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REVIEW OF GAO REPORT ON COMMERCIALIZATION OF EMERGING ENERGY TECHNOLOGIES

HEARING BEFORE THE COMMITTEE ON SCIENCE AND TECHNOLOGY U.S. HOUSE OF REPRESENTATIVES

NINETY-FOURTH CONGRESS
SECOND SESSION

AUGUST 30, 1976

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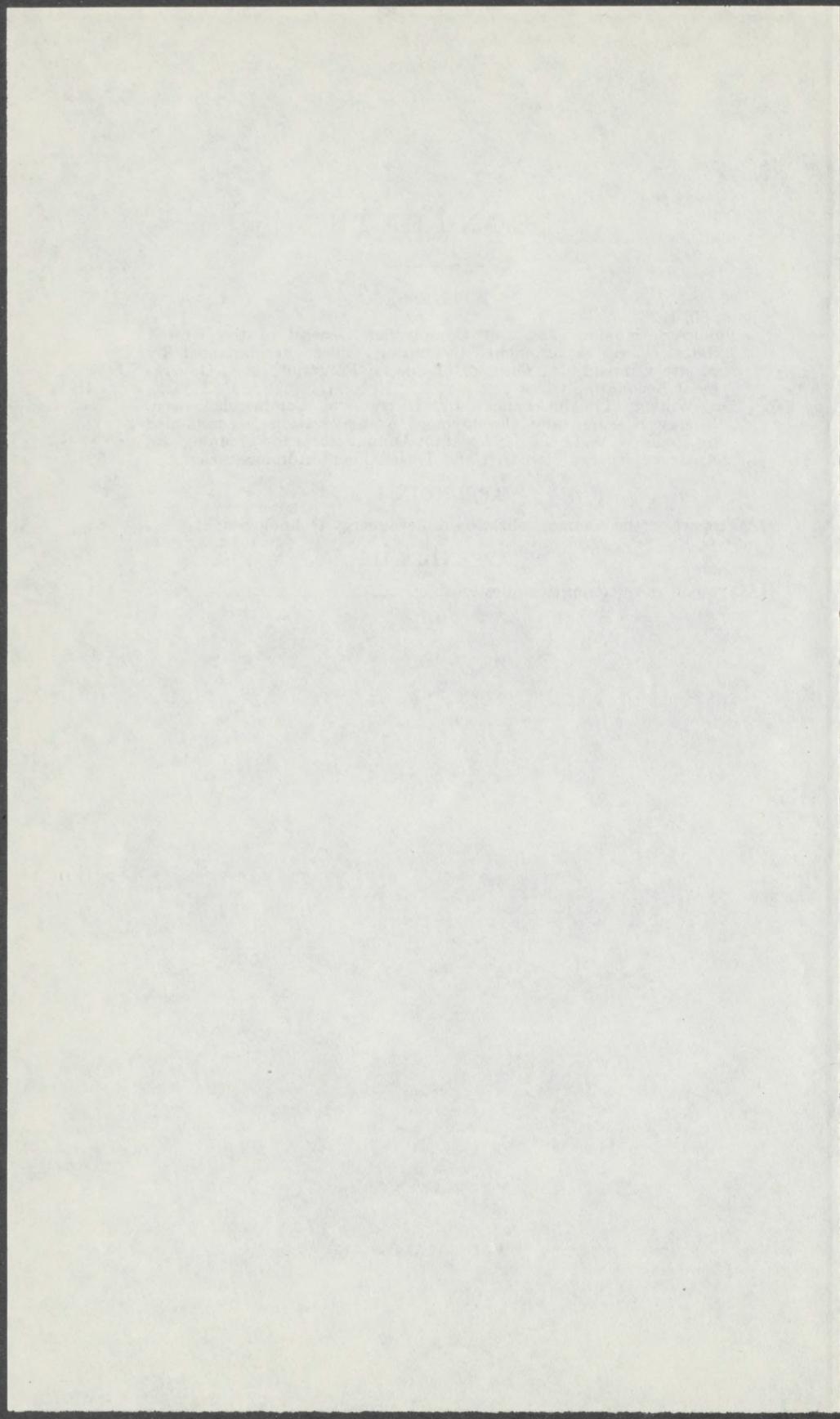
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REVIEW OF GAO REPORT ON COMMERCIALIZATION OF EMERGING ENERGY TECHNOLOGIES

MONDAY, AUGUST 30, 1976

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, D.C.

The committee met, pursuant to notice, at 8 a.m., in room 2318, Rayburn House Office Building, Hon. Olin E. Teague, chairman of the committee, presiding.

[Other Members present were Messrs. Mosher, Hechler, Symington, McCormack, Brown, Milford, Myers, Thornton, Emery, Ottinger, Hayes, and Lloyd of California.]

The CHAIRMAN. The committee will come to order.

Sam, do you have an opening statement?

Mr. HUGHES. Yes, Mr. Teague.

The CHAIRMAN. I'm going to ask unanimous consent that we insert your statement in the record, and go from there with some questions and answers.

Without objection, Mr. Phillip S. Hughes' statement will be placed in the record, and open for questions at any point.

[The statement of Phillip S. Hughes follows:]

STATEMENT OF PHILLIP S. HUGHES, ASSISTANT COMPTROLLER GENERAL OF THE UNITED STATES, ON GAO'S REPORT, "AN EVALUATION OF PROPOSED FEDERAL ASSISTANCE FOR FINANCING COMMERCIALIZATION OF EMERGING ENERGY TECHNOLOGIES," AUGUST 24, 1976

MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE: Our interest and involvement in the issues surrounding the commercialization of synthetic fuel technologies has been quite extensive over the past year. In a report dated March 19, 1976, we commented on the Administration's proposed synthetic fuels commercialization program and suggested that the Congress await completion of further analyses before considering legislation authorizing a commercial synthetic fuel demonstration program. In another report dated May 5, 1976, we presented our evaluation of the status and obstacles to commercialization of coal liquefaction and gasification. In addition, over the past several months, we have testified before the House Committee on Science and Technology; Subcommittees of the Senate Committee on Banking, Housing, and Urban Affairs, House Committee on Banking, Currency and Housing; and House Committee on Interstate and Foreign Commerce, on developing and commercializing energy technologies.

Before each of these Committees we stated that we were continuing our work on the status of feasible technologies which appear to have impediments to full commercialization, and, that we would complete this work by this summer. In addition, we indicated that this work would include an assessment of the priorities attached to the various technological options, and our views on the most appropriate incentives or other actions for encouraging their development. As our study of the matter progressed, it became evident that pursuit of alternative technologies is inextricably intertwined in overall national energy strategies, including strategies for implementing energy conservation actions.

On August 24, 1976, as you know, we submitted to the Congress a report presenting our evaluation of proposed Federal assistance for financing commercialization of emerging energy technologies. The balance of my statement presents the highlights from our report.

In recent months a number of bills have been introduced in the Congress which would provide various forms of Federal assistance to encourage private sector use, or implementation of, a variety of energy technologies. One such bill, H.R. 12112, would provide Federal loan guarantees to accelerate the commercialization of synthetic fuels—gas from coal, oil from coal, and/or oil from shale.

Individual bills before the Congress cover a wide range of objectives and financing techniques. However, no one bill focuses on all emerging energy technologies, considers all costs associated with development, or more importantly, attempts to focus on targets of proposed actions on some consistent priority basis.

The major thrust of our evaluation is aimed at setting forth a framework and perspective for considering (1) energy actions which could contribute to solving energy problems in the next 10 to 25 years and (2) the role of the Federal Government in encouraging activity in each of the areas. Without such a framework and perspective, we run the risk of piecemeal decisionmaking on our energy options without fully considering the implications for overall energy policy of the choices we make.

FRAMEWORK FOR CHOOSING APPROPRIATE ENERGY TECHNOLOGIES AND FINANCING MECHANISMS

In our judgment, making the right choices among energy technologies, requires consideration of three factors:

The contribution that each technology can make in meeting the Nation's energy needs within a specified time frame either through reducing demand or increasing energy supply.

The total cost of making the technology commercial including costs of plant construction, costs of alleviating adverse socio-economic impacts caused by the energy development, and the costs of price supports or further subsidies which may be required.

The price at which energy produced by the technology would have to be sold and the means by which the price would be assimilated by our economic system.

Making the right choice among financing mechanisms requires, in our view, interrelated analysis of at least three factors:

The technology's state of development. Is the technology developed to the extent that it can be deployed on a broad basis?

The technology's economic feasibility. Will the energy produced as a result of deploying the technology be economically competitive with competing energy sources?

The target group whose actions will be influenced. Are they large industrial firms or diverse and widely dispersed groups of homeowners?

The recent slowdown in the rate of growth in demand for energy is a sharp reminder of the importance of the demand side of the energy equation and of conservation in particular. This fact, and the wide differences of opinion on the sources of energy supplies to meet that demand, suggest that the Nation should carefully explore all supply sources as well as conservation alternatives before embarking on a program to commercialize synthetic fuels.

Serious questions exist regarding any national commitment at the present time to uneconomic, high-cost supply technologies which substantially exceed the cost of imported oil. Certainly, larger commitments to building complex, highly capital-intensive energy sources will result in less incentive in future years to develop alternative lower cost energy sources. In addition technologies producing energy that costs more than energy from imported oil would put exporting countries in a position to increase energy prices.

The pricing yardstick used in evaluating emerging technologies needs to be considered very carefully. An incremental cost standard is the only realistic one for making sound economic judgments which treat all emerging technologies equally. The alternative is average, or "rolled-in" pricing. This means that the real cost of new supply sources are averaged with far larger volumes of lower priced energy.

The rolled-in yardstick favors synthetic and other fuels susceptible to rolling in treatment. Incremental cost, on the other hand, would apply the same test to

all energy options, including conservation. Decisions made on this basis would allow a consistent and rational process of choice on a cost effective basis.

CONCLUSIONS

Based on our analysis of the various energy options available to this Nation, we concluded that:

Certain conservation measures are by far the most cost effective way to "produce" energy and, therefore, should have the top priority for Government financial assistance.

Areas offering the greatest opportunity for conservation include insulation and other measures that conserve energy in all buildings; less wasteful uses of energy by industry; and improved management of electrical demand.

Many of the actions we believe are desirable to encourage conservation are authorized by the recently passed legislative extension of the Federal Energy Administration.

Among the energy supply-increasing technologies considered, we found several that are cost effective throughout the country or in particular geographical areas. These technologies are hydrothermal energy, municipal waste combustion systems, solar hot water and space heating, and tertiary oil recovery. The ultimate supply of energy to be captured from these sources may be smaller than the ultimate potential of other supply technologies such as synthetic fuels, but they appear more cost effective.

In our judgment the cost effective technologies should be given priority in Government assistance for commercial development. This assistance will ensure their maximum contribution between now and 2000 and give the Nation time to consider the potentially larger supply sources and develop them as appropriate. These latter sources include synthetic fuels as well as fusion, solar photovoltaic cells, thermal gradients, and breeder reactors.

In our judgment, Government financial assistance for commercial development of synthetic fuels should not be provided at this time. Synthetic fuels production is not cost effective in that the total cost of output is not price competitive with foreign oil. Nor does it look attractive on the basis of present knowledge when compared to other technologies on an actual, or incremental price basis.

The large investments required to build synthetic fuel plants would direct Federal incentives primarily to the large industries which have access to capital. Two basic concerns underlie the stated need for Federal loan guarantees to finance synthetic fuels technology:

(1) Concern that the product produced will not be economically competitive, particularly since the existing world market for oil could always be manipulated to substantially undercut the price of synthetic fuels and

(2) Concern that technological advances in other energy areas or within synthetic fuels technology will make "first" generation synthetic fuels plants obsolete before they ever operate.

Research and development on "second generation" synthetic gas technologies is expected to reduce costs by about 15 percent.

While we do not favor providing Government assistance for commercial development of synthetic fuels at this time, we do not advocate that this option be foreclosed. We would like to strongly emphasize our conclusion that the Government should place a high priority in furthering this option. Such priority should be in the area of Government research, development, and demonstration.

ERDA has emphasized the need to acquire the socio-economic, environmental, and regulatory information associated with the construction of synthetic fuel plants. It appears to us that the Government can acquire much of the necessary information by constructing and operating—either itself or with a contractor—smaller synthetic fuels plants.

Assuming synfuels demonstration plants are successful and prove feasible and capable of regulated, environmentally safe operation, the demonstration plants could be sold to private firms. At that time—when synfuels have been proven viable—if it is considered desirable and inducements are required to stimulate private firms to enter commercial operations of synfuels, consideration could be given to offering some sort of financial assistance to private firms. Options in addition to loan guarantees need to be carefully considered.

In the meantime, the Congress could maintain oversight of the plants through the yearly authorization and appropriation process. This yearly monitoring of

plant progress offers enhanced potential for building smaller, less costly plants while still maintaining maximum information capability. Should the plant not prove to be feasible, yearly oversight would enable project termination at the earliest possible date and may allow minimizing the financial loss related to the project.

Another alternative way of commercializing technologies such as synthetic fuels where the economic competitiveness of the product produced is in question is the so-called "commercial pull" approach. Using this approach, the Government could announce that it would purchase a set amount of synthetic oil or gas at some future point in time and request bids from industry. The Government then could select the lowest bid that appeared technically feasible. This method may prove to be a less cumbersome and perhaps less costly way of stimulating the construction and operation of a desired number of synthetic fuel plants.

MATTERS FOR CONSIDERATION BY THE CONGRESS

Mr. Chairman, in closing, we hope the Congress will:

Continue to place the highest priority on energy conservation actions, requiring improved information on major conservation opportunities which will provide the basis for the development and funding of specific programs which can be tailored to take maximum advantage of the opportunities.

Maintain close oversight of the several new programs to encourage energy conservation, evaluate the effectiveness of incentives offered, and consider such further actions as may be necessary, including the greater use of mandatory energy efficiency standards. The GAO will continue its efforts to aid the Congress in this regard.

Continue to encourage the installation of solar heating technologies, targeting the financial incentives to the users as described in the report.

Maintain close oversight of FEA's actions to increase incentives for tertiary recovery of oil and authorize further incentives if the need and possibility to increase tertiary oil recovery becomes apparent in light of other energy developments.

Consider whether it is advisable to enact legislation which would at this time authorize Federal loan guarantees to builders of synthetic fuel plants, and consider instead directing ERDA to continue and expand its research and development to improve the technology and; in addition, construct and operate smaller plants of a size sufficient to meet its stated goal of obtaining socio-economic, environmental, and regulatory information in a timely fashion.

Consider further actions, including the provision of loan guarantee authority, to encourage municipal waste combustion.

This concludes my prepared statement. We will be glad to respond to questions.

STATEMENT OF PHILLIP S. HUGHES, ASSISTANT COMPTROLLER GENERAL OF THE UNITED STATES, U.S. GENERAL ACCOUNTING OFFICE; ACCOMPANIED BY MONTE CANFIELD, JR., DIRECTOR, ENERGY AND MINERALS DIVISION, U.S. GENERAL ACCOUNTING OFFICE

The CHAIRMAN. Sam, you and I have been around this place a long time; we've been working together for a long time, if I remember right, about 25 years.

Mr. HUGHES. That's about right, Mr. Chairman.

The CHAIRMAN. And I think that probably in those 25 years I was most disappointed when I got this report. Now, Sam, I don't know—I thought I knew generally—what causes you people to put out reports like this. When you were before us, I think we understood your opinions and your questions and your doubts about synthetic fuels, and I think, if my memory is correct, that some mention was made about finishing the report, or something like that. I have read the report and have read your testimony from the beginning, and I came to the conclusion, Sam, that there is really no new evidence. There are some new

opinions, and there are some contradictory opinions, but there is really nothing new in your report or different from what you said before the committee.

Now what I would like to know, Sam, it would seem to me that this is a definite effort to sabotage this bill—to kill the bill, if you want, and it's probably done a pretty good job so far.

But who was behind this; who wrote it; who directed it? There are so many opinions you have that are merely opinions that I don't think it was proper to submit. I think you should have submitted something to us with evidence behind it, and, frankly, I was rather surprised at the report. So if you would comment on that, and then we'll get around to some questions from other members; and we'll give ERDA a chance later.

Mr. Hughes has another committee meeting at 10 o'clock that he has to testify at; and ERDA has another one at 10 o'clock as well. If enough members come in, we're going to have to comply with the 5-minute rule. If they don't, you'll have ample opportunity to ask whatever you want to. I would just ask them to tell us how this report came about; what's the genesis of it; the purpose of it; how it was prepared; who prepared it. That's where we are right now, so Sam, go ahead.

Mr. HUGHES. All right, Mr. Chairman.

Obviously, I'm sorry that you have the reaction that you do to the report. We feel—or we wouldn't have submitted it—that it has a good deal of substantive comment and that it should help in dealing with what is a very complex set of problems.

The genesis of the report was reflected in our earlier statement before this committee and in the earlier report, which was the basis for that statement. We said at that time that we had concerns about both the method of financing involved in this program, the method of Federal participation and support, and also about the right actions, whether the proposed actions were those that should be highest on the Government's list of priorities. We can cite those statements for the record, but I think they are fairly clear.

We had indicated at that time that we had hoped the report would be available by July 15. We were not able to make that deadline, but we have worked as fast and as hard as we could, and the report that is before you at this point is the product of that effort. It is intended to put the issues that it seems to us confront the Congress at this time in perspective, and to present the problem that is before the committee as we see it.

It seems to us that the basic issue is really what the Congress and the Government should do right now about synthetic fuels in the context of a very complicated energy situation.

The CHAIRMAN. Sam, may I ask you one question right there?

Mr. HUGHES. Yes.

The CHAIRMAN. You remember the President's budget in the early 1950's?

Mr. HUGHES. Yes.

The CHAIRMAN. Did you have anything to do with the Paley Report?

Mr. HUGHES. I was aware of it. I did not have anything to do with it.

The CHAIRMAN. Thank you.

Mr. HUGHES. It seems to us that the issue is what the Congress should do now about synthetic fuels. We are talking about needs, about fuel sources, and about fuel consumption some 20 years, perhaps more, into the future, and that is a long period, and, therefore, one full of uncertainties over what should be done.

Should, on the one hand, the Congress do as ERDA proposes and authorize the construction of plants of this sort with guarantees of the sorts that are proposed, or should it do something different? We have tried to set forth in our report, as well as in the statement, the fact that we think something different is appropriate.

We think that essentially three things suggest that: first of all, uncertainty as to the volume and timing of any need for synthetic fuels. We think it's quite clear that the future is uncertain in this regard. Second, the economics.

The CHAIRMAN. You think there's uncertainty?

Mr. HUGHES. As to the volume and timing, yes, we think so.

The CHAIRMAN. But don't you think it is certain that we are going to experience a shortfall?

Mr. HUGHES. Sooner or later we are going to need additional supplies.

The CHAIRMAN. The volume of shortage, I would agree, is uncertain.

Mr. HUGHES. And the timing.

Mr. LLOYD. If the chairman would yield on that?

The CHAIRMAN. Yes, Mr. Lloyd.

Mr. LLOYD. I thank the chairman.

I'm sorry. Maybe I'm just waking up. And I'm sure I didn't hear you correctly. Your statement was that you think that we are going to have a shortage?

Mr. HUGHES. No, sir. My statement was that there clearly is a need for additional energy sources.

Mr. LLOYD. Pardon me. When you make that statement, what time frame are you talking about? Would you say that's now?

Mr. HUGHES. We need them if we are to proceed toward independence, we need them now.

Mr. LLOYD. Would you say that it's now?

Mr. HUGHES. Yes.

Mr. LLOYD. OK. Then we are in agreement, it is now. That's all I wanted to know. I couldn't believe what I was hearing. Thank you, Mr. Chairman.

Mr. HECHLER. Parliamentary inquiry, Mr. Chairman.

I just wondered whether members of the committee who might have a different point of view should proceed to interrupt Mr. Hughes during his initial statement, or are we going to allow Mr. Hughes to present his statement? If we are going to proceed with questions, I know there are a lot of us who have questions.

The CHAIRMAN. Ken, we started out with the chairman asking a question and asking that his opening statement, which is quite long, be put in the record because of the time constraints and the Chair announced that if it became necessary we would limit the questions if enough members showed up—but it looks like there won't be more than five or six here—and that we would go by the 5-minute rule. But if he makes certain statements such as Jim asked about, I see no reason why we shouldn't break in.

Mr. HECHLER. Then members of the committee should break in the middle of his statement? Is that the ruling of the Chair?

The CHAIRMAN. Correct. I may change it before we get through though. It depends on how long Dick Ottinger takes. We only have about 2 hours, and I would hope it can be very informal—that the committee members can ask the things that they want to.

Mr. HECHLER. I thank the chairman.

The CHAIRMAN. Sam, I hope, as a part of your general statement, that you will tell us why and how the General Accounting Office has the expertise in this area; and why we should take your word, as against a number of others that testified—for example, ERDA, FEA, the Ford Foundation, and some others.

Mr. HUGHES. All right. I would like to come to that, Mr. Chairman. I would like to comment on why we think the Congress should consider a different course than the one ERDA proposes. We think that there is uncertainty as to the timing and volume of the need for synthetic fuels. We think the economics of that need—

The CHAIRMAN. [interrupting]. But how would you characterize the kind of uncertainty? Is it uncertainty that we won't need any, or is it uncertainty—

Mr. HUGHES [interrupting]. It is clearly certain that we need additional energy sources. The part that synthetic fuels should play in that, it seems to us, is uncertain, the timing and the volume of that part; the economics of the synthetic fuels seem to us uncertain, and we think that there is greater attraction as to other courses of action for the Government at this time.

The CHAIRMAN. Of course, Sam, we're talking of a time frame of 10 years from now.

Mr. HUGHES. Twenty years.

The CHAIRMAN. We're not talking about commercialization as of this morning.

Mr. HUGHES. That's quite correct.

The CHAIRMAN. We're talking about quite a long ways down the road.

Mr. HUGHES. That is correct. That contributes immensely to the uncertainty, obviously.

Now, with respect to GAO's expertise, we can furnish you with as much information as you wish about those of us who worked on this report, I among them. Two of my associates are here, Mr. Canfield and Mr. McGee. I guess most of the rest of them are somewhere in the room behind us. They are an assorted crowd. Some of them are GAO auditors; some of them are not. As you well know, I spent most of my life in a somewhat different world.

With respect to expertise in the energy business, as we look at the various reports and recommendations in this area, as well as in the energy area in general, we find that the experts have the same problem as experts frequently have: they disagree or they are uncertain, and I think therefore, we are in the business that I think I've been in for some time, the business of government, which is trying to figure out what to do in those circumstances. That is the contribution that we are attempting to make at this point.

Mr. HECHLER. Mr. Chairman.

The CHAIRMAN. Mr. Hechler?

Mr. HECHLER. As I understand the GAO conclusion, the GAO does not preclude the future development of synthetic fuels and is merely analyzing the best cost-effective and energy-effective means of achieving the objective that all of us seek.

Mr. HUGHES. That is correct, Mr. Hechler. More than that, we think the development of synthetic fuels technology should have a high priority. The question again, the basic question, is how to proceed right now.

Mr. HECHLER. Of course, this committee has invested millions and millions of dollars in research and development of synthetic fuels, and I wonder if there is anything in the GAO report that would urge us to slow down such research and development to bring synthetic fuels to the point of where they can be commercially cost-effective?

Mr. HUGHES. There certainly is nothing in the report that suggests a slowdown in present efforts. The issue, again, that we are dealing with is what to do right now. It seems to us that there is an alternative course of action. It is a complex business, and more than one thing is involved; more than one step at a time is involved. There is an alternative course of action, it seems to us, which would enable us to reach the goal that we all wish to reach, an assured energy supply, with somewhat more assurance in the timing, and with less ultimate Government obligation.

Mr. HECHLER. I wonder, Mr. Hughes, if you could elaborate on the conclusion of the General Accounting Office that conservation might be the best option? There's considerable argument within the Congress on that issue, and I would like to see if you could spell out a little more your documentation of the conclusion which you've reached.

Mr. HUGHES. We have examined the ERDA data on this. We have, incidentally, tried to rely basically on the information of ERDA and those others who are specialists in the field. We also have utilized the Ford energy report because it is the best thing and the most complete thing done yet in the conservation business.

It seems to us that that data, which, as far as we know, has not been challenged, shows a number of possible courses of action in the residential area and in the industrial area, which can be very cost-effective and, in effect, can produce energy by saving energy, and, accordingly, we have urged very strongly that the recent FEA legislation, which contains this sort of provision, be looked at, examined carefully, and that it be financed in a fashion which would enable those sorts of measures to proceed.

Mr. HECHLER. Finally, Mr. Hughes, it's been stated by some that this report of the General Accounting Office just was unveiled and thrust on Congress as an independent idea of the General Accounting Office to try to thwart the legislation that was pending in the Congress. I don't know whether the chairman has gone into this question, but why did the GAO suddenly decide to get interested in this subject? I think I know, but I want to get your official reaction.

Mr. HUGHES. The GAO's interest in the matter is not sudden. We tried at the beginning of our statement to review some of the recent actions, some of the recent reports, that we have made. Our special interest, going beyond what I would regard as a normal interest, goes back a number of years when the Comptroller General established an energy group within the GAO—2 or 2½ years ago. Mr. Canfield, on my left, joined us. He had been the Deputy Director of the Ford

energy study before that, and we established a separate office working in the energy area.

It seems to me the reason for an interest in this area is fairly apparent. It's an extremely important area of national policy. It seemed to us that we could perform a useful function by trying to pull together very complex data and complex analyses, and to develop those in a form which would be useful to the Congress.

Mr. HECHLER. In testimony before our committee you stated quite explicitly, I think it was in March:

GAO does have plans for further work, which will attempt to deal with alternative methods of financial support for development of synthetic fuels and the tradeoffs involved, including choosing between such alternatives as allocating federal dollars to the synthetic fuels budget, as opposed to other federal energy projects,

And you indicated quite clearly to the committee that a further study had been initiated, and I believe that you indicated the time frame was that you intended to report this summer. I think those were the words that you had stated.

Mr. HUGHES. We had hoped to report somewhat earlier than we did, Mr. Hechler. We tried to get the report out by mid-July and weren't able to do that.

My point in the earlier comments that I made was that our interest in energy has been a long-standing one, for obvious reasons. This is an extremely important area of national policy.

Mr. HECHLER. I think if only because this report has been very provocative and has elicited a great deal of very useful discussion in the Congress, Mr. Chairman, I appreciate the report very much.

The CHAIRMAN. Since we have nine members here, should we go to the 5-minute rule and try to come back to everybody?

Charlie, I recognize you for 5 minutes.

Mr. MOSHER. I guess I can't use 5 minutes very effectively, Mr. Chairman. I have to confess that I've been out of town for 4 days. I have just come back, to find the report on my desk. I have not read it. So I'm going to have to listen for a while before I can play any responsible part in this discussion—other than that my curiosity has been aroused immediately by what has been said this morning.

Reference was made to other courses of action which are more attractive, and I judge the principal other course of action means a greater emphasis on conservation of energy. Is that correct?

Mr. HUGHES. That is one of the courses of action which we think is preferable. Also we urge that the synthetic fuels effort be continued as an R. & D. effort to explore some of the areas that ERDA has suggested be explored through the construction of these new plants.

Mr. MOSHER. You immediately hit a sympathetic note with me when you talk about an emphasis on conservation. I haven't read your report, but is your report specific as to how this would be accomplished? I have been terribly discouraged, to tell you the truth, about the prospect of the American people being willing to conserve. By what methods are you going to persuade the American people to conserve huge amounts of energy?

Mr. HUGHES. There are a variety of ways, Mr. Mosher, depending on what areas, or what the target group, or population is. I think there is general agreement that substantial amounts of energy can be

conserved in the industrial area. Many of the things that need to be done are capital-intensive, however, and industry is not going to do it unstimulated or unaided. These are areas where we think the Federal Government could be helpful.

Mr. MOSHER. How do you stimulate and aid specifically?

Mr. HUGHES. You stimulate and aid perhaps with loan guarantees, with incentives, with tax incentives, to convert existing technology to more advanced technology which is more energy-conserving, and so on.

Mr. MOSHER. Is that advanced technology well-known, or is that going to require fairly substantial R. & D. efforts, with great uncertainty?

Mr. HUGHES. There are many areas where the technology is well-known and it's simply a matter of doing it.

Mr. MOSHER. I've had the impression that industry has surprised itself in the last couple of years by successfully conserving in many ways. But you're suggesting that it would require really vast Federal effort, with loan guarantees and tax incentives and new research to accomplish this. Will this be a case of, really, jawboning, so to speak, of appealing through pep talk sort of stuff?

Mr. HUGHES. I think jawboning has been effective in some areas, but I think money is more effective. Whether the effort would need to be vast, I think poses a difficult question of definition.

The \$6 billion in plants, \$4 billion in guarantees, that is proposed by ERDA is a very substantial effort, and that kind of an effort in the conservation area, it seems to us, could be very helpful.

Mr. MOSHER. Just one more question, Mr. Chairman.

You say the first emphasis would be on conservation in industry.

Mr. HUGHES. No. It's just one of the areas. Conservation in residences could also be very productive.

Mr. MOSHER. You mean changing the building codes throughout the country, and so on.

Mr. HUGHES. In retrofitting, if you will, houses, with insulation, and so on—stimulation to do that.

Mr. MOSHER. I sure hope we can do it, but it will take 20 to 30 to 50 years, or a century, I'm afraid.

The CHAIRMAN. Mr. McCormack, you're recognized for 5 minutes.

Mr. McCORMACK. Thank you, Mr. Chairman.

Mr. Hughes, on page ii of your report, the Introduction, in the first major paragraph, you say:

This fact, and the wide differences of opinion on the sources of energy supplies to meet that demand, suggest that the Nation should carefully explore all supply sources as well as conservation alternatives before embarking on a program to commercialize synthetic fuels.

Do you find that paragraph, Mr. Hughes? Mr. Hughes, I'm talking about page ii, the second major paragraph. We're using my time. This is the paragraph, "The recent slowdown . . ." and so on. Do you find that paragraph?

Mr. HUGHES. Yes, I have it. I'm sorry.

Mr. McCORMACK. Thank you.

Now I would like to know if this report is directed at, as you seem to be saying, the commercialization of synthetic fuels. Is this what this report is objecting to?

Mr. HUGHES. Yes, sir. We think the issue—

Mr. McCORMACK [interrupting]. Why then do you—

Mr. HUGHES [interrupting]. May I answer the question, Mr. McCormack?

Mr. McCORMACK. Yes. Go ahead, Mr. Hughes.

Mr. HUGHES. We are concerning ourselves with what to do now with respect to synthetic fuels. We think there are alternative courses that may be better than the Congress should consider instead of the construction of the plants as ERDA is proposing.

Mr. McCORMACK. The thrust of this report is to prohibit us from knowing. This is really what's happening here.

Mr. HUGHES. I don't agree with that.

Mr. McCORMACK. H.R. 12112 was designed to provide information, and it's not a commercialization program at all. It is a demonstration program with one facility in each of several categories and two in each of several categories so that the people of this country, its engineers and scientists and economic community will understand the nature of the problems associated with commercialization, so that they can, after 10 years, or 12 years, or 15 years of intensive work, learn the problems of commercialization and make intelligent decisions at that time.

Mr. OTTINGER. Will the gentleman yield?

Mr. McCORMACK. No. I will not yield at this time to anybody.

Now, the problem is that what we need is information and understanding. That's what this legislation is designed to provide; and this report, the thrust of this report, is to undermine this legislation to provide this information; and it will keep us from knowing whether or not we can intelligently commercialize.

I think this is the important problem we are facing here, all across the entire spectrum of energy production, commercialization, and conservation. We are setting up extensive programs of research, development, and demonstration, except in the two areas where this country is richest, in coal and in oil shale; and in these areas where we are trying to get legislation just to understand the problems. What this bill will provide us, this report has condemned to die.

I not only point that out, Mr. Hughes, but I also point out to you that it's based on a number of preposterous assumptions. The first one concerns the recent slowdown in the Nation's growth in demand for energy. I would like to point out that if you take a look at 1976 figures, the so-called slowdown in energy, for instance, in electricity, which was minus 4.9 percent in 1974 and 1975, and it's up to plus 8 percent in the first half of 1976. We're already turning back. As we come out of the recession we are coming back up and consuming less energy.

I would like to point out to you, sir, that you have pointed out four sources of energy here on page ii—solar hot water and space heating, tertiary oil recovery, hydrothermal energy, and municipal waste. You're going to make calculations of the total production; what those would be, in the most optimistic programs in the year 2000.

Mr. HUGHES. Yes, we're aware of those, and, as we pointed out here, they would be less, individually than the potential total volume of synthetic fuels.

[The following elaboration was submitted for the record:]

NOTE.—My statement was with regard to individual items. Collectively, as the table on page 8 of our report reflects, the ERDA scenario shows more output for alternatives combined than for synthetic fuels.

Mr. McCORMACK. I'm glad you make that point that all of them together would be far less than the potential production of synthetic fuels. And here we are spending over \$250 million this year on solar energy research alone, which is a good program, although it's probably over-funded. In the municipal waste programs, in geothermal energy we're spending \$75 million. And yet this report proposes to block a similar program, of much more modest extent, in fossil fuels. I am amazed!

Mr. HUGHES. May I comment on any of that, Mr. Chairman?

The CHAIRMAN. Sam, we're going to get through with the 5 minutes of each member first. Then we'll come back and take the time that we can.

Mr. OTTINGER. Mr. Chairman, is there any reason for departing from the usual practice of this committee of calling on the members in the order in which they appear?

The CHAIRMAN. That's been almost a custom, Dick. Mr. Symington has also been here. I'm taking Mr. Brown next. It just gives you more ammunition, Dick, when we get to you. [Laughter.]

Mr. HECHLER. Parliamentary inquiry, Mr. Chairman.

Is it possible for the witness to respond perhaps in 3 minutes when the members of the committee ask a lot of questions that can't be answered? The purpose of having a witness is not for members of the committee to make speeches, but rather to elicit information from the witness, it would seem to me.

The CHAIRMAN. I'll tell you, Ken, if this committee wants to, we'll come back here at 6 o'clock this afternoon and we'll sit here until midnight and hear everything that anybody wants to say. But I can't condense an hour into 30 minutes' time, and that's what I'm trying to do.

Mr. Brown, you are recognized for 5 minutes.

Mr. BROWN. Mr. Hughes, I share many of the concerns that are expressed in your report, and concur in many of the recommendations. But I have not concurred in the basic thrust, that we do not need to begin a synthetic fuels commercial demonstration program at the present time. I want to try to get at why I should come to a different conclusion than you do.

It seems that you put a considerable amount of stress on the fact that the synthetic fuels production is not cost-effective and that it is not competitive with foreign oil. I noted that that statement occurs in several places in your statement and in the report. My understanding is that these plants—the commercial demonstration facilities that are planned in this bill—are intended to provide a base for the development of private industry built plants that cannot possibly come onstream before the 1990's. Is that your understanding of the situation; that we would get the plants called for in the bill in operation in the mideighties?

Mr. HUGHES. That is correct.

Mr. BROWN. And if they are successful it would lead to a full-scale commercial industry that, say, if they began work in the late eighties, could bring plants onstream in a major way in the nineties?

Mr. HUGHES. The purpose of the initial plants, as we understand it, is to build plants of commercial size which will explore regulatory, environmental, and related socioeconomic considerations, and the question we are raising is whether that needs to be done at this time, in this volume, to accomplish that objective.

Mr. BROWN. Yes. Your suggestion is that we proceed with a smaller size plant. Actually, the committee has been concerned that this program be based upon the smallest size facilities which seemed to provide the information desirable. I would personally support going to whatever smaller size would provide that information, but we're not always clear as to exactly what that should be. But the point that I am trying to get to is—

Mr. HUGHES [interrupting]. If I could say, Mr. Brown, part of the problem here is that the information which would come out these new plants to be constructed that might be different, or in addition to, the information that would come out of these smaller research or demonstration plants has not been made clear to us, or, as far as we know, to the Congress.

Mr. BROWN. Well, I have some feeling for what that information was, and while nothing is crystal clear at this point, I do have some feeling for the value of the information these plants would produce.

The point I am trying to get to is: What basis do you have for making statements concerning cost-effectiveness that relates to the 1990's? What is your assumption with regard to the cost of imported oil, and what is the basis on which you derive that information?

Mr. HUGHES. We are working essentially from the same data base that ERDA is working from, or FEA, or anyone else. We are comparing the best estimates that we can get of the cost of producing synthetic fuels by various means with the price on a current basis of imported fuels.

We have also set forth in the report comparisons with liquefied natural gas imports, and so on. In short, we have attempted to compare prices and the cost of production across the board with the fuels that would compete with the synthetic fuels, and our crystal ball, if you will, with respect to the future is as cloudy as anyone else's.

We are not—I repeat—suggesting that the Government should not carry forward a high priority synthetic fuels effort. We do not wish to deprive the Government or the public of the kind of information which ERDA wishes to produce through these new plants. We simply think there are other things which might be done first which can produce that information and which can in the interim meet our fuel needs.

The CHAIRMAN. Mr. Myers, you're recognized for 5 minutes.

Mr. MYERS. Thank you, Mr. Chairman.

What would your opinion be of how we would stand today if in 1950 or 1945 we had invested more heavily in the technology of secondary and tertiary recovery of oil? What would that have done for us today?

Mr. HUGHES. I really don't have an opinion on that, Mr. Myers.

Mr. MYERS. Isn't this a corollary of what you're trying to make us do here today, in the year 1976? If we had made the decision in 1950 for more recovery of oil in this manner, wouldn't it essentially have been the same decision that we are faced with today, whether or not we should provide for an expansion in another source of energy?

