale oil, and waste disposal. Each have had unique technical, economic and environmental problems, the resolution of which must be confirmed by commercial scale operations.

High-Btu Gas:

High-Btu gas can be made from coal by gasification with steam and oxygen, using the Lurgi Pressure Gasification process, followed by several other processes which result in a gas that is essentially pure methane and has a heating value of about 950-970 Btu/scf.

All of the process steps have been demonstrated on a scale which provides a basis for technical confidence. The gasification process and its combination with the gas conditioning processes are based on forty years of continuous development work, and the experience from 14 commercial plants with a total of 65 gasifiers. Specifically, American coals of the kinds that would be used in the present candidate projects have been evaluated in similar gasifiers located at Westfield, Scotland and at Sasolburg, in South Africa. The tests at Westfield were made between August, 1973, and April, 1974, on Rosebud (Montana), Illinois NO. 5, Illinois No. 6, and Pittsburgh No. 8 coals. The tests at Sasolburg were made in September, 1974, on 10,000 tons of North Dakota lignite.

There has been no commercial-scale methanation of coal gasification product gas, but there is a high degree of technical confidence in this step, based on two pilot plant methanation test programs using gas from coal, and from commercial manufacture of synthetic natural gas (SNG) from naphtha (in which a pure gas containing carbon monoxide and hydrogen is reacted to make methane).

Substitute Fuels for Utility and Industrial Users:

Various fuel forms, and also various technological processes to produce these fuel forms, might be candidates in this category. Among those for which the technology appears to be ready, and for which there also appear to be interested users, are the following categories of candidates:

- Industrial fuel gas: a medium-Btu gas, essentially carbon monoxide and hydrogen, made by gasifying coal with steam and oxygen. Various commercially developed gasifiers are available for this application, including: Lurgi, Koppers-Totzek, Woodall-Duckham, Texaco, Riley-Morgan, Wilputte, Wellman-Galusha, etc. Background on the Lurgi has been discussed earlier; the Koppers-Totzek gasifier has been used widely abroad to make synthesis gas for ammonia manufacture, the

Woodall-Duckham gasifier is in use in Europe for making town gas from coal, the Texaco gasifier gasifies a coal-water slurry and is a development for the widely-used partial oxidation of oil to make gas.

The other gasifiers are smaller capacity units, with substantial experience behind them. The Riley-Morgan gasifier is a `modernized` version of the established Morgan gasifier.

Various industrial gas users and pipeline gas companies have expressed interest in using 300-Btu cu. ft. gas, made by one of the above technologies.

- Fuel methanol: methanol, possibly containing some water and other impurities, which do not interfere with its use as a fuel but may reduce its cost substantially below that for chemical methanol. This fuel is of interest as a clean storable fuel for electric utility peaking applications. It would be made from a synthesis gas ($CO+2H_2$), made by a gasifying coal in a conventional gasifier such as those cited above for making medium-Btu fuel gas. Methanol is traditionally made from a similar synthesis gas made by partial oxidation of natural gas or oil. In any case, the synthesis gas is passed over a catalyst to make the methanol. Until natural gas became cheap and abundant, methanol was made by the coal gasification route. DuPont operated a full-scale plant of this kind in West Virginia until the early 1950`s.

- Solvent refined coal (SRC): is a product made by hydrogenation of coal in a solvent derived from the process itself. The ash contained in the coal behaves as a catalyst for the process. Depending on the amount of hydrogen used, the product can be either a substitute coal (from which the ash and most of the sulfur have been removed) or a clean boiler fuel. The major development activity is underway at Fort Lewis, Washington. Scale-up to commercial capacity depends on developing a superior solid separation system to that presently available. Combustion tests on 3000 tons of the substitute coal, at a power station in Georgia, should be complete in the fall of 1976. Combustion tests of smaller scale are also in progress at the facilities of Babcock and Wilcox of Combustion Engineering.

Biomass Conversion to Gas or Liquid:

Municipal Solid Wastes (MSW) constitutes about 70 percent of the available heat content of all solid wastes, and other significant sources of combustible solid wastes include agricultural (feedlot manure), wood industry, and industrial plant trash. Energy recovery from MSW is an alternative to traditional approaches such as landfills and burning. Among the candidate technical options which result in a liquid or a gas are:

- Pyrolysis of MSW to a fuel gas.
- Pyrolysis of MSW to a fuel oil.
- Anaerobic digestion of MSW to a fuel gas.

All of these approaches are technically feasible, but their rate of acceptance will depend largely on relative efficiency and on economic considerations.

The process for pyrolysis to a fuel gas that appears closest to commercialization is the Purox process of Union Carbide Corporation. This has been demonstrated at the 200 ton/day scale at South Charleston, West Virginia, and is being offered on the market at a module size of about 300 ton/day. It produces a fuel gas with a heat content of about 300 Btu/scf. The reactor consists of three zones: drying, pyrolysis, and combustion of char. Oxygen is injected into the combustion zone at the bottom of the reactor, where it reacts with the carbon char residue from the pyrolysis zone. The specified oxygen-to-refuse ratio is about 0.2 ton of oxygen to 1.0 ton of MSW. The reactor is operated so that the temperature of the slag is about 3000 °F.

The process for pyrolysis to a fuel oil that appears closest to commercialization is that of Garrett Research and Development Company. Details of the reactor design are proprietary. The process has been demonstrated at the 4 tons/day scale, and a 200 tons/day demonstration plant has been built in San Diego County.

Anaerobic digestion is a bacterial decomposition process that takes place in the absence of oxygen. Methane and carbon dioxide are produced, in an approximate ratio of 55:45. This technique might be especially useful in exploiting existing landfills. The rate of decomposition of the fill is an important variable in operating such a process. A study by the Los Angeles Department of Water and Power indicates that the methane content in the gas is 50-55% after 2-3 years, but falls to 7-8% after 5-10 years. Processes of this kind appear feasible, but there are, as yet, no large-scale demonstrations.

FACT SHEET

Identified Candidate Synthetic Fuel Projects

Identified candidate projects for the proposed program in four synthetic fuel categories are shown in the attached table. For some of these projects the sponsors have already invested considerable capital, acquired sites and leases, made detailed development plans, and tested the chosen technology at a demonstration level. Other projects are still in the formative stage but could commit to construction by January, 1979.

In general, the following is concluded regarding these potential projects:

- $250,000 to $210,000,000 per project have already been invested and committed by industry in commercialization planning and designing activities, for a total identified investment of $800,000,000.
- Government incentives support will be needed to accelerate development schedules since no project has yet committed to construction.
- Assistance may be needed to help individual projects resolve schedule delays caused by legal and regulatory constraints.
- Most projects identified plan to use established technologies rather than "second-generation" types now under development in ERDA.
- The estimated total investment cost of all candidate projects is about $12.5 billion.

Of the eight Shale Oil projects, Rio Blanco, Superior and White River have active programs underway. Development progress appears to have slowed considerably for Colony Development and Federal Shale Lease Tract C-b. Superior Oil stated that their activity will proceed independent of incentives support.

For High BTU Synthetic Natural Gas (SNG) projects, ESCO, ANG, El Paso (Burnham), Panhandle Eastern, and Dunn Center have already completed most of their planning and design activities. Their readiness to commit to construction, however, still requires one or more of the following:

- Full financial commitments
- Applicable government permits
- Environmental impact statements

- Coal and water resource commitments
- Established and acceptable product market prices.

All of these active projects plan to use proven Lurgi technology.

Candidate projects in the Utility/Industrial Fuels category include low/medium BTU gas, and liquid fuels from coal. These projects generally are both smaller in capacity and cost than the shale oil or SNG plants.

Many projects are underway for converting municipal solid waste. Biomass combustion plants were excluded from this category since this application appears to be growing significantly without incentives. Only a few projects were identified which plan to use pyrolysis techniques to produce gas or oil products and can meet the timing criterion for initial commercialization incentives.

