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SHALE OIL

FOCUS GROUP RESULTS

Prepared for

The Department of Energy

Prepared by:

Market Facts - Washington
1150 F Street, N.W.
Washington, D.C. 20006

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REA

The viewpoints that comprise the findings and major conclusions of this report are those of the focus group discussants and not those of the Department of Energy or its contractor, Market Facts, Inc.

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SECTION I

INTRODUCTION

This is a report of the focus group research on oil shale development prepared for the Department of Energy as part of the commercialization program. The purpose of this research is to evaluate the potential for commercialization of oil shale, to determine the barriers to development of this resource, and to judge what actions are required by the Federal Government to promote commercialization.

The research reported herein discusses the issues of commercialization as examined by a focus group consisting of key individuals from various organizations involved in oil shale development. The report addresses the following questions:

- Is oil shale feasible for commercialization?
- What is the nature and extent of the market for oil shale?
- What barriers and opportunities are critical to the commercialization of oil shale?
- What actions, if any, should be taken by the Federal Government to bring about successful commercialization of oil shale?

These questions are examined from the perspective of the respondents in the focus group. Their attitudes, perceptions, opinions and knowledge provide the basis for the data and conclusions presented in this report.

A. BACKGROUND

Recent energy "crises" of various types, combined with growing public awareness of the depletion of natural resources and the deterioration of the environment, have led to increased efforts to discover alternative energy sources and new methods of conserving energy.

The petroleum shortage is an example of an energy crisis. The United States is increasingly dependent on uncertain foreign oil supply. This fact was underscored by the Arab oil embargo of 1973-74. Total imports of petroleum products have grown from approximately 20 percent of our requirements in 1970 to nearly 50 percent in 1977. According to long-range government projections, if present consumption trends continue, domestic and and world sources combined may not be adequate to meet the expected U.S. demand for petroleum.

Faced with these and other energy problems, the Federal Government and the Department of Energy (DOE) have become increasingly involved in the area of energy consumption and conservation. The result of this involvement has been the promulgation of a growing body of regulations, on the one hand, and the active support of the research, development and implementation of energy technologies, on the other hand. These activities will ultimately have a tremendous impact on American society with strong implications for economic, physical, social and psychological issues.

In the area of energy conservation, a number of technologies have been supported. Some examples of these technologies are given to illustrate their impact. High-efficiency electric motors have already been developed in private industry. DOE is considering what actions could be taken to increase their use by the nation's industries since these motors account for a substantial proportion of the electricity we consume. The further development of electric or hybrid vehicles could reduce the amount of gasoline consumed, thus decreasing our dependence on foreign oil imports. Retrofitting home oil furnaces with the more efficient flame retention heads could reduce fuel oil consumption. In light of recent oil shortages during harsh winters, this conservation measure could have a broad impact on the economy as a whole in addition to reducing the owner's fuel bills.

There is a need to develop new sources of energy that will reduce our vulnerability to energy crises and foreign

energy supplies. The variety of sources is illustrated by the following examples. The development of shale oil resources could provide a substantial supply of domestic oil. The installation of low-head hydropower plants in existing dam sites could provide a widespread source of clean energy that would have minimal effect on the environment. The development of wind energy technology is another source of new energy that could reduce oil consumption by replacing some of the use of oil-fired generating plants.

To further these goals of energy conservation and development, the Department of Energy is conducting a program of commercialization for a number of energy related technologies. The intent of this program is to promote conservation of energy and use of new energy sources by bringing these technologies to the market place. By encouraging the widespread use of the appropriate technologies, DOE can attain the goal of energy efficiency.

The commercialization program requires that DOE evaluate a number of energy technologies in terms of their commercialization potential. The particular questions that need to be answered for each technology are these:

- Is the commercialization of this technology feasible?
- What is the extent and nature of the market for this technology?
- What barriers or opportunities can be identified as critical to the commercialization effort and what is the relative importance of each?
- What actions, if any, should the federal government take to promote commercialization of these technologies?

Since the technologies that are candidates for this program vary widely in their technical maturity and economic circumstances, the answers to these questions will have a substantial impact on the course of the commercialization processes.

B. RATIONALE FOR FOCUS GROUPS

The commercialization program is now at the stage of evaluating the commercialization potential of various energy technologies. As a means of guidance in decision-making, DOE requires comprehensive input from key individuals associated with these technologies. Such individuals include representa-atives from government, industry, and environmental groups whose knowledge and expertise enable them to provide input to the decision-making process. The complexity of the issues and interrelationships surrounding those energy problems makes the contributions of such qualified people essential.

The focus group methodology is ideally suited to such an information gathering effort. A focus group brings together a number of individuals whose discussion of the relevant issues is led by a trained moderator. The rationale for such a group discussion is that the interaction of the respondents will produce a more thorough understanding of the topic than would interviews conducted individually. This effect is due in part to each respondent's contribution to the others as well as to the nature of the leadership exerted by the moderator.

The information needs of DOE require input to policy decisions from outside DOE. Such input is best obtained by identifying target populations of organizations and individual roles within those organizations. From these populations, qualified respondents can be selected who represent a variety of opinions about and attitudes toward the commercialization of a particular technology. Such representation helps assure

coverage of the commercialization issues from many viewpoints - developers, manufacturers, distributers, purchasers and users.

The reader should be aware that focus groups have certain critical limitations that must be kept in mind when interpreting data derived from this technique. One must be cautious in making generalizations and drawing definitive conclusions from any qualitative research data, since the information obtained is not only based on a small number of cases, but relies upon a volunteer sample. Such a sample could not be statistically representative of its assumed universe even if it were many times larger. As a result, these findings should be viewed primarily in the context of discovery, offering working hypotheses to be validated with quantitative techniques, if that is the desired goal.

Overall, this report should be read as primarily qualitative, providing insights into perceptions and knowledge of these technologies. The major questions to be answered by the research will describe WHAT, HOW and WHY participants know, think and feel about the issues, with less emphasis to be placed on HOW MANY know or think and feel in given ways. As a result, not every respondent would agree with each conclusion of the report.

Finally, the conclusions presented in this report and the findings on which they are based represent Market Facts' objective analysis of the information derived from the focus group respondents. That is, they do not represent any particular point of view held by Market Facts. Instead, the report is based on the knowledge, perceptions, attitudes and opinions of the respondents as brought forth in the focus group.

C. PROFILE OF GROUP

The research reported herein concerns oil shale development. Since this technology is almost completely confined to the intermountain areas of Colorado and Utah, the focus group was held in Denver, Colorado. The meeting took place from noon to 3PM on July 20, 1978. Dr. Morris Gottlieb, Vice President of Market Facts, Inc., served as a moderator for the group.