Mr. HUGHES. Mr. Myers, we are using standard data here: The data set forth, incidentally, on page 8 of our report, the data that Mr. McCormack was referring to, and we have tried to show, on the basis of standard estimates, if you will, the production, what might be produced in 1985 or in the year 2000 from those sources.

Mr. MYERS. What I'm trying to get at is wasn't it very easy in 1950 to sit and say that we shouldn't be concerned about investing in stimulating secondary and tertiary recovery of oil, much like we're sitting here today and saying that we shouldn't be stimulating the growth of synthetic fuels?

Mr. HUGHES. I really can't put myself back in 1950. We obviously did—

Mr. MYERS. [interrupting]. I'm trying to force you into the framework that I see the Congress being in.

Mr. HUGHES. I think the Congress is in a very difficult position here because it is speculating about what's going to happen 20 years from now.

Mr. MYERS. Certainly, and that is the point. The point was that in 1950 they speculated there was not a need for secondary or tertiary recovery, there was not a need for some of the other developments, and that is exactly the framework that we are forced to be in today.

Mr. HUGHES. We are trying to show, Mr. Myers, some alternative sources of energy, which we believe can meet the Nation's needs more effectively, more cost-effectively, through those years. We have set forth the data upon which we are suggesting alternative courses of action.

Mr. MYERS. What is the most important ingredient in conservation—the single most important, common denominator? Would it be the price of the fuel in the marketplace?

Mr. HUGHES. I think it depends, Mr. Myers. Price is certainly an important factor in conservation, witness the immediate reaction to the embargo and to what flowed from that. But also there is the question of what are the rules of the game; what is the Federal Government willing to do to propose, to encourage, by way of conservation, for example. There are things far beyond price that can be done. Mr. Mosher and I talked about some of them.

Mr. MYERS. What would have the most immediate effect on conservation?

Mr. HUGHES. There are a number of provisions in the FEA Extension Act on the conservation side, which cover quite a spectrum. We think some strong implementation of those provisions would be very helpful in the conservation area.

Mr. MYERS. The question I ask is what could we do to stimulate conservation most rapidly? What is the single most important thing that we could do today to stimulate conservation?

Mr. HUGHES. Price increases would be helpful in that regard; loan guarantees for home insulation would be very useful; some tax incentives for industrial conservation would be very useful.

Mr. MYERS. Out of those that you mentioned, which do you think would have the most immediate impact?

Mr. HUGHES. I guess I don't know, Mr. Myers. I would want to sit down and think about it a lot.

Mr. MYERS. If you had the decision to make on how to stimulate the synthetic fuels program how would you do it so that you would provide knowledge of the technology base for growth in that industry, if you wanted to just have it as a shelf item to pull off at a later time?

Mr. HUGHES. It seems to us, Mr. Myers, the choice is not between having it as a shelf item and something more active. We see active pursuit of the synthetic fuels technology as a very important thing to do.

The question is, how best to go about it, and we are suggesting in the report that the Congress should consider whether it would not be better to continue that effort as an R. & D. effort, to conduct the explorations of the environmental and regulatory and socioeconomic considerations in that context rather than through a rather substantial program of commercial sized plants.

Mr. MYERS. I have one last question.

Would the GAO in any way temper its report if it had knowledge of the most recent indication of our import levels of oil?

Mr. HUGHES. No, Mr. Myers. We are aware that imports are rising. We think that's regrettable. We think they will rise though inevitably for some time, almost no matter what we do.

Mr. MYERS. Thank you, Mr. Hughes. Thank you, Mr. Chairman.

The CHAIRMAN. Mr. Milford.

Mr. MILFORD. Thank you, Mr. Chairman.

Mr. Hughes, on page iv of the digest section of your report it is asserted that "the projected prices," I assume of synthetic fuels, "are not competitive with existing or other energy source." Now, where specifically in your report are comparisons of the prices of synthetic fuels and other emerging energy sources?

Mr. HUGHES. They're in the body of the report, fairly well spread out. We can identify the points, if you wish, sir.

Mr. MILFORD. I would appreciate it.

[The GAO submitted the following for the record:]

Each technology discussed in the GAO report was compared, on an economic basis, with its competing energy source, as follows:

Hydrothermal compared to the cost of electricity (p. 32);

Municipal waste combustion compared to the combined cost of otherwise providing energy and disposing of the waste (p. 25);

Solar water and space heating compared to electricity (p. 30), and

Tertiary oil recovery compared to imported oil (p. 29).

All the emerging technologies discussed, except for synthetic fuels from coal and shale, appear competitive within some constraints (such as geographic areas) with the competing energy sources.

The economics of synthetic fuels are compared to natural gas, imported oil, and imported liquified natural gas on page 36.

Mr. MILFORD. In addition to that, Mr. Hughes, you make certain assumptions. I would like you to make the assumption that the OPEC countries should decide to increase crude oil prices by some 10 or 20 percent, and see what, if any, effect that would have on the findings of your report.

Mr. HUGHES. The OPEC countries are free obviously, or free within economic constraints, to do any of a number of things that could affect alternative fuel source development very vitally. They could raise or lower prices.

Mr. MILFORD. Mr. Hughes, the point I'm trying to make, and one that's bothering me right now, is they can do it with a sweep of the pen tomorrow. It's going to take us 10 to 20 years to develop these synthetic fuels technologies, and I find that as one of the problems in buying the report which you submitted.

Mr. HUGHES. The OPEC countries certainly can move with more freedom with respect to their oil prices than we can. They have some constraints on them, however. With respect to synthetic fuels it will inevitably take us some time to develop a technology and the related

environmental and regulatory aspects of the situation. We believe that we can proceed as rapidly toward the development of synthetic fuels by other means, and that's the argument essentially that we're putting forth.

Mr. MILFORD. Did you take into consideration in making your findings in this report the possibility—or would say even, the probability—of substantial increases in crude oil prices from OPEC nations?

Mr. HUGHES. We are assuming that all prices are going to go up. Really, what kind of rises would be speculative. The odds are it would affect all fuel sources, whatever OPEC did. If one looks back at the estimates of the cost of producing synthetic fuels before the OPEC embargo, those costs were roughly commensurate with, or a little higher than, the prices of fuel at that point. Markets tend to be established one way or another, and the costs seem to adjust with prices.

Mr. MILFORD. Mr. Hughes, did you take into consideration national security factors in rendering this report?

Mr. HUGHES. Yes; we certainly attempted to. We are, again, not urging that we not stress the synthetic fuels option. We are suggesting another course of action can keep that option moving and can do that as effectively with less Government obligation and more opportunity to explore and pursue other options that we think are important and more cost-effective.

Mr. MILFORD. Mr. Chairman, I yield back the balance of my time.

The CHAIRMAN. Mr. Thornton.

Mr. THORNTON. Thank you, Mr. Chairman.

Mr. Hughes, I would like to follow along with the outline of some of those questions. You have just stated that you think we should pursue a synthetic fuels development program, but on perhaps a somewhat limited scope. You are aware, are you not, that the bill which is under consideration provides, for example, for only a single modular oil shale development, only one, to test whether that technology might become commercially feasible? Are you aware that that is what is in the bill?

Mr. HUGHES. Yes. My understanding is that ERDA contemplates a single oil shale plant.

Mr. THORNTON. A single 6,000–10,000-barrel-a-day plant, I believe, rather than a 50,000-barrel-a-day commercial plant. I think that is correct.

But let's move on quickly, because I'm concerned that perhaps the criticism of your agency is directed toward a full-scale commercialization program rather than a testing program. You are aware that the loan guarantees would be available for biomass conversion and other conservation programs as well?

Mr. HUGHES. Yes; we are aware of that. The proposal, though, is to build essentially commercial-sized plants.

Mr. THORNTON. OK. Two commercialized-sized natural gas plants would be built, I believe. Are you aware that the price comparison for those plants indicates a comparison with imported liquefied natural gas which would give those plants an economic ability to exist in view of today's market prices for imported liquefied natural gas?

Mr. HUGHES. Yes; they would compete.

Mr. THORNTON. And it would be under the synthetic naphtha gases?

Mr. HUGHES. Yes.

Mr. THORNTON. Are you aware that with this particular area there is some likelihood that commercialization is imminent, whether or not there is a loan guarantee program, and that it's a marginal operation today?

Mr. HUGHES. Yes. There are plants operating in Europe.

Mr. THORNTON. And with regard to plants operating in Europe, I believe your report states that those plants operate because those countries do not have an adequate supply of domestic oil or gas, and that makes it feasible for them to have synthetic plants.

Mr. HUGHES. Yes.

Mr. THORNTON. OK. What happens if this country no longer has an adequate supply of oil and gas?

Mr. HUGHES. First, Mr. Thornton, the timing of that is one of the things that we are struggling with.

Mr. THORNTON. Yes, sir, it sure is.

Mr. HUGHES. It's uncertain.

Mr. THORNTON. It certainly is.

Mr. HUGHES. There are alternative energy sources available to us.

Mr. THORNTON. And we should explore all of them?

Mr. HUGHES. Yes.

Mr. THORNTON. Conservation, solar, geothermal, every one?

Mr. HUGHES. Precisely the point, Mr. Thornton. One of the things that concerns us is that the prophecies that we are working with tend to be self-fulfilling.

Mr. THORNTON. Right.

Mr. HUGHES. And a commitment in a particular direction tends to keep us moving in that direction, no matter what, and we think for the time being that would be unwise.

Mr. THORNTON. However, I do want to get to that question of prophecies because there is a basic assumption contained in this report which gives me a great deal of concern, if I understand it correctly. I hope I am mistaken. Do you assume that the world's supply of oil and gas is inexhaustible?

Mr. HUGHES. Not hardly, no indeed, Mr. Thornton, I guess is the best I can say.

Mr. THORNTON. OK. Either way. It is a finite resource.

Mr. HUGHES. It certainly is.

Mr. THORNTON. Are demands upon that resource increasing?

Mr. HUGHES. Yes, indeed.

Mr. THORNTON. All over the world?

Mr. HUGHES. Yes.

Mr. THORNTON. Then on what basis do you make the assumption contained on page iv of your index that synthetic products " * * * will not be economically competitive, particularly since the existing world market price for oil could always be manipulated to substantially undercut the price of synthetic fuels * * * "

How, if the world supply of oil is depleting, is finite, and is not going to be sufficient for the world's future needs; how is it that prices can always be undercut?

Mr. HUGHES. We're talking at present, and—

Mr. THORNTON [interrupting]. Well, this is talking about always.

Mr. HUGHES. No. We're talking about in the context of our report, I think, Mr. Thornton, and it is, as Mr. Milford suggested, possible for OPEC to manipulate prices.

Mr. THORNTON. It could do so today?

Mr. HUGHES. Yes, sir. It could do so for quite some period of time.

Mr. THORNTON. It could do so in 1980?

Mr. HUGHES. I don't know what the time period is, but it certainly could do so for quite a period of time.

Mr. THORNTON. Do you know what you're pricing OPEC oil in 1985 for the base of your comparison?

Mr. HUGHES. It's set forth.

Mr. THORNTON. I would like to see those figures, because you said something a moment ago that you thought that the odds were that the price differentials which now exist would continue to escalate equally, and if that is your assumption I would like to know the basis for that assumption. Could your furnish that?

Mr. HUGHES. Yes. We are using essentially, Mr. Thornton, the same basic data as other people working in this energy area are using.

The question really is how one acts in response to that information. Much of the future is speculative, more or less by definition. We have assumed a basis of essentially present price relationships, because where does one go from there? You can develop alternative models and reach whatever conclusion one reaches. But again, we are not foreclosing, or even retarding, in our judgment, the synthetic fuels technology development.

Mr. THORNTON. I think it's very important that we do not do so. If I may make a point in closing—I realize my time may have expired—I would say that in speculating, in predicting, or looking at a crystal ball it's important to see the figures, to understand the data analysis and also to understand the basic assumption from which those figures are derived.

Mr. HUGHES. We quite agree, and I think we have set forth our data.

The CHAIRMAN. Mr. Ottinger, you're recognized for 5 minutes.

Mr. OTTINGER. Thank you, Mr. Chairman.

If I understand the report correctly, it seemed to me that you said at one point in the report that one of our highest priorities should be given to the development of synthetic fuels. You point to the existing \$416 million program that ERDA presently has underway, and say that substantially all of the answers with respect to the environment and the socioeconomic affect can be gotten from the second generation technology that is going to come on line with respect to demonstration plants more or less simultaneously with this program.

As I understand the report, what you're saying is that in the name of an unquestioned, threatened shortage of fuels in this country, in an energy crisis, we should not, in the name of that potential crisis, do basically unsound things. Is that it?

Mr. HUGHES. Yes; that is correct, Mr. Ottinger. We are trying to suggest an alternative course of action involving several thrusts that we think is preferable.

Mr. OTTINGER. You are trying to be painted by the advocates of this bill as being opposed to synthetic fuels, and I don't think the GAO report, and my own position and Mr. Hechler's position, or any of the people who oppose this legislation, is in opposition to synthetic fuels. What we do oppose is a giant loan guarantee program, and there's no question that once you get in this it's going to expand even beyond the 4 or 6 billion dollars that we're talking about now for the huge

energy companies that already have this capital. It's that the program is unsound, not that we should not go forward with synthetic fuels.

Mr. HUGHES That is correct.

Mr. OTTINGER. Now, on loan guarantees, you came out finally at the end of your study and said that this kind of loan guarantee ought to be in the budget, and I wondered if you would like to elaborate on that a bit, and about the effects on the economy of using loan guarantees for the large energy companies with respect to the already existing concentration of those energy companies and their stranglehold over the energy business.

Mr. HUGHES. Mr. Ottinger, we see this sort of loan guarantee as a substantially different sort of thing from the home loan guarantee, the Veterans home or FHA home loan guarantee. The universe is very limited. The risk appears, to us at least, to be quite high in economic terms, not in technological terms. It seems to us, further, that the Federal Government, or the customer, or some combination of those two, will inevitably be in the position of buying the output of these plants, whether there is a guarantee or not, and in those circumstances it would seem to us that the guarantee approach that is set forth here is inappropriate, that rather the market support approach is probably preferable and a more straightforward one.

Mr. OTTINGER. So translating what you're saying, you are saying that this program—and I suppose these are my words because GAO wouldn't use these words—this is in the name of resolving the energy crisis, what, in effect, we're being asked to do is to have a giant ripoff of the taxpayers,

Mr. HUGHES. Those surely are not my words, Mr. Ottinger. I'd lose my GAO card if I used those words. [Laughter]

Mr. OTTINGER. I understand that, but what you're saying is we're being asked to go into a huge loan guarantee program for large energy companies that have the capital and expose the public to a risk to which they should not be exposed, when in fact, you can get the information that you need from the existing research and development program; and these plants are, according to the figures that you have cited here from ERDA coal gasification plants, estimated to be 15 percent more efficient. If that is so, when they came on line, the same as this program would come on line, chances are the taxpayers would be saved this money, and the giant energy companies would be able to finance this technology themselves.

Mr. HUGHES. We would hope so, Mr. Ottinger. In any event, it seems to us that the output of these plants, once they are built, will be purchased by the taxpayers or by the customers of the plants, whatever the price.

Mr. OTTINGER. And we're trying to save the taxpayers that giant ripoff.

Thank you, Mr. Chairman.

The CHAIRMAN. The Chair will recognize Mr. Emery and Mr. Lloyd, and then we will go to ERDA, and recognize Mr. Symington and Mr. Hayes first. Mr. Emery, you are recognized for 5 minutes.

Mr. EMERY. Thank you very much, Mr. Chairman.

I've had an opportunity to look over some of the figures that apparently were used in this GAO analysis, and I find a few discrepan-

cies that I think ought to be brought to the committee's attention, and I would like to hear some amplification of their use.

For example, on page 36, in a discussion of obstacles to implementing synfuels, I notice the quoted price of \$12 per barrel for foreign oil, and that \$12 figure apparently is used as a base to compute cost relationships for the various alternatives. Now, isn't it true that that's an old price, that the current price of imported petroleum is about \$13.50, and if that's so, doesn't that throw the comparison figures a bit out of line?

Mr. HUGHES. The price is a range, as I understand it, Mr. Emery. and runs in the range of \$11 to \$13. I don't see that the differential we are talking about invalidates our position.

Mr. EMERY. Well, as an engineer, I can tell you that although you may be talking about about a range between \$11 and \$13, or whatever it happens to be, to do the analysis correctly, you have to take into account all the different possibilities, and if you quote a range of \$2.61 to \$3.02 per thousand cubic feet for high Btu syngas, and you base that analysis on one figure of \$12, the current price, you're talking about a range in one case but not in another, and I don't think that's a very accurate comparison. So you ought to make a comparison over that entire range. But also I think you will find that that \$12 figure is low, and in order to have an accurate analysis you ought to include the higher figure at which you can purchase imported petroleum. So I would criticize that analysis in that case, and suggest that you run over the figures again.

Mr. HUGHES. It seemed to us, again, Mr. Emery, that the use of a \$13 or \$13.50 figure doesn't shift the relationship.

Mr. EMERY. Don't you expect that that price is going to go up as well? You don't expect OPEC to drop its price, do you?

Mr. HUGHES. I think all prices are going up, Mr. Emery.

Mr. EMERY. Let me ask you another question following on to that. You commented a while ago that one way to encourage conservation is to increase price, which we don't argue with. So why is it bad, if we are talking of a slightly higher price for synthetic gas, to have a higher price in that case if it's okay to have a higher price on imported petroleum? Don't you follow that logic? Isn't that the same thing?

Mr. HUGHES. No; I certainly don't follow that logic, Mr. Emery. That suggests we should now go to the highest possible priced option to produce energy, and I certainly can't agree with that.

Mr. EMERY. Well, in the New York Times article that was released a short time ago it was suggested that GAO indicated that all our energy needs should be met by increasing the amount of petroleum that's imported and by instituting conservation measures.

Mr. HUGHES. The New York Times has got to defend its own honor. I'm working on mine this morning. I did not write the article. I don't support that conclusion. The report doesn't say that.

Mr. EMERY. Another question: On page 27 of the report you indicate that 1.5 million barrels per day may be provided by tertiary recovery. Now, how current is this figure? In ERDA, volume II, page 37 of the manual, this figure is listed as only 500,000 barrels. Which is GAO's assumption?

Mr. HUGHES. We'll check the figures, Mr. Emery. To the best of our knowledge, we are in agreement with the ERDA national plan pro-

jections, as we've cited there. If we've used the wrong number, I'm sorry. We didn't think we had.

Mr. EMERY. Well, this points out the comment which I made a few minutes ago, that it seems that there are some discrepancies. There are 1 million barrels per day between 1.5 million and 500,000, which is pretty serious in a report of this nature, and I don't think that it would be very responsible of GAO or any other organization to have inaccurate figures in a report of this magnitude.

Mr. HUGHES. I quite agree with you, Mr. Emery. I'm not convinced that it's an error yet, but we will check the number.

Mr. EMERY. All right. If you would clarify that, it would be most interesting to the committee.

[The information to be provided follows:]

With respect to the potential impact of tertiary oil recovery technologies, we consistently used in our report estimates of potential impact of all new energy technologies from Scenario V of ERDA's National Plan (ERDA-48). Scenario V states a potential of 1.5 million barrels per day of tertiary oil in 1985. In Volume 2 of ERDA's National Plan (ERDA-76-1), ERDA quotes a figure of an additional 500,000 barrels a day from tertiary recovery by 1985. Considering that almost 300,000 barrels a day was being recovered through tertiary recovery, this would bring total tertiary oil recovery by 1985 to close to 800,000 barrels a day.

The figures we quoted from ERDA-48 Scenario V (ERDA's most optimistic scenario) represents boundary or limiting case conditions. We used this optimistic scenario, which ERDA states is idealistic, to illustrate the estimates for the various technologies under the best of circumstances. ERDA-76 does not contain the complete information that ERDA-48 does. ERDA has stated that it is updating all figures on the potential of new technologies and hopes to include the updated figures in ERDA-77.

Further, there are other recent actions which are designed to stimulate tertiary production which would apparently affect further estimates. For example, in the recently passed Energy Conservation and Production Act, Congress revised the production incentive to the domestic composite crude oil price and directed that FEA, when applying the adjustment, give priority to providing additional price incentives for the bonafide application of tertiary enhancement techniques. FEA's most recent estimate of tertiary recovered oil in 1985 is 900,000 barrels a day. We understand that FEA is in the process of revising that number.

Mr. EMERY. One of the things that concerns me, I have had an opportunity to read two GAO reports that are very important to me and my district, one being on an entirely unrelated matter, having to do with the purchase of machine guns, and the other, of course, being this report, dealing with our synthetic fuels program; and I must say, in all honesty, in both cases I have not been impressed with the analysis that I've seen from GAO; and, in fact, in both cases it has appeared to me that some of the conclusions were reached by individuals in GAO before the analysis was brought out. There have been discrepancies in figures; there have been conclusions that are not related directly to fact; there have been inconsistencies; and, in fact, in some cases, mistakes, outright mistakes that GAO has admitted to, as in the previous report that I mentioned a minute ago. So I am not necessarily swayed by GAO analyses in all cases, and I would certainly hope that in the future GAO would be much more responsive to facts, to research carefully, in doing the work that they are presenting to the Congress. Maybe this is just a case where my own feelings seem to be at odds with the conclusions that are made, but at the same time when you run into discrepancies, figures like 1.5 million barrels versus 500,000 barrels—I'm very disturbed by it.

Mr. HUGHES. I don't think that's a discrepancy, Mr. Emery. We'll pursue that.

Mr. EMERY. I would appreciate that. Thank you very much.

Mr. HUGHES. I'm not familiar with the machine guns, but we'll pursue that if you wish. I'm simply unfamiliar with the report.

Mr. EMERY. I know you're not familiar with that report.

The CHAIRMAN. Mr. Lloyd.

Mr. LLOYD. I thank the Chairman.

Mr. Hughes, you seem to be kind of on the frying pan at the present moment, and I am indeed sorry, although I would have to say that in the light of the presentation certainly by my colleagues—Mr. Brown, Mr. McCormack, Mr. Emery, Mr. Myers, and all the people who have spoken here—that some very serious doubt seems to have been created.

Mr. OTTINGER. You're not speaking for me, are you, Mr. Lloyd?

Mr. LLOYD. I would even say that there might be some doubts from my colleague from New York now and then.

The thing that hits me, and most importantly, is the impact of this report on what I call the public domain, in other words, the New York Times, and I would like to address myself to the public attitude.

Do you really feel that this report was wise at this point in the light of what seem to be some very serious questions which have been presented here today?

Mr. HUGHES. Well, I hate to equate the New York Times with the public.

Mr. LLOYD. Well, you will accept the fact that the New York Times is probably the most widely read newspaper in the Nation today? For your information, since I dealt in that media, I would tell you that it is, so that you know.

Mr. HUGHES. I thought the Wall Street Journal article was a better reflection of what we said. I really can't be accountable for the New York Times.

Mr. LLOYD. But you see, I disagree with you, Mr. Hughes. I think you are accountable for what is said in these publications, for the simple reason that there are images which are created which can have very long-lasting effects on the attitudes of the American public, and if indeed you felt the New York Times had erred—and apparently you do think that—the question is: What remedial action have you taken to correct that? Have you sent a letter to the New York Times?

Mr. HUGHES. It seems to me it's not a question of error. It was the New York Times interpretation of our report.

Mr. LLOYD. Well, the media interprets what we do here on the Hill, regardless of who we are, don't they, at all times? That's not anything new. That didn't just come as a new and startling revelation to you.

Mr. HUGHES. No; indeed it didn't.

Mr. LLOYD. You do think that your publication had some sort of public impact, don't you?

Mr. HUGHES. Yes. Obviously, it did.

Mr. LLOYD. And do you feel that public impact is the right one in the light of the serious energy problems we face in the Nation today?

Mr. HUGHES. Yes, I think it was right, as reflected in the Wall Street Journal. I was not personally happy with the New York Times' interpretation.

Mr. LLOYD. I'm sorry that I have missed the report in the Wall Street Journal. I wonder if you would be so kind as to provide me a copy of that, if you have it?

Mr. HUGHES I don't have it here. We will see that you have one. [The information to be provided follows:]

SYNTHETIC FUELS SEEN TOO COSTLY FOR U.S. TO FUND

GAO'S REPORT DEALS BLOW TO WHITE HOUSE PROPOSAL TO ASSIST THAT INDUSTRY

(By a Wall Street Journal Staff Reporter)

WASHINGTON.—The General Accounting Office dealt a blow to an already beleaguered White House proposal to aid the synthetic-fuels industry.

The GAO, Congress's fiscal watchdog, concluded that synthetically produced oil and gas will be too costly to be competitive with foreign energy supplies. Therefore, it said, the federal government shouldn't commit billions of dollars for synthetic fuels projects.

Several different bills, authorizing up to \$4 billion in federal loan guarantees to finance construction and operation of commercial-sized synthetic-fuels plants, are ready for action in the House. The Senate, which last year approved a measure authorizing \$6 billion in loan guarantees, is expected to go along with any House bill.

Upset by the GAO report, Rep. Olin Teague, chairman of the House Science Committee and sponsor of one of the loan guarantee bills, said he is calling GAO officials before his committee next Tuesday to elaborate on their conclusions.

"There's no question this report doesn't help our chances (of passing a bill)," the Texas Democrat said, "I don't intend to bring any synthetic-fuels bill to the floor unless I'm convinced we can win."

Rep. Teague shepherded a bill calling for \$6 billion of loan guarantees through his committee last year, only to have it fail in the House, a demise he blames on lack of White House support. His second attempt to pass a smaller loan guarantee bill is already in trouble. Four different House committees have cleared four different versions of the measure ranging from no loan guarantees to \$4 billion in government backing. The House won't consider synthetic-fuel legislation until after Labor Day at the earliest, Mr. Teague said.

Meanwhile, the GAO study concludes that conservation, rather than big spending on synthetic-fuels production, is the most "cost-effective" way to reduce U.S. dependence on foreign oil imports. The U.S. imports about seven million barrels of oil a day of the 16 million barrels consumed daily.

Oil produced from coal or oil shale could cost as much as \$18 a barrel, compared with \$12 a barrel for imported crude oil, the GAO said. Gas produced from coal would cost \$2.61 to \$3.02 for a thousand cubic feet, roughly twice the rate of \$1.42 set by the Federal Power Commission, for new natural gas. To make synthetically produced oil competitive with imported oil the government would have to subsidize its production the GAO said.

"If the price of a barrel of oil from shale were to exceed the price of imported oil by \$5 a barrel, then an additional price subsidy of \$250,000 a day, or about \$90 million each year, could be required for just one small plant," the GAO concluded.

In addition, the GAO reported, synthetic-fuel plants possibly could become outdated before they even began production because of changes in technology. A plant to produce 50,000 barrels of oil a day from oil shale would cost about \$1 billion.

Robert Seamans, head of the Energy Research and Development Administration, which supports loan guarantees for synthetic-fuels projects, criticized the report. In a letter to GAO Comptroller Elmer Staats, Mr. Seamans said the GAO's conclusions aren't supported by sound analysis. Further, he objected to comparisons of the cost of synthetic fuels with present prices for imported oil.

"We believe that the GAO report is so substantially lacking in analysis and information supportive to its conclusions," that the report serves only "to confuse the issues discussed," Mr. Seamans wrote.

Mr. LLOYD. In the other instance, in the postulating of a position, which was suggested by Mr. Emery, do you feel that your people have indeed been very openminded in their seeking of the final results, or the final recommendations? They didn't position themselves and then go out to prove it? That was what was suggested.

Mr. HUGHES. No, sir; they did not, and there were many of us involved in the report in one way or another, and we attempted to build up our data base and analyze it and see where it led us.

Mr. LLOYD. I want you to know I asked that question because I thought there was an element of fairness, because it does question your personal integrity, and I'm not in anyway suggesting we do that. I happen to agree, that I think you probably arrived at your conclusions honestly.

The only thing that I really bring you back to is the light of the tremendous negative reaction, with the exception of several of my colleagues here, in that case, Mr. Ottinger and others, that it would seem to me that there should have been some serious questions asked by your report before it came out into the public domain, and I consider that the general public of the United States, and that's precisely where your report is at the present moment.

Mr. HUGHES. We did expose the report to ERDA; we discussed it with them; and substantially the questions that have been raised here today were raised by ERDA. We attempted to discuss those questions as fully and frankly as possible with them. We obviously have some disagreement with them. I think, by and large, the disagreement is not on the facts but on the significance and what to do about it.

Mr. LLOYD. OK. I have about 30 seconds to go.

To sum up, I feel, Mr. Hughes, that you have failed to do one thing which I think would have been the responsible action, I think, and that is to recognize the impact of your words on the general public in a time of energy crisis, and because of this I really seriously question the value of this report, regardless of the truth that remains within it, which indeed there does. There's no one who's standing around saying that you're wrong based on the data you've collected. They're questioning the data; they're questioning some of the conclusions as a result of that in comparison to other data. But I think that the error you've committed, most importantly, is that you have somehow indicated to the American public that they do not have to pursue all avenues of energy production.

Thank you very much, Mr. Chairman.

Mr. HUGHES. I don't see where that's said anywhere in the report. Quite the contrary.

The CHAIRMAN. Sam, one final question.

Probably you more than any on this committee, more than any one in that audience, have had experience in the internal workings of this Government of ours, in the White House, in the Bureau of the Budget, and in GAO. We've worked together for 25 years. This committee had numerous informal meetings over synthetic fuels and finally, as a full committee, we met and voted to go into the question of synthetic fuels. We heard every witness that asked to testify, to be heard, something over 100. We then considered, I think—Dick—about 75 amendments, every amendment that was offered.

Now we are trying to go to the floor with an open rule. Before that though this bill was referred to the Ways and Means, the Commerce

Committee, Banking and Currency, and they have acted on it. Now we are trying to go to the floor with an open rule, giving each of these committees a chance to offer any amendment that they want to. Now how on God's earth could a committee in Congress come up with a fairer synthetic fuels bill than that? How would you do it? You've had more experience than I have. What would you do? What would you do differently than what we've done?

Mr. HUGHES. Mr. Teague, I haven't had more experience than you've had, and I don't apologize for that. I've lived a little different life. I frankly don't know what I would do differently. You obviously have had lots of discussion, open sessions, and conducted many inquiries, have gathered a lot of data, and I, frankly, don't know what different I would have done, had I been in your shoes.

The point, or the points, that we are trying to make have to do with what the Nation should do in a very difficult and complex set of circumstances. I don't know how to put it any different than that. We are obviously not trying to "do in" the synthetic fuels option. We think it's important to pursue it, and we think it's important to pursue it hard.

We think, however, that it is very important to pursue it in a way which doesn't make it preemptive. We are concerned with that, and that's why we have come up with the report that we have come up with. In a personal sense, I can't help but regret that it's causing you, obviously, a great deal of trouble.

The CHAIRMAN. Well, if your people will come up with suggested amendments that you think will improve this bill, I will offer them on the floor in your name.

Mr. HUGHES. I just don't think we can do that, Mr. Teague, but we will try to work with you in any way that we can.

The CHAIRMAN. Sam, thank you so very much. We have to hear a little from ERDA. We appreciate your coming up.

Mr. HUGHES. Thank you.

The CHAIRMAN. I don't want to appear critical of you. I can disagree with you without being disagreeable, because I have as much or more respect for you as any public servant in the city of Washington.

Mr. HUGHES. Thank you, Mr. Chairman. That's mutual, I might say.

Mr. OTTINGER. Mr. Chairman, while we're changing course in mid-stream here, if I might just make a brief announcement? There has been some confusion apparently about the Commerce Committee hearing on this subject. It will be held at 10 o'clock in room 2359. The newspapers erroneously reported it would be at 2 o'clock this afternoon.

Thank you, Mr. Chairman.

The CHAIRMAN. Dick, we will quit before that time.

Our first witness for ERDA will be Dr. Bill McCormick.

Bill, I want to recognize Mr. Hayes and Mr. Symington for questions.

You have submitted a statement. I assume that statement—I haven't read it—will be in answer to the things which the General Accounting Office has stated.

Dr. McCORMICK. Mr. Chairman, that is correct.

I would like to introduce Mr. Roger LeGassie from ERDA. He is ERDA's Assistant Administrator for Planning, Analysis and Evalua-

tion, and is responsible for ERDA's overall analysis forecasting and supply and demand effort.

The CHAIRMAN. What is the wish of the committee? How do you wish to proceed?

Mr. HECHLER. Mr. Chairman, could we ask them to make a very brief statement for the record, just summarizing their statement?

The CHAIRMAN. Mr. Hayes and Mr. Symington, is that agreeable with you?

Mr. HAYES. Yes.

Mr. SYMINGTON. Yes.

The CHAIRMAN. Suppose you summarize your statement, Bill, as quickly as you can and we'll put the rest of it in the record.

[The complete statement of Dr. McCormick, plus ERDA's views on the recently released GAO report entitled, "An Evaluation of Proposed Federal Assistance for Financing Commercialization of Emerging Energy Technologies," also GAO's response to ERDA's comments, follows:]

STATEMENT OF DR. WILLIAM T. MCCORMICK, JR., DIRECTOR, OFFICE OF COMMERCIALIZATION, U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

Mr. Chairman and members of the committee: I am pleased to be with you today to provide ERDA's views on the recently released GAO report entitled, "An Evaluation of Proposed Federal Assistance for Financing Commercialization of Emerging Energy Technologies." Attached to my testimony is a letter from Dr. Robert Seamans to the Comptroller General summarizing ERDA's major concerns about the GAO report. In addition, as attachment number two, we are providing the Committee a detailed critique of the GAO report.

Mr. Chairman, in general we are deeply concerned about this regard because it presents strong conclusions and recommendations to the Congress without any substantial underlying basis of analysis. The report represents, in our view, a discussion of a particular point of view rather than the result of an objective analysis of real energy alternatives for the Nation.

In our review of the GAO report we have found no analysis which seriously questions the basic rationale for undertaking a limited commercial demonstration program for synthetic fuels and other energy technologies such as is embodied in the legislation considered by this and other committees: i.e., H.R. 12112. There are several major points in this regard. First and most important is the national need for synthetic fuels and the timing of such need. Second, is the question of whether or not Federal financial assistance is needed and last is the issue of the least costly and most efficient form of such assistance. Let me address each of these issues separately.

NEEDS FOR SYNTHETIC FUELS

With respect to the need for synthetic fuels, several facts should be clearly kept in mind. First, is the fact that domestic production of oil and natural gas peaked in the early 1970's and continues to decline. A second fact is that imports of foreign oil have been steadily rising over the past 15 years. Just before the Arab oil embargo of October 1972, 29 percent of all oil consumed in the U.S. was imported; today, that figure exceeds 40 percent. As pointed out last week in a New York Times editorial, we have as a Nation developed an alarming complacency with respect to our growing oil import dependency.

Now consider the future. All major forecasts of domestic supplies of oil and gas project that even with complete decontrol of oil and gas prices, vigorous exploration and development of our Outer Continental Shelf and Alaskan resources and extensive use of tertiary oil and gas recovery technologies, domestic conventional oil and gas production will resume its decline some time in the late 1980's or early 1990's. This means that even assuming rather optimistically that conservation efforts can reduce total demand growth for energy from the historical rate of over 3 percent to 2 percent, the requirement for synthetic fuels in the mid-1990's will be on the order of four to five million barrels per day. If this capacity of synthetic fuels is not available, then the only other alternative for

the Nation is to import more Arab oil at an unknown cost both in economic terms and national security terms. The GAO report fails to make this clear. It also fails to admit that a consensus exists among major forecasters—FEA, ERDA, the Synthetic Fuels Task Force, the Ford Foundation's Energy Project and Bankers Trust—that it is less than two decades before this country will require a new domestic industry to supplement our dwindling conventional oil and gas supplies if we are to avoid large increases in imported oil. The report does not recognize that even vigorous conservation measures cannot obviate the need for either substantial increases in oil imports or substantial production of domestic synthetic fuels. The choice is clear, it is simple and it is unavoidable.

NEED FOR FEDERAL ASSISTANCE

The second major issue is the question of whether Federal financial assistance is needed to lay the foundation for initiating an industry which might need to grow to a capacity of five million barrels per day by 1995 and ten million barrels per day by the year 2000. Bear in mind that five million barrels per day implies 100 major plants and ten million barrels per day implies 200 plants. If we started today to build this industry, it would have to grow at a compounded annual rate of 17 percent per year to meet these projected capacity requirements. Such a sustained growth rate for a large capital intensive industry is, by all measures, an enormous undertaking. One only needs to consider the present contribution of nuclear power 20 years after the first commercial power reactor in Shippingport, Pennsylvania came on line in the late 1950's. Today, two decades later, nuclear power is providing only 9 percent of our electricity generation although its contribution is projected to grow to 45 percent by year 2000. The point of this comparison is that there are long lead-times in launching a completely new industry.

Questions have been raised concerning the comparative economics of synthetic fuels and industry attitudes towards making the investments in these technologies. We believe that, in general, the prices of synthetic fuels are close to being competitive today with foreign oil and with alternatives to natural gas such as imported LNG and conversion of naphtha into gas. Both are expected to be more expensive than coal gas and less reliable because they must be imported. The GAO report incorrectly compares the estimated prices of synthetic fuels with regulated well-head gas prices and imported crude oil. The report should have compared the price of synthetic fuels with the price of alternatives with which they would compete at the margin. For example, while it is true that regulated interstate gas prices are presently at \$1.42 per million Btu's this gas, which is the cheapest of all domestic gas supplies, provides only a fraction of the total domestic gas requirements—a fraction which is continuing to shrink. This means that an increasingly large share of gas consumed must come from higher priced alternatives of which synthetic fuels is one. Failure to recognize this fact is a serious deficiency in the GAO report. A second major deficiency in this connection is the implied assumption of easy substitutability of one fuel type for another. The country has over \$100 billion invested in its gas transmission, distribution and end-user equipment systems. In economic terms this means that keeping the gas pipelines full even with higher priced gas alternatives will in many cases be cheaper for the American consumer than retrofitting to accommodate electricity or imported oil. In any case, such substitution would occur only gradually and its extent, effects, and cost have been ignored in the GAO report.