Synfuel Product	Project Name	Synfuel Produced	Plant Size	Location	Technology Used	Beginning of Construction/ Beginning of Operation	Funds Expended to Date	Project Cost	Project Status
Shale Oil	Colony Development	Shale Oil	48M B/D	Parachute Creek, Colo.	Underground mining, TOSCO II retorting	1977/1980 (contingent on incentives)	204.1MM	1.1B	Suspended state; P & D of commercial plant completed
	Occidental Petroleum	Shale Oil	40M B/D	Garfield County, Colo.	Modified in-situ retorting	1977/1980 (estimate - firm dates contingent on demonstration)	30MM	400-600MM	In-situ commercial size demo. started December 1975; full commercial expansion contingent on demo. perform.
	Rio Blanco	Shale Oil	50M B/D	Piceance Creek Basin, Colo.	Open pit or underground mining, TOSCO II retorting	1977/1980	5MM	1.0B	DDP to be submitted in March 1976, site development to start in April 1977 contingent on DDP
	Superior Oil	Shale Oil, Minerals	50M B/D	Piceance Ck. Basin, Colo.	Underground mining, prop. retorting proc.	1978/1982	Not available	600MM +	Schedule contingent on land exchange; EIA underway
	TOSCO Sand Wash	Refined Shale Oil	75M B/D	Uintah Basin, Utah	Underground mining, TOSCO II retorting	1982/1985	1.0MM	1.5B	Planning & feasibility studies; mine exploration
	Tract C-b	Shale Oil	50M B/D	Piceance Ck. Basin, Colo.	Underground mining, TOSCO II retorting	1979/1983	117.8MM (or committed)	923MM	DDP being prepared; site development contingent on DDP
	Union Oil	Shale Oil	50M B/D	Parachute Creek, Colo.	Underground mining, Union "B" retort	1977/1979 (7000 B/D)	Not available	110MM (7000 B/D)	Project construction is pending financing, (7000 B/D first module)
	White River Shale Oil Corp.	Shale Oil	50M B/D	Uintah County,Utah	Underground mining, TOSCO II & Paraho retorting	1976/1980 (10,000 B/D module)	129.7MM (or committed)	600MM-1B	DDP being prepared; site development to start in 1977 contingent on DDP
High BTU Gas	ANG Coal Gasification Co.	SNG	250MM CFD (40M B/D)	Beulah North Dakota	Surface mining, Lurgi gasifier w/methanation	1977/1981	25MM (or committed)	900MM	Construction pending financing and FPC certification
	Dunn Center (Nat. Gas Pipe.)	SNG	250MM CFD (40M B/D)	Dunn County, North Dakota	Surface mining, Lurgi gasifier w/methanation	1978/1982	11MM	1.0B	FPC filing in 1976; construction pending FPC certification
	El Paso (Burnham)	SNG	250MM CFD (40M B/D)	San Juan Cty. New Mexico	Surface mining, Lurgi gasifier w/methanation	1977/1980	12MM (or committed)	1.0B	Construction pending financing and FPC certification; coal lease being renegotiated
	Panhandle Eastern	SNG	250MM CFD (40M B/D)	Converse Cty. Wyoming	Surface mining, Lurgi gasifier w/methanation	1978/1982	10MM	1.0-1.2B	Construction pending final financing plan and FPC certification
	WESCO	SNG	250MM CFD (40M B/D)	San Juan Cty. New Mexico	Surface mining, Lurgi gasifier w/methanation	1976/1980	20.0MM	825MM	Pending FPC certification; preliminary plant engineering completed
Utility/ Industrial Fuels	Columbia Coal Gas. Corp.	300 BTU Gas	21B BTU/D (3750 CBE/D)	Coatesville, Pa.	Koppers-Totzek	Operational 50 months after go-ahead	Not available	114MM	Preliminary study completed
	Consolidated Natural Gas - 3 projects	300 BTU Gas	70B-100B BTU/D (4900-7000 CBE/D)	Cleveland; Ohio River/ West Va.; Pa.	Koppers-Totzek; Babcock & Wilcox; or Texaco Partial Oxidation	1977/1980	25OMM	120MM (Cleveland plant)	Exploratory studies

Synfuel Product	Project Name	Synfuel Produced	Plant Size	Location	Technology Used	Beginning of Construction/ Beginning of Operation	Funds Expended to Date	Project Cost	Project Status
Utility/ Industrial Fuels (Cont.)	Consumers Power	300 BTU Gas	188MM CFD (12,000 CBE/D)	Bay City, Michigan	Riley Stoker or Koppers-Totzek	1977/1980	20M	178MM	Preproposal
	LAMPCO	140 BTu Gas	115 MWe (5000 CBE/D)	Baldwin, Louisiana	Texaco Partial Oxidation	1977/1980	Not available	62MM	Economic and engineering reports finalized and documented
	UGI	Methanol	2500 T/D (9500 CBE/D)	Pennsylvania or Ohio	Texaco	1978/1981	500M	300MM	Planning
	Wheelabrator-Frye	Boiler Grade Fuel, Naphtha	46M B/D Boiler Fuel, 4M B/D naphtha	North Central Alabama	SRC Process	1977/1980 (Plant No.1)	28MM	100MM (Plant No. 1)	Feasibility study
Biomass	Baltimore, Md.	Pyrolysis Gas	1000 B/D	Baltimore, Md	Monsanto Landgard	1974/1978	16.0MM (or committed)	Not available	Halt in operation to add additional pollution control equipment
	Minneapolis-St. Paul, Minn.	Pyrolysis Gas & Oil, Char	360 B/D	Minneapolis-St.Paul,Minn.	Union Carbide Purox	1977/1980	Not available	20.0MM	Feasibility study
	New York Metropolitan Area	Pyrolysis Gas	3500 B/D	New York City	Union Carbide Purox		Not available	Not determined yet	Feasibility study
	*Brooklyn Navy Yard					1980/1981			
	*Fountain Avenue					1981/1983			
	*Northern Queens					1982/1984			
	San Diego Cal.	Pyrolysis Oil	110 B/D	San Diego County, Cal.	Garrett Flash Pyrolysis	1974/1976	9.0MM (or committed)	Not available	Under construction

FACT SHEET

Synthetic Fuel Product Prices

Estimates of typical prices for several synthetic fuel types follow. No commercial-scale product fuel plants have been built in the United States and therefore no firm prices for fuel from such plants can be quoted.

In addition to the assumptions shown on each cost sheet, the prices are subject to a variety of assumptions. The most critical are:

- The estimated rate of inflation during the period between January 1, 1976, and the date when construction starts.
- The time period required for construction.
- Plant life is assumed to be 20 years--a minimum estimate.
- Return on investment is calculated as a 15% discounted cash flow (dcf) for the "no incentive" cases and 20% dcf on the equity portion of the "with incentives" cases.
- Capital estimates to build plants and the required returns on capital.

Note, the required selling price for synthetic fuels is particularly sensitive to capital charges. An illustration of this sensitivity for one fuel - shale oil - follows the price illustrations (Exhibit E). A relatively sharp rise in selling price accompanies increases in assumed discounted cash flow rate. Note also that at a 15% discounted cash flow rate, an addition of 25 cents per barrel in capital cost raises the required selling price of the fuel from $14.45 per barrel to $15.98 per barrel.

EXHIBIT A

HIGH BTU (PIPELINE QUALITY) GAS — REGULATED CASE

Product Price Per 1000 SCF in 1-1-76 Dollars

OFFICE OF COMMERCIALIZATION ESTIMATES

Without Incentives			With Incentives	
$ ***	%		$ ***	%
3.28	*100.0*	• Total •	3.28	*100.0*
.37	*11.3*	• Interest •	.37	*11.3*
.22	*6.7*	• Profit •	.22	*6.7*
.21	*6.4*	• Tax •	.21	*6.4*
.95	*29.0*	• Feedstock •	.95	*29.0*
1.06	*32.3*	• Operating and Maintenance •	1.06	*32.3*
.47	*14.3*	• Amortization of Plant •	.47	*14.3*

SIZE OF TYPICAL PLANT:	250 million SCF per day
INCENTIVE ASSUMPTION:	Non-recourse loan guaranty for 75% of project cost
RESOURCE BASE:	Western Coal — $9 ton*
FINANCING ASSUMPTION:	Debt equity ratio: with or without incentive 75/25 Interest: 9%
COMPETES WITH:	LNG at nominal price of $3.00 per million Btu and naptha conversion at $3.25 to $5.00 per million Btu
TYPICAL INDUSTRY PRODUCT PRICE PRICE ESTIMATES:	WESCO — $2.50 ** Panhandle — 2.90 El Paso Natural Gas — 3.17 *** American Natural Gas — 3.13 ***
REGULATION:	Product price and method of pricing subject to FPC regulation and to regulation by State PUC in state of re-sale

* A $1 per ton change in coal price will change the OCOM estimates of both the regulated and unregulated product feedstock cost, and total product price by $.11 per M SCF.

** Initial rate to be permitted by FPC per order of 11/21/75. Order recognizes that this price will not permit full recoupment of costs, and provides for adjustments.