There were 9 respondents present at the focus group representing the following types of organizations and interests:

- Environment
- Finance
- State Department of Health
- Architecture
- Engineering
- Oil and gas trade association
- Plant construction
- Oil shale development
- Oil shale leasor

SECTION II

SUMMARY AND MAJOR CONCLUSIONS

This section of the report presents the major conclusions of this research. These conclusions are organized around a matrix of barriers and actions that represent DOE's conceptions of the commercialization issues.

To summarize the group's discussion of oil shale commercialization, the respondents believe that:

- The extent of the resource is very large
- Surface technology is ready for production, though behind schedule, and in situ technology needs further development.
- The projected cost of shale oil presents a substantial barrier at current oil prices.
- Economic uncertainty is further complicated by the lack of a demonstration plant, delays resulting from the permitting process inconsistencies and changes in Federal regulations.
- Capital is needed for front-end costs but oil shale mining is labor intensive as well.
- Capital can help solve the problems of water supply, community development, and regulatory stringency (but not inconsistency).

The respondents feel that the following actions will further the commercialization of oil shale:

- Decontrol the prices of domestic oil to provide both information about shale oil's economic feasibility and capital for its development.
- Control inflation to reduce economic uncertainty particularly related to labor costs.
- Facilitate development by reducing permitting delays and increasing the consistency and stability of regulations.
- Support a privately-run, full-scale pilot plant.

- Provide financial incentives to oil shale development that would be flexible enough to appeal to companies with differing financial positions.

- Promote community development in oil shale areas by coordinating various institutions and supplying a loan fund to communities.

- Relieve the stringency of environmental rules for the pilot plant.

- Provide leadership and research to reconcile the areas of conflict between energy development and environmental protection.

A. FEASIBILITY OF COMMERCIALIZATION

The issue of feasibility of oil shale commercialization can be analyzed on the basis of the following issues:

- Economic Uncertainty
- Environmental Barriers
- Institutional Coordination
- Technological Development
- Nature and Extent of the Market

To summarize this analysis of the focus group research, the respondents perceive a great deal of uncertainty about the commercialization potential of oil shale. They believe that at the present market prices, shale oil will not be feasible.

In future markets, however, they believe that shale oil might be a viable commercial product with prices that are competitive. For this reason, they feel that a commercialization program should continue with the establishment of a full size pilot plant that will resolve the remaining technological problems and refine the broad cost estimates.

The following specific conclusions can be drawn from the group:

1. Economic Uncertainty

The economics of oil shale are highly uncertain. This uncertainty comes from three sources: The nature of the production costs, the lack of demonstration plants to help fix production costs, and the uncertain future price of oil. As a result, the financial risk of oil shale development is perceived to be too high.

The nature of oil shale production costs is considered to consist primarily of capital costs. While this is true to a large extent, it is also true that oil shale is a mining enterprise and mining is a labor-intensive industry. As a result there are high capital costs early in the project. Later the primary costs would be labor related. Since labor costs are highly subject to inflation pressures, they must be considered as unpredictable for the next ten or more years. The labor-intensive nature of oil shale production makes the financing of such an enterprise even more uncertain.

The production costs of oil shale are variously predicted to be from $15 to $30 per barrel. Such a wide range of estimates precludes any serious consideration of financing at this time. It is felt that the uncertainty here can be reduced through the operation of a full scale demonstration plant. Such a demonstration would serve to prove the technical feasibility of the oil recovery process as well as to narrow the range of cost projections.

The absolute size of these cost estimates is perceived to present a further barrier to commercialization. It is assumed that if the price of oil rises at a constant but continuous rate, shale oil prices from surface techniques will not be competitive until 1985 (at $20 per barrel) or 1995 (at $30 per barrel). (Estimates from memo of 5/22/78 from Harry Johnson, DOE.)

These economic barriers are seen as leading to a high financial risk over the near future. Capital cannot be obtained for such a project without extensive government support. Two other factors that would reduce the financial

risk are believed to be the following: 1) the control of inflation to reduce some of the uncertainty associated with oil shale development, and 2) the control of domestic oil prices to establish a more valid market price for oil which would clarify the economic feasibility of shale oil.

2. Environmental Barriers

Another focus of uncertainty is considered to be the environmental impact of oil shale development. The petroleum industry representatives feel satisfied that their industry can meet any stable set of environmental standards. Their primary concern is developing a consistent set of rules that will not change over time. On one hand, the environmental representative feels that the current laws are not enforced and that oil shale development could result in substantial damage to the environment. In response, the petroleum industry feels that environmental standards are set arbitrarily high. Furthermore, these standards are felt to be protecting interests other than the health needs of the nation such as aesthetic and recreational desires.

The petroleum industry and environmentalists agree on two issues, however. One is that substantial delays in development can be created through the permitting process or the courts. The other is environmental impacts. These two areas of agreement suggest that further information is needed to reduce the levels of environmental uncertainty.

It is the opinion of the group that a full size pilot plant could be used to demonstrate the environmental effects of oil shale development. Such a plant could be used to

evaluate some of the environmental controls through experimentation. If regulations could be relaxed for a single plant, engineers could try a variety of environmental controls to evaluate their effectiveness in the field, rather than through theoretical or laboratory analyses. Thus the result of a temporary relaxation of environmental regulations could be an overall improvement in environmental protection.

3. Institutional Coordination

Two kinds of institutional coordination are perceived to be barriers of lesser importance to oil shale commercialization. The first involves the permitting process and is largely concerned with environmental issues. The second is the coordination necessary to develop the living communities for the employees of oil shale developers. The community development involves both social and economic barriers as well as problems with water supply that require coordination at a regional and local level. The formation of capital to finance these communities would be facilitated by the prospect of future tax revenues. The issue of water and how it would be allocated between oil shale processing and community needs is also seen as requiring coordination of state, federal and local governments.

4. Technological Development

The oil industry representatives feel confident that any technological problems can be overcome. Although the current sites are not yet producing shale oil, the respondents see this as a learning process through which technical improvements will develop.

The environmental representative feels that current technologies are not capable of satisfactorily reducing environmental impacts. He further believes that DOE should encourage further research and development to improve this situation.

5. Nature and Extent of the Market

The primary use of shale oil is considered as boiler fuel. With further treatment, it could be used as refinery feedstock or for petrochemicals.

Since these uses of shale oil represent a considerable proportion of the petroleum market, the market potential for shale oil is high.

Other developing technologies believed to be competing with shale oil include enhanced oil recovery, alcohol, and coal gasification. This competition will occur for capital development funds as well as for market shale. The total extent of the market will be further influenced by conservation efforts and the development of alternative energy sources such as wind or solar energy.