Without Federal assistance, it is clear from numerous witnesses before this and other committees that the environmental, regulatory and political uncertainties are such that potential investors are faced today with major financial risks and will not make commitments to synthetic fuel plants. These risks stem from the absence of any domestic experience with the construction and operation of synthetic fuels plants. Even though in many cases the technology is well in hand and entails minimal risk, a major synthetic fuel project faces serious potential delays and even non-completion simply because the regulatory rules have not yet been agreed upon. So although industry may see the future need for synthetic fuels and view the technology as likely to be competitive in the near future, investors simply will not commit the necessary huge sums without some risk-sharing in the case of the first few plants. The recent announcement last week by the Secretary of Interior of the suspension of development of the two richest oil shale lease tracts in Colorado further illustrates the fragile nature of these initial projects. The companies involved complained of

a plethora of environmental, legal and other uncertainties in the development of oil shale leases.

TYPE OF FINANCIAL ASSISTANCE

The last major issue is simply which financial incentives are most effective and least costly to accelerate the construction of these plants. Bear in mind that the proposed synthetic fuels program is not an effort to permanently subsidize the ongoing production of synthetic fuels but rather a carefully limited demonstration of a critical number of "first-of-a-kind" plants.

Last year the Interagency Task Force on Synthetic Fuels under the President's Energy Resources Council analyzed, for each major synthetic fuels technology, the comparative costs and benefits of each major incentive type including loan guarantees, direct loans, price guarantees, purchase agreements, tax incentives, etc. We believe this analysis forms a comprehensive basis for the legislative proposals contained in H.R. 12112 and the Banking Committee amendments. While the GAO suggested that loan guarantees are not an effective or preferred approach, again there is no analysis to dispute the recommendation for loan guarantees made in the Synthetic Fuels Interagency Task Force's extensive analysis.

In summary, the GAO report consistently understates the future requirements for synthetic fuels and overstates the degree to which conservation and renewable energy resources can satisfy this future energy gap. We believe that the GAO assertions regarding relative cost effectiveness of various technologies are without basis and are nowhere supported in the report. We further believe that GAO's assertion that synthetic fuels production is not cost effective is erroneous because it fails to recognize the future sources of supply and likely costs of alternative energy sources. Finally, we strongly urge the Congress to reject GAO's recommendation that "government financial incentives for commercial development of synthetic fuels . . . not be provided at this time." The conclusion is unsupported and clearly not in the best interest of a prudent National energy program.

Mr. Chairman, this completes my prepared remarks. I will be pleased to answer any questions that you or other members of the Committee may have.

ATTACHMENT I

U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION,
Washington, D.C., August 19, 1976.

Hon. ELMER B. STAATS,
Comptroller General of the United States, General Accounting Office.

DEAR MR. STAATS: ERDA has reviewed the draft GAO report entitled "Are There Better Choices?" which is concerned with Federal proposals to finance the commercialization of advanced energy technologies.

We are deeply concerned about this report because it presents strong conclusions and recommendations to the Congress without a sound underlying basis of analysis supporting them. The draft report represents in our view, a presentation of a point of view rather than any new, independent analyses of alternatives.

This lack of underlying objective examination is particularly important since the opinions expressed in the report have implications not only with respect to important legislative proposals now pending before the Congress for synthetic fuels and other technologies, but also with respect to the broader matter of the overall balance among ERDA's energy R,D&D programs.

In particular, I wish to call your attention to the following major concerns which we regard as serious deficiencies in the draft report:

1. In arguing that it is not necessary to provide now a Federal guaranty program for synthetic fuels, GAO has used for its analysis a very optimistic estimate of the future effects of conservation (i.e., Ford Foundation technical fix case) and coupled this with an equally optimistic high estimate of domestic conventional oil and gas production in the year 2000 (20 million b/d greater than today's domestic production). We believe such unrealistic demand/supply cases cannot prudently be used as a basis for national energy policy. Nevertheless, even using such optimistic projections, the GAO report still admits to a substantial synthetic fuel production requirement beginning in the 1990's if we are to avoid a further increasing dependence on foreign oil. With this requirement, lack of certainty as to the future price and availability of imported fuels, and with the long lead times associated with the growth of such a large new capital intensive industry, uncertainty facing investment must be resolved by

the middle 1980's if we are to maintain a capability to have plants in operation in the early 1990's. This means that we cannot delay taking action now to obtain needed information regarding the environmental, regulatory and overall economic characteristics which can affect the commercial viability of this option.

2. The GAO draft report has numerous assertions about the favorable comparative economics of new and emerging conservation and renewable energy resource technologies vis-a-vis synthetic fuels. Such discussion is hardly germane to an evaluation of synthetic fuels technologies. Indeed, ERDA shares GAO's enthusiasm concerning the attractive features of conservation and renewable resource technologies. However, even if these technologies are very rapidly introduced, they, by themselves, cannot obviate the indicated need in the 1990's for substantial quantities of synthetic fuels, or alternatively, continued imports.

3. The GAO report fails to either present or analyze the underlying rationale for the financial incentive program for synthetic fuels and other technologies embodied in H.R. 12112. Repeatedly, the draft GAO report characterizes this program as one which is aimed at augmenting domestic fuel supplies through subsidized synthetic fuel production. While one effect of the program would be to supplement domestic fuel supplies by some modest amount, the primary purpose of the program is to maintain the option to develop a synthetic fuel industry that can meet a projected demand in the 1990's of several million barrels per day of synthetic liquids and gaseous fuels. The guaranty program, therefore, is designed to acquire critical information and, to the extent possible, resolve at an early date regulatory, environmental, financial, political and other barriers which may preclude later private sector investment because of the lack of information concerning the commercial viability of these plants. The Nation's experience with commercializing nuclear power has demonstrated that early attention to these matters is essential to preclude later delays. The report continually refers to a production program which "chooses" or "commits" to synthetic fuels. Such choices, as we see it, are to be made by the Nation, not today, but at a later date. The Synthetic Fuels Commercialization Program is designed to provide a needed meaningful basis for that decision, not to preempt it.

4. The draft GAO report compares the costs of synthetic fuels with *today's* price of imported crude oil and today's regulated price of natural gas. We believe the price of synthetic fuel products should be compared with the price of *future* alternatives against which they will compete beginning in the late 1980's. They should also be compared with products that will realistically compete in the end use markets which they are likely to serve. For example, synthetically produced gas from coal should be compared with alternatives to natural gas such as Alaskan gas, LNG (now priced at about \$3 per million Btu) and gas made from petroleum products, as well as higher priced depleting domestic conventional resources. When these comparisons are made, one finds that these other alternatives to natural gas are projected to be equally expensive and even more expensive in the case of gasification of petroleum products which is already occurring in the U.S. While over the next 20 years some substitution for natural gas will occur among electric utilities and large industrial users, we see no way in which these conversions can be assured to be large enough to offset a steady or rising demand for liquids and gaseous fuels and a steadily declining domestic supply.

5. In Chapter 5, we found the comparisons of alternative Federal financial incentives to lack objectivity and to be without a systematic basis for comparison. For example, the incentive analysis did not contain criteria against which the incentives were compared. Furthermore, although advantages and disadvantages were cited for some incentives, in the case of loan guarantees the disadvantages were cited without noting some of the major advantages. Also in the case of tax incentives which were later recommended in the report for accelerating the introduction of conservation technologies, the report did not cite any major disadvantages, not the least of which is the permanent status tax subsidies generally assume and the general failure of tax incentives to be focused on individual projects. We continue to believe that in many situations where capital availability and project scale relative to the sponsor's net worth are the major financing problems, that loan guarantees are the most effective, efficient, and least costly financial tool available to the Government.

Finally, we believe that the draft GAO report is so substantially lacking in analysis and information supportive to its conclusions, that publication of the report would only serve to confuse and further obfuscate the issues discussed. Furthermore, the publication of the report in anything near its present form will be damaging to the early implementation of our needed energy supply programs.

My staff has transmitted more detailed concerns regarding the report in the nature of factual, editorial and judgmental material.

Sincerely,

ROBERT C. SEAMANS, Jr.,
Administrator.

ATTACHMENT II

ERDA—PAGE BY PAGE COMMENTS ON GAO REPORT

August 26, 1976.

Page i, para 4

In making the "right" choice among financing mechanisms, GAO has ignored as criteria the factors of risk, credit and rate of return. These were carefully evaluated by the President's Task Force last year, but are not even addressed in the GAO report.

Page ii, para 3

ERDA agrees that the nation should explore all promising supply and conservation alternatives. However, the agency believes that conservation alternatives, even if aggressively pursued cannot obviate the need for substantial quantities of synthetic fuels in the early 1990's. This conclusion is supported by all major supply/demand analyses in recent years.

The reference to the slowdown in the rate of growth in demand for energy is largely due to the post-embargo measures and more recently the national and world recessions. However, this year demand is rising rapidly as evidenced by the Edison Electric Institute figures (see August 16 Wall Street Journal) of a growth of 5.2% in electricity demand in the first 32 weeks of this year.

The GAO emphasis on conservation does not take into consideration how much of the potential for price-induced conservation has already been captured.

Page ii, para 4

The GAO conclusion that certain conservation measures are the most cost-effective than synthetic fuels is based on an "appearance" (last line) rather than on a sound analytic analysis. Neither the measures of cost-effectiveness are discussed in the report nor are the quantitative comparisons shown.

Page iii, para 1

This is the first of several instances in which all synthetic fuels are asserted to be not cost-effective when the cost of their output is compared to that of foreign oil.

Two points must be made :

1. The economic comparison of high Btu gas produced from coal with alternatives should, as is later noted in the report, use LNG and synthetic gas from naphtha as the alternatives rather than imported oil. These are the real alternatives that are available.

2. Where oil is the appropriate competing fuel the economic comparisons should be made as of the time that the synthetic fuel plants come into operation in the early 1980's rather than at the present time. All major forecasts project world oil prices to continue to rise.

Page iii, para 3

The GAO questions the prudence of ". . . any national commitment . . .". H.R. 12112 does not represent a commitment but rather a preservation of the option to proceed in a timely manner with development of a synthetic fuel industry to meet the projected requirements of about 5 million barrels per day in 1995.

Page iii, para 4

This paragraph appears to confuse the economic evaluation of emerging technologies on an incremental (or marginal) basis with the later pricing of the output of such plants on an incremental versus a rolled-in pricing basis. In any event, the administrative analysis showing the desirability of synthetic fuels was not based on rolling in these products.

Page iv, para 6

The GAO report makes the statement ". . . the projected prices are not competitive with existing or other emerging energy sources." ERDA believes that high Btu gas is now competitive with existing higher priced alternative sources such as LNG and naphtha conversion. Moreover, at least one potential builder of

a shale oil modular plant (Union Oil) indicates that the output of the plant will, with only a government loan guaranty, be competitive with existing world oil prices.

Page v, para 2

The possible 15% cost reduction which the GAO report cites, would be applicable only to that part of the investment which represents process technology. Infrastructure, socioeconomic impact assistance, financing costs, and other elements which are insensitive to the specific coal conversion process used will not be affected.

Page v, para 3

ERDA does not agree that it is possible to gain the information sought by the H.R. 12112 program from smaller plants under government control. Only commercial-scale plants operating in the private sector will acquire a credible body of information addressing the environmental, regulatory, socio-economic, and other uncertainties which restrain private investments without Federal assistance. GAO has not presented any evidence suggesting that the information desired from the commercial demonstration program can be obtained any other way.

Page vi, para 2

The GAO report recommends that Congress "... place the highest priority on ... obtaining better cost/benefit data on the whole range of conservation opportunities." This directly contradicts the numerous assertions in the GAO report about "cost-effectiveness" of conservation opportunities.

Page 1, para 1

The GAO report does not recognize that the purpose of H.R. 12112 includes commercialization of renewable resources as well as synthetic fuels and demonstration of energy efficient facilities and equipment.

Page 1, para 3

This paragraph states that "... the price of synthetic fuels is almost certain to be higher than the price of energy produced from traditional energy sources, ...". This assertion is presented without supporting analysis. ERDA believes the assertion to be not true with regard to synthetic high Btu gas which ERDA now believes to be competitive with the alternative sources of LNG and synthetic gas from naphtha. Although it appears, with regard to non-high Btu gas synthetic fuels, to be at least partially true now, and may remain so in the near-term, the correct timeframe for this analysis is the post-1985 period when synthetic fuels will begin to be ready for substantial market penetration. Further, this discussion ignores the dimensions of risk, credit, and uncertain world oil pricing, and the part that they play in discouraging private sector investment in synthetic fuel.

Page 2, para 4

GAO lists three factors which they believe to be important in "... determining the incentive which would 'best' stimulate a particular energy or conservation technology ...". A fourth factor which ERDA believes to rank equally with these in importance is the assessment of the financial barrier to be addressed by the incentive, i.e. is the financial incentive needed because of risk, credit limitation, or a rate of return problem?

Page 3, para 1

The GAO report states that "... no one bill ... considers all costs associated with development ...". It fails to note that H.R. 12112 covers a broad range of technologies and requires consideration of all costs associated with development including socioeconomic and environmental costs.

Page 5, para 3

The GAO report states that the recent and perceived reduction in historical energy growth rates indicates that "... conservation actions may buy time to fully consider tradeoffs and make choices ...". A large part of the observed and perceived reduction is the consequence of conservation resulting from post-embargo and one-time measures, the sharply increased price of energy, and the recent world and national recessions. The reductions have reduced the severity of the problem somewhat, but they have not eliminated it. ERDA is of the opinion that the Nation is not yet in a position to make choices and must maintain the

integrity of all of our major options. If synthetic fuels demonstrations are not vigorously pursued now, there is no way we can meet the projected demand of the 1990's.

Page 7, para 4

The table on page 8 is described in the GAO report as illustrating "... the range of choices available for the United States energy future ...". It should be noted that even in Scenario I which is an optimistic case for the effect of conservation measures, that oil imports would rise in year 2000 to 21 quads. This clearly demonstrates that even with aggressive conservation and renewable resource development, these measures cannot obviate the need for synthetic fuels if we are not to increase our foreign oil dependence. In fact, all of the major supply-demand analyses including FEA's and the Ford Foundation scenarios all project a substantial requirement for synthetic fuels by the end of the century, if we are not to increase imports.

Page 9, para 1

ERDA agrees with GAO's assertion that both emerging supply and conservation technologies have vast potential, but disagrees with the implication that the requirements for increased imported oil and gas can be made up through conservation and application of renewable resource technologies. These approaches are not focused toward ameliorating the "liquids and gaseous fuels gap." Elsewhere in the report, GAO also fails to address the makeup of demand by energy sector.

Page 9, para 3

Many conservation technologies are described in this paragraph as being "... *potentially* cost-effective alternatives to developing new energy supplies ...". On page ii, such technologies *are asserted* to be cost-effective. Nowhere in the GAO report is this assertion substantiated by analysis.

Page 9, para 5

This paragraph cites "estimates" of the Ford Foundation Technical Fix scenario. As previously noted, these are not really estimates, but rather boundary conditions. Further, the Ford Foundation Technical Fix scenario is generally regarded as being highly optimistic with regard to the effects of conservation and is conceded by GAO to be "dated" at this time. Finally, even granted that the savings which appear in this scenario could be achieved, there is still a large deficit in liquid and gaseous fuels in the millions of barrels that must be met by either imports or synthetics in the mid-1990's.

Page 10, para 4

This paragraph compares natural gas production in ERDA Scenarios I and V with a GAO report. The GAO report expects natural gas production to decline to levels well below those of Scenarios I and V. The nation's need for synthetic high Btu gas or imports of LNG will be even greater than ERDA or FEA projects to the extent that GAO's expectation proves correct, or alternatively, will require highly expensive and possibly unmanageable fuel switching by consumers.

Page 11, para 5

This paragraph states that "... certain solar technologies *appear* to be cost-effective on a life cycle basis ...". Page ii states that these *are* cost-effective. Further, since no analysis is presented it is not clear what life cycles are being compared and what fuel prices are being assumed in the comparison. ERDA believes that with the possible exception of solar hot water heating in certain parts of the country," [sic]

Page 12, para 2

This paragraph and those which follow quote ERDA's plan with regard to energy conservation. ERDA believes that the quotations cited are correct. It is important, however, to understand that ERDA's plan still envisions the need for aggressive development of the synthetic fuels options because all energy saved is not in the form of oil or natural gas, and that the focus of the synthetic fuels program is on oil and gas.

Page 13, para 3

The GAO report states "The physical potential for energy conservation has been estimated in a number of studies. However, the questions of how much of the potential can be realized, in what timeframe, at what cost, and with what approaches, requires much more examination." ERDA agrees with this observation.

However, page ii states "GAO concluded that certain conservation measures are by far the most cost-effective way to 'produce' energy and therefore should have the top priority for government financial assistance." It is hard to reconcile these two statements.

Page 13, para 4

GAO characterizes the Ford Foundation's Energy Policy Project as "dated" and as providing "useful estimates". Despite this, GAO leans heavily on it as a basis for its conclusions.

Page 15, para 1

GAO states that insulation retrofitting is "cost-effective in 'tens of millions' of American houses". This statement is made without backup or analysis.

Page 15, para 5

The Ford Foundation Technical Fix and Historical Growth scenarios are described as "projections". As previously noted, the Ford Foundation report disclaims this and calls them only "possible energy futures" and states that ". . . they are illustrative, to help test and compare the consequence of different policy choices . . . and it is not likely that the real energy future will closely resemble any of our scenarios."

Page 16, para 2

In this paragraph and many which follow that describe conservation savings, a statement is made regarding the level of energy consumption without Federal action. These statements are ascribed by GAO to the Ford Foundation Technical Fix. These statements contain phrases such as "would grow" or "is expected to grow to". It should again be noted that Ford disclaims any claim to prediction.

Page 16, para 4

The use of the words "can" and "could" are very significant. It does not appear that consumers are implementing the strategies outlined (such as setting back thermostats) to nearly the extent needed to achieve GAO's quoted savings.

Page 19, para 3

This paragraph and the following one are concerned with savings in the electric utility sector. The fifth paragraph on page 22 notes certain institutional barriers which stand in the way of achieving certain conservation goals. GAO fails to mention the role of state regulation in electric utility conservation as it is a formidable barrier to achieving the conservation goals established.

Page 20, para 4

The statement is made that "many of the conservation strategies discussed above are cost-effective today". This contradicts previous paragraphs in which uncertainty was expressed regarding the costs and benefits of conservation strategies. Further, here as in other statements of a like nature, the assumptions and analysis underlying the statement are not presented. There are, of course, many conservation strategies such as lowering the thermostat or turning off the lights which would be cost-effective since their cost (to the consumer) is zero. These measures are necessarily voluntary and recent experience suggests that they cannot be sustained over a long period of time. With regard to others of a lasting nature, such as home insulation, we do not feel that most of the analyses properly account for the personal discount rate which consumers, particularly homeowners, apply to a proposed investment.

Page 21, para 4

GAO states that ". . . many potential energy conservation actions are now cost-effective." Later in this same paragraph GAO states there is a ". . . lack of incentive for many users to improve their energy efficiency" It is difficult to reconcile these two statements.

Page 22, para 3

GAO asserts without supporting analysis that ". . . the total life cycle cost of buying and operating an energy efficient house, car, appliance, or other product would be lower." This statement, like other similar ones in the report, carries with it embedded assumptions about the life of the equipment and of future prices of competing fuel systems. Such analyses are also, as noted above, sensitive to personal discount rates.

Page 24, para 2

The statement is made that "However synthetic fuels technologies appear to us to be the only ones which could need all three levels of financial assistance, front-end money, construction assistance, and product price support". The word "could" puts the assertion of the quotation beyond debate, but one could as easily have said could not. It is important to note that "front-end" money for socio-economic impact assistance would be needed for only four to six large-scale, synthetic fuel plants which are expected to be built in remote areas.

Product price supports will not be needed for plants, such as high Btu coal gasification, which produce regulated fuels but might be needed for plants producing unregulated fuels. In this regard, the words "product price support" implies the need for a product price differential above predicted world price to be paid. With the possible exception of industrial fuel gas, product price guaranties (the preferred term), where required, will serve as a protection against aberrant pricing of world oil and not to provide a production cost subsidy.

ERDA disagrees with the assertion in this paragraph that synthetic fuels technology cannot compete with conventional energy sources. ERDA believes that high Btu gas presently competes successfully with its alternatives, LNG and synthetic gas from naphtha. At least one potential builder (Union Oil) of a modular shale oil plant believes that shale oil can be economically competitive. In any event, the time when these plants will come on stream is a significant factor in making comparisons of this type because the price of competing world oil is generally expected to continue to rise.

Page 25, para 1

The GAO report states that the cost of solar space heating, solar hot water heating, energy from municipal waste, tertiary oil recovery, and geothermal energy (hydrothermal) ". . . appear favorable . . .". The report does not state what they are favorably compared to, and does not offer any analysis to support this assertion.

Page 26, para 6

The statement that "Tertiary oil recovery techniques may be used after primary and secondary methods no longer yield economic quantities of oil" says nothing about the economics of tertiary recovery. Tertiary recovery is not always economic. Tertiary recovery is far from an exact science. Fields differ markedly from reservoir to reservoir. Different chemicals and different techniques may be indicated for each field. Most importantly, there is no methodology for predicting from field to field which, if any, techniques for tertiary recovery will be most suitable.

Page 29, para 1

The cost estimates given in this paragraph for tertiary recovery technologies are significant. The \$8.00 to \$18.00 per barrel unscrubbed estimates, and the more authoritative Oil and Gas Journal \$20.00 to \$25.00 per barrel estimate indicate both the uncertainty and the extent of the cost range for tertiary recovery. These cost estimates are not used in any analysis when discussing the relative economics of synthetic fuels and tertiary recovery.

Page 30, para 1

The GAO report states that the environmental problems of tertiary recovery are, except for chemical disposable problems, the same as those associated with primary recovery. This statement fails to note the environmental hazards of leaking gas and leaching chemicals associated with tertiary recovery.

Page 30, para 2

The statement that certain solar techniques appear to have economic application today is an assertion and is not supported by analysis or economic information. As noted earlier, ERDA generally does not subscribe to this view.

Page 30, para 3

This paragraph notes that a ten-year payback is assumed assessing the cost-effectiveness of solar. This is an extremely long payback period and undoubtedly contributes to the reluctance of consumers to invest in solar equipment.

Page 31, para 4

The GAO report makes the statement concerning solar technology that "Evaluations of system efficiency and durability, storage subsystems, backup system

requirements, aesthetics and mass production costs are not complete." The next paragraph states "Life cycle costs of solar hot water and space heating are less than conventional systems in many areas of the country." The two statements are in conflict. Further, the GAO report presents no analysis of life cycle costs.

Page 33, para 5

The GAO report states that ". . . synthetic fuel technologies are the least economical (sic) of all the new energy supply technologies." This does not appear consistent with a tertiary oil cost of up to \$25.00 per barrel. Further, the statement is not supported by any comparative analysis. Extensive analysis carried out by the Synthetic Fuels Interagency Task Force suggest that synthetic fuels will be an economically competitive option.

Page 35, para 3

The statement "In many foreign countries where domestic oil and gas is not as abundant as in the United States, gasification processes have been able to survive.", implies something about the potential commercial viability of synthetic fuels in the United States and the need for sectoral analysis which is missing from the GAO report. These low and medium Btu gasification plants in Europe are generally used for industrial application where liquid fuels such as foreign imported oil cannot compete economically.

Page 36, para 1

This paragraph speaks of ERDA's national plan "projections". ERDA's national plan scenarios are boundary or limiting case conditions and are not expectations of the future.

Page 36, para 4

The statement that the Synfuels Interagency Task Force estimated the prices of synfuels on a discounted cash flow basis after taxes on entire capitalization is incorrect. Prices for regulated fuels were estimated on a utility rate base method.

Page 36, para 6

This paragraph notes ERDA's high estimate for shale oil at \$18.00 per barrel, and states that recent industry estimates range up to \$18.90 per barrel. The report fails to note ERDA's central estimate of \$15.00 per barrel for shale oil and further does not note some of the lower industry estimates at \$13.75 per barrel. The price range, whether up to \$18.00 or \$18.90, is fully competitive with oil produced by tertiary processes. This is the only liquid fuel technology favored by GAO. It should be noted that ERDA recommends against inclusion of high-grade coal liquids in the H.R. 12112 program since they are clearly uneconomic.

Page 37, para 1

This paragraph overemphasizes the technical uncertainty of the processes for manufacturing synthetic fuel as a constraint to private sector financing. The regulatory, environmental and institutional factors, the licensing requirements, and the questions of capital investment, risk and credit are more important than technical uncertainties. This viewpoint was repeatedly emphasized in testimony by project sponsors and the financial community.

Page 37, para 4

The discussion in this paragraph about environmental impact is out of context because it does not compare the impacts from synthetic fuels plants with those of conventional energy conversion processes. Again, there is no quantitative or other backup to give an indication of the relative seriousness of environmental impacts produced by these plants.

Page 37, para 5

This paragraph discusses socioeconomic considerations. It fails to state that H.R. 12112 contains provisions to mitigate the socioeconomic impacts expected from large synthetic fuels facilities.

Page 39, para 2

GAO makes the assertion that loan guaranties ". . . generally result in only moderate shifts in cost benefit ratios. They are not normally best suited to assist technologies which require large advances to become economically competitive." This assertion seems to indicate a lack of understanding of the capital budgeting process. Investors who bear the ultimate financial risk of a project

assume a 100% equity investment, since financial failure will convert any indebtedness into equity. Loan guaranties serve the function of transferring part of the ultimate financial risk from the investor to the taxpayer. In doing so, they permit calculation of investments which show returns only on the equity portion. The effect on project costs is significant and is indicated in Tab J of the Fact Book which ERDA prepared for this program.

Page 40, para 4

The thrust of this paragraph is that the major effect of loan guaranties on investment decisions is their effect on reduction of borrowing costs. With regard to the H.R. 12112 loan guaranties two factors should be noted. First, the probable elimination of any risk premium because of the Federal guaranty will in all likelihood be more than offset by the at least 1% guaranty fee charged and the increased administrative costs which the recipient of such a guaranty will, without question, bear. The second important point is that the effectiveness of loan guaranties is in the transfer of risk for the reason noted previously, and in the provision of credit in instances when it is otherwise not available. A clear-cut example of this would be the availability of \$750 million in debt to a coal gas investor whose total net worth may be half of that figure.

Page 40, para 5

See GAO's footnote 2 regarding this paragraph.

The continuation of this paragraph on the top of page 41 implies that investments in certain energy projects (such as synthetic fuels) because of loan guaranties may come at the expense of investment in oil or gas development. This statement should be viewed in the context of recent major oil company diversifying investments. Some of these are: Mobil Oil in MARCOR Corporation (Montgomery Ward); Gulf Oil in real estate ventures, and Tenneco in an agricultural division. These investments clearly show that these companies are not restricted from oil and gas investments because of difficulty in obtaining capital, but rather are attracted to these investments because of their favorable rate of return. GAO's next paragraph concedes this point: if firms can obtain a higher rate of return on other activities, they won't invest in synthetic fuels whether or not loan guaranties are available.

Page 41, paras 3 and 4

GAO incorrectly states that loan guaranties do not compete for funds in the budget. However, 25% of the face amount of the guaranties authorized by H.R. 12112 have been requested to be appropriated as a fund in case of defaults, and will appear in the budget and counted in the budget authority totals. The recommended budget approach is fully consistent with the spirit and letter of the Budget Act.

The GAO report further asserts that loan guaranties frustrate budgetary discipline because they do not compete for Federal tax money in the same manner as other programs. The GAO report fails to address this question for tax incentives.

Page 41, para 5

As previously noted, ERDA does not agree with the blanket statement that synthetic fuel plant output is not expected to be competitive with the price of energy from traditional sources. This paragraph incorrectly asserts that synthetic fuels will need price guaranties. No price guaranties would be needed for High Btu Gas Plants. The implication of this paragraph is that price guaranties would be of a cost reimbursing nature applicable to the difference between cost of production and market prices. The principal use of price guaranties will be to protect investors in non-regulated fuels projects against aberrant reductions in world oil prices. There is a possibility that such guaranties might be used to pay higher than world prices for Industrial Fuel Gas Projects (low or medium Btu gas). These, however, would not be an open-end cost-reimbursement nature, but rather would provide support up to a fixed or indexed dollar price.

Page 42, para 2

This paragraph implies that the program might expand to subsidize an entire industry. In doing so, it thereby indicates a lack of understanding of the very limited nature of H.R. 12112; that is, to construct and operate a few plants of each type to gather the critical information and resolve uncertainties in order to permit future timely industry investment without Federal assistance.

Page 43, paras 2 and 3

Under the government ownership case, it should be pointed out that costs would be all on budget. The government would take all risks and, therefore, there would be no efficiency incentive. The GAO also fails to note the loss of tax revenues to the Treasury which should be considered in assessing government ownership.

Para 44, para 2

In recapping the focus of the report, GAO broadly overstates what was done. The report inaccurately states "For each technology, we have attempted to define and assess its potential role in filling energy needs by both 1985 and 2000." Instead, the report merely quotes and agrees with selected supply and demand figures from other studies. The report contains no assessment in the sense of analysis but it contains numerous unsupported assertions and conclusions.

Page 44, para 4

Discussion of the "slow-down" in the growth rate for energy demand should be tempered by such considerations as price induced conservation and the recession that the United States and indeed the world has recently suffered. This slow-down as previously discussed, appears to have ended.

We agree with the GAO report that all promising supply and conservation sources should be explored. We do not agree with the characterization of the H.R. 12112 program as commercializing synthetic fuels. We characterize it rather as an initial effort focused on resolution of uncertainties which, unless resolved, will inhibit timely private sector investment in synthetic fuel projects. The synthetic fuel production of this program is trivial when compared with our import requirements in the 1985 timeframe. No one has suggested the program as relieving that situation. It is the uncertainty of impact beyond 1985, both for synthetic fuels and for all other technologies, which requires that all be explored. The same uncertainty constrains the private sector from unassisted investment.

Page 45, last para

H.R. 12112 limits development of initial shale plants to modular plants of 6,000 to 10,000 barrels per day capacity. The characterization of a 50,000 barrel per day plant as "... one small plant ..." is highly questionable.

Page 46, para 1

The price of synthetic gas is characterized as being twice the recently announced FPC price for newly discovered regulated gas. However, as noted by FEA in its review of the GAO report, synthetic fuels should not be compared with the cheapest source of market supply, but rather with those sources at the margin such as LNG and naphtha conversion. It should be noted that the price of high Btu gas from coal is equal to or less than the price for gas from new LNG or naphtha conversion sources.

Page 46, para 4

This paragraph and those which immediately follow it describe three important factors which should be carefully examined in determining financing incentive mechanisms. As previously noted, the nature of the constraint to unassisted investment must also be examined; viz. is the barrier to private sector investment a question of risk, credit, or return on investment?

Page 47, para 2

This paragraph is true. Companies may be able to invest in synthetic fuel projects, but will not because of more attractive investment opportunities elsewhere. Providing such companies with loan guaranties which transfer risk from them to the taxpayers permits them to calculate return on only the equity portion and thereby enhances the desirability of the investment.

Page 47, para 4

This paragraph repeats the assertions of page ii. The text, as has been pointed out above, is inconsistent with the assertion.

Page 48, para 2

The report again asserts that synthetic fuel production is not price competitive with foreign oil. As previously noted, only certain synthetic fuel technologies should be compared with foreign oil and then only at the time of completion

of the plant. High Btu gas plants when completed are presently competitive with alternative sources of gas.

Page 48, para 3

Neither ERDA nor H.R. 12112 is proposing any "deep national commitment to uneconomic high-cost supply technologies." What both do propose is a program to resolve at or near full-scale the regulatory, socioeconomic, environmental, and other uncertainties which presently inhibit private sector investment, but which must be resolved if the private sector is to invest in a synthetic fuel industry in the mid-1980's. The purpose of the H.R. 12112 program is to preserve the synthetic fuel option, not to elect it.

Page 49, para 3, numbered point 3

Again, the unsupported assertion that synthetic fuels are not cost-effective.

Page 50, paras 2 and 4

On the one hand the GAO report describes the economic desirability of conservation and on the other notes its relatively unfavorable payback. This is a contradiction. ERDA does not debate the desirability of conservation as a contributor to national energy goals. We do have problems with assertions of cost-effectiveness.

Page 50, para 3

The discussion in this paragraph regarding tax credits should include the cost to the nation of such credits. This same paragraph notes the long payback period for conservation investments. Payback is an important measure of favorability in investment analysis. This contradiction appears several times in the GAO report.

Page 52, para 2

This paragraph is in error when it addresses loan guarantees as the appropriate incentive to relieve concerns that the product price will not compete economically with manipulated world oil prices. The appropriate incentive to address this concern is a price guaranty.

Loan guarantees do address the questions of risk transfer, credit, and return on investment.

Page 52, para 5

GAO believes that adequate information can be gained from smaller plants under government control. However, regulatory, environmental and socioeconomic information will not be credible coming from small plants. There is a critical cut-off size below which this information cannot be extrapolated to the full-size plant. Several witnesses testified on this point before the Economic Stabilization Subcommittee of the House Banking, Currency and Housing Committee.

Page 54, para 2

This paragraph again makes the assertion that solar hot water and solar space heating are currently economic in certain instances, but then says that they are not being implemented because of long payback periods. The two statements are inconsistent.

Page 55, para 4

The GAO report characterizes itself as an analysis. It appears to us rather to be a series of assertions unsupported by analysis. It is really an expression of philosophy regarding energy policy. To make an effective case, GAO should provide an analysis which demonstrates that the work of the Synthetic Fuel Task Force and the continuation of that work by ERDA, is deficient or incorrect.

GAO'S RESPONSE TO ERDA'S COMMENTS ON GAO REPORT "AN EVALUATION OF PROPOSED FEDERAL ASSISTANCE FOR FINANCING COMMERCIALIZATION OF EMERGING ENERGY TECHNOLOGIES" (EMD-76-10, AUGUST 24, 1976)

1. ERDA statement (page i, para 4): "In making the 'right' choice among financing mechanisms, GAO has ignored as criteria the factors of risk, credit, and rate of return. These were carefully evaluated by the President's Task Force last year, but are not even addressed in the GAO report."

GAO response: Risk, credit, and rate of return were an inherent part of our analysis and considered in arriving at our conclusion. In any case, we are not convinced "risk" should be transferred to the taxpayer given the current state of these technologies.

2. ERDA statement (page ii, para 3): "ERDA agrees that the nation should explore all promising supply and conservation alternatives. However, the agency believes that conservation alternatives, even if aggressively pursued cannot obviate the need for substantial quantities of synthetic fuels in the early 1990's. This conclusion is supported by all major supply/demand analyses in recent years."

GAO response: A number of supply/demand analyses—including ERDA's conservation scenario and the Ford Project's Zero Energy Growth Scenario—indicate no supply from syn-fuels. In any event, we are not questioning the need for synthetic fuels in the later part of the century but rather, ERDA's approach to providing Government assistance to industry in commercializing synthetic fuels at this time.

ERDA statement (page ii, para 3): "The reference to the slowdown in the rate of growth in demand for energy is largely due to the post-embargo measures and more recently the national and world recessions. However, this year demand is rising rapidly as evidenced by the Edison Electric Institute figures (see August 16 Wall Street Journal) of a growth of 5.2% in electricity demand in the first 32 weeks of this year."

GAO response: We agree that electricity demand is up markedly and foresee a continued rise in demand for all energy sources unless the Government aggressively pursues a program of encouraging conservation. In addition, the Government needs to carefully explore all supply sources, including synthetic fuels.

ERDA statement (page ii, para 3): "The GAO emphasis on conservation does not take into consideration how much of the potential for price-induced conservation has already been captured."

GAO response: ERDA's statement is not correct. We explicitly discuss the estimated savings to be captured by existing legislation and describe further opportunities for savings beyond those programs now in effect. Current GAO work in the conservation area indicates that only a small amount of the opportunities (including price-induced conservation) for energy savings have been captured. To increase this savings many changes will be required, such as restructuring utility rates, and incentives for reducing industrial wastefulness and retrofitting of insulation for housing.

3. ERDA statement (page ii, para 4): "The GAO conclusion that certain conservation measures are the most cost-effective and others are more cost-effective than synthetic fuels is based on an 'appearance' (last line) rather than on a sound analytic analysis. Neither the measures of cost-effectiveness are discussed in the report nor are the quantitative comparisons shown."

GAO response: Our report discusses the price of synthetic fuels as well as the price of other energy sources, as projected by various studies, without restating the details and mechanics of each study. In addition, the method of economic comparison, prices, and energy resource with which comparisons were made are explained in the report. (See pages 25, 29, 30, and 32 of our report.)

4. ERDA statement (page iii, para 1): "This is the first of several instances in which all synthetic fuels are asserted to be not cost-effective when the cost of their output is compared to that of foreign oil.

Two points must be made:

1. The economic comparison of high Btu gas produced from coal with alternatives should, as is later noted in the report, use LNG and synthetic gas from naphtha as the alternatives rather than imported oil. These are the real alternatives that are available.

2. Where oil is the appropriate competing fuel the economic comparisons should be made as of the time that the synthetic fuel plants come into operation in the early 1980's rather than at the present time. All major forecasts project world oil prices to continue to rise."