*** Assumes a charge levied on present customers to pay for financing costs during period of construction.

EXHIBIT B

SHALE OIL — UNREGULATED CASE

Product Price Per Barrel in 1-1-76 Dollars

OFFICE OF COMMERCIALIZATION ESTIMATES

FULL-SCALE PLANT

Without Incentives			With Incentives	
$	%		$	%
14.45	*100.0*	Total	13.31	*100.0*
		Interest	1.51	*11.3*
4.57	*31.6*	Profit	3.08	*23.1*
4.05	*28.0*	Tax	2.89	*21.7*
.68	*4.7*	Feedstock	.68	*5.1*
3.50	*24.2*	Operating and Maintenance	3.50	*26.3*
1.65	*11.4*	Plant	1.65	*12.4*

SIZE OF TYPICAL PLANT:	Full-scale — 50,000 bpd Single train — 8000 bpd
INCENTIVE ASSUMPTION:	Full-scale — mortgage loan* guaranty Single train — construction loan* guaranty
RESOURCE BASE:	Oil shale
FINANCING ASSUMPTION:	Debt equity ratio with incentive — 50/50 without incentive - 0/100 Interest — 9%
COMPETES WITH:	Crude oil — but upgraded shale oil will be a superior product
TYPICAL INDUSTRY PRODUCT PRICE ESTIMATES — ALL EQUITY ON BASIS COMPARABLE TO OCOM $14.45:	Union — $13.75/$15.50** TOSCO — $18.90

* Non-recourse loan guarantee for 50% of project cost plus product price support.

** Assumes no inflation, no delays. $13.75/bbl for single train product; $15.50 for full-scale. Single train product is not upgraded; full-scale product is.

EXHIBIT C

MEDIUM BTU GAS (AS PROXY FOR SUBSTITUTE FUELS GENERALLY) — REGULATED CASE

Product Price Per 1,000,000 BTU's

OFFICE OF COMMERCIALIZATION ESTIMATES

Without Incentives $	Without Incentives %		With Incentives $	With Incentives %
2.64	*100.0*	Total	2.26	*100.0*
.24	*9.1*	Interest		
.13	*4.9*	Profit		
.12	*4.6*	Tax		
		Interest	.12	*5.3*
		Profit	.07	*3.1*
		Tax	.07	*3.1*
.83	*31.4*	Feedstock	.83	*36.7*
1.02	*38.6*	Operating and Maintenance	1.02	*45.1*
.30	*11.4*	Plant	.15	*6.6*

SIZE OF TYPICAL PLANT:	25,000 Cbe/day 290 MM SCF cubic feet/day at 500 Btu/cubic foot)
INCENTIVE ASSUMPTION:	Grant for 50% of project cost
RESOURCE BASE:	Illinois Coal — $9/ton*
FINANCING ASSUMPTION:	With incentive 50% Grant 37 ½% Debt 12 ½% Equity Without incentive 75% Debt 25% Equity Interest — 9%
COMPETES WITH:	LNG at nominal price of $3.00 per million Btu and naptha conversion at $3.25 to $5.00 per million Btu
TYPICAL INDUSTRY PRODUCT PRICE ESTIMATES:	CNG — $3.06
REGULATION:	Subject to state regulation. If used for generating electric power for resale, may also be subject to FPC jurisdiction

* A $1 per ton change in coal price will change the OCOM estimates of both the regulated and unregulated product feedstock cost, and total product price by $.09 per MM Btu.

EXHIBIT D

MEDIUM BTU GAS (AS PROXY FOR SUBSTITUTE FUELS GENERALLY) — UNREGULATED CASE

Product Price Per 1,000,000 BTU's

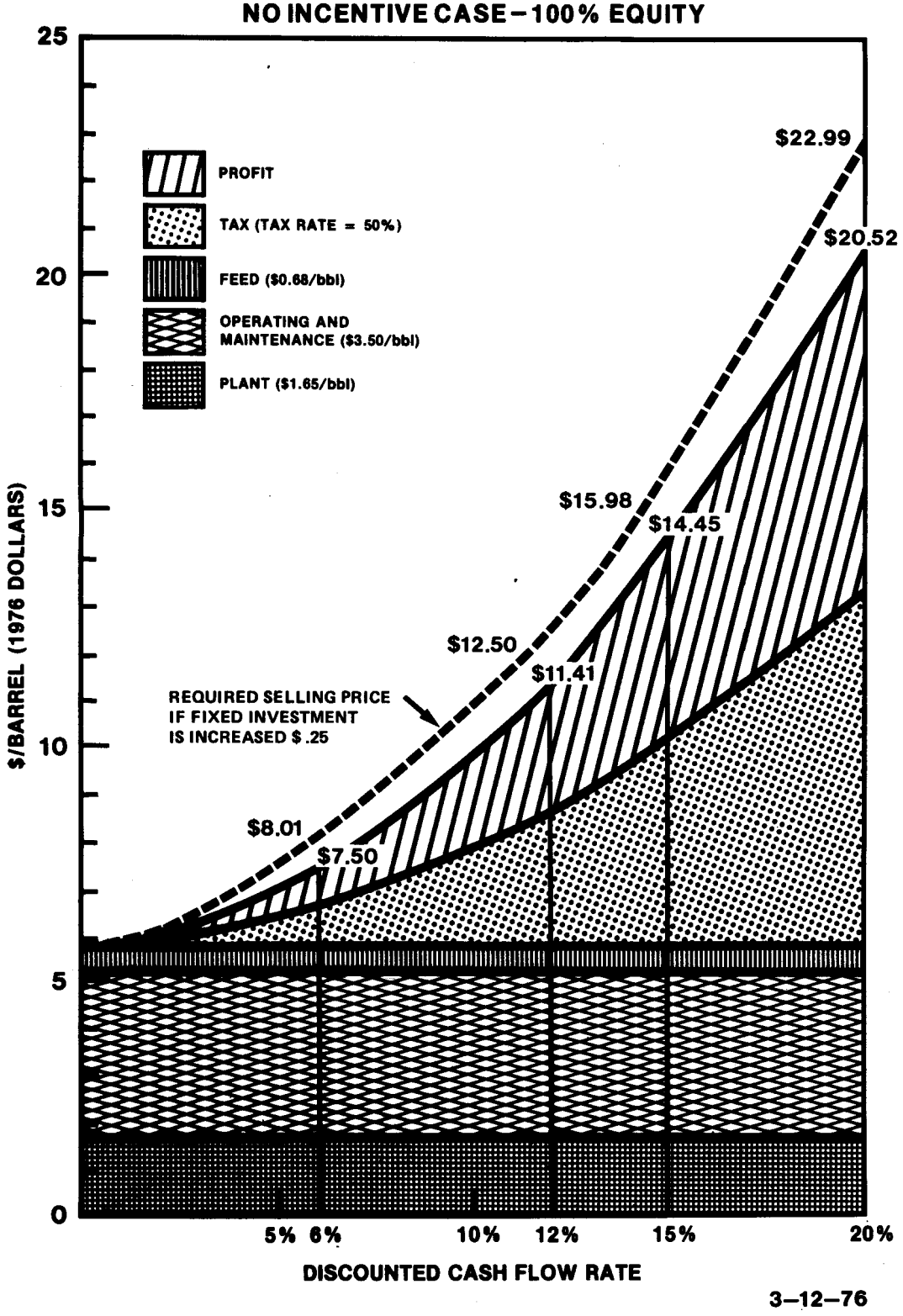
OFFICE OF COMMERCIALIZATION ESTIMATES

Without Incentives $	Without Incentives %		With Incentives $	With Incentives %
4.23	*100.0*	Total	3.96	*100.0*
		Interest	.26	*6.6*
1.05	*24.8*	Profit	.78	*19.7*
1.00	*23.6*	Tax	.74	*18.7*
.83	*19.6*	Feedstock	.83	*21.0*
1.01	*23.9*	Operating And Maintenance	1.01	*25.5*
.34	*8.0*	Plant	.34	*8.6*

SIZE OF TYPICAL PLANT:	25,000 Cbe/day (290 MM SCF cubic feet/day at 500 Btu/cubic foot)
INCENTIVE ASSUMPTION:	Non-recourse loan guaranty for 50% of project cost plus product price support
RESOURCE BASE:	Illinois Coal $9/ton*
FINANCING ASSUMPTION:	Debt equity ratio with incentive — 50/50 without incentive - 0/100 Interest — 9%
COMPETES WITH:	LNG at nominal price of $3.00 per million Btu and naptha conversion at $3.25 to $5.00 per million Btu
TYPICAL INDUSTRY PRODUCT PRICE ESTIMATES:	Non-available — see regulated case

* A $1 per ton change in coal price will change the OCOM estimates of both the regulated and unregulated product feedstock cost, and total product price by $.09 per MM Btu.