Since the potential uses of shale oil are so diverse, its market share is determined by its relative cost and the availability of other petroleum sources.

B. CRITICAL BARRIERS AND ACTIONS

The following barriers are judged by the respondents to be critical to the success of oil shale commercialization. These barriers are presented roughly in order of perceived importance.

1. Shale Oil Economics

The projected costs of shale oil are as large as $30 per barrel in 1977 dollars. This is approximately twice the current cost of oil. A separate issue from the size of the costs is their uncertainty. Some of the uncertainty is believed to be due to projections of labor costs. Permitting delays also are seen as contributing to this uncertainty. Changes in capital costs are less of a factor.

As a means of reducing the uncertainty of the cost estimates, the group recommends these federal government actions:

- Control inflation - this action would have the primary effect of stabilizing cost estimates, particularly from labor costs.
- Decontrol the price of domestic oil - this action would set a more realistic price for oil against which projected costs for shale oil could be compounded.
- Promote the consistency of regulations - this action would allow the planning process to be more precise.
- Reduce permitting and court delays - this action would also facilitate planning.
- Provide assistance to build a privately-run, full size pilot plant - the experience from this plant would further refine cost estimates.

The respondents suggested the following actions that would reduce the costs of shale oil development:

- Re-examined the stringency of environmental regulations - this action would require less research and development on environmental protection controls.

- Provide a program of financial incentives that fits the varying needs of oil companies - this set of actions could allow the developer to choose the incentive that would reduce costs most effectively for its own financial circumstances.

2. Rural Community Development

The development of oil shale resources will require the establishment of local communities to serve the needs of the workers and their families. These communities will need the prompt development of roads, schools, housing and, particularly, water and sewage facilities. In addition to the capital needs of these communities, unforeseen socioeconomic problems may arise from an interaction of events.

The respondents feel that the following actions by the federal government would alleviate these problems:

- Promote capital resources through the establishment of a revolving loan fund backed by local tax revenues.
- Coordinate with state and local governments to monitor regional effects of development that might not be noticed by a single leaseholder.
- Facilitate the development and coordination of water resources necessary for community development.

3. Environmental Barriers

The environmental barriers are discussed above as problems of inconsistency, delay, and stringency that increase the costs and uncertainty of costs for oil shale development.

The respondents agree that a consensus of what is "acceptable environmental impact" is unlikely to be reached. Under these conditions, the following federal government actions are suggested:

- Relieve the stringency of environmental rules for the pilot plant so experiments may be done to seek effective and efficient environmental control procedures.
- Reconcile the mutual needs of energy development and environmental protection.

The environmental position is that oil shale development can have strong effects of an undesirable nature. The uncertainty associated with these environmental effects must be explored. The following actions are felt to be effective means of reducing these barriers:

- Support research into the possible adverse environmental impacts of oil shale production.
- Support development of technology that would protect against those effects.

C. ROLE OF THE FEDERAL GOVERNMENT IN THE COMMERCIALIZATION PROCESS

The overall sentiment of the group is that the federal government should be involved in the commercialization of shale oil. Representatives from various groups differ profoundly in the nature of the involvement desired, however there is no question that such involvement is necessary for the following functions:

- Administration and monitoring of environmental effects
- Financial planning and assistance
- Coordination of interagency relationships to reduce delays
- Coordination of state and local infrastructures in community development
- Management of water resources

SECTION III

MAJOR FINDINGS

This section of the report presents the detailed results of the focus group. These results are the basis for the conclusions drawn in the previous section.

A. RESOURCE AVAILABILITY

To summarize, the respondents generally agree with the DOE analysis of oil shale resources. However, they point out quickly that the costs of recovering those resources are highly variable and should be considered part of a reserve analysis. Many respondents feel that the production schedule is behind the DOE estimates. Although water resources are known to be a problem, there was some expression of confidence that they could be sufficient for the anticipated production levels.

The following discussion elaborates the respondents evaluation of resource availability. The respondents are in general agreement with the DOE analysis of resource availability. The total quantity of oil shale resources is expected to be two trillion barrels of shale oil. Of these resources, 600 billion barrels are in high grade shale (25 or more gallons of oil per ton of shale).

When economics of recovery are considered, however, the respondents feel that substantially lower quantities are recoverable, although precise figures were not given. The respondents feel that larger proportions of the resources can be recovered at higher costs than those currently projected. In making the distinction between a resource and a reserve, there is some feeling that the costs of recovery should be an integral part of any judgment about the size of the reserves. The extent of the resource, then, is the amount of shale oil present, regardless of the cost of recovery.

The respondents were given the following DOE estimates of the shale oil production schedule:

YEAR	BARRELS OF SHALE OIL PER DAY
1985	200,000
1990	600,000
2000	1,400,000

One respondent remarked that he had recently seen DOE figures that were about 50% higher than these. Many respondents indicated that they are often skeptical of DOE figures because of inconsistencies of this sort. Another said, in reference to an earlier DOE estimate, "I doubt very seriously that by 1985 that shale oil would be 6% of the U.S. oil supply".

The respondents feel that the estimates presented in this meeting are "overly optimistic". They do not believe that the construction of commercial oil shale plants will be completed in time to meet such a schedule. One respondent said that there would be a four year delay between the beginning of plant construction and actual oil production.

Another respondent feels that problems in meeting air quality standards would further reduce the quantities of shale oil produced. The extent to which these standards would delay shale oil production is believed to depend on two factors. First, air quality standards might be relaxed at the stage of initial plant development. Secondly, technological advances in controlling emissions might increase the rate of development.

An abundant water supply is another aspect of resource availability that will influence the development of oil shale.

Water is needed both for processing the shale as well as for meeting the human needs of the labor force living in the area of the plant. The respondents agree with the DOE projection that enough water is available to process 500,000 barrels per day.

However, some uncertainties about water exist among the respondents. Some feel that water is a serious problem that must be resolved. Others are more optimistic -- the quantity of water is not the problem, only its cost.

B. TECHNICAL BARRIERS

To summarize this discussion, the general consensus is that surface technology is ready for commercialization efforts in the form of a pilot plant but that in situ techniques require substantial development. It was also suggested that further technological development might lead to more acceptable environmental impacts. Limited federal action is seen as desirable for establishing a pilot plant that would be owned and operated by private industry. A discussion of these issues follows.

The respondents from private industry feel that a full size pilot plant using surface technology is needed to demonstrate the economic and technological feasibility of the process. They are confident that such a pilot plant would be successful, but they feel it is necessary for two reasons. First, it would provide a basis from which to refine cost estimates for surface retorts. Secondly, it would provide a final test to uncover any unanticipated technological problems that may result from changes of scale.