GAO response: In the report we do compare high-Btu synthetic gas with liquified natural gas (LNG), new natural gas, and imported oil (see page 36 of the GAO report). In our view, synthetic gas will not only be compared with other new gas technologies, but also with the primary existing energy sources (natural gas and oil).

We agree with ERDA that an increase in imported oil prices is probably inevitable. At the same time, we feel that a price increase, possibly of equal magnitude, is also inevitable for synthetic fuels.

ERDA is currently proposing that Congress favorably act on legislation which would help private industry commercialize synthetic fuels. Comparing prices of energy under the various alternatives available on the basis of current dollars, in our view, provides a meaningful framework for Congress to fully evaluate the expected price the consumer will pay for future energy. In essence, such a comparison allows Congress to consider current proposals for Government financial assistance to synthetic fuels production using trade-offs based on the present value of money. The decision before Congress on synthetic fuels is an immediate one, and we believe the use of current dollars to assist in this decision is sound.

5. ERDA statement (page iii, para 3): "The GAO questions the prudence of "... any national commitment...". H.R. 12112 does not represent a commitment but rather a preservation of the option to proceed in a timely manner with development of a synthetic fuel industry to meet the projected requirements of about 5 million barrels per day in 1995."

GAO response: We recognize that the scope of H.R. 12112 has been limited. However, the position of both ERDA and the Administration has consistently been that H.R. 12112 represents the first step of a more comprehensive program which would include the Energy Independence Authority. Loan guarantees for synthetic fuels would be folded into that larger program which would also authorize direct investments, loans, and price supports.

6. ERDA statement (page iii, para 4): "This paragraph appears to confuse the economic evaluation of emerging technologies on an incremental (or marginal) basis with the later pricing of the output of such plants on an incremental versus a rolled-in pricing basis. In any event, the administrative analysis showing the desirability of synthetic fuels was not based on rolling in these products."

GAO response: The report does distinguish between pricing for evaluation purposes and later pricing of the output. (See page 49 of our report.)

In our view, incremental pricing should be used for evaluation purposes in order to allow the technology to be analyzed on its own merits regardless of the method used to price the actual output. We do note for the record that a draft report prepared for the Federal Power Commission entitled "Task Force Report of the Supply Technical Advisory Task Force—Regulatory Aspects of Substitute Gas", dated July 27, 1976, states the following on page G-1—"The Federal Power Commission should allow the "rolled-in" concept in developing a new tariff schedule where synthetic gas is to be supplied to an interstate system." These conclusions seem to cover high-Btu synthetic gas from coal as well as liquid based synthetic gas.

7. ERDA statement (page iv, para 6): "The GAO report makes the statement "... the projected prices are not competitive with existing or other emerging energy sources...". ERDA believes that high Btu gas is now competitive with existing higher priced alternative sources such as LNG and naphtha conversion. Moreover, at least one potential builder of a shale oil modular plant (Union Oil) indicates that the output of the plant will, with only a government loan guaranty, be competitive with existing world oil prices."

GAO response: We recognize in our report that high-Btu synthetic gas may compete more favorably with Liquefied Natural Gas (LNG) than with foreign oil or other conventional sources. However, a recent study by the Energy Resources Council (ERC) estimates LNG may be priced somewhat lower than our report shows—around \$2.50 to \$3.00 per thousand cubic feet. In ERDA's Fact Book on the Proposed Synthetic Fuels Commercial Demonstration Program, ERDA's Office of Commercialization estimates the price of high-Btu synthetic gas to be \$3.28 per thousand cubic feet. In this regard, we have recently become aware of a draft interim report by C. F. Braun being jointly funded by ERDA and the American Gas Association. We understand that this draft report shows cost figures for second generation high-Btu coal gasification processes using western coal which range as high as \$4.66 per MCF with utility financing and \$6.68 per MCF with non-utility financing. We were unable to obtain a copy of this draft report as of the date of this transmittal.

The draft report to the FPC, cited in our answer to question 6 states on page C-12 "... the price of liquid based SNG ranges from \$3.00 to \$5.50 per MCF at the tailgate of the plant." These are the same SNG sources, such as naphtha, which ERDA argues are competitive with high-Btu synthetic gas from coal.

These prices are considerably higher than LNG prices and the products are being produced by the private sector without current financial assistance from the Federal Government.

The current status of many of the proposed shale oil projects is one of dormancy. Companies have asked for and were granted a suspension of development and an extension of bonus payment obligations by the Secretary of the Interior. Shell Oil Company has very recently stated the expected cost for shale oil at around \$20 a barrel.

8. ERDA statement (page v, para 2): "The possible 15 percent cost reduction which the GAO report cites, would be applicable only to that part of the investment which represents process technology. Infrastructure, socioeconomic impact assistance, financing costs, and other elements which are insensitive to the specific coal conversion process used will not be affected."

GAO response: We agree with ERDA's statement.

9. ERDA statement (page v, para 3): "ERDA does not agree that it is possible to gain the information sought by the H.R. 12112 program from smaller plants under government control. Only commercial-scale plants operating in the private sector will acquire a credible body of information addressing the environmental, regulatory, socioeconomic, and other uncertainties which restrain private investments without Federal assistance. GAO has not presented any evidence suggesting that the information desired from the commercial demonstration program can be obtained any other way."

GAO response: We concluded that smaller plants could be an alternative for gathering needed information on socio-economic, environmental and regulatory impacts. We pointed out that this option could provide Congress with yearly oversight, offer enhanced potential for less costly plants, and provide greater flexibility in terminating the projects or selling them to private parties. Further evidence will be available when ERDA's studies concerning plant size are completed and reviewed. Our consistent view has been that legislative action should be delayed until all the evidence is gathered and fully evaluated. We also point out that it seems ERDA feels that such information can be gathered in other programs with less than commercial-sized plants—such as in the LMFBR program. Further, ERDA has not disagreed with the financing of smaller shale oil plants, which would be authorized under some versions of H.R. 12112, as the next appropriate step for that technology.

See also our comments on ERDA statements 14 and 33.

10. ERDA statement (page vi, para 2): "The GAO report recommends that Congress "... place the highest priority on ... obtaining better cost/benefit data on the whole range of conservation opportunities." This directly contradicts the numerous assertions in the GAO report about the "cost-effectiveness" of conservation opportunities."

GAO response: GAO does not feel that the statements are contradictory. We indicated that certain conservation actions are cost-effective. Many studies exist which support these specific cost-effective options. That fact, however, does not preclude the need for additional studies on a comprehensive, across the board basis to further refine economic detail and identify favorable individual conservation actions. We pointed out on page 13 of our report that the Executive Branch had contemplated at least two such studies but that one was not completed and one was not funded.

11. ERDA statement (page 1, para 1): "The GAO report does not recognize that the purpose of H.R. 12112 includes commercialization of renewable resources as well as synthetic fuels and demonstration of energy efficient facilities and equipment."

GAO response: The GAO report is not an analysis of H.R. 12112. We examined a number of emerging energy supply technologies and conservation actions which are technically feasible and estimated to have a significant supply impact by 1985 and 2000, but are not being actively commercialized by the private sector.

12. ERDA statement (page 1, para 3): "This paragraph states that "... the price of synthetic fuels is almost certain to be higher than the price of energy produced from traditional energy sources...". This assertion is presented without supporting analysis. ERDA believes the assertion to be not true with regard to synthetic high-Btu gas which ERDA now believes to be competitive with the alternative sources of LNG and synthetic gas from naphtha. Although it appears,

with regard to non-high Btu gas synthetic fuels, to be at least partially true now, and may remain so in the near-term, the correct time frame for this analysis is the post-1985 period when synthetic fuels will begin to be ready for substantial market penetration. Further, this discussion ignores the dimensions of risk, credit, and uncertain world oil pricing, and the part that they play in discouraging private sector investment in synthetic fuel."

GAO response: See our response to comments 1, 4, and 7.

13. ERDA statement (page 2, para 4): "GAO lists three factors which they believe to be important in "... determining the incentive which would 'best' stimulate a particular energy or conservation technology ...". A fourth fact which ERDA believes to rank equally with these in importance is the assessment of the financial barrier to be addressed by the incentive, i.e., is the financial incentive needed because of risk, credit limitation, or a rate of return problem?"

GAO response: See GAO's response to ERDA's comment number 1.

14. ERDA statement (page 3, para 1): "The GAO report states that "... no one bill ... considers all costs associated with development. ..." It fails to note that H.R. 12112 covers a broad range of technologies and requires consideration of all costs associated with development including socio-economic and environmental costs."

GAO response: We feel that ERDA's quote of our statement was taken out of context. Our complete statement was "Individual bills before the Congress cover a wide range of objectives and financing techniques. However, no one bill focuses on all emerging energy technologies, considers all costs associated with development, or more importantly, attempts to focus on targets of proposed actions on some consistent priority basis." We still believe this to be a valid statement. H.R. 12112 does not pretend to cover all the options. ERDA also supports additional legislation such as the Energy Independence Authority which indicates to us that H.R. 12112 is not seen by ERDA as a "comprehensive" piece of legislation.

15. ERDA statement (page 5, para 3): "The GAO report states that the recent and perceived reduction in historical energy growth rates indicates that "... conservation actions may buy time to fully consider tradeoffs and make choices ..." A large part of the observed and perceived reduction is the consequence of conservation resulting from post-embargo and one-time measures, the sharply increased price of energy, and the recent world and national recessions. The reductions have reduced the severity of the problem somewhat, but they have not eliminated it. ERDA is of the opinion that the Nation is not yet in a position to make choices and must maintain the integrity of all of our major options. If synthetic fuels demonstrations are not vigorously pursued now, there is no way we can meet the projected demand of the 1990's."

GAO response: See response to comment number 2. In addition, we agree that the synthetic fuels option would not be dropped. We believe that an aggressive program of research, development, and demonstration should be pursued rather than attempting to commercialize current, first generation technologies which are basically uneconomic and less attractive in comparison with other options.

16. ERDA statement (page 7, para 4): "The table on page 8 is described in the GAO report as illustrating "... the range of choices available for the United States energy future. ..." It should be noted that even in Scenario I which is an optimistic case for the effect of conservation measures, that oil imports would rise in year 2000 to 21 quads. This clearly demonstrates that even with aggressive conservation and renewable resource development, these measures cannot obviate the need for synthetic fuels if we are not to increase our foreign oil dependence. In fact, all of the major supply-demand analyses including FEA's and the Ford Foundation scenarios all project a substantial requirement for synthetic fuels by the end of the century, if we are not to increase imports."

GAO response: Our report does not argue against synthetic fuels. Instead, we are suggesting that trade-offs between synthetic fuels and other new and existing technologies need to be carefully considered.

In addition, it should be noted that the Ford Foundation's Zero Energy Growth Scenario does not envision any supply from synthetic fuels by 2000. Also, as stated previously, ERDA's high conservation scenario (Scenario I) does not project any synthetic fuel supply in 2000. We are not aware of any major National Energy Outlook Scenario of FEA which projects energy supply and demand to the year 2000.

Finally, while ERDA says its conservation scenario is optimistic, there exist other conservation studies which allow for considerably larger savings from conservation than does ERDA's Scenario.

17. ERDA statement (page 9, para 1): "ERDA agrees with GAO's assertion that both emerging supply and conservation technologies have vast potential, but disagrees with the implication that the requirements for increased imported oil and gas can be made up through conservation and application of renewable resource technologies. These approaches are not focused toward ameliorating the 'liquids and gaseous fuels gap.' Elsewhere in the report, GAO also fails to address the make up of demand by energy sector."

GAO response: Based on ERDA's statement, it appears that there is considerable disagreement between us concerning the substitutability of energy source and/or energy conservation in the time frames discussed. GAO believes that in the time frame considered in our report there exists great potential for substitution. In Chapter 3 of the GAO report (Energy Conservation) an analysis of energy demand by the residential, commercial, industrial, transportation, and utility sectors is presented along with the potential for energy savings in those sectors. See also the GAO Report, "Implications of Deregulating the Price of Natural Gas", OSP-76-11, January 14, 1976, pgs. 35-53, in which we discuss in some detail the substitution potential for natural gas over the longer run. Again, we point out that we do not wish to foreclose the synthetic fuels option.

As to the liquid and gaseous gap ERDA describes, we note several items:

(1) coal liquefaction, the major source of synthetic liquids in the year 2000 under the ERDA scenarios, is not included in H.R. 12112;

(2) shale oil, another major source of liquids in 2000, under H.R. 12112 is provided with 6,000-10,000 barrels a day plants, not full-scale commercial facilities of 50,000 barrels a day or larger;

(3) synthetic gas, under ERDA's most optimistic scenario, is expected to provide only 3.5 quads in 2000 out of a total gas demand of about 26 quads. If LNG were substituted for this within current ERC guidelines (LNG not to exceed 10 percent of domestic gas production) it would virtually eliminate the need for high-Btu gas from coal. The remainder, about 1 quad or 4 percent of total gas supply, could easily be covered by substitutability steps (such as banning gas for boiler fuel use) over the next 20 years.

18. ERDA statement (page 9, para 3): "Many conservation technologies are described in this paragraph as being ". . . *potentially* cost-effective alternatives to developing new energy supplies . . ." On page ii, such technologies are *asserted* to be cost-effective. Nowhere in the GAO report is this assertion substantiated by analysis."

GAO response: Our analysis was largely based on work and studies already in existence. The studies we used are referenced in the appropriate places throughout the report.

19. ERDA statement (page 9, para 5): "This paragraph cites 'estimates' of the Ford Foundation Technical Fix scenario. As previously noted, these are not really estimates, but rather boundary conditions. Further, the Ford Foundation Technical Fix scenario is generally regarded as being highly optimistic with regard to the effects of conservation and is conceded by GAO to be 'dated' at this time. Finally, even granted that the savings which appear in this scenario could be achieved, there is still a large deficit in liquid and gaseous fuels in the millions of barrels that must be met by either imports or 'synthetics in the mid-1990's.'"

GAO response: For a discussion of the estimate-boundary point, see the GAO response to ERDA's comment 26. The question of the usefulness of a dated scenario such as the Ford Foundation's work is discussed in our response to ERDA's statement 24. Our response concerning meeting the liquid and gaseous fuels supply deficit appears in GAO's response to ERDA's statement 17 and 20.

20. ERDA statement (page 10, para 4): "This paragraph compares natural gas production in ERDA Scenarios I and V with a GAO report. The GAO report expects natural gas production to decline to levels well below those of Scenarios I and V. The nation's need for synthetic high Btu gas or imports of LNG will be even greater than ERDA or FEA projects to the extent that GAO's expectation proves correct, or alternatively, will require highly expensive and possibly unmanageable fuel switching by consumers."

GAO response: We basically agree with ERDA's interpretation of our report as it relates to future natural gas production. However, as previously stated, ERDA and GAO disagree on the substitutability of energy technologies and/or energy conservation. (See our answer to ERDA statement 17.) ERDA apparently

believes that a decrease in supply from any existing source must automatically be accompanied by an increase in reliance on synthetic fuels or LNG. GAO believes that other options—as stated in our report—are available to this Nation. Again, we point out that we do not wish to foreclose the synthetic fuels option. In our report we favor a strong RD&D program for synthetic fuels and also consideration of the “commercial pull” approach.

21. ERDA statement (page 11, para 5): “This paragraph states that “. . . certain solar technologies *appear* to be cost-effective on a life cycle basis . . .” Page ii states that these *are* cost-effective. Further, since no analysis is presented it is not clear what life cycles are being compared and what fuel prices are being assumed in the comparison. ERDA believes that with the possible exception of solar hot water heating in certain parts of the country,” (sic)

GAO response: While it is true that life cycle assumptions and fuel prices are not analyzed on page 11, paragraph 5, these considerations are discussed on page 30 of our report. It should be noted that the statement, including the assumptions and prices, were provided by an ERDA official currently working in the solar area.

22. ERDA statement (page 12, para 2): “This paragraph and those which follow quote ERDA’s plan with regard to energy conservation. ERDA believes that the quotations cited are correct. It is important, however, to understand that ERDA’s plan still envisions the need for aggressive development of the synthetic fuels options because all energy saved is not in the form of oil or natural gas, and that the focus of the synthetic fuels program is on oil and gas.”

GAO response: See comments on Statements 17 and 20.

23. ERDA statement (page 13, para 3): “The GAO report states “the physical potential for energy conservation has been estimated in a number of studies. However, the questions of how much of the potential can be realized, in what time frame, at what cost, and with what approaches, requires much more examination.” ERDA agrees with this observation.

However, page ii states “GAO concluded that certain conservation measures are by far the most cost-effective way to ‘produce’ energy and, therefore, should have the top priority for government financial assistance.” It is hard to reconcile these two statements.”

GAO response: See comments on statement 10.

24. ERDA statement (page 13, para 4): “GAO characterizes the Ford Foundation’s Energy Policy Project as ‘dated’ and as providing ‘useful estimates’. Despite this, GAO leans heavily on it as a basis for its conclusions.”

GAO response: Despite being dated (late 1974), the Ford Foundation work is still the most comprehensive assessment of energy conservation which is available. The conservation estimates in the Technical Fix Scenario of that report were built up on an engineering basis, technology by technology, sector by sector, independent of overall supply and demand considerations. With only some minor modification, the conservation estimates could be overlaid on any supply/demand scenario and still remain valid. We have also strongly recommended that more up-to-date comprehensive conservation studies be conducted. We have indicated in our report two such studies which the Executive Branch failed to complete or fund.

25. ERDA statement (page 15, para 1): “GAO states that insulation retrofitting is ‘cost-effective’ in ‘tens of millions’ of American houses”. This statement is made without backup or analysis.”

GAO response: This statement is based on work of the Ford Foundation and the Federal Energy Administration’s Monthly Energy Review (March 1976).

26. ERDA statement (page 15, para 5): “The Ford Foundation Technical Fix and Historical Growth scenarios are described as ‘projections’. As previously noted, the Ford Foundation report disclaims this and call them only ‘possible energy futures’ and states that “. . . they are illustrative, to help test and compare the consequences of different policy choices . . . and it is not likely that the real energy future will closely resemble any of our scenarios.”

GAO response: We agree that the scenarios should not have been referred to as projections.

27. ERDA statement (page 16, para 4): “In this paragraph and many which follow that describe conservation savings, a statement is made regarding the level of energy consumption without Federal action. These statements are

ascribed by GAO to the Ford Foundation Technical Fix. These statements contain phrases such as 'would grow' or 'is expected to grow'. It should again be noted that Ford disclaims any claim to prediction.

GAO response: See GAO response to ERDA statement 26.

28. ERDA statement (page 16, para 4): "The use of the words 'can' and 'could' are very significant. It does not appear that consumers are implementing the strategies outlined (such as setting back thermostats) to nearly the extent needed to achieve GAO's quoted savings."

GAO response: If indeed consumers are not yet implementing these strategies, then the need for providing incentives to stimulate these actions is all the more evident.

29. ERDA statement (page 19, para 3): "This paragraph and the following one are concerned with savings in the electric utility sector. The fifth paragraph on page 22 notes certain institutional barriers which stand in the way of achieving certain conservation goals. GAO fails to mention the role of state regulation in electric utility conservation as it is a formidable barrier to achieving the conservation goals established."

GAO response: We agree with ERDA. This, however, does not in any way change our belief that the main objective of reducing the barriers must be pursued.

30. ERDA statement (page 20, para 4): "The statement is made that 'many of the conservation strategies discussed above are cost-effective today'. This contradicts previous paragraphs in which uncertainty was expressed regarding the costs and benefits of conservation strategies. Further, here as in other statements of a like nature, the assumptions and analysis underlying the statement are not presented. There are, of course, many conservation strategies such as lowering the thermostats or turning off the lights which would be cost-effective since their cost (to the consumer) is zero. These measures are necessarily voluntary and recent experience suggests that they cannot be sustained over a long period of time. With regard to others of a lasting nature, such as home insulation, we do not feel that most of the analyses properly account for the personal discount rate which consumers, particularly homeowners, apply to a proposed investment."

GAO response: See GAO's responses to ERDA statements 10, 18, and 23. In addition, if indeed "personal discount rate" is an overriding factor, it makes even more evident the need to stimulate specific target groups.

31. ERDA statement (page 21, para 4): "GAO states that '... many potential energy conservation actions are now cost-effective.' Later in this same paragraph GAO states there is a '... lack of incentive for many users to improve their energy efficiency.' It is difficult to reconcile these two statements."

GAO response: The "cost-effective" statement refers to life-cycle costs. Even though life-cycle costs may be economically attractive, this does not by itself eliminate the reluctance of institutions, builders, and consumers to make large initial investments in the absence of financial incentives or with a lack of awareness of the benefits of making decisions based on life-cycle costs.

32. ERDA statement (page 22, para 3): "GAO asserts without supporting analysis that '... the total life cycle cost of buying and operating an energy efficient house, car, appliance, or other product would be lower.' This statement, like other similar ones in the report, carries with it embedded assumptions about the life of the equipment and of future prices of competing fuel systems. Such analyses are also, as noted above, sensitive to personal discount rates."

GAO response: See GAO's response to ERDA statement 30.

33. ERDA statement (page 24, para 2): "The statement is made that 'However synthetic fuels technologies appear to us to be the only ones which could need all three levels of financial assistance, front-end money, construction assistance, and product price support.' The word 'could' puts the assertion of the quotation beyond debate, but one could as easily have said could not. It is important to note that 'front-end' money for socioeconomic impact assistance would be needed for only four to six large-scale, synthetic fuel plants which are expected to be built in remote areas.

Product price supports will not be needed for plants, such as high Btu coal gasification, which produce regulated fuels but might be needed for plants producing unregulated fuels. In this regard, the words 'product price support' implies the need for a product price differential above predicted world price to be

paid. With the possible exception of industrial fuel gas, product price guaranties (the preferred term), where required, will serve as a protection against aberrant pricing of world oil and not to provide a production cost subsidy.

ERDA disagrees with the assertion in this paragraph that synthetic fuels technology cannot compete with conventional energy sources. ERDA believes that high Btu gas presently competes successfully with its alternatives, LNG and synthetic gas from naphtha. At least one potential builder (Union Oil) of a modular shale oil plant believes that shale oil can be economically competitive. In any event, the time when these plants will come on stream is a significant factor in making comparisons of this type because the price of competing world oil is generally expected to continue to rise."

GAO response: The Federal Energy Development Impact Assistance Act of 1976 (H.R. 11792 and S. 3007) would, if enacted provide a \$1 billion fund, administered by the Department of the Interior Secretary, to make planning and management grants to States and Indian tribes and loans and loan guarantees to States, local governments, and Indian tribes, to assist in providing public facilities necessitated by the development of Federal energy resources found in land (including the Rocky Mountain States) and in the Outer Continental Shelf. Passage of this Act would apparently provide the Secretary of the Interior with authority to provide socioeconomic assistance to synthetic fuel plant development.

In addition, the 100 or 200 synthetic fuel plants perceived as necessary by ERDA to meet their projected liquid and gaseous gap in the 1960's will also likely require varying degrees of "front end" socio-economic assistance. See also our answer to ERDA statement 14.

ERDA, in the second paragraph of their statement, seems to be agreeing with GAO that price supports will be needed for high-Btu gas. Their statement on the aberrant pricing of world oil seems to agree with the statement on page 52 of the GAO report that one basic concern underlying the need for Federal loan guarantees is concern that the world oil price could always be manipulated. We also point out, on page 48 of our report, that commitments to high cost synthetic fuel technologies could enable imported oil to become a defacto floor price for energy as opposed to its current role as an energy price ceiling. This could enable the exporting countries to achieve a better position from which to exert continued upward pressures on energy prices.

For a discussion concerning shale oil see GAO's response to ERDA statement 7. See also our response to ERDA statement 14.

34. ERDA statement (page 25, para 1) : "The GAO report states that the cost of solar space heating, solar hot water heating, energy from municipal waste, tertiary oil recovery, and geothermal energy (hydrothermal) ". . . appear favorable . . ." The report does not state what they are favorably compared to, and does not offer any analysis to support this assertion.

GAO response: The comparison of the cost against its competing energy source for each emerging energy technology is contained within the individual section describing the technology. In our cost comparisons, we used costs provided by Executive Branch agencies. We have not yet been provided by ERDA any additional numbers which would serve to question the numbers used in our report.

35. ERDA statement (page 26, para 6) : "The statement that 'Tertiary oil recovery techniques may be used after primary and secondary methods no longer yield economic quantities of oil' says nothing about the economics of tertiary recovery. Tertiary recovery is not always economic. Tertiary recovery is far from an exact science. Fields differ markedly from reservoir to reservoir. Different chemicals and different techniques may be indicated for each field. Most importantly, there is no methodology for predicting from field to field which, if any, techniques for tertiary recovery will be most suitable."

GAO response: We address the economics of tertiary oil recovery on pages 26-29 of our report. We agree in our report with ERDA's comment that tertiary oil recovery is not always economic. We also agree with their technical comments. GAO will be issuing a report within the next two months on tertiary recovery which deals with these points.

36. ERDA statement (page 29, para 1) : "The cost estimates given in this paragraph for tertiary recovery technologies are significant. The \$8.00 to \$18.00 per barrel unassigned estimates, and the more authoritative Oil and Gas Journal \$20.00 to \$25.00 per barrel estimate indicate both the uncertainty and the extent of the cost range for tertiary recovery. These cost estimates are not used in any

analysis when discussing the relative economics of synthetic fuels and tertiary recovery.

GAO response: The \$8.00 to \$18.00 range was taken from a number of sources and presented in a study done for FEA by Lewin and Associates, Inc. We also present a chart on page 28 of our report from the same Lewin and Associates, Inc. study showing the range of prices at which tertiary oil will be economically attractive.

37. ERDA statement (page 30, para 1): "The GAO report states that the environmental problems of tertiary recovery are, except for chemical disposal problems, the same as those associated with primary recovery. This statement fails to note the environmental hazards of leaking gas and leaching chemicals associated with tertiary recovery."

GAO response: We agree that there are hazards other than the ones which we stated. However, the actual statement which we made in the report was that "except for this chemical disposal problem, environment problems are *principally* the same as those associated with primary recovery." It was not our purpose in this report to do a detailed environmental analysis of the technologies, but to highlight some of the expected problems.

38. ERDA statement (page 30, para 2): "The statement that certain solar techniques appear to have economic application today is an assertion and is not supported by analysis or economic information. As noted earlier, ERDA generally does not subscribe to this view."

GAO response: We did not refer to "certain solar technologies", we referred to solar hot water heating and solar space heating. The information we received about the two specific solar technologies was obtained from an ERDA official involved in their solar program, and who is in the process of completing an economic analysis of solar hot water and space heating.

39. ERDA statement (page 30, para 3): "This paragraph notes that a ten-year payback is assumed assessing the cost-effectiveness of solar. This is an extremely long payback period and undoubtedly contributes to the reluctance of consumers to invest in solar equipment."

GAO response: We agree that the payback period does effect the consumer investment in solar equipment. This supports our recommendation for financial assistance to overcome this obstacle. (See report, page 54).

40. ERDA statement (page 31, para 4): "The GAO report makes the statement concerning solar technology that 'Evaluations of system efficiency and durability, storage subsystems, backup system requirements, aesthetics and mass production costs are not complete.' The next paragraph states 'Life cycle costs of solar hot water and space heating are less than conventional systems in many areas of the country.' The two statements are in conflict. Further, the GAO report presents no analysis of life cycle costs."

GAO response: The first statement deals with questions to be answered on the solar technology. As the answers to the questions become available, they will impact on the estimated future costs of solar hot water and space heating. The second statement deals with the current "State of the Art" costs, which now appear cost-effective with electricity in 90 percent of the country. As more knowledge is gained on solar technology, the effect will likely be to lower the cost of current competitive systems.

Again the life-cycle costs were obtained from various sources, including an ERDA official who is involved in a study of the economic analysis of solar hot water and space heating. We have not seen more recent figures from ERDA which disagree with our statements.

41. ERDA statement (page 33, para 5): "The GAO report states that ". . . synthetic fuel technologies are the least economical (sic) of all the new energy supply technologies." This does not appear consistent with a tertiary oil cost of up to \$25.00 per barrel. Further, the statement is not supported by any comparative analysis. Extensive analysis carried out by the Synthetic Fuels Interagency Task Force suggest that synthetic fuels will be an economically competitive option."

GAO response: We sow the cost of tertiary oil to be a range where some, not all, oil could be recovered on a cost-effective basis. See the graph on page 28 of our report.

In Chapter 4, we compare the cost of each emerging technology with its competing energy source. In all of the emerging technologies, except for synthetic

fuels from coal and shale, the technologies are shown to be competitive, within some constraints, such as geographic areas, with the competing energy sources. Thus, on this basis, the synthetic fuels from coal and shale are the least economical of these technologies.

42. ERDA statement (page 35, para 3) : "The statement 'In many foreign countries where domestic oil and gas is not as abundant as in the United States, gasification processes have been able to survive,' implies something about the potential commercial viability of synthetic fuels in the United States and the need for the sectoral analysis which is missing from the GAO report. These low and medium Btu gasification plants in Europe are generally used for industrial application where liquid fuels such as foreign imported oil cannot compete economically.

GAO response : There are a number of different low- and medium-Btu gasification processes which are in existence which could be (and have been) built in the United States today for industrial applications. We believe, as well as many industry officials, that the economics of the processes are a major constraint. (See the May 5, 1976, report "Status and Obstacles to the Commercialization of Coal Liquefaction and Gasification" (RED-76-81) for a discussion of the various processes.)

43. ERDA statement (page 36, para 1) : "This paragraph speaks of ERDA's national plan 'projections'. ERDA national plan scenarios are boundary or limiting case conditions and are not expectations of the future."

GAO response : We agree.

44. ERDA statement (page 36, para 4) : "The statement that the Synfuels Interagency Task Force estimated the prices of synfuels on a discounted cash flow basis after taxes on entire capitalization is incorrect. Prices for regulated fuels were estimated on a utility rate base method."

GAO response : Our statement was partially correct. That is true for the regulated fuels. However, the task force did use a discounted cash flow method for unregulated fuels.

45. ERDA statement (page 36, para 6) : "This paragraph notes ERDA's high estimate for shale oil at \$18.00 per barrel, and states that recent industry estimates range up to \$18.90 per barrel. The report fails to note ERDA's central estimate of \$15.00 per barrel for shale oil and further does not note some of the lower industry estimates at \$13.75 per barrel. The price range, whether up to \$18.00 or \$18.90, is fully competitive with oil produced by tertiary processes. This is the only liquid fuel technology favored by GAO. It should be noted that ERDA recommends against inclusion of high-grade coal liquids in the H.R. 12112 program since they are clearly uneconomic."

GAO response : See our response to ERDA statement 7 on oil shale. We are not in this report saying that all tertiary oil is competitive. The cost will vary from process to process and from field to field. These costs could range from \$8 to \$25 a barrel (see pages 26-29 of our report for further elaboration).

It is interesting to note that ERDA in their statement 45, recommends against inclusion in H.R. 12112 of high-grade liquids from coal which they feel will be needed in the same time frame as synthetic gas. Apparently ERDA believes that they have time to answer the environmental, regulatory and socio-economic questions of coal liquefaction which ERDA's National Plan Scenario #5 show to have almost 3 times the potential supply impact that coal gasification would have by 2000.

46. ERDA statement (page 37, para 1) : "This paragraph overemphasizes the technical uncertainty of the processes for manufacturing synthetic fuel as a constraint to private sector financing. The regulatory, environmental, and institutional factors, the licensing requirements, and the questions of capital investment, risk and credit are more important than technical uncertainties. This viewpoint was repeatedly emphasized in testimony by project sponsors and the financial community."

GAO response : We agree with ERDA that these factors are more important than the technical uncertainty question expressed by the financial community. Furthermore, we believe that, as stated in our report, continued research and development on a less than commercial size can obtain needed regulatory, environmental, institutional, and other data.

47. ERDA statement (page 37, para 4) : "The discussion in this paragraph about environmental impact is out of context because it does not compare the impacts from synthetic fuels plants with those of conventional energy conversion

processes. Again, there is no quantitative or other backup to give an indication of the relative seriousness of environmental impacts produced by these plants."

GAO response: This paragraph describes some of the examples of the expected problems with synthetic fuels production. It is consistent with our discussion of the environmental impacts of the other supply technologies. We have not attempted to perform a detailed environmental study of the technologies. We understand that the Office of Technology Assessment is in the process of examining the environmental impacts of synthetic fuels technologies.

48. ERDA statement (page 37, para 5): "This paragraph discusses socioeconomic considerations. It fails to state that H.R. 12112 contains provisions to mitigate the socioeconomic impacts expected from large synthetic fuels facilities."

GAO response: See our responses to ERDA statements 14 and 33.

49. ERDA statement (page 39, para 2): "GAO makes the assertion that loan guarantees "... generally result in only moderate shifts in cost benefit ratios. They are not normally best suited to assist technologies which require large advances to become economically competitive." This assertion seems to indicate a lack of understanding of the capital budgeting process. Investors who bear the ultimate financial risk of a project assume a 100% equity investment, since financial failure will convert any indebtedness into equity. Loan guarantees serve the function of transferring part of the ultimate financial risk from the investor to the taxpayer. In doing so, they permit calculation of investments which show returns only on the equity portion. The effect on project costs is significant and is indicated in Tab J of the Fact Book which ERDA prepared for this program."

GAO Response: We agree that the investor will see it as an added benefit to transfer the risk to the taxpayer, but whether that would motivate investment in a still uneconomic technology is debatable—as is whether the taxpayer would see it as a benefit. Price supports as well as other Federal assistance would also be added incentives.

50. ERDA statement (page 40, para 4): "The thrust of this paragraph is that the major effect of loan guarantees on investment decisions is their effect on reduction of borrowing costs. With regard to the H.R. 12112 loan guarantees two factors should be noted. First, the probable elimination of any risk premium because of the Federal guaranty will in all likelihood be more than offset by the at least 1% guaranty fee charged and the increased administrative costs which the recipient of such a guaranty will, without question, bear. The second important point is that the effectiveness of loan guarantees is in the transfer of risk for the reason noted previously, and in the provision of credit in instances when it is otherwise not available. A clear-cut example of this would be the availability of \$750 million in debt to a coal gas investor whose total net worth may be half of that figure."

GAO response: If an activity is economic, the raising of capital could be achieved through various means, such as joint-ventures, consortiums, etc. We see no reason why investors in coal gas plants need to be limited to only utility or pipeline companies.

51. ERDA statement (page 40, para 5): See GAO's footnote 2 regarding this paragraph. "The continuation of this paragraph on the top of page 41 implies that investments in certain energy projects (such as synthetic fuels) because of loan guarantees may come at the expense of investment in oil or gas development. This statement should be viewed in the context of recent major oil company diversifying investments. Some of these are: Mobil Oil in MARCOR Corporation (Montgomery Ward); Gulf Oil in real estate ventures, and Tenneco in an agricultural division. These investments clearly show that these companies are not restricted from oil and gas investments because of difficulty in obtaining capital, but rather are attracted to these investments because of their favorable rate of return. GAO's next paragraph concedes this point: if firms can obtain a higher rate of return on other activities, they won't invest in synthetic fuels whether or not loan guarantees are available."

GAO response: There really isn't any argument here. If a company can obtain higher rates of return on other activities, they won't invest in synthetic fuels with or without loan guarantees. Thus, loan guarantees may be ineffective.

52. ERDA statement (page 41, paras 3 and 4): "GAO incorrectly states that loan guarantees do not compete for funds in the budget. However, 25% of the face amount of the guarantees authorized by H.R. 12112 have been requested to be appropriated as a fund in case of defaults, and will appear in the budget and

counted in the budget authority totals. The recommended budget approach is fully consistent with the spirit and letter of the Budget Act.

The GAO report further asserts that loan guarantees frustrate budgetary discipline because they do not compete for Federal tax money in the same manner as other programs. The GAO report fails to address this question for tax incentives."

GAO response: The basic problem is determining the amount of default. There is no past experience with plants of this nature which would allow the computation of a reliable default amount. ERDA has admitted that the 25% figure is an arbitrary number. We believe that in situations where it is difficult to predict the extent of default, the total amount approved for loan guarantees should be shown in the budget as noted in Appendix I of our report. We address the budget implications of tax incentives on page 39 of our report.

53. ERDA statement (page 41, para 5): "As previously noted, ERDA does not agree with the blanket statement that synthetic fuel plant output is not expected to be competitive with the price of energy from traditional sources. This paragraph incorrectly asserts that synthetic fuels will need price guarantees. No price guarantees would be needed for High Btu Gas Plants. The implication of this paragraph is that price guarantees would be of a cost reimbursing nature applicable to the difference between cost of production and market prices. The principal use of price guarantees will be to protect investors in non-regulated fuels projects against aberrant reductions in world oil prices. There is a possibility that such guarantees might be used to pay higher than world prices for Industrial Fuel Gas Project (low or medium Btu gas). These, however, would not be of an open-end cost-reimbursement nature, but rather would provide support up to a fixed or indexed dollar price."

GAO response: If the FPC allows the use of rolled-in pricing, price supports may not be needed for high-Btu synthetic gas. However, the FPC has not as yet ruled on the use of rolled-in pricing for high-Btu synthetic gas or for imported LNG. As noted in earlier responses, a draft report of an FPC task force does recommend "rolled-in" pricing for high-Btu synthetic gas and a recent report of the Energy Resources Council recommends a combination of "rolled-in" and incremental pricing for LNG. Even if the FPC does allow "rolled-in" pricing, the State Public Utility Commissions may not allow these costs to be passed on in their states. The question of jurisdictional authority between FPC and the State Public Utility Commissions may have to be answered in the courts. For this reason, we believe that Congress should be aware that price supports may be required, even for high-Btu coal gasification. We add that the proposed Energy Independence Authority Act specifically provides for price supports for energy projects "not in widespread domestic use" which would cover high-Btu gas from coal.