EXHIBIT E
REQUIRED SHALE OIL SELLING PRICE AS FUNCTION OF DISCOUNTED CASH FLOW
NO INCENTIVE CASE – 100% EQUITY



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FACT SHEET

Patents and Technology

In conducting the proposed synthetic fuels program, it will be necessary to balance the interests of the United States with the need to provide an incentive to firms which have made substantial investments in developing technologies which might be commercially demonstrated under the Program. In balancing these interests, it is necessary to consider the patents and technology existing prior to, and relied upon during the demonstration as well as the improvements made during the construction and initial start-up of the facility. In this regard, it is expected that most of the technologies that will be commercially demonstrated by this program already exist and are patented. Thus, no completely new developments are likely, although there may be refinements in the form of improvements to already patented technologies.

As to preexisting patents and technology, a factor that will be considered in awarding each guaranty will be the availability of such patents and technology to other parties desiring to construct and operate plants utilizing the processes demonstrated. Provisions will be considered for each guaranty which are directed to the availability and licensing of background patents and technology.

Technology developed during the course of the demonstration is generally to be considered a project asset and, in the case of default, would be treated similar to all other project assets. Of course the default provisions of the guaranty will include a requirement that in the event of a default the applicable technology and patent rights are to be made available to the government or its designee if needed to complete and operate the facility.

ERDA has interpreted Sec. 9 of the Federal Nonnuclear R&D Act of 1974, which requires ERDA to obtain title to the inventions made under its contracts, as not being applicable to loan guaranties, because guaranties provide only limited financial assistance, rather than outright Federal support of all or most of the cost project. It is not generally the practice for the Federal Government to acquire title to incremental improvements to existing patented technologies where such limited assistance is provided. For example, other government agencies, (e.g., HUD, Maritime Administration, Department of Agriculture, SBA) that administer loan guaranty programs do not acquire patent rights under agreements they have executed.

Outright Government acquisition of title to inventions under guaranties could have a negative impact on the willingness of certain companies to participate in this program. However, the legislative proposal reported

by the House-Senate Conference last year specifically required that the title and waiver of title provisions of Sec. 9 apply to loan guaranties. In any event, whether or not Sec. 9 applies, the guaranty provisions included in subsequent regulations would protect the public's interest in the availability of inventions. If Sec. 9 applied and waivers of patent rights were granted, the Government would reserve the right to require the waiver recipient to license on reasonable terms to other parties desiring to construct and operate such plants to ensure that the technology is available for rapid commercialization. If Sec. 9 is inapplicable, the background rights provisions generally considered by ERDA would include these inventions and their availability for use by others. An example of such a background provision is found in the ERDA proposed Geothermal Loan Guaranty Regulations, 10 CFR 790.44, 40 Fed. Reg. 50100-50107, October 28, 1975.

FACT SHEET

Capital Market Impact of Program

The precise impact of the Synthetic Fuels Commercial Demonstration Program on capital markets depends on the general availability of investment capital and the demand for funds by the program in any specific time period. However, in general, investments projected to total $8.4 billion for the period 1977-1986 and $9.5 billion over the full term of the 350,000 bbl/day Synthetic Fuels Commercial Demonstration Program are not expected to materially affect conditions in the U.S. capital market for the following reasons:

- The most recent forecasts of the capital market do not envision a general capital shortage for the energy industry through 1985.
- The maximum investment in synthetic fuel plants projected for a single year (1981) totals $1.6 billion (Exhibit 1).
- The peak of net projected Federal budget outlays in connection with the program equals only $195 million in 1985 (Exhibit 1).
- Program investment in 1981 equals only 2.3 percent of the total investment projected for all energy industries and 0.4 percent of total business fixed investment (Exhibit 2).
- Savings (funds) induced by the program will be recycled to the capital market.
- The impact of the program on short-term interest rates during the peak year of investment (1981) is estimated to be insignificant--ranging from 0.005 to 0.05 percent.

Capital Shortage or Adequacy

In recent years a number of studies[1/] have suggested that the energy industries may face a capital shortage in the near future. If realized, the proposed synthetic fuels program would of course be affected by such a shortage. On the other hand, studies by the Brookings Institution, the Department of Labor, Data Resources, Inc. and most recently the Bankers Trust Company found that a general shortage of capital through 1985 can be avoided provided appropriate economic policies are adopted.[2/] In this regard, the study prepared by the Energy Group of Bankers Trust Company concludes that capital markets can adequately meet the needs of the energy industries even if the accelerated investment targets embodied in U.S. energy independence goals are adopted.

Investment Requirements

The combination of financial incentives (i.e., loan guaranties, price guaranties and construction grants) that are proposed for the 350,000 bbl/day synthetic fuels program would result in plant investment totalling about $7.4 billion between 1977 and 1986. Exhibit 1 presents the annual private sector outlays for capital investment in synthetic fuels commercial demonstration plants along with the time phasing of plant construction and production. In addition, Exhibit 1 details the anticipated annual net Federal Government budget outlays between 1977 and 1986. Adding these costs to private sector capital requirements the total investment requirements for the program equals $8.4 billion for the period 1977 - 1986 and $9.5 billion through the year 2005 (see Tab G for more detailed estimates of the cost of the Government). The peak year for the combined private sector and Federal investment is 1981 when approximately $1.6 billion is expected to be expended.

Induced Savings

Although the Synthetic Fuels Commercial Demonstration Program entails a demand for investment capital, savings induced by the program will in turn recycle funds to the capital market. To what extent such savings represent new savings (savings not otherwise forthcoming) cannot be determined since it is not known what investments may be foregone as a result of the program. The amount of ordinary savings generated by the program for capital market use depends on the impact of the program on Gross National Product and the savings rate applicable at the time of impact. The effect of the program on GNP over a specific period will be determined by the level of employment in the economy during that period and the amount of investment, operation and maintenance costs, efficiency improvement and import substitution arising from the synthetic fuels program. Initial estimates indicate gross savings in current dollars induced by the 350,000 bbl/day synthetic fuels program would range from 45 to 90 percent of total program investment ($8.4 billion) for the period 1977 - 1986.

Interest Rates

The effect on interest rates from the program can be inferred from the size of capital investment in synthetic fuels commercial demonstration plants relative to total energy investment requirements and total business fixed investment. These data are presented graphically in Exhibit 2. Comparison of the data reveals that total investment in synthetic fuel plants is very small relative to the totals for all energy industries and business fixed investment. The relative effect on capital markets of the projected investment in synthetic fuels commercial demonstration plants would therefore be minimal. Thus,

the range of interest rates prevailing in the U.S. capital markets at the time investment capital is needed for the commercial demonstration plants will be minimally affected by the demand for funds to invest in such plants.

In order to quantify the impact on interest rates, two econometric models were utilized.[3/] The results of the Data Resources Incorporated analysis indicate that under normal conditions interest rates would be affected by about 2 "basis points", i.e., a .02 percent increase in interest rates (e.g., during 1981 interest rates move from 8 percent to 8.02 percent). However, if the capital market is "tight" as forecast by the New York Stock Exchange and Chase Econometric Associates, the impact on interest rates would equal about 5 "basis points" (interest rates would move from 8 percent to 8.05 percent). On the basis of the Federal Reserve Board model the impact of the program on interest rates is estimated to range in the thousandths of a percent (e.g., interest rates increase from 8 percent to 8.005 percent). These results were to be expected considering the fact that the proposed $1.6 million peak year investment for the synthetic fuels program represents 0.6 percent of the privately held Federal debt in 1975 and 0.2 percent of corporate debt.

1/ The two most pessimistic studies were published by the New York Stock Exchange and the Chase Econometric Associates, Inc.: The Capital Needs and Savings Potential of the U.S. Economy; Projections Through 1985 (The New York Stock Exchange, September 1974); Michael K. Evans, Long-Term Forecast: The Next Ten Years, Inflation, Recession, and Capital Shortage (Chase Econometric Associates, Inc., August 1975).

2/ Barry Bosworth, James S. Duesenberry, and Andrew S. Carron, Capital Needs in the Seventies (Brookings Institution, 1975). Special Study Group, Unpublished materials partially based on The Structure of the U.S. Economy in 1980 and 1985, BLS Bulletin 1831 (U.S. Department of Labor, 1975). Allen Sinai and Roger E. Brinner, The Capital Shortage: Near Term Outlook and Long-Term Prospects, Economic Studies Series #8 (Data Resources, Inc., 1975). The Energy Group, Capital Resources for Energy Through the Year 1990 (Bankers Trust Company, 1976).

3/ Data Resources Incorporated (DRI) Econometric Model for the United States and the Federal Reserve Board (FRB) Quarterly Econometric Model. More detailed information about the methodology and results can be obtained from Allen Sinai (DRI) and Galen Burghard (FRB).