The respondents feel strongly that such a plant must not be a federal project. They believe that operation by an oil company would be a more valid test of the commercial potential of shale oil production. Furthermore, they feel that private industry could complete such a project more quickly.

The in situ processes are not seen as ready for commercialization at this time. The respondents are unwilling to characterize the various in situ projects as failures, however, they feel that more research and development are needed before pilot

plants could be built. The respondents seemed to focus most of their discussion on surface techniques, reflecting their beliefs in its commercial readiness vis-a-vis in situ techniques. Regarding the prototype leasing program, one respondent said, "It is not a failure yet. We haven't reached any production but there are still four active leases." Nonetheless, oil industry representatives feel confident that they have learned from the prototypes and are progressing toward production on a commercial scale.

The environmental representative disagrees with the other respondents about the commercial readiness of surface technology. He believes that solutions to the environmental problems lie in finding the appropriate technology. For this reason, further research and development are needed to generate new technologies that are environmentally acceptable.

Oil company representatives disagree strongly with this position. They feel that, "DOE should provide incentives for development to find out if oil shale can stand on its own two feet. You must have a full scale prototype first ...a prototype industry."

C. ECONOMIC BARRIERS

The discussion of the economic barriers to oil shale development was organized around four issues. The first is whether shale oil can be competitive on the open market. The respondents agree that demand would be sufficient to absorb the production, however, the cost of such oil might be prohibitive. Most respondents feel that decontrol of domestic oil prices would clarify this issue.

Secondly, the costs of production are estimated over a wide range. The respondents feel this is necessary because only a full scale prototype plant could provide the evidence necessary to refine these estimates further. It was further noted that, while shale oil development is highly capital intensive, labs costs contribute significantly to the expense of production.

A third issue is the nature of the financial incentives that would be most effective in promoting development. The $3 per barrel tax credit is seen as a positive factor, however there is some question about the precise dollar amount of credit that would be effective. Other financial incentives, such as decontrol of domestic oil prices, accelerated depreciation, and loan guarantees were discussed in terms of their effectiveness for a company's specific financial status.

Finally the issue of financial risk was discussed. The respondents feel that the level of risk is difficult to specify since it is seriously affected by oil prices and inflation. Although the capital costs can be closely estimated, they believe that labor costs and income from oil shale are areas of fundamental uncertainty.

A detailed discussion of these economic issues follows.

1. Shale Oil Economics

The respondents discussed the economic status of oil shale vis-a-vis competitive fuels. To define the area of competition, they agreed that shale oil is most easily used as boiler fuel. Further treatment would allow its use for refinery feedstock or petrochemicals but this would result in slightly increased costs per barrel.

The directly competing energy sources as perceived by the respondents are enhanced oil recovery techniques, alcohol (or gasahol), coal gasification, and further exploration for petroleum fields. In a larger context, coal and nuclear energy are also seen as possible competitors.

The respondents perceive oil shale development as competing for investment capital as well as for a share of the market. The development of other petroleum technologies are perceived as alternative targets for substantial amounts of government and private financing.

Although, the respondents feel that there is some uncertainty about how well shale oil can compete with other petroleum energy sources, they cited evidence based on decisions by other oil companies. One company

was reported as favoring the development of an oil shale plant over further drilling -- in this case a lease in the Baltimore Canyon was evaluated as less profitable than oil shale. On the other hand, companies without oil shale leases were reported as not moving toward oil shale development. The respondents believe that potential regulatory and leasing problems lead some companies to believe that shale oil would not be profitable from their perspective. Companies who already hold leases, however, are perceived as having a more favorable position for profitable development.

The question of whether shale oil can meet the economic test of the marketplace was met with uncertainty from a number of sources. The respondents feel that the establishment of a tax credit of $3 per barrel would substantially improve shale oil's potential for profitability. However, they are not certain that $3 is the correct amount. The decontrol of domestic oil prices is another action that they believe would reduce the uncertainty associated with oil shale. The respondents were not certain, however, that the outcome would be favorable.

2. Production Costs

One economic barrier to oil shale development is the uncertainty regarding the cost of production. The range of estimates varies from $15 to $30 per barrel. Such a large range of cost estimates is perceived as a strong deterrent to financing and developing full scale production plants.

The consensus of the respondents is that the lack of full scale pilot plants is responsible for the wide range of cost estimates. They feel that the construction of a pilot plant is necessary to deal with any problems that would result from an increase in the scale of production. One respondent feels that a pilot plant is necessary "to see if there is some unanticipated problem that will totally knock you out." Such a test is perceived as a prerequisite for a complete risk assessment prior to any commitment to financing oil shale plants.

A further effect of a full scale pilot plant is felt to be a refinement of cost estimates once pilot production has begun. Since shale oil is not an operating industry at this time, the respondents feel strongly that a demonstration must be made to reduce the uncertainty of per barrel costs. Only after such a demonstration has been conducted would they be willing to project these costs to a commercial plant.

The respondents placed a further constraint on the nature of the pilot plant. They feel strongly that it must not be a government operation. One respondent said that "government financing of pilot plants elongates the time schedule because you have to go through DOE bidding procedures." He feels this could take from two to five years. He further feels that "this discourages thrift and other things so you don't have a true test" of the plant's feasability. The concensus of the respondents is that such a pilot plant should be operated by a private company if accurate cost estimates are to be determined.

Other aspects of cost uncertainty were also discussed. Capital expenditures are perceived as relatively stable. The respondents feel that an estimate of one billion dollars for a full scale production plant (50,000 barrels per day) is an accurate estimate that has not changed much in the last few years. They agree that the magnitude of such an investment is such that it represents a substantial barrier unless the potential profitability of such an installation is demonstrated.

Another respondent feels that the focus on capital costs has resulted in the neglect of the labor costs of shale oil production. He believes that oil shale operations are more similar to mining than other petroleum technologies such as enhanced oil recovery.

He feels that for this reason "labor costs are higher for oil shale than for most other petroleum operations." Since mining operations are highly labor intensive, he feels that the uncertainty of labor costs must be calculated into the production costs. He said, "I have no idea what labor rates will be in 1990." This is in contrast with his feeling that "we know what capital costs will be over the next five to ten years." Such increased uncertainty is a further contribution to the barrier of the potentially high cost of shale oil.