54. ERDA statement (page 42, para 2): "This paragraph implies that the program might expand to subsidize an entire industry. In doing so, it thereby indicates a lack of understanding of the very limited nature of H.R. 12112; that that is, to construct and operate a few plants of each type to gather the critical information and resolve uncertainties in order to permit future timely industry investment without Federal assistance."

GAO response: We understand the limited scope of H.R. 12112. However, there are other proposed programs which would involve price supports such as the administration's proposed Energy Independence Authority (EIA) program. ERDA's and the Administration positions have remained clear that the program envisioned under H.R. 12112 would be folded into and become part of, the EIA program at such time as that program is authorized.

55. ERDA statement (page 43, paras 2 and 3): "Under the government ownership case, it should be pointed out that costs would be all on budget. The government would take all risks and, therefore, there would be no efficiency incentive. The GAO also fails to note the loss of tax revenues to the Treasury should be considered in assessing government ownership."

GAO response: It seems to us that with proper management, efficiencies could be realized. The tax loss could be offset by the benefits to the using public from non-profit production.

56. ERDA statement (page 44, para 2): "In recapping the focus of the report, GAO broadly overstates what was done. The report inaccurately states "For each technology, we have attempted to define and assess its potential role in filling energy needs by both 1985 and 2000." Instead, the report merely quotes

and agrees with selected supply and demand figures from other studies. The report contains no assessment in the sense of analysis but it contains numerous unsupported assertions and conclusions."

GAO response: We have based our observations and our conclusions on the most current data and facts available, as well as on recognized and major studies which relate to this highly complex area.

57. ERDA statement (page 44, para 4): "Discussion of the 'slow-down' in the growth rate for energy demand should be tempered by such considerations as price induced conservation and the recession that the United States and indeed the world has recently suffered. This slow-down as previously discussed, appears to have ended.

We agree with the GAO report that all promising supply and conservation sources should be explored. We do not agree with the characterization of the H.R. 12112 program as commercializing synthetic fuels. We characterize it rather as an initial effort focused on resolution of uncertainties which, unless resolved, will inhibit timely private sector investment in synthetic fuel projects. The synthetic fuel production of this program is trivial when compared with our import requirements in the 1985 time frame. No one has suggested the program as relieving that situation. It is the uncertainty of impact beyond 1985, both for synthetic fuels and for all other technologies, which requires that all be explored. The same uncertainty constrains the private sector from unassisted investment."

GAO response: See GAO's response to ERDA statement 2. In addition, we are not recommending foreclosure of the synfuels option. Instead, we are suggesting that synfuel development can be explored by other means.

58. ERDA statement (page 45, last para): "H.R. 12112 limits development of initial shale plants to modular plants of 6,000 to 10,000 barrels per day capacity. The characterization of a 50,000 barrel per day plant as ". . . one small plant . . ." is highly questionable."

GAO response: A 50,000 barrel a day plant is small when compared to total demand or to domestic oil production or oil imports. If a modular plant of 6,000 to 10,000 bbls. per day capacity can enable ERDA to obtain needed socioeconomic, environmental, and regulatory data, it is difficult to understand why commercial-size plants are necessary to obtain similar type data for synthetic gas plants. (See, also ERDA statement 69 on this subject.)

59. ERDA statement (page 46, para 1): "The price of synthetic gas is characterized as being twice the recently announced FPC price for newly discovered regulated gas. However, as noted by FEA in its review of the GAO report, synthetic fuels should not be compared with the cheapest source of market supply, but rather with those sources at the margin such as LNG and naphtha conversion. It should be noted that the price of high Btu gas from coal is equal to or less than the price for gas from new LNG or naphtha conversion sources."

GAO response: See GAO's response to ERDA's statement 4, 6, and 7.

60. ERDA statement (page 46, para 4): "This paragraph and those which immediately follow it describe three important factors which should be carefully examined in determining financing incentive mechanisms. As previously noted, the nature of the constraint to unassisted investment must also be examined; viz. is the barrier to private sector investment a question of risk, credit, or return on investment?"

GAO response: See GAO's response to ERDA's statement 1.

61. ERDA statement (page 47, para 2): "This paragraph is true. Companies may be able to invest in synthetic fuel projects, but will not because of more attractive investment opportunities elsewhere. Providing such companies with loan guarantees which transfer risk from them to the taxpayers permits them to calculate return on only the equity portion and thereby enhances the desirability of the investment."

GAO response: See GAO's response to ERDA's statement 51.

62. ERDA statement (page 47, para 4): "This paragraph repeats the assertions of page ii. The text, as has been pointed out above, is inconsistent with the assertion."

GAO response: See GAO's response to ERDA's statement 3.

63. ERDA statement (page 48, para 2): "The report again asserts that synthetic fuel production is not price competitive with foreign oil. As previously noted, only certain synthetic fuel technologies should be compared with foreign

oil and then only at the time of completion of the plant. High-Btu gas plants when completed are presently competitive with alternative sources of gas."

GAO response: See GAO's response to ERDA's statement 4, 6, and 7.

64. ERDA statement (page 48, para 3): "Neither ERDA nor H.R. 12112 is proposing any "deep national commitment to uneconomic high-cost supply technologies." What both do propose is a program to resolve at or near full-scale the regulatory, socioeconomic, environmental, and other uncertainties which presently inhibit private sector investment, but which must be resolved if the private sector is to invest in a synthetic fuel industry in the mid-1980s. The purpose of the H.R. 12112 program is to preserve the synthetic fuel option, not to elect it."

GAO response: See GAO's response to ERDA's statement 57.

65. ERDA statement (page 49, para 3, numbered point 3): "Again, the unsupported assertion that synthetic fuels are not cost-effective."

GAO response: See GAO's response to ERDA's statement 4, 6, and 7.

66. ERDA statement (page 50, paras 2 & 4): "On the one hand the GAO report describes the economic desirability of conservation and on the other notes its relatively unfavorable payback. This is a contradiction. ERDA does not debate the desirability of conservation as a contributor to national energy goals. We do have problems with assertions of cost-effectiveness."

GAO response: See GAO's responses to ERDA's statements 4 and 10.

67. ERDA statement (page 50, para 3): "The discussion in this paragraph regarding tax credits should include the cost to the nation of such credits. This same paragraph notes the long payback period for conservation investments. Payback is an important measure of favorability in investment analysis. The contradiction appears several times in the GAO report."

GAO response: See GAO's response to ERDA's statement 39.

68. ERDA statement (page 52, para 2): "This paragraph is in error when it addresses loan guarantees as the appropriate incentive to relieve concerns that the product price will not compete economically with manipulated world oil prices. The appropriate incentive to address this concern is a price guaranty.

Loan guarantees do address the questions of risk transfer, credit, and return on investment."

GAO response: Our report states that both loan guarantees and price subsidies will be needed for a synthetic fuels industry. We believe this point of view is reflected in a combination of H.R. 12112 and the proposed Energy Independence Authority legislation.

69. ERDA statement (page 52, par 5): "GAO believes that adequate information can be gained from smaller plants under government control. However, regulatory, environmental and socioeconomic information will not be credible coming from small plants. There is a critical cut-off size below which this information cannot be extrapolated to the full-size plant. Several witnesses testified on this point before the Economic Stabilization Subcommittee of the House Banking, Currency and Housing Committee."

GAO response: ERDA is in the process of having a study completed on the information received as a function of plant size. ERDA has stated that this study is now expected to be completed within 2 months. It is interesting to note that the bill (H.R. 12112) which ERDA supports has a provision for the construction of single modular 6,000 to 10,000 barrel a day shale oil plants while a commercial size plant is expected to be 50,000 barrel a day. Apparently ERDA expects to obtain the regulatory, environmental, and socioeconomic information from this smaller than commercial size plants. See also ERDA's statement 58 and the accompanying GAO response.

70. ERDA statement (page 54, para 2): "This paragraph again makes the assertion that solar hot water and solar space heating are currently economic in certain instances, but then says that they are not being implemented because of long payback periods. The two statements are inconsistent."

GAO response: See GAO's response to ERDA's statement 40.

71. ERDA statement (page 55, para 4): "The GAO report characterizes itself as an analysis. It appears to us rather to be a series of assertions unsupported by analysis. It is really an expression of philosophy regarding energy policy. To make an effective case, GAO should provide an analysis which demonstrates that the work of the Synthetic Fuel Task Force and the continuation of that work by ERDA, is deficient or incorrect."

GAO response: As stated earlier, we have based our observations and our conclusions on the most current data and facts available, as well as on recognized and major studies which relate to this highly complex area.

**STATEMENT OF DR. WILLIAM T. McCORMICK, JR., DIRECTOR OF
COMMERCIALIZATION, ENERGY RESEARCH AND DEVELOPMENT
ADMINISTRATION; ACCOMPANIED BY ROGER W. A. LeGASSIE,
ASSISTANT ADMINISTRATOR FOR PLANNING AND ANALYSIS,
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION**

Dr. McCORMICK. Mr. Chairman, the basic concerns that we at ERDA have are summarized in Dr. Seamans' letter to Mr. Staats, which is included as an attachment to my testimony. We have also included a detailed, page-by-page, point-by-point analysis of our problems with the report.

Basically, the overall difficulty we have with the GAO report is that there is no substantial analysis in that report which undermines the rationale for the program which this and other committees have considered and which is embodied in H.R. 12112. There are numerous assertions throughout the GAO report of the cost-effectiveness and the relative cost-effectiveness of various energy options, and the measures of those cost-effectivenesses are not even presented; they are not even outlined.

There are numerous assertions about the relative economics of one technological approach versus another, and there is simply not even a table in the report which compares on a year-by-year basis what the projections will be and what GAO expects the economics of various technologies to be.

We feel there has been an inadequate analysis of the question of the basic need for synthetic fuels in this country.

I would like to remind the committee just briefly of a couple of facts that are before us.

The imports of foreign oil, as you know, have been rising for the last 15 years. Before the Arab oil embargo in October of 1972, we imported 29 percent of our total oil; today that number is 40 percent. So in four years our oil imports have risen 11 percent, from 29 to 40 percent. On the other hand, our domestic production of both oil and gas has declined since the early 1970's. So we think the basic problem of supply and demand for liquid and gas cars fuels in this country is something that has not been given sufficient attention in the GAO report.

In terms of the forecast in the near future, all of the major forecasts that have been made that have any reputability at all in this country, by the Ford Foundation, by the FEA, by ERDA, by Bankers Trust and others, all forecast, every one of them forecasts a substantial requirement for increased imported oil beginning in the late eighties and running into the nineties, even assuming very vigorous conservation efforts. Even if you take the basis of the GAO hypothesis, which is the Ford Foundation's energy policy project, technical fix scenario, which is, among all the major forecasts, the single most optimistic case, if you take that case and analyze it in detail, it still forecasts a requirement of 4 million barrels a day of synthetic

fuels in the year 2000, and that, I would claim, is not a central estimate. It is the most optimistic.

Our own analyses have shown that we expect on the average synthetic fuels requirements to be about 5 million barrels per day in 1995 and 10 million barrels in the year 2000.

Now, what that simply means is that by 1995, if our central estimates are correct, we're going to need 100 major synthetic fuel plants in this country. That, if we started today, represents, a compounded annual growth rate of 17 percent in synthetic fuel plants, which is an unprecedented growth of a new industry. If we look back over the nuclear power experience today, where 9 percent of our electricity is generated by nuclear power, and we had the first commercial nuclear power 20 years ago. So we have a big job ahead of us, and we think the basic recommendation that comes out of the GAO report that we wait, that we delay, is just unsupportable. If we start tomorrow to build the kind of plants that are in H.R. 12112, they would be on line, as noted several times during these hearings, in the middle 1980's. We would then be able to have the information base that would allow industry, without Federal assistance, to make the large-scale investments that are needed to have the capacity on-line in the 1990's which we think we need.

Another major GAO point which I would take strong issue with, and which Mr. Thornton has discussed in detail during questions and answers, but which I would like to emphasize, is the statements made throughout the GAO report about the economics of synthetic fuels technology.

One thing that the GAO report fails to make clear is that today in this country we have 11 plants making synthetic gas from naphtha and petroleum products, most of which is imported. There is even one in this country that's 250 million cubic feet per day, which is of same scale of a synthetic gas plant, and that plant is making synthetic gas from imported naphtha at \$4.20 per million Btu. On a dollar-per-barrel basis, that's \$25 a barrel.

So anybody who compares the cost of synthetic fuels with the regulated wellhead price of natural gas, as GAO did, is not making the comparison that ought to be made. The comparison that ought to be made, and that the Congress ought to make, is the cost of synthetic fuels with the alternatives at the margin that this country is already faced with choosing. Almost every major gas supply transmission and distribution company in this Nation is faced with serious curtailments in the next 5 to 10 years, and to make the price comparisons that are made in the GAO report is just downright false.

With that, I've probably overstepped my time, but I'll be happy to answer any questions.

Mr. OTTINGER. Mr. Chairman, might I?

The CHAIRMAN. Dick, after Mr. Hayes and Mr. Symington you'll have a chance.

Mr. Hayes, you're recognized for five minutes.

Mr. HAYES. Thank you, Mr. Chairman.

With all this enthusiasm, if I have some time left I can yield back.

Dr. McCormick, I don't know whether it's false or not. All I know is that I also sit on the Banking, Currency and Housing Committee, and Dillon-Read Co. doesn't seem to think that that's a poor comparison, nor do they think that there is any possible way to ignore

price at the wellhead. Let me tell you a little about what Dillon-Read thinks, and these, by the way, I think are considerations that have not been considered in this particular piece of legislation.

I know that this committee has done an enormous amount of work in putting this piece of legislation together, and has taken reams and reams of recorded testimony from a variety of witnesses, but I don't believe that some of the financial characteristics of the regulated natural gas industry have really been weaved into the fabric of consideration that we have in this particular bill. For example, the Dillon-Read testimony in the Banking, Currency and Housing Committee said simply that the personal predisposition of the writer, who in this case was Mr. Willett of Dillon-Read, was to avoid Federal financial support and loan guarantees for the development of synthetic fuels. That was his beginning prejudice. But he went on to point out that, considering the state of the market and the regulated natural gas industry, it was going to be necessary to do that, and so, you see, as long as we have that basic premise that we're going to deal with, it is not a false comparison at all.

He goes on to say that the characteristics of affecting the financial viability of any synthetic program, coal gasification and geothermal specifically, are untested technologies for projects of the size contemplated; and you're very casually suggesting, that is, ERDA is very casually suggesting whipping into 100 major synthetic plants, relatively long construction periods lasting several years, with, of course, concomitant cost increases that move along a high level of capital.

Dr. McCORMICK. Mr. Hayes, what I'm saying is that if we are to meet the requirements for liquid and gaseous fuels in the 1990 time frame, we have a choice between building, we estimate, 100 major synthetic fuel plants, or importing another 5 million barrels of oil per day. That, I think, is the choice which the Congress has.

Mr. HAYES. Is it really the choice? Because does that particular choice that you are giving me in your testimony take into account all of the other energy alternatives that we have to deal with?

Dr. McCORMICK. Yes sir, it does. As I said, even taking the rather optimistic scenarios about supply and demand, and looking at the maximum contribution of alternatives, you still come out with a substantial requirement for synthetic fuels.

Mr. HAYES. Then why is it that the natural gas industry is unable to attract the capital necessary to launch off even into a small percentage of the program contemplated by this bill?

Dr. McCORMICK. First of all, it's not a matter of desire, because there are a number of gas companies who have testified before this and other committees—

Mr. HAYES [interrupting]. Why can't they attract the capital in the marketplace?

Dr. McCORMICK. There are really two reasons. One is their own financial structure.

Mr. HAYES. Which is?

Dr. McCORMICK. Most of them are not like major energy companies. They are regulated companies, with limited rates of return, and their net worths and assets are in the order of a billion or less dollars, about the size of a major project.

Mr. OTTINGER. Would the gentleman yield?

Isn't Exxon an applicant for one of these gasification plants?

Dr. McCORMICK. I think, if you look at the 11 or 12 major plants, I think 10 or 11 of the 12 are regulated utilities. All the leading projects are sponsored by regulated utilities, as I said, with net worth on the order of less than a billion dollars. They, in order to build these plants, have to go out and essentially borrow money, get it under debt, mortgage.

Mr. HAYES. That's right. Not only that, but according to every investment banker in America, who will testify to this, they not only have to do that but they have to rearrange the tariffs so that the consumer, so that the gas consumer, and the consumer—or those fuels, will ultimately be contributing to the cost of the synthetic manufacture, and that is an enormous amount of money that is not toted up. So that if there's an absence of some figures somewhere, I suggest that one of the absences has been in ERDA's contemplation because they have not keyed in the amounts that are going to be necessary to be put back into the rate structure. That's an enormous load that's going to have to be carried by the American people.

Dr. McCORMICK. Mr. Hayes, I've already pointed out that we have a number of plants in this country that make synthetic gas from naphtha and other petroleum products. They are already operating at costs three times the regulated wellhead price of new gas, and the American consumers are not only paying for extremely high priced gas, but they are importing it as well. The projections of synthetic gas that we are talking about from all these major coal gasification plants, from every project sponsor, is less than the cost of some of the gas that's being produced in this country right now from petroleum projects.

Mr. HAYES. But certainly not on the scale that we're talking about.

Dr. McCORMICK. Yes, sir, on the scale. That plant is 250 million cubic feet per day, and that's the same size that we're talking about for a first demonstration project.

Mr. HAYES. Thank you, Mr. Chairman.

The CHAIRMAN. Mr. Symington.

Mr. SYMINGTON. Thank you, Mr. Chairman.

Dr. McCORMICK. I'm going to try to just get things straight in a larger perspective if I can. What is the estimated period in which the yield of our oil sources will be depleted beyond reasonable industrial yields in the world?

Dr. McCORMACK. Mr. Symington, there are two aspects of that problem. One is the domestic situation and one is the international situation. Our petroleum production peaked in this country in 1971 and has been declining for the last 4 years. Our natural gas production peaked in 1973 and has been declining for the last 3 years. All the projections in the United States show that, even if we develop Alaska and the Outer Continental Shelf rather successfully, production may stop declining for some period of 5 to 7, maybe 10, years, but then will continue its decline in the late 1980's into the 1990's. Almost all the major forecasters, to the extent they're able, and admittedly there's a lot of uncertainty in that business, come out with that general conclusion. This includes the U.S. Geological Survey and others.

The fact is that we are in a declining supply situation. On the international market, the picture is a little bit better because the Middle Eastern reserves are expected to last at current production rates maybe another 10 to 20 years before they get into depletion problems.

Mr. SYMINGTON. Ten to twenty years beyond 1990?

Dr. McCORMICK. Beyond today. They'll go beyond there, of course, but there will be a depleting resource and the producers will be concerned about it. I think already we have seen, just this week, a reluctance on the part of some of the Arab producers about the level of their production and they're concerned about whether to hold production down in order to keep their resources for a longer time.

Mr. SYMINGTON. What is Europe doing about this projection of depletion of their sources, which are practically entirely foreign derived? Are they going into these synfuels arrangements?

Dr. McCORMICK. Mr. Symington, there already are in Europe a number of synthetic gas plants, low and medium Btu gas plants, that are operating economically in Europe. I expect that they will continue to operate and that more will come on line in the near future.

Mr. SYMINGTON. And how are they set up, through corporate or government sources? That is to say, did they require, or did they lean on, investors for their resources, or are they government sponsored?

Dr. McCORMICK. There is a mixture. In some cases they are completely self-sustaining. They generally are in more specialized applications. Those are, the first places where they would be most economic.

Mr. SYMINGTON. How do they view themselves? Do they expect to pick up a considerable portion of their needs over a period of time, or are they just experimenting?

Dr. McCORMACK. I'd like to have Roger LeGassie comment on that.

Mr. LEGASSIE. Thank you. If I could respond to that?

First, of course, as you are aware, the Europeans do not have shale oil resources. Second, except in England, the coal resources are really not very significant. Germany's coal resources are not basically usable to the extent the U.S. resources are. We're quite blessed in that regard. So they do not have the option that we have of turning to synthetic fuels. The main course that they have taken is to stress electrification and the use of nuclear energy as a primary source of energy in the future, and they have had to make that choice because they have, as they see it, really no other choice other than to deal with imports. So they are driving very strongly for electrification, in their economies, and the use of nuclear power. We have more diverse opportunities, and we see in ERDA a value toward putting ourselves in a position to use the coal and oil shale resources.

Mr. SYMINGTON. They will seek energy independence by the use of nuclear energy by the turn of the century?

Mr. LEGASSIE. Their analyses show that they cannot achieve independence. They are so far away from independence that that is not a feasible option for them. So it really is a quite different situation.

Mr. SYMINGTON. So that they are permanently dependent, but to the extent that they can reduce their dependency, it would probably be nuclear?

Mr. LEGASSIE. That is correct.

Mr. SYMINGTON. I wish I had more time here.

However, the GAO suggests as an alternative to what is contained in the bill and what ERDA wants is a "commercial pool" approach, by which the Government would address itself to the research and then turn it over to the corporate entities to see if they would like to buy it.

What is your comment on that?

Dr. McCORMICK. Mr. Symington, they are suggesting, I believe, that that is an alternative incentive mechanism as a purchase arrangement, as opposed to a loan guarantee.

Our feeling on that is that price guarantees or purchase arrangements have certain applicability to fuels in unregulated markets, that is, markets where the fuels would have to compete in the open market. However, in the case of fuels which compete in regulated markets, such as synthetic natural gas from coal, there is no need for a purchase agreement or a price guarantee because the market is already there.

As I said before, there are a number of companies throughout the country that want to build these plants and have the customers to buy the gas. It's only a matter of providing a mechanism for the utilities to finance the first-of-a-kind plants.

Because of the uncertainties in the regulatory, environmental, and other areas, in which potential investors have no experience, the basic problem that we have in the country in terms of investment, is that we've never run these plants through the regulatory system and we have no base of experience upon which investors can make sound financial decisions.

The CHAIRMAN. I'm sorry, Jim.

The Chair recognizes Dick Ottinger. But, Dick, before I let you start, we've got to quit at about 5 minutes to 10 because of another committee meeting. So while Dick's talking, those members who feel like they have to talk—we'll divide it up between those who have to, and that will be the time you get.

Mr. OTTINGER. I would like more information about these European plants. The information that we got in previous testimony was that a pilot plant in Scotland which had been operated largely through our auspices closed down; and there was a plant in Germany that had been working on a pilot plant process.

Dr. McCORMICK. The plant in Scotland, Mr. Ottinger, was a methanation plant at Westfield, Scotland for the high Btu process. The plants I mentioned that are operating on a commercial basis in Europe are the low and medium Btu gas plants, and they are commercial scale, and I think there are 12 or 13 of them.

Mr. OTTINGER. What we're talking about here is high Btu. Now, in terms of the naphtha conversion plants, what you're talking about; they don't create a market. If, in fact, that were the measure that one were to use in terms of the economics of high Btu gasification that's called for in this project, then it seems to me quite clear that the companies presently involved would finance it themselves, if the \$18 a barrel equivalent were a fair measure. There's no reason at all why some of these applicants—and applicants for your project, have already made inquiries, the Exxon Corp., the McCardle Oil Co. and these are by some submissions by you—feasibility studies started late in 1973, State and Federal coal leases were committed. Panhandle Eastern Pipeline Co. and El Paso Natural Gas Co., these are all multibillion dollar corporations that certainly would put up the

capital if it were economical. The only reason for this guarantee program is that it is uneconomical.

Dr. McCORMICK. Mr. Ottinger, the characterization of the pipeline gas industry as multibillion dollar corporations, I would take issue with. These are, in general, regulated companies. They're regulated to 15 percent return on equity. They do not have the financial resources that are typically associated with large multinational energy companies, and their financial structure and the way they are treated in the market are entirely different, and they are all faced with, every one of them is faced with, the serious problem of large-scale capital investments, be it in LNG plants, Alaska projects, or synthetic gas projects.

Mr. OTTINGER. Well, Exxon is certainly not in that category.

Dr. McCORMICK. Exxon is atypical on that list, and I believe it's the only one on that list of 13 that involves a major oil company. I can check that, though.

Mr. OTTINGER. On another subject, you testified to us point blank that the \$2 billion that we originally were considering here under this synfuels program would stand on its own feet and had nothing to do with the previous program. When the President issued his list of legislation that he wanted to see come out of this Congress, he said that we would treat them as—maintaining all along, that the \$2 billion program was merely a step in the achievement of the \$6 billion program which was originally contemplated of 350 million barrels of oil per. Which is correct? Is the President deceiving us, are you deceiving us, or where are we?

Dr. McCORMICK. Mr. Ottinger, I don't think anyone is trying to deceive you. Let me try to explain it again. I think we tried to make it clear what our position is on this. The President fully supports the synthetic fuels program as originally outlined, which is a slightly larger program than the one embodied in H.R. 12112. The Congress considered the administration's program proposal, and this committee and others have made various changes in that proposal, and the legislation as it now stands is a \$4 billion program, which the administration has said repeatedly that it supports.

The administration also supports a larger proposal, the Energy Independence Authority, the legislation for which is sitting before several committees. But its support of this is independent of that. It supports both. And the President feels so strongly about this piece of legislation that he has sent up a supplemental request for 1977, and he wants to get this legislation through immediately.

The CHAIRMAN. Mr. Hechler is recognized for 2½ minutes.

Mr. HECHLER. On page 7 of your statement you mention price guarantees. Are you aware of the fact that the Committee on Science and Technology in its report on May 15th on H.R. 12112 specifically indicated—and I'll quote from that committee report:

The Committee especially emphasized that the approval of Section 18 in no way constitutes an expression of approval of approaches or assistance beyond loan guarantees. Nothing in Section 18 authorizes construction grants, price supports, or price guarantees.

Are you aware of that?

Dr. McCORMICK. Yes, Mr. Hechler. I'm aware that that may be the view of the committee. I suppose it is, since it's in the report. It is not our view, and we testified to that.

Mr. HECHLER. You then feel that price supports are an essential ingredient of this legislation, is that correct?

Dr. McCORMICK. We testified that price supports would enable us to do certain projects that couldn't be done with loan guarantees. We think many projects can be done with loan guarantees alone, and if that's all that Congress decides to authorize specifically, then we think there are a number of projects which we could start.

Mr. HECHLER. I would like to lay on the table, of course, the fact that we discovered over the weekend that the amendment inserted into the record by the Chairman included price supports with the specific statement that this had been agreed on by the Committee on Science and Technology. Just as one member of that committee, I would like to indicate, Mr. Chairman, that I was not aware of this, nor did I agree to it. But I wonder, Dr. McCormick, if you have any idea as to how price supports got snuck in over the weekend in the proposal?

The CHAIRMAN. Ken, they got snuck in by the Committee on Banking, Currency and Housing. That's how that got snuck in.

Mr. HECHLER. But the statement in the record indicated "agreed on".

The CHAIRMAN. That's wrong. I agreed to it.

Mr. HECHLER. All right.

But you feel that it is an essential ingredient, and you also feel, I assume from your testimony, that the \$100 billion Energy Independence Authority bill, which the President specifically said on July 22 was a necessary part of the move toward energy independence, is a necessary concomitant to this program, is that correct?

Dr. McCORMICK. I'm not aware of the President's statement.

Mr. HECHLER. The President stated, and I quote: "With the enactment of the Energy Independence Authority, these incentive projects will be transferred to the Energy Independence Authority." That's speaking specifically of the loan guarantee.

Dr. McCORMICK. We've said repeatedly that if the Energy Independence Authority were enacted it would be logical to group these financial incentive programs into one place.

Mr. HECHLER. And you're in favor of or in support of the EIA?

Dr. McCORMICK. Yes.

The CHAIRMAN. Mr. Mosher, 21½ minutes.

Mr. MOSHER. I have no further comments.

The CHAIRMAN. Mr. Thornton, 21½ minutes.

Mr. THORNTON. Thank you, Mr. Chairman.

I would like to pursue briefly the price comparisons and the concerns which I have with regard to that. I believe your analysis makes clear that several of the alternatives which are suggested by the GAO report have a cost per Btu higher than that of a synthetic fuels option, which is opposed, at least in the sense of a loan guarantee program, by the report. Specifically tertiary oil recovery is one example, is it not?

Dr. McCORMICK. In the GAO report, as I recall, there were several estimates of the price of tertiary recovery. There were estimates given by the Oil and Gas Journal, which were \$20 to \$25 a barrel, I believe, and then there were some lower estimates which were unascrbed in the report.

If you use the \$20 to \$25 per barrel estimates, I would say that they are, certainly in the case of oil shale, higher than our estimates and most of the company estimates of what you could produce oil shale for.

Mr. THORNTON. Don't get me wrong. I'm an advocate of tertiary recovery procedures, but I think it's important for us to realize that some of the alternatives are also higher priced than today's market price of oil, and I think it's vital in considering the impact of this report that we be fully aware that one of the detriments to the development of solar energy is that its cost is somewhat higher than present world prices of oil. Is that not correct in many instances?

Dr. McCORMICK. Today that's true for almost all of the major solar technologies.

Mr. THORNTON. Yet ERDA does intend, I hope, to move forward with this technology against the day that resources of oil and gas will have been diminished.

Dr. McCORMICK. Yes, sir. We are vigorously pursuing solar and a number of other options. As a matter of fact, within the structure and scope of H.R. 12112, we could even undertake some demonstrations of solar and other renewable resource technologies.

Mr. THORNTON. I think perhaps when you said that it was a mistake, or false, to compare the cost of a synthetic natural gas with a regulated product you were pointing to the fact that the comparison should be drawn to an unregulated price rather than a regulated price, especially when those who make the comparison also advocate deregulation of the regulated product. What I'm saying is, how can you argue that you should compare it with the regulated product and then also say that for conservation purposes the regulated price should rise?

Dr. McCORMICK. Mr. Thornton, you can't. As I indicated in my statement we believe the correct comparison is with—

The CHAIRMAN [interrupting]. I'm sorry, Bill. If you will submit your response in writing to the committee? Thank you, Bill.

[No response.]

The CHAIRMAN. Mr. Myers.

Mr. MYERS. Thank you, Mr. Chairman.

I'd like to make some observations in relationship to what my colleague, Mr. Ottinger, was speaking to. Even if we address the issue of Exxon, who is the extreme company, and I agree with you, I think we've got to put it in this perspective. Mr. Ottinger, on the one hand, says that a billion-dollar project is to expensive for the Federal Government to get into, and yet their annual revenues are 400 times what Exxon's annual revenues are. It has taken Exxon several generations to build that up to net assets of around \$30 billion. I think perhaps Mr. Ottinger has maybe been in Washington too long, and he forgets how many zeroes he's putting at the end of the figures, because I can assure him that a billion-dollar single research project, is big for anybody, even for Exxon.

I can recall when my company, Armco, went to a \$600 million expansion program in the 1960's. That was a whale of an investment. We are asking a company to make a billion-dollar investment in one single research project for the good of the whole country, and we're doing that because they happen to have \$4 billion in sales. I just think it's not consistent with what we're looking for. We have locked up in this legislation a proposal that what comes out of it will be shared for the country's good. It is not going to be exclusively Exxon, or anyone else. But I think even if you want to argue the case against the single

largest company, Exxon, I think you can make a case against his argument.

I just wanted to bring that up in that regard, and we're forgetting that we're only guaranteeing 75 percent of the loan. Each company has to face up to losing possibly one-fourth of their investment right off the bat.

We talk about conservation, and what the Federal Government's role is. I think the Federal Government has got to put the money in big patches, where it's got to make moves. Conservation can be met by the general consuming public, partially through price controls, but through insulation in their homes, or in some way or another. But that's the way, with a minimum amount of Federal investment, to get a lot for your money, and let the Federal Government move on the larger fronts.

Thank you.

The CHAIRMAN. Mr. Emery.

Mr. EMERY. Thank you very much, Mr. Chairman.

A few minutes ago I asked GAO a question about inconsistencies of figures used to calculate the cost comparisons on page 36. They quote a figure of \$12 per barrel for imported petroleum, as against \$13.50.

The first question is: Do you feel that that difference in assumption price will be a significant factor in price comparisons with synthetic fuels versus oil? Do you disagree or agree with the figures that they use in that comparison?

Dr. McCORMICK. We disagree with the figures, and we also would disagree with the way they are used.

Mr. EMERY. The second question: On page 27, I pointed out the inconsistency in tertiary recovery of 1.5 million barrels per day versus 500,000 barrels a day.

Which figure is accurate?

Dr. McCORMICK. I would have to check that one, Mr. Emery. I don't know which one off the top of my head. We can check that.

Mr. EMERY. More specifically, it says on page 27 of the report, that 1.5 million barrels per day may be provided by tertiary recovery. I asked if the figure was current. According to ERDA, this figure was listed as 500,000 barrels, which is a very significant discrepancy, of a million barrels a day, between the figure that ERDA quotes and the figure that GAO has used in their calculation. I'm very concerned that inaccuracies or inconsistencies of this type may change this report one way or the other—your general comments.

Dr. McCORMICK. We have provided for the committee 17 pages of comments in detail on the report, and we found a number of inconsistencies and assertions and other things that we take issue with. There are plenty of things like that in the report, in our view, and we would be glad at any time to go over them in detail.

Mr. EMERY. You feel, in a quick summary, that the GAO has not done a very good job in analyzing the statistics? I know that question is putting you on the spot, but I think it's an important one. You feel that they have not done the program justice with that presentation of cost comparisons and other figures?

Dr. McCORMICK. In terms of analysis that was promised earlier, in the report, we don't think this is a very good job of analysis, yes.

Mr. EMERY. Thank you very much.

The CHAIRMAN. Mr. McCormack.

Mr. McCORMACK. Thank you, Mr. Chairman. I have just a couple of fast questions here, which will require fast answers, to meet the bell. First of all, under H.R. 12112, as I understand it, you see this not as a program to commercialize synthetic fuels, but as a program to demonstrate technology, to get the information we need so that the questions of commercialization can be answered?

Dr. McCORMICK. Yes, sir.

Mr. McCORMACK. That is correct.

Now, the Ford Foundation Technical Fix Scenario, which I understand is the guideline for this study, assumes that by the year 2000 this country will be consuming 124 quads, or 60 million barrels per day of oil. I would like to go over some mathematics with you very quickly, just for the record as well as for everybody else. Today we are importing about $6\frac{1}{2}$ million barrels of oil per day. I'd like you to check me off on this.

Dr. McCORMICK. Seven.

Mr. McCORMACK. All right. Our domestic oil production is about 10, is that correct?

Dr. McCORMICK. That is correct.

Mr. McCORMACK. And domestic gas, about 10?

Dr. McCORMICK. Correct.

Mr. McCORMACK. Coal, about $6\frac{1}{2}$?

Mr. LEGASSIE. Those sound like the right numbers.

Mr. McCORMACK. Nuclear, between about one and two. Hydro, about two. Solar and geothermal, very little. Now, in the 2000, the ERDA projection for gas and oil is that they will be about the same as they are today. That is, with our exploration effort, we'll have about 10 of each.

Mr. LEGASSIE. That is correct.

Mr. McCORMACK. At that rate, then, if we assume that we will develop all of our hydrosites and maintain this exploration and drilling program for gas and oil, we'd have 10 from oil, 10 from gas, 3 from hydro, with very, very optimistic promise for solar and geothermal, 2 for municipal waste, for a total of 29. Now, that is compared to a demand of 60, under the Ford Foundation Technical Fix Conservation Scenario, leaving 31 that we have to produce—31 million barrels, from other sources: shale, coal, imports and nuclear, for 31 million barrels out of the 60. Now, today we get a total of about 15 from those sources. That means we have to get about 16 more from those sources: nuclear, coal, shale, imports. Now, in view of the fact that our imports may very well be cut off, then we're down to getting it from coal, shale, and nuclear. Do you agree that that's an appropriate perspective, that we are going to have to, first of all, depend on approximately one-half or more of all of our energy in the year 2000 from those sources: coal, shale, imports, and nuclear energy?

Mr. LEGASSIE. Yes; I do. I have a very similar comparison in front of me.

Mr. McCORMACK. OK. So then the question is: How much we're going to depend upon synthetics, whether we're going to depend more

on nuclear or more on synthetics, and more on just burning coal and hoping that we can catch the solar. That's really what it amounts to.

Mr. LEGASSIE. Yes.

Mr. McCORMACK. OK. Now, the GAO report assumes that all energy costs will escalate proportionately. If this is true—and I take it this is all just pure speculation. I don't know if there's anything that guarantees that at all—I think coal will escalate far more than anything else because we're going to have to make coal safe, as safe as nuclear now, and it's going to probably double the cost of coal just to use it. But anyway, if that is true, if they do escalate proportionately, then solar will still be way out of reach, won't it, as far as any use except for heating buildings and hot water?

Mr. LEGASSIE. Heating and cooling may be an effective use of solar.

Mr. McCORMACK. If we have an effective solar technology.

Mr. LEGASSIE. Yes.

Mr. McCORMACK. Which we do not now have.

Thank you, Mr. Chairman. Thank you, gentlemen.

The CHAIRMAN. The meeting will be adjourned to room 2359. Thank you all very, very much.

[Whereupon, the committee was adjourned at 9:58 a.m.]

APPENDIXES
REPORT TO THE CONGRESS



*BY THE COMPTROLLER GENERAL
OF THE UNITED STATES*

An Evaluation Of Proposed
Federal Assistance For
Financing Commercialization Of
Emerging Energy Technologies

Multiagency

In March 1976 GAO said that the Congress needed better information before approving the administration's proposed multibillion dollar Federal loan guarantee program for synthetic fuel plants.

This report analyzes the pros and cons for commercializing synthetic fuels and other emerging energy technologies by responding to the following questions:

- What can Government do to accelerate development of synthetic fuels?
- Can more energy be produced at less cost by stimulating the development of other new energy technologies?
- Is conservation a more cost-effective alternative to Federal incentives?
- Which types of Federal financial incentives are best in specific situations?