CAPITAL MARKET IMPACT OF SYNTHETIC FUELS PROGRAM

Exhibit 1 - Investment Requirements, Construction, and Production Schedule -- Information Option (350,000 bbl/day) 1/

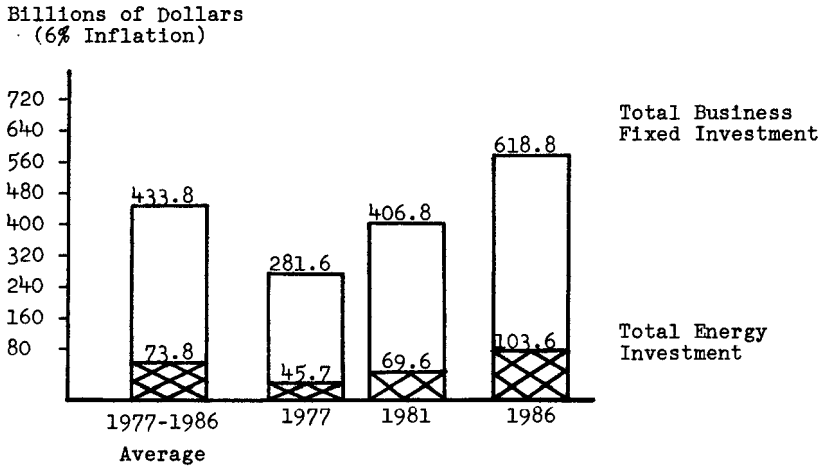
Year	Private Sector Capital	Net Budget Outlay 2/	Total Investment Requirements	Plants in Construction	Plants in Production	Cumulative Prod. Capacity
		($ millions)		(Number)	(Number)	(1,000 bbl/day)
1977	380	12	392	9	0	0
1978	620	26	646	11	0	0
1979	1050	37	1087	14	0	0
1980	1235	55	1290	11	3	18
1981	1520	91	1611	10	4	24
1982	1235	144	1379	9	5	30
1983	855	131	986	3	11	260
1984	380	165	545	2	12	300
1985	95	195	290	0	14	350
1986	50	144	194	0	14	350
1977-86	7420	1000	8420			
1977-2005	7420	2080	9500			

1/ Based on Exhibit 1 of Fact Sheet for Program Budget Estimates (Tab G) and the Synthetic Fuels Commercialization Task Force Report, Volume III, page D-39.

2/ Anticipated Federal expenditures minus loan guarantee fees; $11 oil scenario.

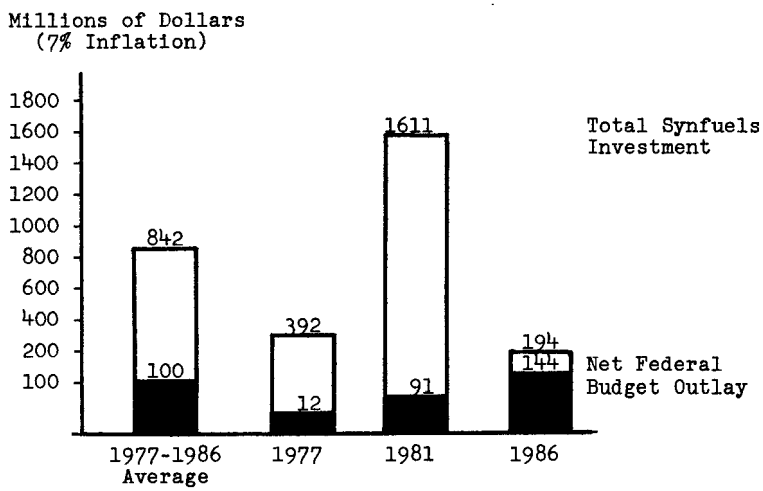
CAPITAL MARKET IMPACT OF SYNTHETIC FUELS PROGRAM

Exhibit 2 - Investment Requirements For The 350,000 bbl/day Synthetic Fuels Program In Relation To Total Energy And Business Investments



Source: Bankers Trust Company - 1974 prices. Their data was adjusted by the historic (1966-1975) implicit price deflator for gross private fixed investment.

Figure 1 - Share of Capital Investment by Business Going to the Energy Industry.



Source: Exhibit 1.

Figure 2 - Investment Requirements for the Synthetic Fuels Commercial Demonstration Program.

FACT SHEET

Environmental Impact

As part of the analysis leading to the recommended 350,000 bbl/day first phase Synthetic Fuels program, an extensive environmental analysis was completed. The analysis included formulation of an explicit environmental protection strategy and preparation of a draft programmatic Environmental Impact Statement (EIS).

The major conclusions of the Synthetic Fuels environmental analysis are:

- Numerous environmental uncertainties exist concerning effluents, pollutant mechanisms and impacts. The severity and types of impacts depend on choice of process and location of plant.

- However, environmental impacts at 350,000 bbl/day level can be minimized through use of existing control technology and programs.

- Considering the information to be gained from the 350,000 bbl/day program, the program is regarded as environmentally advantageous.

In addition to preparation of both programmatic and site-specific environmental impact statements as required by the National Environmental Policy Act, the Synthetic Fuels program would be conducted utilizing a strict methodical environmental protection strategy incorporating the following five major elements:

- Use of environmental protection criteria in evaluation of project proposals. Candidates will be systematically compared with regard to probable primary and secondary environmental impacts, including both direct plant residuals and forecasted secondary and cumulative effects.

- Federal approval and State review of detailed site development plans, as well as off-site project-related plans.

- Extensive coordinated efforts to develop an environmental data base that will benefit the EPA-coordinated Interagency Energy/Environment R&D Program. In particular, the following two Interagency Program objectives will be supported by the environmental data base:

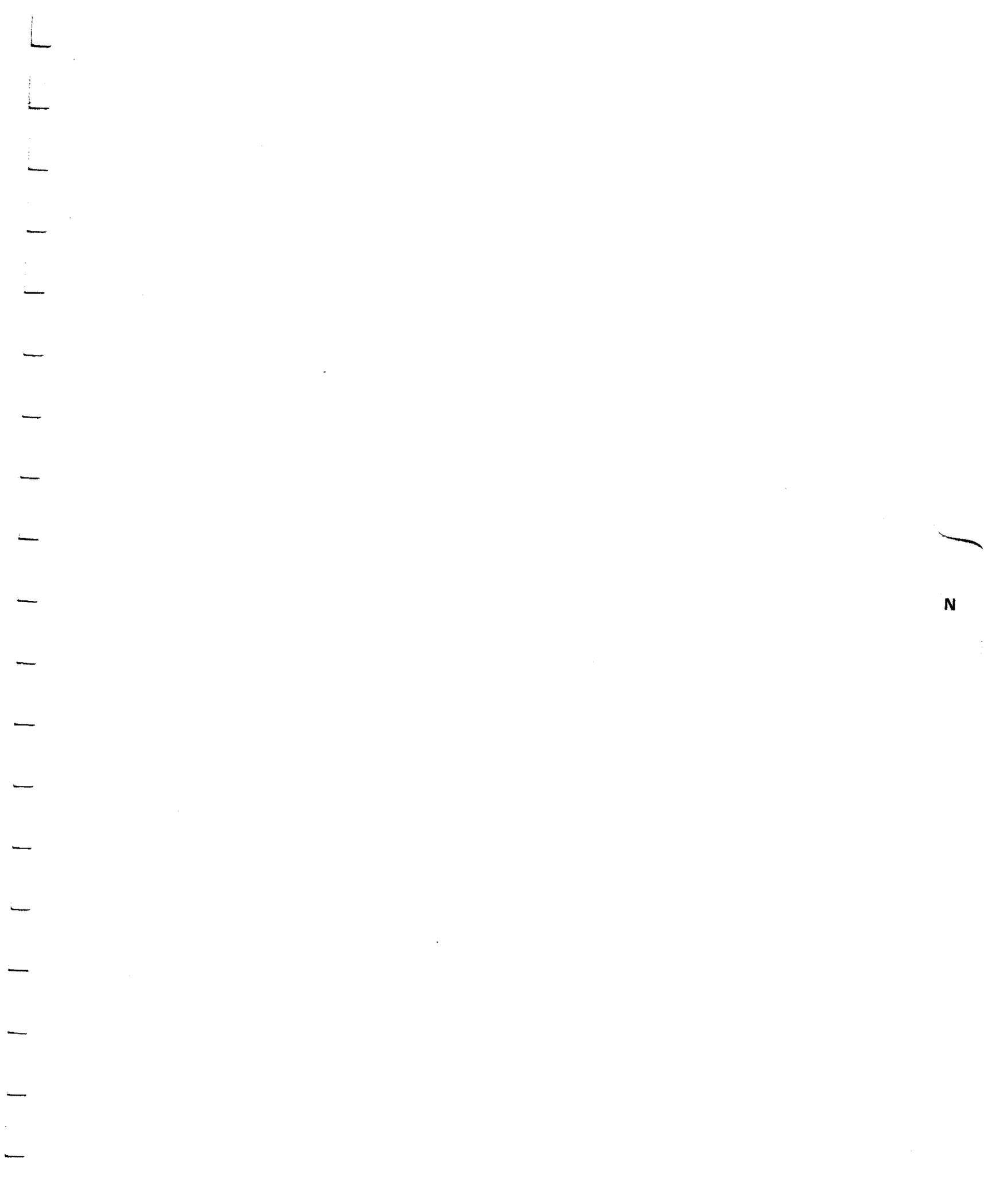
  -- determination of potential environmental impacts of synthetic fuel processing operations of commercial scale.