3. Financial Incentives

A number of possible DOE actions that would promote oil shale development in terms of financial incentives were discussed. One respondent noted that oil companies have differing financial situations particularly with respect to capital holdings which would make some of these incentives more desirable than others. The discussion that follows examines the nature of the incentives and the kinds of economic appeal they hold. The incentives were the decontrol of domestic oil prices, the $3 per barrel income tax credit, accelerated depreciation, and guaranteed loans.

Some respondents feel that the decontrol of domestic oil prices would provide a financial incentive as well as reduce uncertainty about the economic feasability of shale oil. The primary benefit appears to be a more favorable capital position for the oil companies. However, some slight possibility that oil prices

might decrease was acknowledged by the respondents.

A second benefit of domestic decontrol is informational. The respondents feel that the return of a free market might "clarify the economic environment" for shale oil and, in fact, all synthetic fuels. The respondents are not certain that shale oil would pass this economic test. However, the reduction in uncertainty is perceived as highly valuable since it could specify the economic conditions under which oil shale development would be feasable.

The $3 per barrel tax credit is another incentive that was discussed in terms of its ability to promote oil shale development. The respondents believe that such an incentive would only help a company that had profits large enough to benefit from the tax credit. Since profits from oil shale would take some time to accumulate, they feel that a company must have other operations that are highly profitable to realize any effect from this incentive. They noted that a $3 credit is in effect a $6 per barrel reduction in the cost of shale oil to the company. Still, they feel that the $3 amount is somewhat arbitrary and may or may not be successful in adjusting the cost of shale oil appropriately.

A third kind of incentive is accelerated depreciation. It is felt that only companies with substantial capital would benefit from this incentive . Since it does not actually raise capital, many companies would

pass such a measure since it is not seen as politically acceptable.

The final kind of financial incentive is loan guarantees. They feel that such an incentive would favor smaller companies with little or no capital. Some respondents feel that loan guarantees would not help a larger company. They believe that if a large company defaulted, its borrowing ability would suffer in the future. Although a loan guarantee would help in capital formation, it would not reduce some of the consequences of risk for that company. Loan guarantees are further perceived as politically unpopular and, hence, unlikely to be passed by Congress.

4. Financial Risks

The economic uncertainties associated with shale oil are seen as justifying the high financial risk usually perceived in its development. Although the capital costs are believed to be well defined, the selling price of oil and inflation are perceived as key elements in profitability. If domestic oil prices were decontrolled, regulatory uncertainty reduced, inflation controlled, the respondents feel the amount of financial risk could be gauged more closely.

A discussion of the issues of financial risk follows.

The financial representative believes that the approach to financing oil shale is similar to that

of any other industrial development. The first step is to define the limits of risk. To do so, the costs of each problem should be analyzed to at least 80% and preferably 90% accuracy. Only then would lending institutions put money into such a project. If such a risk analysis cannot be done, then financing will be difficult "without credit guarantees or other strings attached."

Another respondent feels that industry can put upper limits on the costs. The real problem is seen as cost inflow - income from selling oil. Although oil is a high demand product with an inherently lower risk, price controls may make shale oil unprofitable.

As a result, this respondent feels the most important factor in risk assessment would be to decontrol the price of domestic oil. Once the price had stabilized in a free market, he believes that the level of risk could be more clearly determined. Decontrol would also increase the rate of capital formation within domestic oil companies, losing their external financing requirements somewhat.

The oil industry representatives also feel that regulatory uncertainty increases the financial risks as well as absolute costs. They feel that DOE should adopt a posture of clarification. They believe that action should be taken to "rationalize regulations" so that planning can be made in a stable environment. Furthermore, they feel that DOE could act to "reconcile

developers and environmentalists". Some do not perceive energy and environmental needs as mutually exclusive. It is hoped that DOE could serve to mediate this conflict.

Finally, the respondents believe that control of inflation could help reduce financial risks. One respondent noted that labor costs continue on after the capital expenditures have been made. Since inflation makes labor costs relatively unpredictable, any steps that could reduce inflation would increase the feasibility of financing oil shale development. The respondents further realize that inflation is not under DOE control. They raise the issue to emphasize its role in hindering risk assessment.

D. ENVIRONMENTAL BARRIERS

To summarize, the primary concern of the respondents is the climate of regulatory uncertainty that surrounds oil shale development. Problems with court delays and inconsistent regulations dominated the discussion of environmental issues. Oil company representatives are confident that any given set of environmental standards could be met, but seen frustrated by what they perceive as frequent and inconsistent changes in these standards.

Of secondary concern is the stringency of the regulations. Environmental concerns were discussed as arising from public concern for health and aesthetics. The respondents agree that some change in the environment must occur as a result of any sort of development. The real question is that of what is acceptable change under circumstances that may require trade offs between energy and environmental needs.

Many respondents feel that DOE should coordinate and clarify the regulations that cover oil shale development and production. Some feel that DOE should reconcile developers and environmentalists. Both actions are perceived as reducing uncertainty and unnecessary delays in decision-making.

What follows is a discussion of the environmental issues raised in this focus group.

Oil company representatives are particularly concerned with the uncertainty surrounding the environmental protection requirements of oil shale development. They cite two major contributions to this uncertainty: delays as a result of court proceedings and

environmental studies, and changes in environmental regulations.

1. Delays in Development

Oil company representatives feel that the present system encourages delaying tactics for those who oppose development. They suggest that limits be placed on the time allowed for environmental studies. The following comments illustrate the industry's feelings on this issue:

> "We have established a mechanism that encourages the imposition of delays by people who may or may not be affected by it (shale oil development) and may or may not understand the problem."

One respondent claims that legal appeals have delayed oil shale plant approval for 5 to 10 years. Citing this as an example of unnecessary delay, he suggests that alternative procedures should be developed to resolve environmental issues without resorting to legal action. This individual expressed his frustration in the following way:

> "The delays bring about uncertainties and change circumstances in ways that make it very difficult for industry to live with. I'm all for groups having their say, having inputs to projects, but there should be legislated time limits."

The environmental representative agrees that such actions would reduce uncertainty. However, he believes that environmentalists perceive the existing enforcement of laws as not strong enough. He feels that these actions would result in less protection of

the environment, since environmentalists do not have the resources to examine all the consequences. He said, "If all these permits hit us at once, we would be totally overwhelmed."

He further feels that, "the existing laws don't mean anything if they aren't enforced and to a large extent they aren't enforced in the way we would like to see them."

2. Regulatory Uncertainty

The second focus of uncertainty expressed by oil company respondents was the inconsistent nature of federal regulations. They believe the rules are constantly changing to be more restrictive. Such changes in the interpretation and importance of environmental laws are perceived as a major cause of the increasing delay and cost of oil shale development. These respondents feel confident they can meet environmental standards, but further feel they are presented with changing rules that result in wasted effort and expense.