EMD-76-10

AUG. 24, 1976

ERRATA SHEET FOR
GAO REPORT TO THE CONGRESS ON
AN EVALUATION OF PROPOSED FEDERAL ASSISTANCE FOR
FINANCING COMMERCIALIZATION OF
EMERGING ENERGY TECHNOLOGIES
EMD-76-10, AUGUST 24, 1976

Digest, p. i - Third line should read "which could contribute to solving energy problems con-"

Digest, p. vi - Third recommendation should read, "Continue to encourage the installation of units for solar hot water and space heating."

Fifth recommendation, sixth line, should read "to continue research and development"

Page 7 - Third paragraph, fifth line, figure in the parenthesis should read " 10^{15} ."

Page 9 - Second paragraph "Energy Conservation" has the scenario description reversed. ERDA's Scenario V emphasizes commercialization; Scenario I emphasizes conservation.

Page 16 - Last paragraph should start "Besides"

Page 21 - Third paragraph, last line, should read "be made on a case-by-case analysis"

Page 23 - First full paragraph, fifth line should read "Federal activities can be pursued which would emphasize the major oppor-"

Page 24 - Second paragraph "oil recovered using tertiary techniques (7.2 quads) is out of descending order.

Page 31 - Footnote blank should read "(See page 51)."

Page 48 - Last line should read "that the current average regulated price of oil and gas may not"



COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-178205

To the President of the Senate and the
Speaker of the House of Representatives

On March 19, 1976, in response to his request, we reported to the Chairman of the Subcommittee on Energy Research, Development, and Demonstration (Fossil Fuels), House Committee on Science and Technology, our comments on the Administration's proposed synthetic fuels commercialization program (RED-76-82).

Subsequently, we testified before the House Committee on Science and Technology; Subcommittees of the Senate Committee on Banking, Housing and Urban Affairs, House Committee on Banking, Currency and Housing; and House Committee on Interstate and Foreign Commerce, on developing and commercializing energy technology. In that testimony, we indicated that we were doing further work on the status of feasible technologies which appear to have impediments to full commercialization.

In addition, we indicated that this work would include an assessment of the priorities attached to the various technological options, and our assessment of the most appropriate incentives or other actions for encouraging their development. As our study of the matter progressed, it became evident that pursuit of alternative technologies is extricably intertwined in overall national energy strategies, including strategies for implementing energy conservation actions.

This report is the result of our analysis. It is intended to aid the Congress by providing a framework and perspective for making decisions on the many energy options before it.

Copies of this report are being sent to the Director, Office of Management and Budget, and the Administrators of the Federal Energy Administration and the Energy Research and Development Administration.

A handwritten signature in dark ink, appearing to read "Thomas R. Staebler".

Comptroller General
of the United States

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ABBREVIATIONS

EPA	Environmental Protection Agency
ERDA	Energy Research and Development Administration
FEA	Federal Energy Administration
FPC	Federal Power Commission
GAO	General Accounting Office

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESSAN EVALUATION OF PROPOSED
FEDERAL ASSISTANCE FOR
FINANCING COMMERCIALIZATION
OF EMERGING ENERGY TECHNOLOGIESD I G E S T

GAO seeks to provide a framework and perspective for considering actions by the Federal Government which could contribute to energy problems confronting the United States over the next 10 to 25 years.

Unless choices of technology and financing method are considered in perspective, the risk of piecemeal decisionmaking increases substantially.

Making the right choices among energy technologies, in GAO's view, requires consideration of three factors.

- The contribution that each technology can make in meeting the Nation's energy needs within a specified time frame either through reducing demand or increasing energy supply.
- The total cost of making the technology commercial including costs of plant construction, costs of alleviating adverse socio-economic impacts caused by the energy development, and the costs of price supports or further subsidies which may be required.
- The price at which energy produced by the technology would have to be sold and the means by which the price would be assimilated by our economic system. (See p. 45.)

Making the right choice among financing mechanisms requires, in GAO's view, inter-related analysis of at least three factors.

- The technology's state of development.
Is the technology developed to the extent that it can be deployed on a broad basis?

- The technology's economic feasibility. Will the energy produced as a result of deploying the technology be economically competitive with competing energy sources?
- The target group whose actions will be influenced. Are they large industrial firms or diverse and widely dispersed groups of homeowners? (See p. 46.)

The recent slowdown in the rate of growth in demand for energy is a sharp reminder of the importance of the demand side of the energy equation and of conservation in particular. This fact, and the wide differences of opinion on the sources of energy supplies to meet that demand, suggest that the Nation should carefully explore all supply sources as well as conservation alternatives before embarking on a program to commercialize synthetic fuels. (See p. 5.)

CONCLUSIONS

GAO concluded that certain conservation measures are by far the most cost effective way to "produce" energy and therefore should have the top priority for Government financial assistance.

Among the energy supply-increasing technologies considered, GAO found several that are cost effective throughout the country or in particular geographical areas. These technologies are hydrothermal energy, municipal waste combustion systems, solar hot water and space heating, and tertiary oil recovery. The ultimate supply of energy to be captured from these sources may be smaller than the ultimate potential of other supply technologies such as synthetic fuels, but they appear more cost effective.

The cost effective technologies should be given priority in Government assistance for commercial development in GAO's judgment. This assistance will ensure their maximum

contribution between now and 2000 and give the Nation time to consider the potentially larger supply sources and develop them as appropriate. These latter sources include synthetic fuels as well as fusion, solar photovoltaic cells, thermal gradients, and breeder reactors. (See p. 47.)

Synthetic fuels production is not cost effective in that the total cost of output is not price competitive with foreign oil. Nor does it look attractive on the basis of present knowledge when compared to other technologies on an actual, or incremental, price basis.

Serious questions exist regarding any national commitment at the present time to uneconomic, high-cost supply technologies which substantially exceed the cost of imported oil. Certainly, larger commitments to building complex, highly capital-intensive energy sources will result in less incentive in future years to develop alternative lower cost energy sources. In addition technologies producing energy that costs more than energy from imported oil would put exporting countries in a position to increase energy prices. (See p. 51.)

The pricing yardstick used in evaluating emerging technologies needs to be considered very carefully. An incremental cost standard is the only realistic one for making sound economic judgments which treat all emerging technologies equally. The alternative is average, or "rolled-in" pricing. This means that the real cost of new supply sources are averaged with far larger volume of lower priced energy.

The rolled-in yardstick favors synthetic and other fuels susceptible to rolling in treatment. Incremental cost, on the other hand, would apply the same test to all energy options, including conservation. Decisions made on this basis would allow a consistent and rational process of choice on a cost effective basis. (See p. 48.)

Conservation

Areas offering the greatest opportunity for conservation include

- insulation and other measures that conserve energy in all buildings,
- less wasteful uses of energy by industry, and
- improved management of electrical demand.

A variety of financial mechanisms can be used to stimulate conservation. (See page 51.) Many of the actions GAO believes are desirable to encourage conservation are authorized by the recently passed legislative extension of the Federal Energy Administration (FEA).

Synthetic fuels

The Energy Research and Development Administration's (ERDA's) most optimistic projections show synthetic fuels production reaching the equivalent of 2.4 quads and 22 quads in 1985 and 2000, respectively. (See p. 8.) However, ERDA is in the process of revising these estimates downward. Moreover, the projected prices are not competitive with existing or other emerging energy sources.

The large investments required to build synthetic fuel plants would direct Federal incentives primarily to the large industries which have access to capital. Two basic concerns underlie the stated need for Federal loan guarantees to finance synthetic fuels technology:

- concern that the product produced will not be economically competitive, particularly since the existing world market price for oil could always be manipulated to substantially undercut the price of synthetic fuels, and

--concern that technological advances in other energy areas or within synthetic fuels technology will make "first generation" synthetic fuels plants obsolete before they ever operate.

Research and development on "second generation" synthetic gas technologies is expected to reduce costs by about 15 percent.

In the present circumstances, GAO believes Government financial assistance for commercial development of synthetic fuels should not be provided at this time. Full priority should be directed to development of improved synthetic fuels technologies, however, it appears possible to gain adequate information of an environmental and regulatory nature from smaller plants under Government control. When commercialization of the technology becomes a prime objective, consideration also should be given to approaches other than loan guarantees for gaining private industry interest.

AGENCY ACTIONS AND UNRESOLVED ISSUES

In commenting on a draft of this report (see Appendices III and IV) the ERDA Administrator expressed deep concerns with GAO's analysis, presentation, conclusions, and recommendations, particularly as they related to actions on synthetic fuels. The Administrator pointed to what he regarded as five serious deficiencies.

In some of the items pointed out by the ERDA Administrator, GAO made revisions to its final final report. Basic differences remain over what steps the Government should take today to maintain the option of developing a synthetic fuels industry in the 1990s. (See p. 60.)

MATTERS FOR CONSIDERATION
BY THE CONGRESS

GAO recommends that the Congress:

- Continue to place the highest priority on energy conservation actions, including obtaining better cost/benefit data on the whole range of conservation opportunities. This will provide the basis for further developing and funding specific programs.
- Maintain close oversight of the new conservation programs. As these programs prove effective or ineffective, shift emphasis accordingly.
- Continue to encourage the installation of units for solar, hot water, and space and heating.
- Maintain close oversight of the Federal Energy Administration's actions to increase incentive for tertiary recovery of oil and authorize further incentives if the need and possibility to increase tertiary oil recovery becomes apparent in light of other energy developments.
- Consider whether it is advisable to enact legislation which would at this time authorize Federal loan guarantees to builders of synthetic fuel plants and consider instead directing ERDA to continue research and development to improve the technology and; in addition construct and operate smaller plants of a size sufficient to meet its stated goal of obtaining socio-economic, environmental, and regulatory information in a timely fashion.
- Consider further actions, including the provision of loan guarantee authority to encourage municipal waste combustion systems.

CHAPTER 1INTRODUCTION

In recent months considerable legislation has been introduced in the Congress which would provide various forms of Federal assistance to encourage private sector use, or implementation of, a variety of energy technologies. One such bill, H.R. 12112, is currently the subject of intense congressional deliberations. It would provide Federal loan guarantees to accelerate the commercialization of synthetic fuels--gas from coal, oil from coal, and/or oil from shale.

The President, in his 1975 State-of-the-Union-Message, called for Government financial incentives to stimulate industry investment in developing and demonstrating the commercial viability of synthetic fuels. In February 1975, an Interagency Task Force on Synthetic Fuels Commercialization was established to study the various factors associated with commercializing synthetic fuels.

Because the price of synthetic fuels is almost certain to be higher than the price of energy produced from traditional energy sources, the Task Force recommended that loan guarantees, construction grants, and price supports would be needed to encourage industry participation. A GAO report entitled "Comments on the Administration's Proposed Synthetic Fuels Commercialization Program" (March 19, 1976) evaluated that proposal.

This report goes beyond the earlier effort, addressing the following questions bearing on whether Federal financial incentives should be used to accelerate commercialization of alternative energy sources and conservation actions.

- How could the Government accelerate the development of synthetic fuels to meet the Nation's future energy needs?
- Can more energy be produced at less cost if Federal incentives are used to stimulate the development of other new energy supply technologies such as solar energy, geothermal power, and enhanced oil recovery?
- Is conservation a more cost-effective alternative for use of Federal incentives?

--Which types of Federal financial incentives--loans, loan guarantees, tax actions, purchase agreements, price regulation, Government ownership--are most appropriate in specific situations?

In considering these issues, the report attempts to avoid the risk of piecemeal decisionmaking by directing attention to some of the implications of certain choices for our national energy situation.

Our report examines a number of emerging energy supply technologies and conservation actions which are technically feasible and estimated to have a significant supply impact by 1985 and 2000, but are not being actively commercialized by the private sector. A major consideration in choosing among energy technologies obviously is the total time and cost to make the technology commercial. The report does not include a discussion of more uncertain technologies not ready for commercialization such as fusion, solar photovoltaic, thermal gradients, or breeder reactors.

No single mechanism for providing financial incentives appears appropriate to all circumstances. In determining the incentive which would best stimulate a particular energy or conservation technology, we believe the following three factors are important:

- The technology's state of development. Is it developed sufficiently so that it can be scaled up and deployed on a broad basis?
- The technology's economic feasibility. To determine this, we compared the incremental cost of the appropriate competing source of supply. For example, synthetic oil was compared with imported oil, synthetic gas with imported liquified natural gas and with imported oil, solar heating with electricity, and retrofitting actions with imported oil.
- The target group who would be influenced by the incentives. Are we trying to influence the actions of a few large industrial firms or of many small businesses or of a large number of homeowners? What kind of resources does the target group normally have at its disposal?

Individual bills before the Congress cover a wide range of objectives and financing techniques. However,

no one bill focuses on all emerging energy technologies, considers all costs associated with development, or more importantly, attempts to focus on targets of proposed actions on some consistent priority basis.

In the remaining chapters of this report, we

- Provide perspective on the role of new energy technologies and energy conservation. (Chapter 2, pages 4 to 11.)
- Analyze the potential energy savings associated with various energy conservation actions, the cost of such actions, and the impediments to their widespread implementation. (Chapter 3, pages 12 to 23.)
- Discuss the status of emerging energy supply technologies, the potential supply impact and cost of these technologies, and the obstacles to their commercial implementation. (Chapter 4, pages 13 to 37.)
- Review the actions available to the Government to accelerate development of emerging energy supply technologies or conservation actions, including the advantages and disadvantages of each. (Chapter 5, pages 38 to 43.)
- Present our conclusions as to the Government actions we believe are desirable to accelerate energy conservation and supply, focusing on the relative priority of various conservation and supply choices. (Chapter 6, pages 44 to 56.)

CHAPTER 2PERSPECTIVE

Before the Arab oil embargo in the fall of 1973, the United States was importing about 6 million barrels of oil a day, principally from the Arab oil producing countries. This oil accounted for about 35 percent of domestic oil consumption. The embargo made the American public aware that energy consumption was exceeding domestic production and that the Nation was becoming increasingly dependent on imported oil. In response to the embargo, the President established the goal of "Energy Independence."

Progress toward achieving this goal is, as yet, not apparent as oil imports have risen to about 6.8 million barrels per day and now represent about 42 percent of the oil being consumed in this country. This growing dependence on imports has increased the United States' vulnerability to supply disruptions and oil price rises.

What can be done to lessen U.S. dependence on imported oil as well as to what extent that dependence should be lessened have been the subject of considerable debate on the part of the Administration, the Congress, and the Nation. One of the issues in this debate is how we will assure our energy supplies in case of future embargos. The major action which has been legislated so far to respond directly to the embargo problem is the authorization of a strategic petroleum reserve in the Energy Policy and Conservation Act (Public Law 94-163). In addition, debate on the issue also centers around uncertainties over (1) our future energy needs, (2) the probability of further domestic discoveries of oil and natural gas, and (3) the ability to properly balance social, environmental, economic, and technological concerns associated with the future development of existing and new energy sources and conservation technologies.

Numerous studies 1/ have been made using various scenarios to attempt to understand the nature, extent, and timing of

1/ These studies include FEA's "1976 National Energy Outlook;" ERDA-48, "A National Plan for Energy Research, Development, and Demonstration: Creating Energy Choices for the Future;" "A Time to Choose" by the Ford Foundation; "Achieving Energy Independence" by the Research and Policy Committee of the Committee for Economic Development; and the Bureau of Mine's "United States Energy Through the Year 2000 (Revised)."

actions required to balance future energy supply and demand. The conclusions reached by these studies differ widely on the mix and relative emphasis that should be given to developing new and existing energy sources primarily because different sets of assumptions are made. The assumptions in turn reflect differing levels of optimism about the feasibility of obtaining slower growth through conservation. The energy growth rates and the level of imports are the two most crucial components of most of these studies because they have a direct bearing on how urgent the need is to develop domestic energy sources, i.e., the higher the growth rate, the greater the need to aggressively develop all possible energy supplies.

The highest energy growth studies are generally based on the 4.3 percent rate of growth in energy consumption experienced in this country from 1965 to 1973. However, most studies now question whether historical trends are the best indication of future energy growth. For example, the lowest of the scenarios (zero energy growth scenario) presented in the Ford Foundation study is predicated on redirecting economic growth away from energy intensive industries toward economic activities that require less energy. This assumption results in very limited increases in energy demand until the late 1980s and then zero growth after that.

In a recent speech, the Administrator of the Federal Energy Administration (FEA) stated that the United States must set up a goal of limiting the growth in energy demand to 2 percent per year if it is to escape the political and economic consequences of energy dependence. Different scenarios show energy growth rates ranging from 0 to 4.5 percent annually, however, recent studies appear to cluster around 2-1/2 to 3 percent annual growth in energy demand. This consensus on reduction in historical growth rates is based largely on increased conservation measures--both price induced and as a result of explicit Government actions. This rate of growth suggests that although the United States must step up its work on developing emerging energy technologies to meet long-term needs, conservation actions may buy time to fully consider trade-offs and make choices that will result in the most energy at the least cost to society. This is not to say that conservation and improved efficiency in energy use are not also long-term options and that energy conservation in particular could not be a cornerstone of any national energy policy.

The uncertainty over the mix of energy sources that will best meet future energy growth rates is caused by the lack of systematic methods of computing, comparing, and projecting the costs and benefits associated with implementing energy conservation measures, new energy supply technologies, and

the future development of existing energy sources. However, to some extent the costs and to a larger extent the benefits are not always clear and, in many cases, may be subjective. Another important factor, but one which can only be roughly estimated, is the time frame required for perfecting new technologies still in the research and planning stages.

Even though uncertainties exist, based on the energy supply and demand scenarios, the following are available courses of action which can be taken individually or in some combination to help lessen U.S. reliance on imported oil.

1. Adoption of conservation measures to reduce the growth rate in energy demand.
2. Increase (or slow the decline of) domestic production of oil and natural gas through new exploration and greater use of enhanced recovery techniques.
3. Expanded use of coal.
4. Expanded use of nuclear power.
5. Encouraging the use of emerging energy technologies such as synthetic fuel, solar power, and geothermal power.

Both the appropriate mix and the possible contribution of these opportunities are still hotly debated. To illustrate the possible role of different energy sources, we use in this perspective two scenarios from the Energy Research and Development Administration report entitled "A National Plan for Energy Research, Development, and Demonstration: Creating Energy Choices for the Future,"--one emphasizing the energy savings potentially available through conservation measures and the other emphasizing the additional energy supplies available from emerging technologies.

ERDA's Scenario I--Improved Efficiencies in End-Use-- shows that an intensive energy conservation program directed at improving end-use efficiencies has the potential of making a substantial impact on total energy consumption. Much of the energy savings are not dependent on technological development but on educational programs and other policies that will assist end-users in making decisions necessary to implement energy efficient technologies. Beyond the initial phases, however, substantial new technology is seen to be needed to continue the drive toward efficiency in energy production and use to achieve the full set of benefits which are indicated by the scenario.

ERDA's Scenario V shows simultaneous commercialization of all new technologies. The scenario assumes continuation of historical demand trends modified to reflect recent price increases. ERDA points out that this scenario is idealistic and that it is highly unlikely that all new technologies can be developed with complete success. However, according to ERDA, based on the assumption that domestic production of oil and gas has peaked, and is declining, only the successful development and implementation of a large number of new technologies in a combination of approaches can make importing fuel a matter of choice.

In this report we concentrate only on those new technologies that have been proven technically feasible and are estimated to be capable of making a significant supply contribution by 2000, not the broad range of new technologies covered by the ERDA study, such as solar photovoltaic. All of the technologies covered in this report could be simultaneously commercialized if the country is willing to pay the price.

The table on page 8 shows for both ERDA scenarios the mix of energy sources and conservation actions to meet demand for 1985 and 2000. The charts are calibrated in terms of quadrillion British thermal units (Btu) $\frac{1}{}$ or quads. One quad equals a thousand trillion (10¹⁵) or 180 million barrels of oil equivalent.

The table serves to illustrate the range of choices available for the United States energy future depending on the extent to which conservation actions or various new supply technologies are emphasized. There are of course many more possible scenarios for the United States energy future presented in a variety of studies all of which illustrate the range of the choices facing our Nation.

In the case of the two ERDA scenarios, the largest differences by the year 2000 are in (1) the amount of energy saved by conservation actions (43 quads in Scenario I versus 28.4 quads in Scenario V); (2) the amount of oil imports required (20.6 quads in Scenario I versus 4.1 quads of exports in Scenario V); and (3) the amount of supply from emerging technologies (19.6 quads in Scenario I versus 48.6 quads in Scenario V). The differences in the two

1/ The amount of heat required to raise the temperature of 1 pound of water 1 degree Fahrenheit.

COMPARISON OF ERDA'S SCENARIO I (EMPHASIS
ON CONSERVATION) AND SCENARIO V
(EMPHASIS ON NEW ENERGY TECHNOLOGIES)
FOR 1985 AND 2000

	1985		2000	
	<u>Scenario I</u>	<u>Scenario V</u>	<u>Scenario I</u>	<u>Scenario V</u>
	(In Quads)		(In Quads)	
Existing Sources:				
Domestic oil	21.1	21.1	12.5	12.5
Natural gas	26.5	26.5	22.8	22.8
Coal a/	18.5	16.7	22.9	25.1
Nuclear	10.9	13.2	20.4	24.4
Hydroelectric	3.4	3.4	3.6	3.6
Imported oil	<u>10.5</u>	<u>7.8</u>	<u>20.6</u>	b/ <u>.0</u>
Subtotal	90.9	88.7	102.8	88.4
Emerging Sources:				
Tertiary oil	3.0	3.0	7.2	7.2
Geothermal	.9	1.6	2.4	6.6
Solar	.2	.3	3.5	4.8
Biomass	2.0	2.0	6.5	8.0
Oil Shale	.0	1.0	.0	8.0
Liquids from coal	.0	.5	.0	10.5
Gas from coal	<u>.0</u>	<u>.9</u>	<u>.0</u>	<u>3.5</u>
Subtotal	<u>6.1</u>	<u>9.3</u>	<u>19.6</u>	<u>48.6</u>
TOTAL - Energy resources	97.0	98.0	122.4	137.0
Impact of energy conservation	<u>10.3</u>	<u>9.2</u>	<u>43.0</u>	<u>28.4</u>
	<u>107.3</u>	c/ <u>107.2</u>	<u>165.4</u>	<u>165.4</u>

a/ Excludes synthetic fuels from coal.

b/ No imported oil, furthermore 4.1 quads of exports are assumed.

c/ Difference due to rounding.

scenarios indicates to us that while the roles of conservation and emerging supply technologies are uncertain, both have vast potential depending upon the priorities assigned to them.

Also obvious from the scenarios is that extra emphasis on either conservation or energy supply technologies can likewise reduce the need to emphasize the other. Moreover, because emerging energy supply and conservation technologies are potential sources to balance our energy needs, they will involve consideration not only of the aggregate role of each source but also of the individual technologies which make up the aggregate source. Hence, less emphasis on emerging supply technologies could provide more flexibility of choice between, for example, synthetic fuels and solar and biomass. On the other hand, less emphasis on conservation could provide more flexibility, for example, between efficiency measures and so-called "belt tightening" measures.

Energy conservation

Many conservation technologies can provide potentially cost effective alternatives to developing new energy supplies --i.e., in many instances it can cost less to save a barrel of oil through, for example, constructing more energy efficient buildings than it will to supply a new barrel.

ERDA's Scenario I which emphasizes simultaneous commercialization of all new technologies shows conservation contributing 9.2 and 28.4 quads by 1985 and 2000, respectively. In contrast, Scenario V, which emphasizes energy conservation actions, shows conservation contributing 10.3 quads and 43 quads in 1985 and 2000, respectively.

Other studies assume considerably higher estimates of the potential savings from energy conservation actions. For example, the Ford Foundation in its Technical Fix Scenario estimated that using energy saving technologies presently known and economically justified at existing prices, conservation actions could contribute about 24 quads and 64 quads in 1985 and 2000, respectively. That scenario is the "middle case" scenario for that project. Their more optimistic "Zero Energy Growth" Scenario is not used in this report for analytical purposes.

Oil and natural gas production

Oil production peaked in 1970 at 9.6 million barrels per day and has been declining ever since to the current level of 8.2 million barrels per day. Production of natural gas has fallen from a peak of 22.6 trillion cubic feet (TCF) in 1973 to 20.1 TCF in 1975. The only expected major increases in

the near future are from the Prudhoe Bay field on the North Slope of Alaska and the Outer Continental Shelf.

Before the embargo, new oil exploration and development was curtailed because of availability of less expensive imported oil. The advent of higher crude oil prices has stimulated greater exploration activities, however, U.S. production continues to decline. The Trans-Alaskan pipeline, when it is completed, will initially deliver about 1.2 million barrels per day ^{1/}, an increase which at most could lift domestic supplies to levels reached in the early 1970s.

Under both Scenarios I and V, ERDA-48 shows domestic oil production (including tertiary oil production) to be 24.1 quads in 1985 and 19.7 quads in 2000. For 1985 this represents an increase of 14 percent over 1974 production and for 2000 a decrease in production from 1974 of 6 percent. These figures include production from the Outer Continental Shelf and Alaska.

ERDA's Scenarios I and V show natural gas production to reach 26.5 quads in 1985 and to decline to 22.8 quads by 2000. However, a January 14, 1976, GAO report entitled "Implications of Deregulating the Price of Natural Gas" (OSP-76-11) pointed out that even with price deregulation, production of natural gas can be expected to decline to 16.8 quads in 1985 primarily because of the inability to sustain the new field discovery rate experienced in the past.

Expanding the use of coal

Coal is the country's most abundant energy resource. The U.S. coal resources are estimated to be about 4 trillion tons. However, over the last 75 years, the use of coal has declined from supplying over 90 percent of the Nation's energy needs to about 17 percent.

The regulated price of natural gas, cheap import prices before the embargo, and continued development of nuclear power have limited the growth of coal use. Additionally, growth in coal production and consumption has been affected by State and Federal laws governing mining health and safety, strip mining, and land reclamation, and air quality.

The Arab embargo and the dramatic increase in the price of oil have stimulated interest in direct burn of coal as a primary energy source.

^{1/} FEA's latest estimate.

Most studies indicate that coal production must rise substantially. The question is by how much? Under its Scenario V which emphasizes commercialization of new technologies ERDA shows coal consumption (including coal for synthetics and exports) to be 18.1 quads or 18 percent of 1985 resource consumption and 39.1 quads or 28 percent of resource consumption in the year 2000.

Under its Scenario I, which emphasizes conservation actions, coal use in 1985 and 2000 is estimated to be 18.5 quads and 22.9 quads, respectively. No coal is used for synthetics under this scenario.

Expanding the use of nuclear power

The use of nuclear power has grown in recent years, but it still only supplies about 2 percent of total energy demand. Nuclear plays a significant role in both the ERDA scenarios.

In Scenario I it provides 10.9 quads and 20.4 quads in 1985 and 2000, respectively. In Scenario V which emphasizes technological development it supplies 13.2 quads or 14 percent of 1985 resource consumption and 24.4 quads or 18 percent of resource consumption in the year 2000. Other studies have included lower predictions for nuclear power. These predictions reflect certain problems that have yet to be overcome including economic considerations, availability of uranium, efforts to develop new nuclear reactor technologies, and certain safety and safeguard problems.

Development of new energy supply technologies

Some energy technologies appear to be technically feasible and are at the point where they could be demonstrated: tertiary oil recovery, solar hot water heating, solar space heating, biomass conversion, synthetic gas from coal, synthetic liquid from coal and/or shale, and geothermal power. Many of these technologies are not being commercialized because the technology is simply too expensive, resulting in the price of energy produced from projects using these technologies to be greater than competing prices from traditional energy sources, like foreign oil. Others, like certain solar technologies, appear to be cost effective on a life cycle basis but are not being widely commercialized because of higher initial costs and perhaps, because of lack of information on the part of the consumer.

ERDA in its most optimistic scenario for new technologies shows new energy sources providing 7 percent of resources consumed in 1985 and 34 percent of resource consumption in the year 2000.

CHAPTER 3ENERGY CONSERVATION

Energy conservation means using less energy and using it more efficiently. There has been increasing recognition of the major role conservation can play in slowing or even reversing the growth of the gap between energy demand and our domestic energy supplies. The overall potential is prodigious. A recent report by two physicists estimated that available and feasible changes could have reduced 1973 energy consumption in the United States by a full 43 percent 1/. Another report, by the Office of the Chief Engineer of the Federal Power Commission, indicated that a number of common energy-consuming systems use only 2 to 8 percent of the total energy available from the fuels they consume 2/.

ERDA's plan recognizes energy conservation as its highest priority and cited the following characteristics:

- "A barrel of oil saved can result in reduced imports."
- "It typically costs less to save a barrel of oil than to produce one through the development of new technology."
- "Energy conservation generally has a more beneficial effect on the environment than does energy produced and used."
- "Capital requirements to increase energy use efficiency are generally lower than capital needs to produce an equivalent amount of energy from new sources since most new supply technologies are highly capital intensive."
- "Conservation technologies can generally be implemented at a faster rate and with less government involvement in the near term than can supply technologies."
- "Energy efficiency actions can reduce the pressure for accelerated introduction of new supply technologies."

1/ "Assessing the Potential for Fuel Conservation," Marc H. Ross and Robert H. Williams, The Institute for Public Policy Alternatives, State University of New York, July 1, 1975.

2/ "Staff Report - A Technical Basis for Energy Conservation," Office of the Chief Engineer, Federal Power Commission, April 1974.

-- "Since the actions persist over time, the benefits are continuing."

Beside the continuing effects of conservation, measures taken need not be repeated to continue saving energy. For example, as a rule of thumb, one barrel saved in consumption saves an additional barrel used for conversion and delivery of energy.

The physical potential for energy conservation has been estimated in a number of studies. However, the questions of how much of the potential can be realized, in what time frame, at what cost, and with what approaches, requires much more examination. One study planned by a Federal agency to perform such an in-depth assessment was not completed, while another study to assess the capital costs of energy conservation actions, was not funded.

The following section of this chapter presents a review of the conservation programs included in the Energy Policy and Conservation Act, along with FEA's estimates of their potential impact. ^{1/} The analysis in the latter portions of this chapter is based, in large measure, on the Ford Foundation's Energy Policy Project (hereafter referred to as the Project) report entitled "A Time to Choose." Because the energy situation has been changing, some of the Project's work is dated. Even so, it provides useful estimates of the energy savings possible through conservation.

ENERGY SAVINGS FROM CURRENT POLICY

The Energy Policy and Conservation Act, Title III, requires mandatory fuel economy standards for new autos starting in 1978, provides for voluntary energy efficiency improvement goals for consumer products, includes a voluntary industrial conservation program, continues the Federal conservation program, and supports voluntary state energy conservation programs. By 1985, these efforts will reduce energy requirements about 7 quads per year which represents only a small portion of the potential for conservation. Conservation potentials cited for these activities are FEA estimates.

^{1/} On August 11, 1976, the President signed legislation extending FEA's life (Public Law 94-163) which included a number of new conservation programs. While many of the programs address conservation opportunities discussed in this chapter, we have not had time to fully analyze their potential impact. Page 51 in our summary chapter contains a brief discussion of these conservation programs.

FEA estimates that the auto fuel economy standards will lead to savings of 2.1 quads a year by 1985. Based on the historical automobile replacement rate, we estimate that the entire auto fleet will reach the maximum efficiency requirement of 27.5 miles per gallon by the mid-1990s. This would result in a further saving of 24.5 percent in automobile fuel use or an additional 1.5 quads a year.

Should consumer products meet the efficiency goals scheduled for 1980, 1.6 quads a year will be saved by 1985. Because this goal is scheduled for 1980, a large proportion of the savings will be realized by 1985, so this saving will not grow as much as the auto saving will in the years beyond 1985. FEA estimates that the State energy conservation programs under the Energy Policy and Conservation Act will result in savings of 1.8 quads a year by 1985. The Federal program is expected to slowly expand on savings previously achieved under the presidentially mandated Federal Energy Management Program. FEA estimated that the savings attributable to this program were 0.6 quads in 1975 and will remain in this range through 1985.

Smaller amounts of energy savings are anticipated from the voluntary industrial energy conservation program. The industrial program, aimed at the ten most energy-intensive industries, is expected to save 0.9 quads in 1980, but only 0.6 quads in 1985. This decline is anticipated because the program is only expected to accelerate actions which companies would have carried out on their own by 1980 because of price increases.

FURTHER POTENTIAL FOR ENERGY CONSERVATION

The major thrust of the programs adopted in the Energy Policy and Conservation Act have aimed at a limited number of fairly significant energy use activities, such as automobiles and home appliances. Additional measures focusing on other energy uses can yield substantial savings beyond those anticipated for the programs now in effect.

Changes in energy use which could result in energy savings can be classed roughly into three types. The first class involves changes in practices which can be implemented immediately (turning down thermostats) or within a few months or years. These changes, such as the mandatory 55 mile per hour speed limit, will usually not have large dollar costs, but the changes of convenience or habits can be important. The second class of changes can be called "retrofitting." Retrofitting involves changes or additions to existing energy

using equipment, such as adding insulation to buildings, or adding an automatic control system for a factory process. Individual retrofitting actions can be carried out relatively quickly, but it will take a number of years, for example, for insulation retrofitting to be completed in the tens of millions of American houses in which it is cost-effective: such a program could begin to yield energy savings very quickly, with little lag period, but the full savings would not be achieved until the program was completed.

Retrofitting changes will involve dollar costs, which can range from being very cost effective to being prohibitively expensive, and thus their extent of accomplishment will be affected greatly by economic factors. For example, expensive storm windows may be cost effective in New England but probably not in most Southern states.

The third class of energy-use changes involves replacing existing equipment, facilities, and processes. These will be the slowest to reach their full potential for energy savings, because many of these changes may be delayed until existing equipment has served its useful lifetime. This lifetime ranges from over a decade for cars to half a century or more for homes and commercial buildings. Increasing energy costs may speed up the retirement of some extremely energy-intensive equipment or structures.

In light of those differences of timing, it will be important to focus on changes of practices and retrofitting to achieve early energy savings from conservation policies, and also to consider ways in which the retirement of inefficient energy-using equipment and structures can be accelerated.

For our estimates of the potential for additional energy savings, we have relied on the Ford Foundation's Energy Policy Project. The project considered several scenarios, one called "Historical Growth" which projects the trend of energy use if energy supplies are emphasized, one called "Technical Fix" which incorporates a number of supply and conservation actions, which the Foundation saw to be both energy and economically efficient, and another named "Zero Energy Growth" which emphasizes energy conservation and even greater efficiency. The conservation estimates we use are based on the "Technical Fix" results and the consumption estimates are based on the "Historical Growth" projection. Though energy consumption is not expected to grow as fast as the 3.4 percent growth rate of the Historical Growth scenario (most projections today are in the 2.5 to 3 percent growth range), the higher consumption estimates still can be used to illustrate the potential impact for conservation actions.

Finally, it should be noted that neither the Ford Project's study nor other studies mention every possible opportunity. In the following discussion, we consider only some of the more important actions which could be taken by the residential, commercial, transportation, and industrial sectors and the utility industry to conserve energy.

The residential sector

The residential sector consumed about 22 percent or 15.3 quads of energy during 1975. Without additional Federal actions, consumption would grow to about 22.9 quads by 1985 and 30.1 quads by 2000. About 21 percent of this energy can be saved each year by 1985 and, by 2000, almost 36 percent. The following table shows the major areas where the savings can be achieved.

<u>Savings area</u>	Potential savings in quads (
	<u>1985</u>	<u>2000</u>
Space heating	2.7	7.0
Air conditioning	.8	1.3
Water heating	.6	1.5
Other	<u>.6</u>	<u>1.0</u>
Total	<u>4.7</u>	<u>10.8</u>

The largest opportunity for saving energy in the residential sector is in space heating and water heating. Weatherproofing both existing buildings and new housing with ceiling and wall insulation, storm windows, weatherstripping, and constructing thermally "tighter" homes are important conservation steps. Using heat pumps in homes with central air conditioning rather than electric resistance heating is another important measure. Other conservation actions in this area include use of more efficient fossil fuel furnaces, and electric igniters rather than pilot lights.

Beside these measures, consumers themselves can reduce consumption by lowering thermostat settings and not heating or cooling unoccupied rooms. A study done for the Environmental Protection Agency (EPA) estimated that a practical thermostat control program could achieve as large a saving in 1985 as an insulation program could. Public education would improve awareness of these opportunities.

The commercial sector

The commercial sector used about 14 percent or 9.8 quads of energy during 1975. By 1985, consumption is expected to grow to 15.1 quads and 21.3 quads by 2000 without additional Federal actions. About 9 percent of this energy can be saved each year by 1985 and, by 2000, about 21 percent. The following table shows the major conservation areas.

<u>Savings area</u>	<u>Potential savings in quads</u>	
	<u>1985</u>	<u>2000</u>
Space heating and total and energy systems <u>a/</u>	0.7	3.2
Air conditioning	0.3	0.5
Other	<u>0.3</u>	<u>0.7</u>
Total	<u>1.3</u>	<u>4.4</u>

a/ Figure based on space heating at 1.3 quads plus total energy systems at a decrease of 0.6 quads.

Many of the savings opportunities for the residential sector apply in this sector as well. For instance, better insulation could save 0.7 quads in 1985. Other opportunities include using heat pumps instead of electric resistance heating and using total energy systems, which would combine electricity generation with waste heat recovery for use in space heating and cooling, say for use in a large building or a shopping mall. Though total energy systems could only make a minor contribution during the next 10 years, they could over the long-run, be almost as important an energy saver as the improved insulation of commercial buildings.