  -- develop control technology to minimize negative impacts and diseconomies associated with retrofitting.

- Comprehensive environmental monitoring of plants, including ambient air quality, water quality at key well and stream locations on- and off-site, noise levels, continuing investigations into revegetation dynamics and other ecological aspects, and survey of land use changes.

- Environmental advisory committee with state and other representation to ensure regional and state participation in decision process.

Finally, it is intended that the Synthetic Fuels program be carried out in such a manner as to meet or exceed all applicable Federal and State environmental laws and regulations.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FACT SHEET

Water Resources

Water resources considerations for the Synthetic Fuels Commercialization Program focus primarily on water consumption and availability where required. Water supplies in all the potentially affected basins are believed to be sufficient to support the complete 350,000 bbl/day Program, along with anticipated non-energy and in-stream uses.

Water Consumption:

Each kind of plant that could be included in the commercial demonstration program consumes water--both within plant processes and through evaporative losses from cooling systems. Water consumption rates for various standard size synthetic fuel plants are compared with consumption rates associated with other major energy facilities in Chart I.*

In addition to these direct operating water uses, other water requirements assocated with any major coal energy plant--either synthetic fuels or conventional power--would include:

- Mine and plant construction: relatively small water amounts for dust control and sanitation.
- Mined area reclamation: major water consumption for revegetation and/or irrigation.
- Spent shale deposition: major water usage for reclamation purposes.
- Municipal demand increases: about 2-3.6 million gallons per day per standard size plant (from CEQ, Sixth Annual Report, Table 30).

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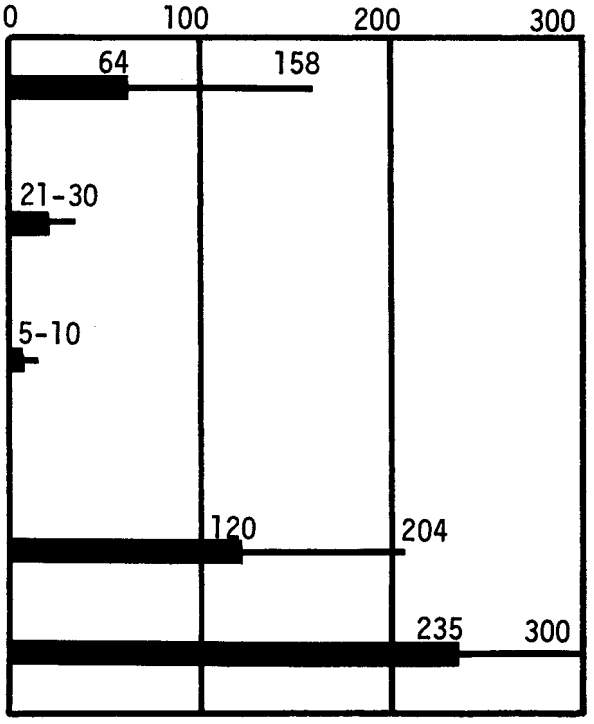
*Sources: Radian Corporation, Western Regional Energy Development Study, August 1975, Table B-6.
USGS, Circular 703, 1974, Page 8.
FEA, Project Independence Blueprint Water Report, November 1974, Table (from WRC and USGS data).
CEQ, Sixth Annual Report, Table 28.

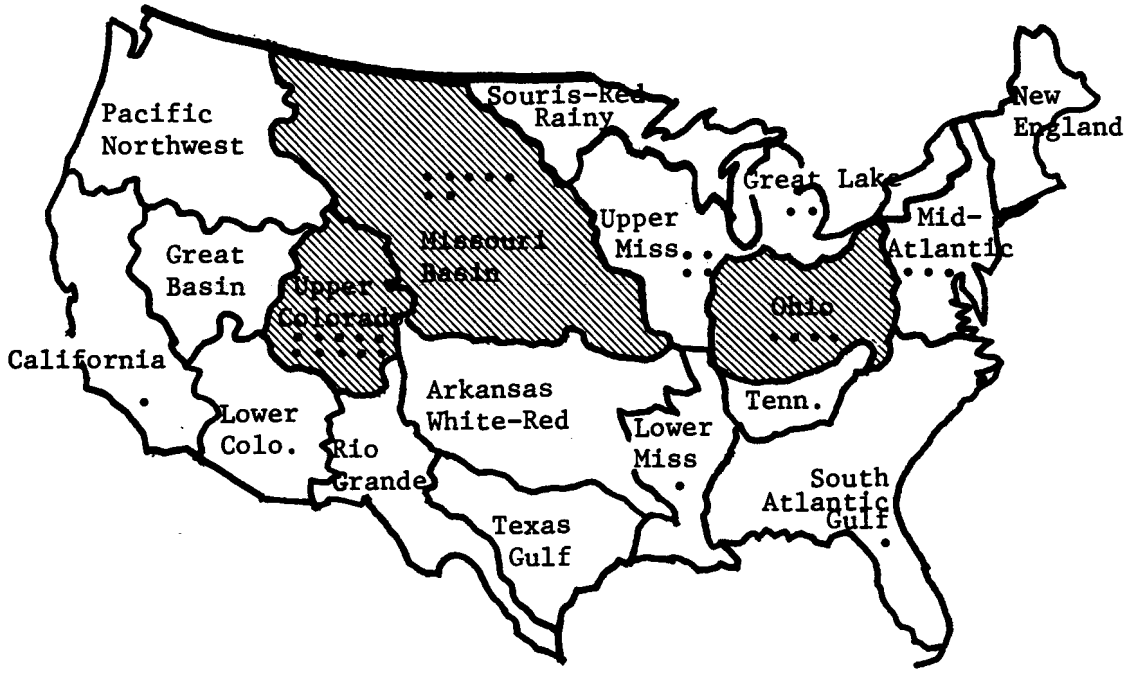
WATER CONSUMED
(million of gallons per day)

Standard Size Units	... per Standard Size Unit	...per Quadrillion Btu Produced Daily (low and high estimates)
• High Btu coal gasification--40,000 bbl/day equivalent	5.8	64 – 158
• Oil shale conversion 50,000 bbl/day	7.3	21-30
• Substitute fuels 25,000 bbl/day equivalent	1.6	5-10
Others for Comparison		
• Coal-fired power plant--1000 mw	7.9 - 13.4	120 – 204
• Nuclear--1000 mw boiling water reactor	15.4 - 19.6	235 – 300



Water Availability:

All identified candidate synthetic fuel projects are located on the map below with respect to the eighteen river basins in the continental United States:



The significant water-using candidates for commercial development are situated mainly in the three shaded basins--the Missouri, Upper Colorado, and Ohio River Basins. Gross water availability within these basins is estimated as follows:

OVERALL WATER AVAILABILITY
IN RIVER BASINS POTENTIALLY MOST AFFECTED
(millions of gallons per day)

	Missouri River Basin	Upper Colorado River Basin	Ohio River Basin
(A) Projected 1985 non-Energy Water Demand	13,600	4,200	1,500
(B) Estimated 1970 Supply*	39,100	5,700	14,800
(C) Available Water Supplies for Energy and In-stream Uses: (B) - (A)	25,500	1,500	13,300
(D) Estimated Water required for 350,000 bbl/day Program**	13	21	5
(E) Percent of Total Supply: 100 x (D)/(C)	0.05%	1.4%	0.04%

Source: FEA, Project Independence Blueprint Water Report, November 1974, Table 11 (from WRC and USGS data).

*Includes natural regulated and unregulated fresh water supplies and groundwater.

**Assumed oil shale plant sites: 1 each in Utah and Colorado. Assumed high-Btu gasification sites: 1 each in four corners area, Wyoming, and North Dakota. Assumed low-Btu gasification sites: 3 in Ohio River Basin, 1 elsewhere. Assumed biomass conversion sites in other basins.

Other factors influence the availability of water for synthetic fuel projects in these basins, including Indian and other legal rights, concurrent municipal and industrial development, and the progress of water resource developments.