The process of planning such development is described as requiring considerable lead time. The respondents expressed their frustration as making repeated alterations in plant design. One respondent feels, "We are designing to a moving target at all times and that complicates life."

Oil company representatives believe that some of the uncertainty is inherent in our understanding of what conditions are harmful to the environment. They believe, however, that the "worst case" is predictable, and has been protected against. The bulk of the uncertainty, they believe, is due to constantly shifting regulations that are based on somewhat speculative analyses of the possible impact of development. Regarding the strictness of some quantitative regulations, one respondent reported, "I have dealt with agencies that said, 'Well, its been that way for some time, so let's cut it in half.'"

Another respondent feels that a period of uncertainty follows any legislation and that the number of energy-related and environmental laws passed recently has increased the confusion. He suggests that such legislation be reviewed to consolidate it into a consistent set of rules. He further suggests that some of the rule changes are a result to interdepartmental conflicts among government agencies that have caught industry in the middle.

One respondent said of interagency conflict, "We have bureaucratic feifdoms set up. Where they should be cooperating, they are in opposition." Another respondent added that, "Industry gets caught in the crossfire."

An industry representative clarified the point that the issue was not circumventing environmental laws. Instead he seeks a consistent of rules that would be reasonably stable over a period of time whose effect would be to reduce the uncertainty associated with planning for the future.

3. Regulatory Stringency

Another issue was the substance of the regulations themselves. Oil company representatives are concerned with the stringency of the environmental regulations. Some respondents feel that although environmental rules were developed to protect health, they now protect aesthetic and recreational needs. The environmental representative disagrees that these concerns are based on recreational needs, but instead reflect the possibility of dangerous and extensive environmental damage.

Oil company representatives feel that the regulations consist of fixed standards that must be met immediately. This inflexibility precludes any opportunity to experiment with different techniques that might be superior in cost and effectiveness. One states, "We must satisfy the most stringent requirements instantly for the first day of operation."

Another respondent feels it would be "worthwhile to have flexibility built into the rules in special cases." A further comment affects the feeling of frustration with what is perceived as strict and unyielding regulations: "There is no allowance for correction - no variance, no appeal, no nothing."

The State regulatory representative agrees that the federal rules are too restrictive and inflexible. He further believes that if Colorado were given primacy, it would provide a more flexible and reasonable interpretation to the standards, consistent with Federal laws.

Oil company representatives also feel that the regulations are based on theoretical analyses that are not calibrated precisely. Although the theory may be correct, a failure of accuracy in the empirical analysis results in unrealistically strict standards. Furthermore, they believe these standards demand zero environmental risk without any possibility of trade offs between energy and environment. They feel that developers and environmentalists disagree on the degree of environmental impact considered acceptable.

There is some feeling that the best available methods are used to develop environmental standards and that these are not developed as absolutes or "zero-risk" goals but as attempts to minimize harmful impact. The feeling is that most people

recognize the trade-off relationship. Furthermore, it is felt that the knowledge gained from pilot plants would result in more accurate and realistic standards.

One oil company representative feels that public opinion may have changed since these environmental laws were passed. Public concern about energy supplies may be greater than their concern for the environment, but the regulations are too inflexible for their concerns to be reflected. He suggests that DOE must examine how people will react to their future energy needs when confronted with rigid environmental regulations.

The environmental representative feels that, "in terms of what DOE could be doing, that the emphasis here on commercialization is really misplaced. We are not prepared now to go into this effort for oil shale because the technology is not there yet. We need more R and D into oil shale technology." In particular, he feels that current technology is not capable of meeting acceptable environmental import.

An oil industry representative replied, "My definition of environmental acceptability is whether we can comply with the regulations and I think we can do that."

Another respondent said, "I would like to see DOE instill themselves, if you will, with the commitment I heard from the Department of Defense ... (to be sure) we have adequate energy supplies in 1985."

Finally, a respondent remarked, "We need to prepare now. It's in the national interest."

4. Institutional Aspects of Environmental Barriers

The discussion of environmental problems became largely an issue of institutional barriers. Delays in obtaining permits and approvals are perceived as more important than the actual number of permits and approvals. Inconsistencies among these regulations and changes in the rules are perceived as the fundamental reasons for the delays.

The gist of the discussion is that DOE should act in two ways: First, inconsistencies among regulations should be resolved so that the most strict regulations are immediately apparent. Such action might reduce the number of permits required but, at a minimum, should result in coordination among the state, local, and federal agencies involved. Secondly, DOE should do whatever it can to enhance the stability of the standards once the planning process for an installation has begun. This might require anticipating tougher standards and increasing levels of communication with the developer early in the project.

The oil company representatives seem to feel that the problems of coordinating and managing institutional requirements exceed those of meeting environmental constraints. They feel that the economic consequences of institutional barriers are strongly detrimental to the time development of oil shale energy.

E. SOCIOECONOMIC BARRIERS

The rapid development of rural areas is seen as presenting a set of problems that can be overcome with careful planning. Three kinds of barriers are anticipated: the capital requirements of developing a town, the social issues of community development, and water resource management.

The following is a discussion of the respondents' perceptions and beliefs about these issues.

A principal problem in developing these communities is perceived to be a supply of capital for streets, services, and other residential needs. The respondents believe that these needs could best be satisfied by loans from the federal government, since other financial sources would be wary of such an investment. These government loans would be backed by the future tax resources of the communities. Such an arrangement is felt to be inexpensive to the federal government while allowing the local area to retain a substantial measure of autonomy.

They feel that changes in state tax laws could have a beneficial effect for those communities. A proposal to equalize property taxes is believed to have failed to pass the state legislature. An oil company representative considered the possibility that DOE might have some influence on state tax laws that would help these new communities. In particular, they feel that allowing the oil companies to pay their taxes in advance could provide "front-end money" to help community development.

The respondents recognize the socio-economic problems that might arise from the rapid development of a resident labor force

in previously unpopulated areas. Success is resolving these problems is perceived to lie ultimately with the local population with the help of state and federal coordination and loan assistance.

State and local action in this area has already come to the attention of the respondents. The State of Colorado has already prepared a report on the problems of "boom towns". The respondents feel that such state action is desirable since it coordinates the solutions to problems in an integrated fashion.

The respondents also feel that DOE could serve such a coordinating function in conjunction with the state and local governments. A single developer may not be aware of problems that cut across lease holding or resulted from the joint but uncordinated action of developers. They feel that DOE could play a significant role in monitoring such effects. One respondent feels "It's a problem that involves regional consensus, overlapping impacts between projects and things like that which make it difficult for a single developer to cope with by itself."