Additional conservation opportunities pertaining more to user practices than installed technology are available in the commercial sector. Examples include reduced lighting levels and reduced ventilation rates. These changes could be implemented quickly, according to an EPA study, and could save as much as 1.6 quads by 1985, but would require changes in building codes.

The transportation sector

The transportation sector of the economy accounted for 26 percent--or 18.6 quads--of the Nation's energy use in 1975.

Without Federal actions, it is expected to grow to 26.0 quads in 1985 and 38.4 quads by 2000. Automobiles consume about 57 percent of the transportation energy and offer the largest potential for saving energy. This was recognized by the setting of fuel economy standards in the Energy Policy and Conservation Act discussed earlier. Additional transportation savings can be obtained from the following areas.

<u>Savings area</u>	<u>Potential savings in quads</u>	
	<u>1985</u>	<u>2000</u>
Air transportation	1.1	3.4
Trucks	<u>0.3</u>	<u>2.1</u>
Total	<u>1.4</u>	<u>5.5</u>

For air transportation, the conservation opportunities include increasing passenger and freight load factors, slightly reducing flight speeds and reducing the number of short distance flights. Fuel use by trucks can be reduced by shifting from gasoline to diesel engines and increasing the use of trains for intercity freight.

Additional opportunities, such as increased carpooling, vanpooling, and shifts from autos to buses in urban areas will reduce fuel use. Regarding carpooling, a study done for EPA estimated that an increase of average vehicle occupancy of 0.4 persons in commuting trips could be attained and result in energy savings of 1.0 quads a year by 1985.

The industrial sector

Industry is the largest of the Nation's energy consuming sectors accounting for about 38 percent of U.S. energy use, or 27.3 quads in 1975. Without Federal actions, this is expected to grow to 52.1 quads in 1985 and 96.9 quads by 2000. The voluntary industry efficiency program of the Energy Policy and Conservation Act will obtain only a small portion of the potential for industrial conservation.

Overall savings opportunities in the industrial sector constitute about 12.1 quads of the energy projected to be used by industry in 1985. This is more than double the savings potential of the residential sector and about 80 percent of total energy use by the commercial sector. By 2000, about 36 percent of projected industry energy consumption could be saved.

By 1985, roughly 30 percent of all industrial energy use will occur in five industries--paper, aluminum, steel, plastic, and cement. Major savings are possible through the use of more efficient production processes in these five industries. The steel industry has the largest potential but by 2000 the introduction of new processes could make the percentage savings in paper and plastic comparable. Today some Swedish and German industries are using 20 to 43 percent less energy per ton of output than U.S. industry requires. Major conservation opportunities for industry are identified below.

<u>Savings area</u>	<u>Potential savings in quads</u>	
	<u>1985</u>	<u>2000</u>
Five energy intensive industries	4.0	11.6
Miscellaneous cogeneration of steam and electricity	0.4	2.9
Miscellaneous direct heat	2.9	5.4
Other	<u>4.8</u>	<u>13.9</u>
Total	<u>12.1</u>	<u>33.8</u>

Energy savings pertaining to industry across the board are available for direct heat applications by using heat recuperators and regenerators and if fossil fuels were used instead of electric resistance heating. Another possibility is cogeneration, which is the simultaneous production of steam and electricity. However, cogeneration has a long implementation time associated with it, and is not expected to make its major contribution until after 1985. Yet it is a proven technology--almost 30 percent of electricity generated in West Germany is produced in industrial plants.

Electric utilities

In addition to the four end-use categories, the electric utility industry plays an important role in the energy economy. In 1975, utilities consumed over 28 percent of all U.S. primary energy resources for generating the electricity consumed in other sectors. (Consumption statistics for the sectors previously discussed include the appropriate electricity they consume.)

Because electricity was an inexpensive and flexible source of energy, its use has been promoted for many years. Utility rate structures were designed this way--rewarding power users with lower priced electricity as their consumption grew. Changing utility rate structures to end these promotional features and substituting conservation oriented rate structures will discourage wasteful electricity use, encourage industrial and onsite power generation, and reduce peak load demands.

The major aspect of conservation oriented utility rate structures is called load management. Utilities generally meet base-load and intermediate demands with nuclear and coal-fired plants, and meet short-term (several hours per day) peak demands with oil or gas fired turbines which have substantially lower capital costs but which have much higher energy costs. Pricing structures which increase electricity costs when demands are greatest can reduce the range of daily fluctuations in electricity demand. This will allow utilities to generate a greater share of their output with the more energy-efficient nuclear and coal-fired plants and, thus, save some of the energy wasted due to the inefficiency of peaking turbines. Consideration is also being given to special measures to protect low income persons such as "life line pricing" which would provide a minimum amount of electricity at low rates.

Besides such rate structure revisions, improvements can be made by increasing generating and transmission efficiency, and sharing demands through system interconnections.

Cost effectiveness of conservation

Many of the conservation strategies discussed above are cost effective today. For example, FEA has found that in a climate like Indianapolis, Indiana, a typical homeowner could install ceiling insulation at a cost that would be equivalent to purchasing oil at \$5.90 a barrel, or 14 cents per gallon of heating oil. Additional retrofitting might be wall insulation and storm windows, at 28.5 cents and 30.5 cents per gallon of oil equivalent. These savings can be compared to heating oil which is now priced at over 40 cents per gallon and rising with the cost of petroleum.

A study by the National Bureau of Standards found a number of industrial conservation actions to be cost effective. Some of these examples are shown below.

<u>Action</u>	<u>Estimated cost</u>	<u>Estimated annual savings</u>
Schedule use of 12 30KW furnaces to minimize peak demand	None	\$3,600
Insulate 420 feet of steam line	Minimal	\$1,720
Installing steam traps on phonograph record molding presses	Minimal	\$105,000
Recover boiler flue gas heat for space heating and feed-water preheating	a/ \$9,040	\$5,360
Improved Combustion Control for Dual Feed Systems	\$29,000	\$40,090

a/ Incremental cost for recovery system.

There are other energy conserving actions which have been proposed that appear to be cost effective because they entail no capital expenditure. Changes in user practices such as turning down thermostats cost nothing and offer immediate savings.

Modifying transportation practices such as increasing airline load factors, reducing the number of short distance air trips, and increasing carpooling and railroad use are all cost effective changes. Changes such as these reduce the passenger or freight costs per mile traveled.

These examples show some conservation actions which are cost effective, however, many more not mentioned here may also be cost effective. Often, specific circumstances will dictate whether an action is economical, and a determination can only case-by-case analysis.

IMPEDIMENTS TO IMPLEMENTATION OF ENERGY CONSERVATION

Although many potential energy conservation actions are now cost effective, there are a number of impediments to accomplishing these actions. These include (1) a need for more accurate and complete information on conservation costs and benefits, (2) a lack of incentive for many users to improve their energy efficiency, (3) preoccupation with

initial costs rather than life-time costs, (4) several Government regulations, and (5) the slow rate at which existing technology is replaced.

Besides the lack of information, access to capital, especially for small borrowers, also may be lacking. Another problem is the lack of incentive, especially in the case of builders, owners, and renters in the residential and commercial sectors who may not pay utilities directly or who may not plan on occupying the building long enough to justify retrofitting it themselves.

An obstacle to more efficient new homes and manufactured goods is the concern of manufacturers and builders regarding the impact that the selling price of their products will have on sales. The problem is that initial cost can determine salability of a product, even though the total life cycle cost of buying and operating an energy efficient house, car, appliance, or other product would be lower.

Industry, as well as consumers overemphasize first cost, or avoid conservation investments for other reasons. Tentative indications in one of our reports now in preparation are that, in parts of the industrial sector, energy-conserving investments are only being made if they offer extremely fast paybacks (1 to 3 years).

Several Federal regulations promote inefficiency. For example, Interstate Commerce Commission regulation of the trucking industry results in inefficient routing and empty backhauls, and Civil Aeronautics Board rules may adversely affect airline load factors. These regulations were written with service and industry competition in mind, but may need to be overhauled to take into consideration the efficient use of energy. Electricity and steam cogeneration by industry is impeded by laws which discourage the sale of electricity by industry.

A final impediment is the slow rate at which equipment and facilities throughout the economy are replaced; for example, there are steel plants in operation today that were built in the first quarter of this century. Often the potential energy savings from a new process or efficient industrial equipment are insufficient to justify replacing the existing ones while retrofit may also be unjustified.

Despite the potential for conservation and recent recognition, Federal funding is only a small portion of total energy expenditures. Excluding the state energy conservation programs, about 8 percent of FEA's fiscal year 1977 budget is devoted to conservation. About 4 percent of ERDA's fiscal

year 1977 budget is devoted to conservation research and development activities. In addition, ERDA's combustion, fuel cell, and magnetohydrodynamics research may begin to contribute to energy efficiency between 1985 and 2000.

Although better data on costs and potential impacts needs to be developed, energy conservation should play a major role in Federal energy activities. Enough is known to place priority on particular conservation actions in each sector. Federal activities which would emphasize the major opportunities, provide public information services and, in some cases, financial incentives to stimulate activity.

CHAPTER 4EMERGING ENERGYSUPPLY TECHNOLOGIES

In addition to improving existing technologies and encouraging and developing energy conservation techniques, energy research and development also involves new energy technologies. This chapter focuses on these new technologies designed to increase the Nation's energy supply, their potential, and the factors constraining their widespread use. Included are those technologies that have been proven technically feasible and are estimated to be capable of making an important supply contribution by 2000.

Although there exists a wide range of projections of the potential of new energy supply technologies, ERDA's most optimistic scenario in their National Plan 1/ shows that no individual new technology which we examined in this report is expected to provide more than 10.5 quads or 8 percent of total domestic supply required by 2000. 2/ Within this perspective, synthetic liquid fuel from coal is expected to produce the largest impact in 2000 (10.5 quads), followed--in descending order--by oil from shale (8 quads), energy from biomass (waste material only--mostly municipal waste) (6.5 quads), electric energy from geothermal (mostly hydrothermal) resources (5.6 quads), oil recovered using tertiary techniques (7.2 quads), solar water and space heating energy (3.5 quads), and synthetic gas from coal (3.5 quads). The combined potential impact from synthetic fuels shown in ERDA's National Plan is higher than the other emerging energy supply technologies. However, synthetic fuels technologies appear to us to be the only ones which could need all three levels of financial assistance --front end money, construction assistance, and product price supports. Essentially, this is because synthetic fuels technologies appear at this time unable to compete economically with conventional energy sources.

1/ Throughout this chapter, we use Scenario V of ERDA's National Plan.

2/ ERDA is in the process of reevaluating and adjusting downward its projections for synthetic fuels.

TECHNOLOGIES WHICH APPEAR
TO BE ECONOMICALLY COMPARABLE
TO CONVENTIONAL ENERGY SOURCES

Along with their potential impact, any ranking of the relative attractiveness of new energy supply technologies should also consider their economic feasibility in comparison to traditional energy sources. The cost of solar space heating, solar hot water heating, energy from municipal waste, tertiary oil recovery, and geothermal energy (hydrothermal) appear favorable in certain applications and locations.

Energy from municipal waste systems

The combustion methods of recovering energy from municipal waste which now appear to be commercially viable are (1) water-wall incinerators which burn municipal waste directly and (2) powerplant boilers which burn municipal waste mixed with a fossil fuel in industrial or utility powerplants.

Estimates in ERDA's National Plan indicate that by 1985 2 quads per year of municipal waste materials could be converted to usable energy. The plan also shows that, by 2000, 6.5 quads per year could be converted.

An EPA official stated that some municipal waste conversion processes appear economically attractive in locations where the alternative cost of waste disposal is over \$6 per ton. He further stated that the actual cost of waste disposal ranges between \$2 and \$25 a ton, however, most cost over \$6 per ton.

EPA has a program which provides planning assistance to municipalities for demonstrating the use of municipal wastes as a fuel. ERDA also has a biomass program, however, its program is directed toward developing biomass technologies other than municipal waste combustion.

At least five municipal waste systems are currently operating. Twenty-eight additional plants are planned or under construction and approximately 37 other communities have expressed interest in building plants.

Obstacles to implementing
municipal waste systems

Although the municipal waste combustion technologies appear commercially viable and should not be impeded by

technical problems, fuel resources and plant planning may affect the growth of this industry. A concern among municipalities is access to a reliable source of sufficient waste material to fuel a plant. ERDA has also cited inadequate information and planning as obstacles to implementation. Lack of information slows planning, system selection, procurement, and project financing. The failure of municipalities to recognize the importance of the planning process, hire appropriate experts to guide them, and carry out the planning properly has, in the past, slowed system implementation.

Tertiary oil recovery techniques

Primary recovery of oil is that produced by drilling and natural forces, such as gas in solution, subsurface pressures, and natural water drives.

The two terms secondary recovery and tertiary recovery are often used synonymously with enhanced recovery. Technically, secondary recovery means a "second crop" of oil after the "first crop" from primary production and tertiary means a "third crop".

For simplicity, we will define secondary recovery to include the already economically and technically proven techniques of pressure maintenance, traditional waterflooding, and cyclic steam injection. Tertiary oil recovery--the subject of this section--will be defined to include the newer, less widely used techniques.

Nearly 106 billion barrels of oil (about 590 quads) --about 24 percent of total identified domestic reserves --have been recovered using largely primary and secondary recovery techniques. Another 34 billion barrels (about 190 quads)--about 8 percent--remain recoverable using primary and secondary techniques. ^{1/}

Tertiary oil recovery techniques may be used after primary and secondary methods no longer yield economic quantities of oil. According to an ERDA official, 20 to 60 billion barrels (about 110 to 330 quads) may be recoverable using tertiary recovery techniques. Others estimate range from less than 20 to over 100 billion barrels.

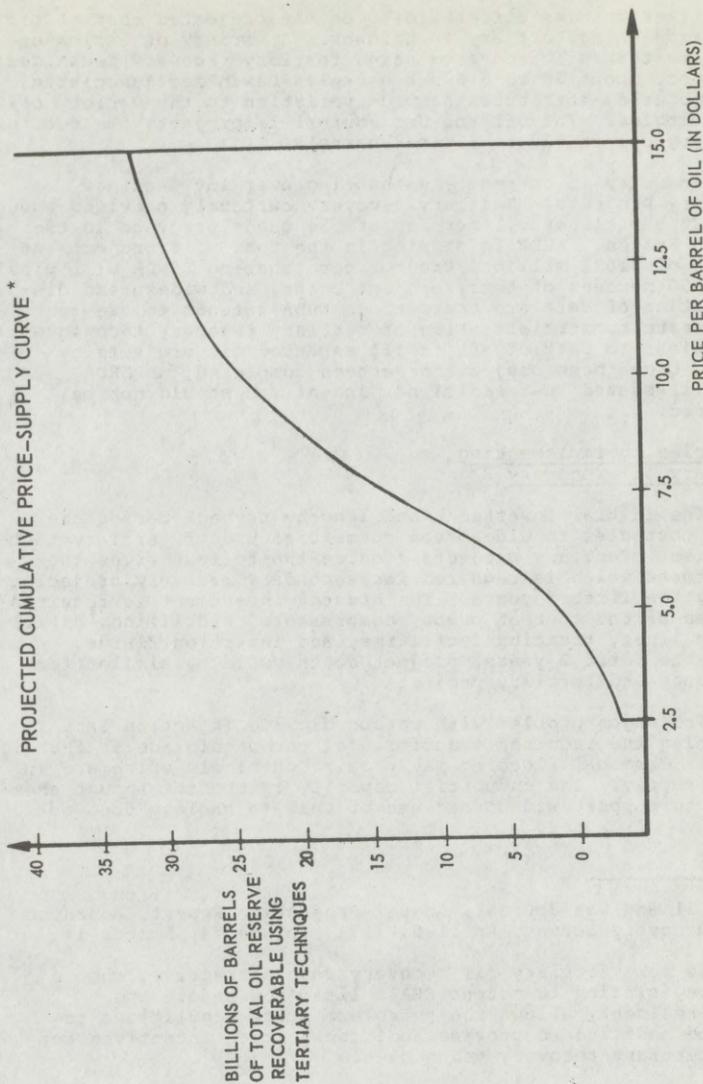
^{1/} "Analysis of the Potential and Economics of Enhanced Oil Recovery," Preliminary Report, October 31, 1975, Lewin and Associates, Inc.

Among the three tertiary recovery techniques that have the widest application, ERDA considers chemical flooding to be the most promising. Chemicals are injected into the oil reservoir to free or displace petroleum from the rock formations. Chemical flooding is expected to provide about 50 to 60 percent of total oil recovered using tertiary recovery techniques.

Another method, thermal enhanced recovery, involves injecting an oil reservoir with steam or hot water or using in situ combustion to release petroleum which is trapped in rock formation. Carbon dioxide can be injected into oil reservoirs, reducing the oil viscosity and stripping it from the rock formations. Gas or water is then pumped into the reservoir to drive the combined carbon dioxide and oil through the formation to a recovery well. Gulf Universities Research Consortium estimates that thermal recovery techniques will account for about 30 percent and carbon dioxide injection less than 10 percent of all oil recovered by tertiary techniques.

ERDA's National Plan projections show that tertiary recovery technique may provide an additional 1,500,000 barrels of oil per day (3.0 quads per year) by 1985 and 3.6 million barrels of oil per day (7.2 quads per year) by 2000.

A Lewin and Associates, Incorporated, study conducted for FEA included an analysis of the potential for tertiary recovery in California, Texas, and Louisiana--which account for 64 percent of total domestic reserves (lower 48 States only)--indicated, as can be seen in the following chart, that recovery of some tertiary oil is now economically attractive, but that the majority of tertiary oil will not be recovered at current prices.



* ADOPTED FROM "THE POTENTIAL AND ECONOMICS OF ENHANCED OIL RECOVERY
 — PRELIMINARY REPORT #3," MARCH 19, 1976, BY LEWIN AND ASSOCIATES, INC. WASHINGTON, D.C.

Other studies differ widely on the projected cost of oil recovered using tertiary techniques. A variety of estimates indicate that oil recovered using tertiary recovery techniques will cost about \$8 to \$18 per barrel. Lewin and Associates, Incorporated, attribute the wide variation to the variety of technologies. The Oil and Gas Journal 1/ projects the cost of tertiary oil at \$20 to \$25 per barrel.

Industry is currently sponsoring over 150 tertiary recovery projects. Tertiary recovery currently provides about 270,000 barrels of oil per day or .54 quads per year in the United States. ERDA is sharing in the cost of 8 projects at a cost of \$16.2 million. Project cost sharing (ERDA will provide up to 50 percent of total project costs) and widespread dissemination of data are the methods ERDA intends to use to accelerate commercialization of tertiary recovery techniques. ERDA plans to participate in 111 enhanced oil projects by 1980. Once these projects have been completed, an ERDA official stated that additional incentives should not be required.

Obstacles to implementing
tertiary oil recovery 2/

The initial investment and lengthy payback period are major obstacles to widespread commercial use of tertiary technologies. Tertiary projects require two to four times the investment which is required for secondary recovery projects during the first 2 years. The greater investment is required because of the cost of pumps, compressors, redrilling, distribution lines, treating facilities, and injection fluids. After the first 2 years, project costs would be similar for secondary and tertiary projects.

The major problem with carbon dioxide injection is obtaining the required quantities of carbon dioxide at the oil field. Chemical flooding may require chemicals which are in short supply. The industrial capacity to produce enough chemicals to support widespread use of this technology does not

1/ Oil and Gas Journal, Annual Production Report, Enhanced Recovery Survey, April 5, 1976, Volume 74, Number 14.

2/ To make tertiary oil recovery more attractive, the legislation to extend FEA's life, now before the President, allows the petroleum price regulations to be modified to provide additional price incentives for tertiary recovery techniques.

now exist. In addition, the amount or combination of chemicals required may have to be altered to suit each oil field. Chemically saturated water retrieved from wells present a disposal problem. Except for this chemical disposal problem, environment problems are principally the same as those associated with primary recovery.

Solar energy

Numerous systems have been devised to convert sunshine into usable energy. However, only direct thermal systems--solar hot water heating and solar space heating appear to have economic application today and only in some geographic areas. Direct thermal applications involve collecting solar energy for heating water and heating and cooling homes. Industry and agriculture can also use direct thermal technology as a source of low temperature heat. Currently, solar equipped buildings are custom designed and require an energy storage system or a conventionally fueled backup system. A typical system for solar heating consists of a collector exposed to the sun's rays, a heat transfer fluid (usually air or liquid) which carries the collected energy to the points of storage or use, a storage device, and equipment for distributing heat within the building as well as conventional backup equipment.

According to an ERDA official, solar water heating appears to be competitive with electricity in about 90 percent of the country, where electricity costs exceed 5 cents a kilowatt hour in the Northeast or 3 cents a kilowatt hour in other parts of the country, and assuming a 10-year payback. However, solar space heating would only be competitive in about 20 to 30 percent of the country, under these conditions.

The U.S. Department of Labor's data on the cost of electricity for March 1976 shows the cost of electricity in the Northeastern United States to average 4.41, 5.86, and 7.23 cents per kilowatt hour for 500, 250, and 100 kilowatt hours per month respectively. The rest of the country's metropolitan areas average cost was between 3.7 and 6.2 cents per kilowatt hour, depending on quantity consumed.

The Federal Government intends to demonstrate the practical use of this technology by 1977. Systems analysis and overall design of the demonstration program for Federal buildings are underway and proposals have been solicited for installing heating systems in new and existing buildings at selected locations. A variety of Federal incentives--including low interest loans to homeowners and builders, tax credits, and accelerated

amortization of solar energy equipment for commercial buildings--are being considered to remove barriers for widespread use and commercialization. 1/

Already, State Governments have begun to encourage the use of solar equipment. Ten states have passed legislation and two others have proposed legislation which reduces the taxes associated with solar energy systems. In these cases, all or a portion of the solar equipment was exempted from property taxes. Texas has exempted solar systems from sales tax. New Mexico and Arizona have reduced solar's first cost handicap by providing an income tax credit of 25 percent of the cost of the solar equipment (up to \$1,000).

Because solar energy systems offer opportunities to reduce life-cycle costs, five states have passed legislation requiring life-cycle cost analyses to be considered for new and remodeled state buildings. Demonstration of solar systems on state buildings are also authorized in four states. Acceptance by the building industry is being encouraged directly in Florida and Minnesota by adding solar provisions to their state building codes. For example, Florida's building code was amended to require home hot water systems which will accept solar heating devices.

Obstacles to implementing solar hot water and space heating

The solar energy industry is small but expanding rapidly; about 118 manufacturers now produce solar equipment. Most applications require conventional (oil, gas, or electric heating systems) backup systems, however, few integrated solar-conventional heating systems are available. Evaluations of system efficiency and durability, storage subsystems, backup system requirements, aesthetics and mass production costs are not complete.

Life-cycle costs of solar hot water and space heating are less than conventional systems in many areas of the country but high initial costs may be a major problem. A typical hot water unit may cost about \$1,000 to \$2,000, but units are also available costing up to and above \$16,000 for space heating. The homeowner who decides to equip his home with solar hot water or space heating must finance these costs

1/ As discussed in the summary chapter of this report, the FEA extension legislation recently signed by the President includes a number of incentives of this type (see page).

at installation time and builders must include solar costs in their selling prices. However, banks do not uniformly allow inclusion of the solar system costs in their mortgages. The institutional problems associated with heating involve, among other things, sun rights, acceptance by the building industry, zoning laws, and building codes.

Geothermal energy

Geothermal energy is the natural heat of the earth. Where heat is concentrated in areas of the earth's crust similar to oil reservoirs, it is accessible and has potential commercial uses. Geothermal reservoirs have been found primarily in the Western United States; more than half are on Federal land.

Only the hydrothermal technology--which includes dry steam and steam from mineralized water (wet steam)--has progressed to the commercial stage. Dry steam is now being used at an area known as the Geysers to generate power for northern California. This hydrothermal dry steam field, located about 85 miles north of San Francisco, is operated by the Pacific Gas and Electric Company and has an electrical generating capacity of 502 megawatts to help meet the power requirements of San Francisco. The Geysers' ultimate capacity is expected to reach 2,500 megawatts of electric power by the year 1985. The United States Geological Survey has not identified any other major dry-steam fields suitable for commercial production in the United States.

Another hydrothermal field exists in the Imperial Valley in Southern California. Private concerns plan to produce electricity from wet steam in this area in the near future. Hot geothermal fluids are also providing heat to more than 400 buildings in Klamath Falls, Oregon, and to about 200 homes in Boise, Idaho. ERDA's National Plan projections show that this form of energy will provide 1.4 quads per year by 1985 and will increase to about 5.6 quads per year by 2000. It should be noted that this impact is highly regionalized.

ERDA currently estimates that electricity produced from hydrothermal (wet steam) energy resources, when built, will be competitive with any new coal or oil fueled generating plant. ERDA has estimated that electricity generated from the wet steam fields in the Imperial Valley may cost 1.5 cents to 2 cents a kilowatt hour which would be more than 1 cent per kilowatt hour cheaper than current electric costs in any major metropolitan area of the country except Seattle.

Effective June 25, 1976, ERDA implemented a 75 percent loan guarantee program (\$30 million for fiscal year 1977 to cover possible defaults) designed to encourage, assist, and accelerate private development of geothermal energy by minimizing the lender's financial risks and to develop normal borrower-lender relationships which will eventually encourage the flow of credit without the need for Federal assistance. ERDA expects to be able to guarantee loans totaling approximately \$200 million (assuming 1 in 7 default ratio) with the fiscal year 1977 funds. As of August 12, 1976, ERDA had not received any loan guarantee applications.

ERDA anticipates that additional incentives may eventually be required to further accelerate and enhance the economic attractiveness of geothermal energy. ERDA is considering the impact created by tax incentives, direct project subsidies, cost sharing projects and financial support to local communities for planning grants. Tax incentive possibilities include depletion allowances and deductions for intangible drilling costs.

Obstacles to implementing geothermal energy

Today's only major commercial areas are the hydrothermal steam fields at the Geysers in California. For this area and other geothermal sources, there are uncertainties or a lack of information on exact location, magnitude and longevity of exploitable resources. Technical problems include demonstration of the technology on a commercial scale, corrosion and scaling. Concern has also been expressed over the resource lifetime and ability to sustain a given level of power generation. Hydrothermal, like all geothermal energy, use is highly regionalized; steam cannot be transported without high heat loss. Plants and associated facilities must be constructed onsite.

Effluents from hot water or vapor systems can pollute streams or ground waters, although objectionable fluids and gases could be reinjected into a deep reservoir. Noise, land use, visual impact, potential subsidence of the land surface due to fluid withdrawal, and potential seismic disturbances are other problems faced in geothermal energy development.

TECHNOLOGIES WHICH APPEAR UNABLE TO COMPETE ECONOMICALLY WITH CONVENTIONAL ENERGY SOURCES

The ERDA plan shows that of the total energy demand projected for 2000, synthetic gas from coal could supply about

3 percent, synthetic liquid from coal over 8 percent, and shale oil could contribute about 6 percent. ^{1/} However, at this point, synthetic fuel technologies are the least economical of all the new energy supply technologies.

Coal liquefaction

Coal liquefaction is the process of converting coal into a liquid fuel. There are several different methods; some processes burn coal, condense the resulting gases, and add hydrogen to form a liquid while other processes chemically dissolve coal with hydrogen to form a liquid.

Technology for converting coal to liquid fuels was developed in Germany over 60 years ago. Commercial operation, which started in Germany in the 1930s, expanded and accelerated with the onset of World War II. However, there appears to be only one commercial coal liquefaction plant in the world. This plant is owned and operated by a South African government-controlled corporation and produces about 5,000 barrels of fuel per day as well as other chemicals, petro-chemicals, and fertilizers.

ERDA's National Plan projects that the coal liquefaction processes will be capable of providing .48 quads per year by 1985 and 10.5 quads per year by 2000.

Oil shale

Two methods are being studied to recover shale oil from rock--surface retorting and in-situ retorting which is not far enough developed to be considered a near-term alternative. In the surface retorting process, oil shale is mined, crushed, and hauled to a surface retort, where it is heated and the oil recovered. Spent shale is dumped on the surface or partially returned to the mine.

Oil shale deposits are found in several areas of the United States. However, the only U.S. deposit having adequate size and availability using present technology is the Green River formation, located in Colorado, Wyoming, and Utah. These deposits are estimated to contain about 600 billion barrels of shale oil (over 3,000 quads). Much larger quantities are believed to be contained in poorly defined and generally lower grade oil shale deposits. The ERDA plan shows that the potential

^{1/} ERDA's now reevaluating these estimates and adjusting them downward.

impact of oil recovered from oil shale is 1 quad by 1985 and 8 quads by 2000. Currently, eight firms have announced plans for oil shale projects.

Coal gasification

In this process, coal is fed into a high-temperature vessel, called a gasifier, into which steam and either air or oxygen is injected. Chemical reactions occur and a mixture of gases is produced; usually carbon monoxide, hydrogen, and methane. Methane is the main constituent of natural gas. The gases are then cooled and undesirable components, such as carbon dioxide and sulfur, are removed.

The raw gas produced at this point is referred to as low British thermal unit (Btu) $\frac{1}{2}$ gas if produced with air, and medium Btu if produced with oxygen. This gas has a low or medium heat value (less than 450 Btu's a cubic foot) and cannot be economically transported over long distance by pipeline. It is valuable, however, as a fuel supply for electrical power generation plants or industrial processes using gas-fired furnaces which are located near the conversion plants. Low- and medium-Btu gas can be upgraded to a high-Btu gas --950 to 1,000 Btu's a cubic foot--through a reaction between hydrogen and carbon monoxide, referred to as methanation. High-Btu synthetic gas is a direct substitute for natural gas and can be transmitted in existing pipeline networks with natural gas.

Coal gasification processes were used in the United States in the late nineteenth century. During the 1920s and 1930s, approximately 12,000 coal gasification units were in operation in the United States. These units produced a low-Btu gaseous fuel generally known as producer, or town gas. With the advent of inexpensive natural gas during the next 2 decades, most of the units were either scrapped or mothballed. Today, low-Btu coal gasification processes are used rarely in the United States. In many foreign countries where domestic natural gas and oil is not as abundant as in the United States gasification processes have been able to survive. All of these (at least 50 plants) processes produce either low- and/or medium-Btu gas.

1/ The amount of energy necessary to raise the temperature of 1 pound of water by 1 degree Fahrenheit. A barrel of crude oil has an energy content of 5.6 million Btu's; a gallon of gasoline, 125,000 Btu's.

Projections in ERDA's National Plan show that by 1985, coal gasification will provide about .92 quads of energy. By 2000, the output is expected to increase to about 3.5 quads--only 2 percent of total projected demand.

At least 16 U.S. companies have announced plans to build high-Btu gasification plants in the United States. Three of these companies have applied to the Federal Power Commission (FPC) for approval of their projects.

ERDA feels that to develop a scale of synthetic fuel industry by the year 2000 which will hold oil imports at current levels, an informational 350,000 barrel-a-day program, must exist by 1985, which could be expanded later as results from the program indicated.

Obstacles to implementing synfuels

The major financial obstacles are the high cost of the output from synfuels plants--projected to be substantially higher than oil and natural gas, and the high capital costs--about \$1 billion for a commercial size (about 50,000 barrels of oil a day equivalent) synfuel facility. The Synfuels Interagency Task Force estimated the prices of synfuels which would be required to yield various rates of return (on discounted cash flows after taxes on entire capitalization).

At 15 percent rate of return, the estimated regulated price of high-Btu synthetic gas--\$2.61 to \$3.02 per thousand cubic feet ^{1/}--is about double the proposed FPC domestic price of new natural gas (\$1.42 per thousand cubic feet). Converted to the equivalent price per barrel of oil, the \$15 to \$18 per barrel price of high-Btu synthetic gas does not favorably compare with the \$12 current price of foreign oil. However, the estimated price of synthetic gas compares more favorably with the current price of imported liquified natural gas --approximately \$3.00 per thousand cubic feet.

The Synfuel Interagency Task Force's report shows the price of oil from shale to be in the \$10 to \$18 per barrel range. However, some recent industry estimates of the expected cost of shale oil range up to \$18.90 per barrel. The Task Force's report and recent industry estimates project the price for synthetic oil from coal to be about \$20 to \$30 per barrel.

^{1/} Projection contained in the report by the Synfuels Interagency Task Force. Most of the recent industry estimates are over \$3.00 a thousand cubic feet.

Officials of the three companies which have applied to FPC to build high-Btu coal gasification plants said that lenders are reluctant to finance plants partly because the lenders are skeptical of technical success. However, ERDA officials, as well as other industry officials, told us that the technical risks of the proposed gasification plants using first-generation technology are minimal.

Shale oil technology does not appear as advanced as existing gasification technology. A commercial-size module (approximately 10,000 ton a day) has not been built. To date, in the United States, operation has occurred in experimental 1,000 ton-a-day plants and there are differences of opinion about the technical risk in scaling up to commercial size. Some companies believe a single, commercial-size module should be built, while other companies, believing the technology proven, consider the module approach a waste of time and money and that building a commercial plant with five or six modules is preferable.

Risks associated with coal liquefaction appear to be greater than gasification and oil shale. The only commercial plant in the world today uses coal provided at roughly one-third to one-half the projected costs of eastern U.S. coal. Based on the data resulting from operation of this South African plant, the economics of first-generation liquefaction technology and the product mix appear to constrain application of the process in the United States. We were unable to find anyone who is actively seeking to commercialize this technology in the United States.

Air and water pollution, solid waste disposal and water use problems are expected for the plants and associated coal mines. The extent of the environmental effects would depend on what type of process and equipment is used. Besides the environmental effects of mining, other environmental effects of shale oil production include solid waste disposal --which in some cases are expected to be of an amount larger than the shale used--and effects on wildlife, land, air, and water quality.

There are also social-economic considerations. Coal conversion plants or shale facilities are expected to be built in a rural setting close to the resource. This would increase population and therefore increase demand on schools, stores, roads, waste facilities, water, police and fire protection, and other important community services. These areas often are not well prepared or in a position to finance the front end cost of such rapid change.

CHAPTER 5
PROS AND CONS OF ALTERNATIVE
FEDERAL FINANCING INCENTIVES

This chapter discusses the major Federal actions that can be used to stimulate new energy supply technologies and conservation actions. The array of potential Federal actions can be classified as indirect or direct. Indirect actions operate through the market mechanism to affect the price of products, thereby influencing, hopefully, consumer behavior. They are the best suited to new energy supply technologies and conservation actions that are currently economic or nearly so.

In contrast, direct actions bypass ordinary market mechanisms, involving the Government as a commercial agent, allocating resources directly.

The principal types of direct and indirect actions are shown below.

Major Government actions
available for stimulating new energy
technologies and conservation actions

<u>Type of action</u>	<u>Examples of such action</u>
Indirect:	
1. Tax action	Excise tax on gasoline/percentage depletion allowance
2. Price regulation	Price controls on oil
3. Credit assistance	Direct loan/loan guarantee
4. Subsidy	Price guarantee
Direct:	
1. Specific regulation	Tariffs/quotas
2. Contracts	Purchase agreement
3. Grants	Construction grants
4. Government ownership	Tennessee Valley Authority

This report does not take a position on whether market or nonmarket forces work best in the U.S. economy. Rather, it tries

to address various actions from the perspective of what each can be expected to do to "get a particular job done."

INDIRECT ACTIONS

As stated earlier, these actions operate through the market mechanism to affect the price of products and, hopefully, appropriately modify energy supply and use patterns. The steps involved seek to modify the decisions of energy users and energy producers. Since such actions generally result in only moderate shifts in cost-benefit ratios, they are not normally best suited to assist technologies which require large advances to become economically competitive.

Tax actions

Tax actions are some of the most effective and frequently used methods of influencing economic behavior. Tax actions can be used to stimulate conservation actions and accelerate the commercialization of emerging energy supply technologies. Like other indirect actions, tax incentives (tax credits to promote insulation of residencies and business structures) and disincentives (excise tax on gasoline to promote conservation) are most effective when applied to conservation actions and energy technologies that are currently economic or nearly so.

The major advantages of tax actions over other types of Federal incentives are that tax actions can be relatively easy to administer, provide for public visibility, and are capable of being precisely tailored to reach the targeted population. Most ordinary tax incentives may not be effective in modifying the behavior of low income individuals. Thus, low interest loans or other incentives may be needed in such cases.

Tax incentives, of course, have the disadvantages of reducing the tax revenue collected by the U.S. Treasury and of assuming permanent status.

Price regulation

Price controls are useful in emergency situations in that they can temporarily prevent hardship to low income consumers. On the other hand, price controls may induce waste, often require a large bureaucracy to administer them, and reduce--or render more costly--the effectiveness of other initiatives such as price supports for synthetic fuels.

As indicated above, price controls may be imposed in the context of regulation, such as setting a "fair rate of return" on utility profits. In that event, price controls on one fuel may be set so as to affect the use of another fuel.

For example, if FPC regulation extended to synthetic gas, the costs of such gas might be "rolled-in" with the costs of natural gas and the consumer charged a price based on average costs. In this case, price controls on natural gas would be used to promote development of a new fuel source, rather than merely to set a ceiling on the price of traditional fuel.

One of the major drawbacks to price controls, which hold prices below market levels 1/, is that they work at cross purposes with national efforts to conserve energy. For example, natural gas consumers have little incentive to upgrade the insulation of their buildings given the continuation of gas price controls.

Conversely, allowing gas prices to rise should tend to encourage installation of insulation in structures. It should be obvious here, that the issue is one of relative prices, not regulation per se.

Credit assistance

Loans and loan guarantees are most effective in making investment decisions in which fixed costs are a major component of total costs and investor choice is sensitive to relatively small variations in the cost of capital. In such a situation, a loan guarantee can eliminate or reduce any risk premium demanded by investors. Loan guarantees also appear attractive because their observable, direct, and immediate impact on the budget is low or even trivial. (See below for the GAO position on this issue. Appendix I also addresses this question in more detail.)