Summary:

From the foregoing, water demanded by the complete 350,000 bbl/day commercial demonstration program is a small portion of available water supplies in all potentially effected basins, accounting generally for less than 1%. Irrigation, municipal, and industrial consumption will continue to demand the majority of available supplies. Finally, it is noted that most of the major water-using candidate synthetic fuel plants have already made needed arrangements for obtaining water rights at their planned sites.

FACT SHEET

Socio-Economic Impact Assistance for Synthetic Fuels Commercial Demonstration Program

State and Local Concerns:

Factors which inhibit the ability to raise and invest public capital on a lead time basis give rise to state and local governments' concerns about the secondary impacts of synthetic fuels development. The ability to raise front-end money is a primary factor in preventing or mitigating the adverse social impacts of rapid growth and "boom towns."

These factors include revenue lags, local statutory constraints, inability to market bonds due to the substantial risks involved with synthetic fuels, exposure to risk after bonding due to possible plant delay or failure, and, in the case of Indian tribes, lack of access to traditional sources of revenue and credit.

Need for Federal Aid:

Front-End Money. State and local governments may not be able to raise sufficient front-end capital for planning and development of infrastructure through issuance of bonds because of the uncertainty associated with a plant's ultimate success, particularly if plants are built in remote, undeveloped areas.

Continued Ability to Amortize Debt. After front-end capital is raised and invested in infrastructure, a delay in plant construction or premature shut-down would jeopardize a community's ability to service its debt from plant-generated revenues and could put the community into default.

Estimated Total Costs of Public Infrastructure:

The expected cost of Federally assisted additional public infrastructure development necessitated by the 350,000 bbl/day program is estimated to be in the neighborhood of $425MM over the next 5-10 years. (See Table 1 for derivation of cost estimate.) It is expected that normal and customary State and local taxation will, over twenty years, be more than enough to pay such costs including interest. The problem is how to make sure that happens.

Possible Solutions to Problem:

Analysis was made of several options including use of existing Federal programs; a new grant program; industry financing; and ERDA guarantee of debt service derived from expected tax payments from projects.

The Recommended Solution:

Eligibility:

- A government jurisdiction or Indian Tribe is eligible if a major increase in its total population will occur as a direct result of a synthetic fuels commercial demonstration plant and additional public facilities are required.

- In general, there are three types of areas that will be impacted by synthetic fuel plants.

  (1) A well developed area with significant existing population and supporting facilities; the influx of population caused by the synthetic fuels plant would be small in comparison to existing population.

  (2) Areas with some existing population and supporting facilities; the influx of population caused by the synthetic fuels plant would be a major increase to the existing population.

  (3) Areas with little or virtually no population and supporting facilities; the influx of population caused by the synthetic fuels plant would be an explosive increase.

- In general, undeveloped and partially developed areas and areas of which they are a subdivision would be eligible. Well developed areas and areas of which they are a subdivision would generally not be eligible.

- The ERDA Administrator will promulgate regulations on eligibility consistent with the preceding requirement and after consultation with affected State/local governments. The ERDA Administrator will make final determinations on eligibility. No project application would be approved by ERDA unless adequate State/local planning has occurred and adequate provision has been made for financing and any necessary revenue sharing agreements between jurisdictions. It is expected that the ERDA Administrator will make planning grants available for such planning.

Estimation of Community Facility Needs:

Based on Nation-wide average costs:

- The cost of eligible public infrastructure needed is expected to be $5,500 per capita.

- In remote, undeveloped locations an additional $1,500 per capita may be needed.

- An estimate of total capital necessary for public infrastructure is determined by multiplying the per capita cost by the total plant employment and associated population increase (See Table 1 and accompanying footnotes). In addition, this amount will be adjusted for:

  ---increases due to inflation during the construction period (the per capita amounts of $5,500 and $1,500 are based on 1976 costs);

  ---public infrastructure existing in the area prior to plant construction;

  ---density of population existing prior to plant construction.

Types of Assistance:

The ERDA Administrator will determine which form of assistance is appropriate in each case. Possible forms of assistance include:

Direct loans

Loan guaranties

Guaranty of an annual tax revenue stream

Requiring applicant to prepay taxes

Requiring applicant to bear infrastructure costs

Planning grants

Scope of Assistance:

Depending on local community needs, there will be some restriction on the types of facilities eligible for inclusion in this program. It is not anticipated that assistance will be provided for operating expenses.

The program should:

- make assistance available only where needed,
- make assistance available when needed (at front-end),
- limit assistance to appropriate purposes and in appropriate amounts,
- be relatively easy to administer,

- rely on State and local community participation in decision-making and development of the necessary facilities,
- enhance rather than replace State and local access to capital markets, and
- encourage pass-through of costs to the end user.

Form of Securities:

- Guaranty will be provided if:

  --Interest on bonds will be subject to Federal Income Tax.

  --Municipality(s) agree to earmark sufficient direct tax revenues received from plant (property and other) to amortize debt.

  --Term of debt is limited to two-thirds of the useful plant life, to be fully amortized by equal annual installments.

  --Debt is issued within five years from the start of construction by the plant developer.

- Debt instrument may be called for redemption by guarantor.
- Administrator is authorized to pay interest differential between tax exempt and taxable debt as determined by Secretary of Treasury.

Administration:

- ERDA will administer the assistance program, subject to Treasury concurrence in specified areas.
- ERDA will negotiate directly with the appropriate jurisdiction, generally the affected municipalities on the terms and agreements.
- ERDA will consult with State and local governments, communities and Indian Tribes.

Cost of the Program:

The total of public infrastructure for the 350,000 barrel per day program is estimated to be about $465MM. Allowing $5MM for planning grants for the synthetic fuels plants assumed to be built in partially developed or remote areas, and deducting $45MM for non-Federally assisted facilities, the total estimated cost of Federally assisted public infrastructure for this level of program would be $425 MM.

The current estimated cost of public infrastructure is greater than the $350MM reported previously. The reasons for the increase are:

- Higher cost estimates on certain facilities based on re-evaluation of previous analysis.
- The amount of support for eligible community development projects is increased from a maximum of 75% to a maximum of 100%.
- The new estimates are based on 1976 costs whereas the $350MM estimate was based on 1974 costs.

TABLE 1

POPULATION IMPACTS AND INFRASTRUCTURE COSTS [1/]

Type Plant	During Peak Construction Population	During Peak Construction Costs (000)	During Operation & Mining Population	During Operation & Mining **Additional Costs (000)	**Additional Costs if New Towns Needed (000)	Total Costs (000)
Shale 2 Western in remote areas	21,952	$81,000	21,354	$39,000	$32,000	$152,000
Hight BTU 2 Western in remote areas in 1 Eastern (surface mine) in partially developed area	53,760	$199,000	23,720	$43,000	$22,000	$264,000
Low BTU 1 Western & 1 Eastern (underground mine) in partially developed areas & 2 Eastern (surface mine) in well developed areas	4,480	$17,000	8,795	$32,000	--	$48,000
TOTAL		$297,000		$113,000	$54,000	$465,000 [2/]

1/ See following background material on per capita community costs, additional community expenses because of varying population, new town supplemental expenses, etc.

2/ Exclude $45MM for non-federally assisted projects to be determined at time of local planning analysis and include $5MM for ERDA planning grants.

Per Capita Costs of Community Facilities 1/

(4th Quarter, 1975)

A. Permanent Population.

1.	Water	
	Pipeline	$ 525
	Source Development	58
		$ 583
2.	Sewage and Storm Drainage	
	Sewer Pipeline	$ 181
	Dumping Station & Treatment Plant	93
	Drainage Pipeline	329
		$ 603
3.	Solid Waste	$ 10
4.	Fire	$ 25
5.	Police	$ 46
6.	Recreation	
	Parks & Playgrounds	$ 102
	Open Space Development	16
		$ 118
7.	Libraries	$ 45
8.	Health	$ 241
9.	Education	
	Elementary	$ 1,130
	Secondary	548
		$ 1,678
10.	Streets and Roads	$ 1,144
11.	Government Administration	$ 22
12.	Land Acquisition	$ 377 2/
	TOTAL, 4th Quarter, 1975	$ 4,892 3/
	ESTIMATED 1976 TOTAL	$ 5,500

B. Construction population.

Assumes cost of $3,700 per capita. (Based on analysis done for Wyoming Select Committee which estimates 2/3 of total infrastructure would be in place during this phase.)

C. New town supplement.

Assumes cost of $1,500 per capita. (Based on analysis done for Wyoming Select Committee which estimates infrastructure costs 1/3 more if built in new town than added to existing town.

**Additional Costs are calculated as follows:

A. $1,800 additional per capita for permanent population if permanent population is less than or equal to construction population. Assumes total cost of infrastructure for permanent population is $5,500 per capita and that infrastructure built at $3,700 per capita for construction population is entirely available for permanent population.