The respondents feel that the coordination of the governments involved would mitigate problems of demographic changes. One respondent said, "Any increase in population will be looked at as a terrible problem by somebody."

The supply of water is known to be a potential problem in development of communities. The respondents acknowledge that "water is a big factor" but one respondent believes "I'm not really concerned about that." Some kind of water management programs are seen as necessary to meet the needs of the residents as well as shale oil processing requirements.

The fundamental problem with water is believed to be its cost. The respondents feel that the supply is adequate both for processing the shale as well as for supplying the roads of the communities.

APPENDIX

MF
MATH

Oil Shale

ECONOMIC BARRIERS

- Projected economics range from $15-30/bbl and are uncertain since no commercial plants have operated. BI=5*
- Shale oil is most economic of syn fuels but, without incentives, is not competitive with imported crude. BI=5
- Projected high capital cost, i.e., $1 Billion/50,000 bbl plant. BI=5
- Uncertain economics, compounded with the economic impact of environmental/regulatory problems, translate to high financial risk. BI=5

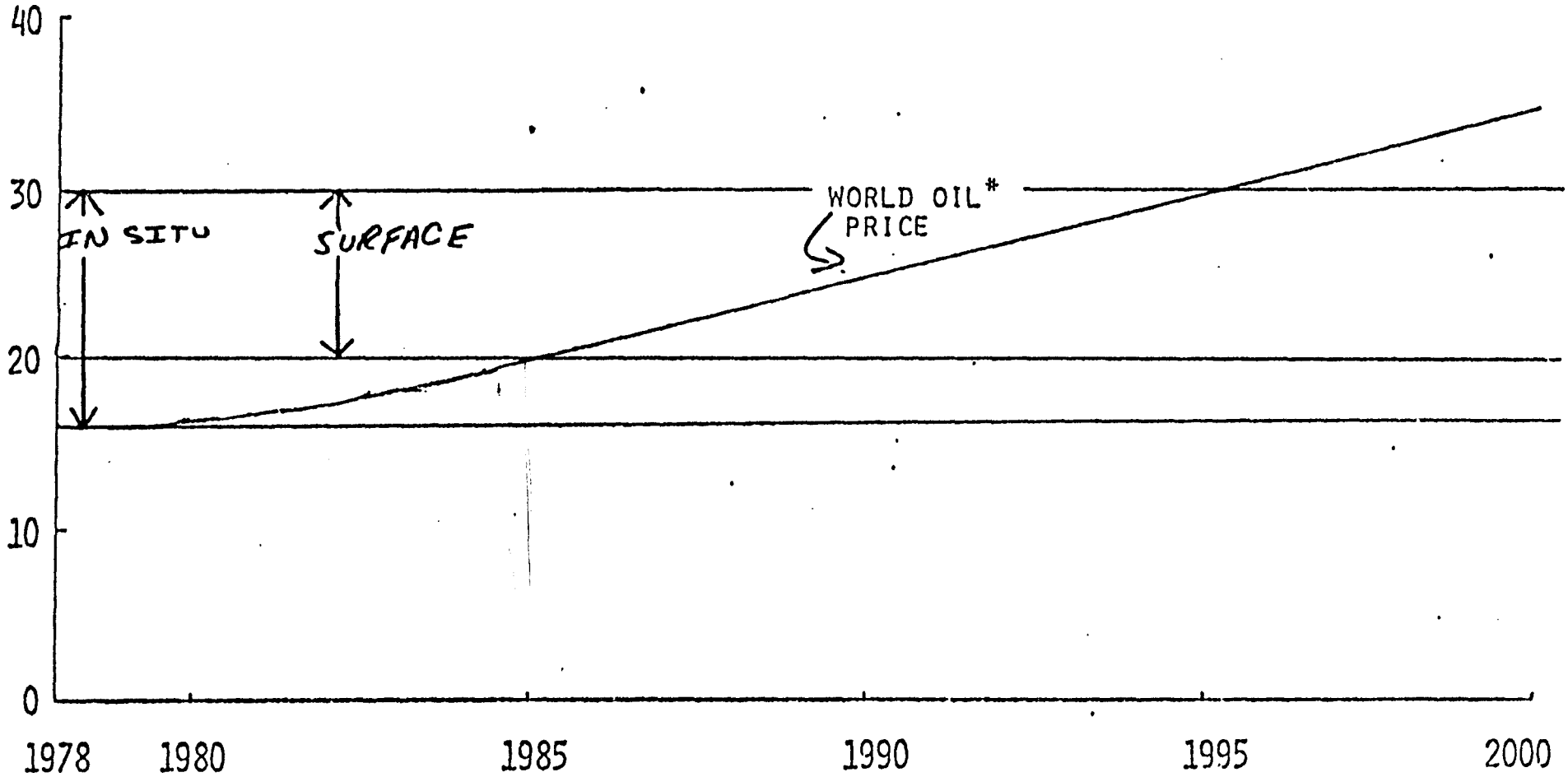
* BI=Barrier Index; 1=No barrier, 5="Showstopper"

Federal Actions Required

- Financial Incentives For Construction and Operation of Commercial Size Installations. F(4)**
- Pervasive Program of Incentives Is Needed; Different companies need different incentives: tax credit, accelerated depreciation, adjusted tax policy, loan guarantees, guaranteed purchase, et al. F(4)
- Help resolve environmental/regulatory problem to reduce impact of these issues on financial risk. R(4)

** F=Financial, R=Regulatory, I=Information, T=Taxes + Penalties; 1=Little Effect; 5=Removes Barrier

COMPARISON OF COST OF SHALE DERIVED
LIQUIDS TO WORLD OIL PRICE IN 1978 DOLLARS



*per memo 5/22/78 from Harry Johnson

Technical Barriers

- Surface technology ready for testing at commercial size installations. BI=1
- In situ require further development. BI=4
  - Consistent success at pilot scale not yet achieved
  - Current and future in situ tests should tell much

Federal Actions Required

- Through incentives, insure construction and operation of one or more commercial size surface installations. F(5)
- Joint government/industry R&D program to resolve technical problems of in situ F(4)

RESOURCE AVAILABILITY

- 600 BILLION BARRELS OF HIGHGRADE (25 OR MORE GPT) SHALE IN WEST. BI=1
- WATER AVAILABLE FOR AT LEAST 500,000 BBL/DAY. BI=1
- MANUFACTURER STATUS BI=1; NG
  - AVAILABILITY OF REACTOR VESSELS, PIPING, MINING EQUIPMENT
  - AVAILABILITY OF SKILLED LABORERS, MINERS, PIPEFITTERS, SHEET METAL WORKERS, ETC.

FEDERAL ACTIONS REQUIRED

WATER

- o Analyze sources of water for initial 500,000 bbl/day shale oil production. I(1)
- o Develop water supply program in cooperation with other Federal Agencies. I(3)

MANUFACTURER

- o Update and maintain knowledge base on equipment and manpower constraints. I(1)

INSTITUTIONAL BARRIERS

- Large number of permits and approvals from Local, State and Federal Government BI-4; GF, GNF
  - NEPA
  - Clean Air Act and Amendments
  - Water Quality Control Act
  - Toxic Substance Control Act
  - Rights of Way
  - Mine Land Reclamation Laws

FEDERAL ACTIONS REQUIRED

PERMITTING

- o Analyze permitting process in detail with the aim of streamlining process. I(3)
- o Reduce redundancy between local, State and Federal permits. R(3)
- o Establish group to coordinate local, State and Federal permits. R(3)
- o Improve stability of standards, esp. for initial plants. R(3)

INSTITUTIONAL BARRIERS

- Availability of land BI-3
  - Leasing from Federal Government: GF*
  - Land exchanges to develop economic parcels; GF
  - Clouded land claims: GF, GNF
  - Conflicting claims with grazing rights and interests in other minerals; GF, GNF

*GF = Gov. Fed, GNF = Gov. Non-Fed, NG = Non Gov.

FEDERAL ACTIONS REQUIRED

LAND

- o Accelerate selective leasing of Federal Land. R(4)
- o Expedite land exchanges. R(3)
- o Expedite resolution of clouded land titles and conflicting claims. R(3)

INSTITUTIONAL BARRIERS (CONT'D)

- CONCENTRATION OF RESOURCE PLACES SEVERE DEMANDS ON LOCAL INFRASTRUCTURES BI=5
  - RAPID POPULATION INCREASE IN RURAL AREAS CAN BRING SEVERE SOCIO-ECONOMIC PROBLEMS
  - NEW ROADS, SEWAGE AND WATER FACILITIES, SCHOOLS, HOUSING, ETC., REQUIRED IN A SHORT TIME FRAME
- WATER AVAILABILITY BI=1;GF, GNF
  - NOT A PROBLEM FOR PRODUCTION UP TO 500,000 BBL/DAY
  - OVER 500,000 BBL/DAY, COMPETING WATER NEEDS CONFLICT

FEDERAL ACTIONS REQUIRED

Infrastructure Needs

- o Establish Federal focus to interact with State and Local Government concerning "boom" town problem. I(3)
- o Propose legislation to provide financial assistance to State and Local Government for roads, schools, housing, etc. R(4)

Water

- o Analyze sources of water for initial 500,000 bbl/day shale oil production. I(1)
- o Develop water supply program in cooperation with other Federal agencies. I(3)

INSTITUTIONAL BARRIERS

- Perceived lack of Federal policy on oil shale. BI-4

Federal Actions Required

- Demonstrate visible inter-agency Federal commitment to oil shale. F(4)

INITIAL DEPLOYMENT

- ID WILL BE SURFACE RETORTING; USER AND PRODUCER KNOWLEDGE GOOD; GEOGRAPHIC LOCATION WELL DEFINED, BI=1
- FINANCIAL INSTITUTIONS SUPPORT INSUFFICIENT, BI=5
- SUPPORT INFRASTRUCTURE LACKING, BI=5
- ACCEPTABILITY OF RAW SHALE OIL AS BOILER FUEL OR REFINERY CRUDE INTAKE, BI=2

Environmental Barriers

- Many details on projected emissions from commercial plants are unknown. BI=5
- In some areas of Colorado and Utah, background exceeds federal air quality standards for ozone, particulates and non-methane hydrocarbons. BI=5
- Contamination of underground water supplies from in situ. BI=4
- Spent shale disposal: revegetation and leaching. BI=4

Federal Actions Required

- Insure that commercial scale plant construction and operation provides needed environmental data. I(3)
- Variances may be needed for some pollutants. R(4)
- Need to stabilize standards. R(3)
- Environmental research on surface and in situ technology. I(3)
- Develop land reclamation program. R(4)

DISCUSSION GUIDE

I. Introduction

A. Topic and Purpose of discussion

B. Discussion format

C. Background of participants

1. Organization identity
2. Role of organization in technology
3. Individual's role

II. Current State of the Energy Technology

A. What is the current state of the art?

B. To what extent has the technology advanced over the years?

C. What have been the characteristics of this advancement?

D. What will be the net effect on energy output in short-term? Long-term?

III. Commercialization

A. Is the technology understood and far enough along in its development that it can be commercially implemented?

B. Is industry physically and psychologically ready to accept and implement the technology?

C. What are the likely markets for the technology: Consumer? Governmental? Industrial?

D. Are these markets physically and psychologically ready to accept and utilize the technology?

E. Are any of the following barriers to commercialization What are they? How are they barriers? How important are they?

1. Technological barriers
2. Economic barriers
3. Social barriers
4. Political barriers
5. Environmental barriers

F. Do any of the following present themselves as opportunities or facilitators of commercialization? What are they? How are they opportunities? How important are they?

1. Technological factors
2. Economic factors
3. Social factors
4. Political factors
5. Environmental factors

G. What, if any, information should be provided to insustry and the public to enhance the acceptability of the technology? In what form should it be conveyed? Who should provide the information?

H. Financial considerations

1. What are the estimated costs associated with the commercialization of the technology?
2. What are the sourees for these funds? Why these sources?

IV. Impacts

A. What if any, impact will there be on the following as a result of commercialization?

1. Physical environment
2. Social structures
3. Political structures
4. Economic structures
5. Labor market

B. How important are these impacts?

V. Role of the Federal Government in commercialization of the Technology?

A. Should the government exercise a role?

B. What role is desired or necessary?

1. Provide findings?
2. Favorable legislation?
3. Provide knowledge?
4. Provide equipment, materials and facilities?
5. Other?

C. What departments and agencies should be involved?

VI. Presentation of and Reaction to DOE Thinking

A. (Present concept statements to participants)

B. General reactions

C. Are these plans realistic/feasible given the:

1. Current state of technology
2. Realities of the market place
3. Realities of social, economic, political structures?

D. (Focus on specific aspects of the concept statement. Included here:)

1. Has DOE realized all of the opportunities and barriers? Are there others? How important is each?
2. Has DOE presented all of the possible solutions to the barriers? Are there others? What is the relative likelihood of success of each solution?
3. Is DOE's time schedule realistic/feasible?

VII. Summary

(The discussion will be reviewed with the participants in order to develop "bottom line" statements about each critical issue).