B. $5,500 additional per capita for permanent population in excess of construction population.

C. $1,500 additional per capita for permanent population if new town is involved.

Footnotes:

1/ All cost estimates are taken from The Costs of Sprawl, prepared for CEQ, HUD, and EPA by Real Estate Research Corporation (April, 1974) and have been inflated to fourth quarter 1975 dollars using indices provided by the Government Division of the Bureau of Economic Analysis, Department of Commerce.

Costs are based on a community size of 33,000. No economies or diseconomies of scale have been taken into account. It is assumed that the community has a mix of housing types and that the development has been planned.

Costs include allowances for vehicles and equipment.

Costs are based on national averages and reflect present technologies, construction practices and service standards.

Assumptions about capacity and use are in The Costs of Sprawl: Detailed Cost Analysis pp. 90-130.

2/ 32 acres per 1,000 population at $9,000 per acre, from The Costs of Sprawl, pp. 92 and 194.

3/ Costs for Alaska are estimated to be about 45% higher or $7,250 per capita.

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FACT SHEET

State and Local Participation

It is the Administration's intent in planning and in executing the synthetic fuels program to involve fully state and local governments which are likely to be affected by synthetic fuels projects. In particular, a Synfuels Environmental Advisory Board (SEAB) will be established to provide an effective mechanism for ensuring that State and local governments and the public will have a continuing voice in the Synthetic Fuels Commercialization Program. SEAB will advise ERDA officials regarding the overall strategy and implementation of programs for environmental protection, including socio-economic concerns. In particular, SEAB will provide continuing consultation on meeting the main objectives of the environmental protection strategy:

- to ensure that synfuels projects selected are environmentally sound in design, construction, and operation;
- to mitigate or prevent any significant adverse impacts that may otherwise result from a project included in the program; and,
- to develop a complete environmental knowledge base for subsequent decisions concerning synfuels commercialization.

SEAB will advise ERDA with respect to environmental and socio-economic matters concerning the Synthetic Fuels Commercialization Program. The membership of the SEAB would include representatives nominated by Governors, the National Academies of Science and Engineering and ERDA.

As implementation of the program begins, ERDA would publish solicitations for specific synfuels projects only after the Programmatic EIS is completed and the final decision has been made to actually implement the program. A separate solicitation would be issued for each different type of project. Industry would respond with detailed project proposals developed in coordination with State and local governments. Before construction begins on any individual project, site-specific development plans and EIS's would need to be prepared, publically reviewed, and approved. Also, the proposed Environmental Protection Strategy provides substantial opportunities for State and local inputs into the process of selecting individual projects and ensuring environmentally sound construction and plant operations.

FACT SHEET

Program Implementation

The President has decided to proceed with implementation of the 350,000 bbl/day commercial demonstration program involving 12-17 plants. The overall life of the program may extend for 25-30 years depending on the actual operating life of the plants that are included.

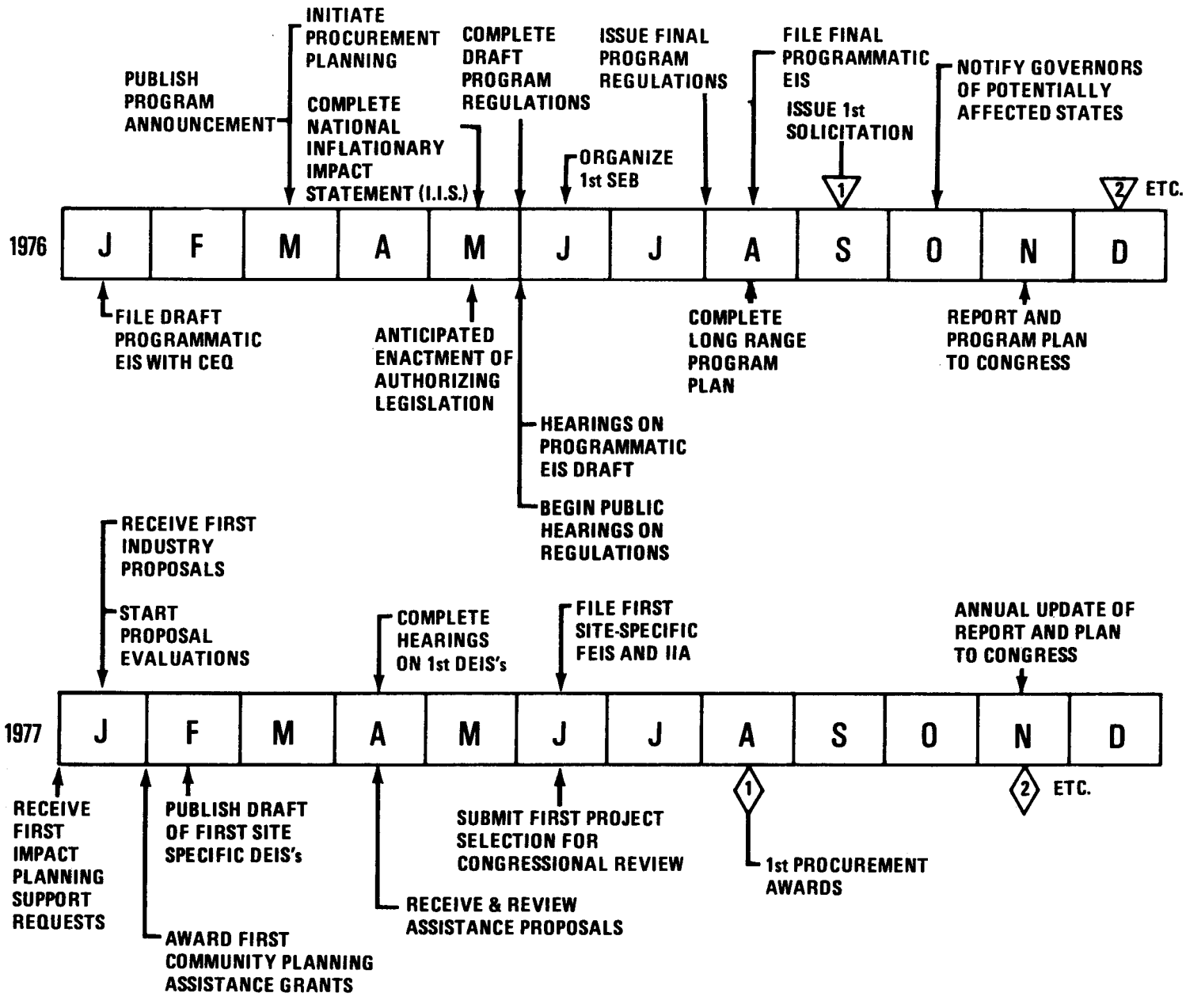
The more significant next steps in implementation include:

- completion of necessary analyses, announcements, etc., necessary to proceed with the program
- Congress providing funding authorizations for the program
- issuance of solicitation for specific project proposals
- evaluation and selection of proposals.

Exhibit A outlines the individual items to be completed and the relative time frames for completion of this phase.

Once final decisions are made and plant selections determined, actual construction of the plants could proceed if regulatory clearances are obtained. The construction period may be as little as three years for a biomass conversion plant to as long as 6-7 years for an oil shale or high BTU gasification plant. Thereafter the plants would become operational and may operate up to 20-30 years.

INTEGRATED SCHEDULE OF MAJOR EVENTS



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FACT SHEET

Relationship of the Commercial Demonstration Program to the Energy Independence Authority

The proposed Commercial Demonstration Program is intended to provide Federal assistance to construct and operate a limited number of synthetic fuel plants to provide economic, environmental and other information to enable industry and government to make appropriate decisions on the future role of synthetic fuels. The Energy Independence Authority on the other hand, would provide a wide range Federal financial assistance to help achieve energy independence goals. The EIA could provide a variety of kinds of financial assistance, including direct loans, to a large number of energy projects, many of which would not necessarily involve emerging technologies. The proposed synthetic fuels information program on the other hand, involves a set of financial tools to assist a specific group of emerging technologies (synthetic fuels).

Much of the planning work for Program initiation has already been completed by the Interagency Synthetic Fuels Task Force and implementation of the program could occur very soon after enactment of the proposed legislation (See TAB Q). It is expected that the EIA will involve lengthy Congressional consideration and would involve some start-up period, delaying early synthetic fuel commercial demonstration efforts. After the EIA has been formed the Synthetic Fuels Program will be transferred to EIA, possibly with construction of some projects well underway.

In the event that the EIA is not enacted, the Synthetic Fuels Commercial Demonstration Program would remain a part of ERDA. ERDA would then request additional authorizations for FY 1977 to fund the full information program.

In the 1979-1980 time frame a decision would be made on the need for a second phase of the program to achieve the President`s million barrel per day goal by 1985.

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