However, loan guarantees have several disadvantages. First, and most importantly, they are unlikely to increase the total supply of investment funds 2/ and hence would likely divert such funds to insured areas and away from others. This affects both the economy as a whole and the energy sector. If loan guarantees were issued for energy

1/ Whether or not those levels are themselves "controlled" by other forces, such as the Organization of Petroleum Export Countries control of world oil prices.

2/ This issue is not clear cut. Some members of the financial community are now arguing that some money, otherwise not available for venture capital, might be siphoned from nonproductive savings activities (hoarding and gold holding) into these relatively secure areas.

projects, this might divert investment funds away from home mortgages or even State/local bond issues. In addition, any stimulus to investment in certain energy projects may come at the expense of investment in oil or gas or other areas.

Alternatively, loan guarantees may be ineffective. Despite the lower interest rates which loan guarantees would generate, firms may be unwilling to undertake the activity if a higher rate of return on capital is available elsewhere. If the loan guarantee is for a basically unprofitable activity such as the production of synthetic fuels, the reduction in interest rates would not reduce total costs by enough to make the venture look attractive and to warrant participation by firms with alternate investment possibilities.

Thus, to the extent that loan guarantees stimulate investment and result in lower (than otherwise) prices for certain fuels, users of those fuels benefit in proportion to their consumption. However, the stimulus to investment was effected by a transfer of risk from investors to taxpayers. This risk transfer is a form of indirect subsidy, which under currently proposed legislation for synthetic fuels would not completely appear in the budget. The true costs of such subsidies may also be hidden because they are difficult to estimate at the time decisions are made. To exemplify, prospective default rates often cannot be reasonably calculated at the time guarantees are made.

Loan guarantees also frustrate budgetary discipline because they do not compete for Federal tax monies in the same manner as other programs. Since few--if any--immediate outlays are made as the program begins, less attention is paid to the opportunity costs of any guarantee program.

Subsidies

Because the output from synthetic fuel plants is not expected to be competitive with the price of energy from traditional sources, subsidies in the form of price guarantees may be needed.

Price guarantees would involve a commitment by the Federal Government to pay the difference between market prices at the time of production and any costs of production above those prices. For a price guarantee to be of much use for development of synthetic fuels, for example, it would have to be considerably above equivalent current world price for crude oil.

The cost of price guarantees would depend on expected volume of the fuel whose price was being guaranteed. For

limited commitments to synthetic fuels, e.g., 350,000 barrels per day or equivalent, the budgetary cost would be over \$600 million per year (assuming a \$5 per barrel equivalent price differential between the cost of synthetic fuels and the world oil prices).

However, a price guarantee system may eventually lead to large expenditures if there is significant growth in the industry being so subsidized. These expenditures can also present a problem if economies of scale necessitate production of the subsidized product by one or a few firms. In such a situation lack of adequate competition and/or inefficiency could result in excess costs to the Government.

DIRECT ACTIONS

These actions are best suited to situations when (1) some action is required to deal with an emergency or very urgent problem, usually national in scope; (2) effective action of the type desired in a predetermined time frame by private enterprise seems unlikely; (3) the action is deterred principally by cost-ineffectiveness together with uncertainty regarding the future and the size of necessary capital requirements; or (4) the action requires attention to goals, such as developing environmental and socio-economic data, which industry may be unwilling or unable to pursue.

Direct actions would tend to provide more specific visibility and control than some indirect actions. This can be important in (1) assessing performance on projects, and (2) making appropriate comparisons with competing alternatives.

Specific regulation

A tariff on imported oil would stimulate production of and drilling for domestic crude oil and could also be used to provide partial support for development of new energy technology. However, tariffs on imported crude oil are not a precise means of stimulating any given activity, such as synthetic fuels or other new energy technologies. This is because the effect of higher prices caused by the tariffs may not be directed at the activities which the policy seeks to promote. Quotas, on the other hand, may create equity problems by producing large windfall gains to favored domestic producers.

Contracts

Related to price guarantees are actions such as procurement contracts and grants. For example, the Federal Government might choose to promote synthetic fuel development of new energy technologies by guaranteeing to purchase at a stated price a specific amount of output. This would provide producers a minimum demand for their products and hence set a floor for potential profits. Unless a firm price is agreed to beforehand, such contracts tend to be "cost-plus" in nature and share all the advantages and disadvantages of similar Government involvements in the past. Disadvantages common to such contracts include complexity, incentives for inefficiency, and the need for sustained monitoring. However, the Government need not retain the output purchased. It could resell it on the open market were that course of action the least costly one. As stated earlier, advantages of this option include more control of project efficiency and progress and greater visibility of financing as compared to indirect methods.

Grants/Government ownership

Grants could be provided for specific development work or for construction. In the latter case, the required volume and cost of capital to the enterprise would be reduced. In some circumstances, the Federal Government might finance all of the construction costs, in which case it would still have the option of contracting out to private industry operation of the plants as was done during World War II, and as we are doing with uranium enrichment.

If Federal ownership were retained, the operation would not be constrained by a need for profit and such an effort would less likely be deterred by large capital requirements. Again, these options would provide the Government with greater control of project efficiency and progress and greater visibility of funding as compared to indirect methods.

CHAPTER 6SUMMARYOVERALL CONCLUSIONS

Our basic purpose in this report has been to provide a framework and perspective for considering (1) energy actions which could contribute to solving energy problems in the next 10 to 25 years and (2) the role of the Federal Government in encouraging activity in each of the areas. Without such a framework and perspective, we run the risk of piecemeal decisionmaking on our energy options without ever focusing on the implications for overall energy policy of the choices we make.

Our report focuses on two things:

- Emerging energy supply and conservation technologies which are technically feasible but for a variety of reasons, are not being actively commercialized by the private sector. For each technology, we have attempted to define and assess its potential role in filling energy needs by both 1985 and 2000.
- The major financial and pricing mechanisms which are available to the Government for stimulating activity with regard to emerging energy supply and conservation technologies.

The recent slowdown in the rate of growth in demand for energy is a sharp reminder of the importance of the demand side of the energy equation and of conservation in particular. This fact and the wide differences of opinion on the sources of energy supplies to meet that demand suggest that the Nation should carefully explore all supply sources as well as conservation alternatives before embarking on a program to commercialize synthetic fuels. Even if an all out effort were undertaken to develop commercially all new supply technologies, such technologies offer little hope for reducing dependence on imported oil prior to 1985. Also their impact beyond 1985 is highly uncertain. The projected output in 2000 of each of the new supply technologies cited throughout much of this report are based on ERDA's most optimistic scenario which ERDA acknowledges is idealistic. Moreover, ERDA believes that it is highly unlikely that all new technologies can be developed with complete success.

Major considerations in choosing
among technologies

The three key factors which we believe should be carefully considered in choosing among energy technologies are:

- The contribution that each technology can make in meeting the Nation's energy needs within a specified time frame either through reducing demand or increasing energy supply.
- The total cost of making the technology commercial including costs of plant construction, costs of alleviating adverse socio-economic impacts caused by the energy development, and the costs of price supports or further subsidies which may be required.
- The price at which energy produced by the technology would have to be sold and the means by which the price would be assimilated by our economic system.

Analysis of the potential contribution of energy technologies indicates that some are preferable to others. In particular, conservation technologies and actions seem to offer great potential. Once a conservation investment is made, the energy savings go on year after year. Conversely, failure to make conservation investments will require the production of more and more energy supplies year after year to meet essentially inefficient uses of energy.

With regard to the choices among new supply technologies the various forms of oil and gas production from coal and oil shale are complex and highly capital intensive. Development of the technology on a commercial scale requires creation of a substantial industry infrastructure to sustain it once it is in place even if the product produced cannot compete economically. There are obvious disadvantages in sinking costs in technologies where the economics are uncertain and where improved technology or competing energy sources in years ahead may make the plants obsolete. For example, the costs of constructing an oil shale plant producing 50,000 barrels a day is estimated at \$1 billion. If the price of a barrel of oil from shale were to exceed the price of imported oil by \$5 a barrel, then an additional price subsidy of \$250,000 a day or about \$90 million each year could be required for just one small plant.

It is important also to focus on the incremental price of the energy produced or saved by any action. The incremental price of numerous supply increasing actions is often overlooked because the additional supply will initially be only a small part of the total energy used and the price can be "rolled in" with the substantially lower price of existing energy supplies. Any immediate effect on the consumer is thereby mitigated. For example, the price for synthetic gas is expected to be twice the recently announced FPC price for new gas discovered, but because it might be rolled in with the price of existing gas supplies, the incremental price of the new supply can be easily overlooked. Conversely, the cost of implementing certain other technologies or actions including most conservation options and many solar options is usually presented only on an incremental basis. We discuss the importance of this distinction later in this chapter.

In short, in choosing any energy technologies, it is important to keep in mind the full implications of the technology to which we commit ourselves and the incremental costs of the actions we take.

Financing mechanisms

In determining the mechanism which would best stimulate a particular energy technology, we believe at least three factors should be carefully examined.

- The technology's state of development. Is the technology developed to the extent that it can be deployed on a broad basis?
- The technology's economic feasibility. Will the energy produced as a result of deploying the technology be economically competitive with competing energy sources?
- The target group whose actions will be influenced. Are they large industrial firms or diverse and widely dispersed groups such as homeowners?

Interrelated analysis of these three factors should precede the choosing of the most appropriate financing mechanism or other Government activity to stimulate a particular financing technology.

For example, loan guarantees have received much attention as a potential way of encouraging a variety of energy technologies. In general, loan guarantees would seem to best fit those circumstances where the technology has been known to work, is economical, and where the person wanting to make an investment

in the economically attractive energy technology cannot do so primarily because of financial constraints. By transferring some of the risk, loan guarantees tend to marginally reduce the interest costs of a loan and to assure the availability of financing which otherwise may not have been available. This is the basic logic, for example, for making Federal loan guarantees available for housing. Conversely, loan guarantees should be carefully examined and other options considered where there are questions regarding the viability of the technology or the economic competitiveness of the product.

Loan guarantees also may not be appropriate for target groups consisting of large firms with reasonable access to capital markets even if the energy activity in question is technically and economically feasible. Investment capital is normally available to such firms and their basic decision not to invest in a particular energy activity may be influenced primarily by the availability of attractive investment opportunities elsewhere.

CONCLUSIONS REGARDING TECHNOLOGIES

On the basis of our review, in terms of dollars expended on a cost effective basis, we believe that certain conservation measures have by far the greatest potential benefits and should have the top priority for stimulative Government actions.

Among the supply-increasing technologies considered, we found several technologies to be cost effective either in total or in particular geographic areas. These technologies are hydrothermal energy, municipal waste combustion systems, solar hot water and space heating, and tertiary oil recovery. Because they are cost effective, these technologies would be the most efficient to implement in the near future in terms of dollars expended now and in the near future on supplies of energy.

The supply of energy to be captured from these sources may be smaller than the potential of other supply technologies considered in this report such as synthetic fuels, but the economics appear more certain. Thus, we believe these technologies should be given priority for Government assistance in commercialization to (a) insure their maximum contribution between now and 2000 and (b) to provide a source of additional supply to give the Nation additional

time to consider and fully develop efficient means of producing energy from larger supply sources including synthetic fuels and other technologies not considered in this report such as fusion, solar photovoltaic cells, thermal gradients, and breeder reactors.

Synthetic fuels production--while technically feasible with first generation technologies--is not cost effective in that the total cost of output is not price competitive with foreign oil. Nor does it look as attractive when compared to other technologies, which we examined, on an incremental price basis. We believe synthetic fuels technologies should receive a high priority for Government research, development, and demonstration efforts designed to develop more advanced and efficient production technologies, but we question whether assistance should be given to commercialization of synthetic fuels at the present time.

There are also serious questions regarding any deep national commitment to uneconomic, high-cost supply technologies which substantially exceed the cost of imported oil; certainly, the deeper the commitment to building a broad industry infrastructure of highly capital intensive energy sources, the less the incentive in future years to support development of lower cost energy supply options. Further, for such high cost technologies, imported oil is likely to form a defacto price floor as opposed to its current role as an energy price ceiling. In such circumstances, the exporting countries could be in a better position to exert continued upward pressure on energy prices.

The role of pricing policy as a tool to help stimulate commercialization of emerging technologies also needs to be considered very carefully.

Certainly, careful decisions are needed to provide a stable regulatory framework for oil and gas which clearly recognizes that the Nation is moving into an era of higher priced and relatively scarce energy and that world energy prices are established not in a free market, but by a cartel of producing Nations. The alternative, of course, is orderly deregulation of oil and gas--a process already started with oil.

In any event, we need to remove the current uncertainty as to the duration and intent of Government price regulation. Such uncertainty is at least as much a deterrent to commercializing of emerging energy technologies as the concern the current average regulated price of oil and gas may not

fully reflect the costs of developing or finding new energy supplies. Further, if future decisions to provide Government assistance to new technologies for commercialization purposes are to be made on an incremental cost basis, then the price of oil and gas, which in effect will be the standard for many years, must be both realistic and certain.

We believe that the incremental cost standard is the only realistic one for making sound economic judgments and treating all emerging technologies equally. The only other measure which can be used is rolled-in pricing which would serve to average the real cost of a new supply source across a far larger volume of lower priced energy.

Among the technologies we have considered, a rolled-in yardstick would clearly favor synthetic fuels; likewise, it would clearly discriminate against such options as conservation and solar hot water and space heating. Using incremental cost to evaluate alternatives on the other hand, would reduce all of these options to the same test --the actual cost of the output from the new technology--and allow a consistent and rational process of choice on a cost effective basis.

1. We favor the use of incremental cost as a yardstick to select cost-effective technologies or actions which receive priority for government financial assistance in the commercialization process.
2. We believe that certain conservation actions and other technologies are cost effective and should receive top priority for Government financial assistance.
3. We believe that emerging and promising technologies which are not cost effective, such as synthetic fuels, should receive high priority for research, development, and demonstration assistance but we question whether commercialization assistance should be given to technologies that are not cost effective.
4. We believe further recognition needs to be given to the role of pricing policy in developing new energy technologies and the related need for the price of domestic oil and gas to reflect clearly the cost of finding and developing new energy supplies. Higher prices can be provided either in a stable, responsive regulatory environment or through deregulation.

Our specific conclusions regarding the areas of technology we examined follow.

Conservation

Conservation should have top priority for Government financial assistance because it has the greatest potential payoff and is most attractive on an incremental cost basis. Areas offering the greatest opportunity include insulation and other measures to conserve energy in new and existing buildings, industrial energy conservation, and improved utility load management. Still, there is a need as discussed in our report for more detailed, reliable, and comprehensive information on a variety of energy conservation opportunities.

The preferable financial mechanism or Government action for stimulating different conservation opportunities varies because different target populations are involved. For example, tax credits would likely be most effective in stimulating middle and upper income homeowners to install energy conserving measures. However, for low income homeowners and others of limited financial capability, low interest loans or grants from the Treasury may be more effective mechanisms. In addition, Federal leadership and action in developing uniform building standards which incorporate desirable energy conservation features would be useful.

Tax credits also could be used to stimulate energy conservation investments by industry. However, because the payback period for such investment may not compare favorably with other investment opportunities--even with added incentives--consideration should be given to establishing Federal standards for energy efficiency, particularly for the more important industrial uses of energy.

Utility load management affects a broad range of consumers and can best be addressed by Federal leadership in establishing and encouraging implementation of utility rate structures which use the price mechanism to encourage reduced use of energy.

Overall, price is an important concept in achieving effective energy conservation. Energy price increases would serve to stimulate the implementation of some conservation technologies without direct Government financial assistance. However, we emphasize that both price induced conservation measures and those resulting from explicit Government actions are needed to insure the desirable and necessary goal of maximum energy conservation implementation.

Many of the incentives and actions which we believe are desirable to encourage conservation are addressed in whole or in part in the recently signed law on to extend the Federal Energy Administration. This includes:

- A variety of proposals for improving electric utility rate design including Federal funding of demonstration projects and participation in the proceedings of utility regulatory commissions (\$15 million is authorized to be appropriated for these activities during fiscal year 1977).
- Federal development of conservation-oriented performance standards for new residential and commercial buildings (\$5 million is authorized to be appropriated for grants to State and local governments to finance the cost of adopting these standards).
- FEA's development of a program to assist low income persons in weatherizing their homes (\$200 million is authorized to be appropriated through fiscal year 1979).
- Federal support and assistance to States which develop energy conservation programs (\$105 million is authorized to be appropriated through fiscal year 1979).
- A 2-year energy conservation and renewable resource demonstration program to test various forms of Federal financial assistance including grants, low interest loans, and loan guarantees (\$200 million is authorized to be appropriated for the demonstration program).
- Federal loan guarantees for installing conservation and renewable resource equipment (obligation authority for loan guarantees up to \$2 billion is authorized).

Careful monitoring of the effectiveness of these new programs will be required and adjustments made in the incentives authorized and more stringent measures adopted as needed to achieve conservation savings. In this regard, we are specifically required to monitor the new program to test various forms of financial assistance.

Synthetic fuels

ERDA's most optimistic scenarios show synthetic fuels production reaching the equivalent of 2.4 and 22 quads in 1985 and 2000, respectively. However, ERDA is in the process

of revising these estimates downward. Moreover, the projected prices are not competitive with traditional energy sources and research and development on second generation technologies is expected to reduce costs by only about 15 percent.

Because of the size and investment required to build synthetic fuel plants, incentives must be targeted at large industry which normally has access to the capital markets. Two basic concerns underlie the stated need for Federal loan guarantees to induce the investment needed to commercialize first-generation synthetic fuels technology: (1) concern that the product produced will not be economically competitive and that the existing world market price for oil could always be manipulated to substantially undercut the price of synthetic fuels, thereby increasing its economic unattractiveness and (2) concern that technological advances in other energy areas or within synthetic fuels technology will make first-generation synthetic fuel plants obsolete before they ever become operational.

Against those concerns, the stated purpose of ERDA's synthetic fuels commercialization program is to identify and resolve potential future socio-economic, environmental, and regulatory impediments associated with constructing large commercial scale synthetic fuels plants before the synthetic fuels are needed to meet our Nation's energy needs.

Given ERDA's basic objective and the present economic unattractiveness of first-generation synthetic fuel technology, we believe that, in lieu of providing Federal loan guarantees for billion dollar size "commercial" plants, efforts should be directed to research and development of improved synthetic fuels technologies and to meeting ERDA's objective of identifying and resolving socio-economic, environmental, and regulatory problems. To meet this latter objective, it appears possible to gain adequate information from smaller plants under Government control. At the point in time that commercialization of the technology becomes the prime objective, we believe consideration also should be given to the "commercial pull" approach of gaining private industry interest in commercialization.

Smaller plants

Because synthetic fuels are not expected to be economic, even if built to commercial size, an alternative approach would be not to emphasize the cost of the output and concentrate on acquiring the socio-economic, environmental,

and regulatory information. We believe this could be done by having the Government construct and operate--either itself or with a contractor--smaller synthetic fuels plants.

Assuming synfuels demonstration plants are successful and prove feasible and capable of regulated, environmentally safe operation, the demonstration plants could be sold to private firms. At that time--when synfuels have been proven viable--if it is considered desirable and inducements are required to stimulate private firms to enter commercial operations of synfuels, consideration could be given to offering some sort of financial assistance to private firms.

In the meantime, the Congress could maintain oversight of the plants through the yearly authorization and appropriation process. This yearly monitoring of plant progress offers enhanced potential for building smaller, less costly plants while still maintaining maximum information capability. Should the plant not prove to be feasible, yearly oversight would enable project termination at the earliest possible date and may allow minimizing the financial loss related to the project.

Commercial pull

The so-called "commercial pull" approach advocated by a number of people ^{1/} could also be considered as a way of moving the commercialization of technologies such as synthetic fuels where the economic competitiveness of the product produced is in question. Using this approach, the Government could announce that it would purchase a set amount of synthetic oil or gas at some future point in time and request bids from industry. The Government then could select the lowest bid that appeared technically feasible. This method may prove to be a less cumbersome and perhaps less costly way of stimulating the construction and operation of a desired number of synthetic fuel plants.

^{1/} Dr. R. H. Holloman, Director, Center for Policy Alternatives, Massachusetts Institute of Technology, discusses potential new approaches by Government of this type to encourage commercial implementation of energy technologies in the book Energy Research and Development, prepared for the Ford Foundation's Energy Policy Project, Ballinger Publishing Company, Cambridge, Massachusetts, 1975.

Municipal waste combustion

This is a cost-effective technology, and while it is being implemented to a limited extent, Federal financial assistance could hasten and maximize its use. Because this technology could best be employed by utilities, municipalities, or local government units which, in many instances, may have limited financial capability, loan guarantees would appear to be a preferred mechanism for accelerating this technology.

Solar heating

Solar hot water and solar space heating are currently economic in many parts of the country, but like many conservation measures, are not being widely implemented because of the long payback period and general lack of consumer awareness. We believe that Federal financial incentives should be used to accelerate the commercialization of these technologies. The incentives should be directed to consumers--homeowners and businesses. Again, like certain conservation actions, tax credits seem like the most appropriate mechanism to stimulate middle and upper income homeowners and business to install solar heating units, while low interest loans or grants would best stimulate low income homeowners and small businesses with limited financial capability. In addition, loan guarantees could be a useful mechanism to assist State, municipal, and non-profit institutions obtain the necessary capital to invest in such solar heating for their facilities.

As indicated earlier, the legislation to extend the FEA includes a program designed to test various forms of financial assistance. Under that program, persons installing renewable energy resource devices could receive a grant not to exceed \$2,000 or 25 percent of the cost of installing such devices and could have obligations issued to finance installation of such devices guaranteed by the Government. Whether or not the magnitude of incentives offered will be sufficient to encourage wide implementation of solar heating is something we have not analyzed.

Hydrothermal

ERDA recently implemented a loan guarantee program to accelerate the development of geothermal energy, including hydrothermal technology--the only type of geothermal energy currently economic. We believe no further Federal financial assistance to accelerate commercialization of hydrothermal energy is warranted at this time. For other geothermal applications, Federally sponsored research, development, and demonstration of the economic and technical visibility

of the concept seems to us to be the appropriate Government role.

Tertiary oil recovery

In general, secondary measures to recover oil are economic and widely used. Tertiary recovery techniques for the most part are not widely used since they are not economic. One quick action which would improve the economics would be to release domestic oil produced by tertiary techniques from price controls. This should increase the use of tertiary techniques on old producing wells. In this regard, the bill to extend FEA recently signed by the President requires that early consideration be given to amending petroleum price regulations to provide additional price incentives for bona fide tertiary recovery techniques.

In addition, ERDA should continue to carry out its program of research, development, and demonstration designed to acquire more information and promote the use of tertiary oil recovery techniques. We have in process a report on ERDA's progress under the program which will include specific recommendations for program improvement.

MATTERS FOR CONSIDERATION BY THE CONGRESS

This report is intended to provide the Congress with a framework and perspective to aid it in making decisions on the plethora of energy options before it. We have analyzed the various options in the light of the key factors which must be carefully considered in choosing (1) among energy technologies and actions and (2) funding mechanisms for encouraging implementation of the technologies and actions. On the basis of our work, we recommend that the Congress:

1. Continue to place the highest priority on energy conservation actions, requiring improved information on major conservation opportunities which will provide the basis for the development and funding of specific programs which can be tailored to take maximum advantage of the opportunities.
2. Maintain close oversight of the several new programs to encourage energy conservation, evaluate the effectiveness of incentives offered, and consider such further actions as may be necessary, including the greater use of mandatory energy

efficiency standards. The GAO will continue its efforts to aid the Congress in this regard.

3. Continue to encourage the installation of solar heating technologies targeting the financial incentives to the users as described in the report.
4. Maintain close oversight of FEA's actions to increase incentives for tertiary recovery of oil and authorize further incentives if the need and possibility to increase tertiary oil recovery becomes apparent in light of other energy developments.
5. Consider whether it is advisable to enact legislation which would at this time authorize Federal loan guarantees to builders of synthetic fuel plants, and consider instead directing ERDA to continue and expand its research and development to improve the technology and; in addition, construct and operate smaller plants of a size sufficient to meet its stated goal of obtaining socio-economic, environmental, and regulatory information in a timely fashion.
6. Consider further actions, including the provision of loan guarantee authority, to encourage municipal waste combustion.

LOAN GUARANTEES SHOULD BE
INCLUDED IN THE BUDGET

The Congressional Budget Act of 1974 (Titles I - IX of Public Law No. 93-344, July 12, 1974) is a comprehensive statute which sets forth many of the procedures by which the Federal budgetary process is to operate. Our interpretation of the Act's language and the intent of the Congress in enacting this legislation is that the total amount of loan guarantees including associated contingent liabilities are not required to be included in the Federal budget. Review of S. 2532 and H.R. 12112 indicate that such disclosure is not contemplated.

However, one must look beyond the language of the Act and consider that one of the fundamental objectives of the Congressional Budget Act of 1974 was to establish a process through which the Congress could systematically consider the total Federal budget and determine priorities for the allocation of budget resources. We believe this process achieves its maximum effectiveness when the budget represents as complete as possible a picture of the financial activities of Federal agencies. We further believe it is vital to maximizing the effectiveness of the process that Federal financial resources be measured as accurately as possible because priorities are actually established through decisions on the conferring of the authority to enter into obligations which will result in immediate or future outlays of Government funds. From this standpoint, therefore, the budget should (a) encompass all actions which confer authority to spend money, (b) reflect as accurately as possible the amount of such authority which is conferred, and (c) recognize the point at which control over the spending of the money passes from the Congress to the administering agency. The consequence of excluding loan guarantees and their associated contingent liabilities from the budget is to thwart Congress' achieving the maximum effectiveness of the process it established to review the Federal budget and determine priorities.

In the case of Federal loan guarantees for housing and other programs, historical experience permits the default rate to be estimated with reasonable accuracy and included in the budget. However, if the Congress enacts S. 2532, H.R. 12112, or similar legislation, authorizing a relatively small number of very large loan guarantees, we believe that it will be difficult to accurately predict the extent of default, and therefore, the total amount approved for loan guarantees should be shown in the budget.

COMMENTS ON THE PROPOSED FINANCIAL
RESOURCES FOR THE ENERGY INDEPENDENCE AUTHORITY

The Energy Independence Authority (EIA), as proposed by President Ford on September 22, 1975, would be a quasi-public Federal corporation which would provide financial assistance to energy projects which would make a significant contribution to energy independence and would not otherwise be undertaken by the private sector. The Authority could create wholly owned subsidiaries to carry out its functions with financial resources of \$100 billion. Of this amount, \$25 billion would comprise capital stock to be purchased by the Treasury and the remainder would comprise debt obligations, requested initially as a once and for all congressional authorization. Any issuance of Authority securities or other assistance would be subject to Treasury Department approval.

EIA financing would be by direct loans, loan guarantees, price guarantees, purchase and leaseback of facilities, and even purchase of equity capital. Assistance to any one project would be limited to \$10 billion. Loans would bear interest at a rate determined by the Authority Board and guarantees for loans would be backed by the full faith and credit of the government. EIA would concentrate its efforts in those energy subsectors least likely to attract private capital. Theoretically, EIA's efforts would stimulate investment in these areas from the private sector. The overall effect of EIA would presumably be an increase in the likelihood of energy independence in the foreseeable future.

EIA's success will depend largely on its ability to induce private investment. However, the likelihood of increasing private investment is dependent on other variables such as the price of foreign oil, the demand for energy, the economic attractiveness of investing in the energy sector as opposed to other possible investments, and the size of energy investments planned without inducement from EIA.

A priori arguments can be made that EIA's \$100 billion would stimulate large amounts of investments by industry in energy projects, however, because of the many non-quantifiable variables, any assessment of the adequacy of EIA financial resources would be highly speculative and judgmental. If the Congress decides that legislation similar to S. 2532 is required, an attractive modification may be to provide a lesser amount initially, say for example, \$10 or \$20 billion.

Further funding could then be provided through annual appropriations as needed.

Funding EIA annually would provide the Congress with a mechanism to annually assess the impact Federal funds are having toward stimulating private investment in energy projects. Such assessments could be made through the annual authorization and appropriation hearings. These assessments could provide for not only an evaluation of the extent to which Federal funds have stimulated private investment, but also the impact additional Government funding could have on furthering energy independence. During this annual review, the Congress would assess the progress being made in developing new energy technologies and have greater flexibility in allocating Federal funds to technologies which industry is unlikely to develop independently.

ERDA COMMENTS AND
GAO EVALUATION

In commenting on a draft of this report, ^{1/} the ERDA Administrator expressed his deep concern with our analysis, presentation, conclusions, and recommendations. For the most part, ERDA's concerns related to the position we take on Government loan guarantees for the construction of commercial-size synthetic fuel plants. The Administrator specifically pointed to five serious deficiencies that he felt were contained in the draft.

Subsequent revisions were made in the body of the report in light of items 1, 4, and 5 listed in the Administrator's letter. Specifically, we

- revised Chapter 2 to use instead two of ERDA's scenarios to set the perspective for our work and to illustrate the wide range of opinions regarding the energy choices our Nation faces.
- recognized that the current estimated price for liquified natural gas imports is similar to the estimates for synthetic gas from coal.
- cited disadvantages for tax incentives in Chapter 5.

Points 2 and 3 in the ERDA Administrator's letter go more to the heart of what we perceive as ERDA's basic concern. In essence, ERDA believes that a financial incentives program which includes loan guarantees is needed immediately if the Nation is to have the option of a major synthetic fuels industry in the 1990s. ERDA believes the plants constructed now must be of commercial size to obtain needed environmental, regulatory, and economic data and provide the commercial operating experience necessary to overcome investor uncertainty by the middle 1980s.

Nowhere in our report have we suggested that the synthetic fuels option be foreclosed. Rather, we concluded from our work (1) that synthetic fuels deserved high priority for

^{1/} See Appendix IV for the full text of his comments.

Government research, development, and demonstration; and (2) that, given the state of the technology and current economic unattractiveness, Government loan guarantees or other financial incentives for commercial-size plants which could cost upwards of a billion dollars each did not seem appropriate at this time.

In a broader context, our more basic intent was to provide the Congress a framework and perspective for making choices among the many options before it, including not only synthetic fuels but other energy technologies and conservation actions.

APPENDIX IV

APPENDIX IV



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

AUG 19 1976

Honorable Elmer B. Staats
Comptroller General of
the United States
General Accounting Office

Dear Mr. Staats:

ERDA has reviewed the draft GAO report entitled "Are There Better Choices?" which is concerned with Federal proposals to finance the commercialization of advanced energy technologies.

We are deeply concerned about this report because it presents strong conclusions and recommendations to the Congress without a sound underlying basis of analysis supporting them. The draft report represents in our view, a presentation of a point of view rather than any new, independent analyses of alternatives.

This lack of underlying objective examination is particularly important since the opinions expressed in the report have implications not only with respect to important legislative proposals now pending before the Congress for synthetic fuels and other technologies, but also with respect to the broader matter of the overall balance among ERDA's energy R,D&D programs.

In particular, I wish to call your attention to the following major concerns which we regard as serious deficiencies in the draft report:

1. In arguing that it is not necessary to provide now a Federal guaranty program for synthetic fuels, GAO has used for its analysis a very optimistic estimate of the future effects of conservation (i.e., Ford Foundation technical fix case) and coupled this with an equally optimistic high estimate of domestic conventional oil and gas production in the year 2000 (20 million b/d greater than today's domestic production). We believe such unrealistic demand/supply



cases cannot prudently be used as a basis for national energy policy. Nevertheless, even using such optimistic projections, the GAO report still admits to a substantial synthetic fuel production requirement beginning in the 1990's if we are to avoid a further increasing dependence on foreign oil. With this requirement, lack of certainty as to the future price and availability of imported fuels, and with the long lead times associated with the growth of such a large new capital intensive industry, uncertainty facing investment must be resolved by the middle 1980's if we are to maintain a capability to have plants in operation in the early 1990's. This means that we cannot delay taking action now to obtain needed information regarding the environmental, regulatory and overall economic characteristics which can affect the commercial viability of this option.

2. The GAO draft report has numerous assertions about the favorable comparative economics of new and emerging conservation and renewable energy resource technologies vis-a-vis synthetic fuels. Such discussion is hardly germane to an evaluation of synthetic fuels technologies. Indeed, ERDA shares GAO's enthusiasm concerning the attractive features of conservation and renewable resource technologies. However, even if these technologies are very rapidly introduced, they, by themselves, cannot obviate the indicated need in the 1990's for substantial quantities of synthetic fuels, or alternatively, continued imports.
3. The GAO report fails to either present or analyze the underlying rationale for the financial incentive program for synthetic fuels and other technologies embodied in H.R. 12112. Repeatedly, the draft GAO report characterizes this program as one which is aimed at augmenting domestic fuel supplies through subsidized synthetic fuel production. While one effect of the program would be to supplement domestic fuel supplies by some modest amount, the primary purpose of the program is to maintain the option to develop a synthetic fuel industry that can meet a projected demand in the 1990's of several million barrels per day of synthetic liquids and gaseous fuels.

The guaranty program, therefore, is designed to acquire critical information and, to the extent possible, resolve at an early date regulatory, environmental, financial, political and other barriers which may preclude later private sector investment because of the lack of information concerning the commercial viability of these plants. The Nation's experience with commercializing nuclear power has demonstrated that early attention to these matters is essential to preclude later delays. The report continually refers to a production program which "chooses" or "commits" to synthetic fuels. Such choices, as we see it, are to be made by the Nation, not today, but at a later date. The Synthetic Fuels Commercialization Program is designed to provide a needed meaningful basis for that decision, not to preempt it.

4. The draft GAO report compares the costs of synthetic fuels with today's price of imported crude oil and today's regulated price of natural gas. We believe the price of synthetic fuel products should be compared with the price of future alternatives against which they will compete beginning in the late 1980's. They should also be compared with products that will realistically compete in the end use markets which they are likely to serve. For example, synthetically produced gas from coal should be compared with alternatives to natural gas such as Alaskan gas, LNG (now priced at about \$3 per million Btu) and gas made from petroleum products, as well as higher priced depleting domestic conventional resources. When these comparisons are made, one finds that these other alternatives to natural gas are projected to be equally expensive and even more expensive in the case of gasification of petroleum products which is already occurring in the U.S. While over the next 20 years some substitution for natural gas will occur among electric utilities and large industrial users, we see no way in which these conversions can be assured to be large enough to offset a steady or rising demand for liquids and gaseous fuels and a steadily declining domestic supply.

APPENDIX IV

Mr. Elmer B. Staats

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APPENDIX IV

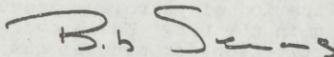
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5. In Chapter 5, we found the comparisons of alternative Federal financial incentives to lack objectivity and to be without a systematic basis for comparison. For example, the incentive analysis did not contain criteria against which the incentives were compared. Furthermore, although advantages and disadvantages were cited for some incentives, in the case of loan guarantees the disadvantages were cited without noting some of the major advantages. Also in the case of tax incentives which were later recommended in the report for accelerating the introduction of conservation technologies, the report did not cite any major disadvantages, not the least of which is the permanent status tax subsidies generally assume and the general failure of tax incentives to be focused on individual projects. We continue to believe that in many situations where capital availability and project scale relative to the sponsor's net worth are the major financing problems, that loan guarantees are the most effective, efficient, and least costly financial tool available to the Government.

Finally, we believe that the draft GAO report is so substantially lacking in analysis and information supportive to its conclusions, that publication of the report would only serve to confuse and further obfuscate the issues discussed. Furthermore, the publication of the report in anything near its present form will be damaging to the early implementation of our needed energy supply programs.

My staff has transmitted more detailed concerns regarding the report in the nature of factual, editorial and judgmental material.

Sincerely,



Robert C. Seamans, Jr.
Administrator

APPENDIX II

COMPTROLLER GENERAL OF THE UNITED STATES,
Washington, D.C., September 14, 1976.

HON. OLIN E. TEAGUE,
*Chairman, Committee on Science and Technology,
House of Representatives.*

DEAR MR. CHAIRMAN: Your letter of September 1, 1976, requested that we answer certain questions pertaining to our report "An Evaluation of Proposed Federal Assistance for Financing Commercialization of Emerging Energy Technologies" issued on August 24, 1976.

In response to your request, we are enclosing a list of your 15 questions and our responses.

During the hearings before your Committee, witnesses of the Energy Research and Development Administration provided with their testimony a number of detailed comments on our report. As agreed with you, we are also enclosing our responses to these detailed comments for inclusion in the hearing record.

In addition, we are also enclosing a copy of a letter responding to certain questions raised by Congressman David F. Emery of your Committee during the hearings for insertion in the hearing record at the appropriate point.

As agreed with your staff, an appropriate quantity of the enclosures are being provided for distribution to Committee members.

We appreciate this opportunity to answer questions raised regarding our report.

Sincerely yours,

ELMER B. STAATS,
Comptroller General of the United States.

Enclosure.

Question 1. When GAO contrasts the cost to the government of their R&D program with the potential cost (in high failure mode) of H.R. 12112, what is the ratio?

Answer. We have not computed a ratio contrasting the cost to the Government of a high priority research and development program in synthetic fuels with an estimate of the potential cost of H.R. 12112. Our conclusion regarding the desirability of loan guarantees for commercial synthetic fuels demonstration plants at this time flowed from several factors:

The state of development of the technology.

The cost effectiveness of existing synthetic fuels technologies compared to competing energy sources, principally imported oil and imported liquid natural gas.

The appropriateness of loan guarantees as an incentive for the target group expected to build the commercial-size synthetic fuels demonstration plants.

The stated purpose of ERDA's program which is to develop information on environmental, socio-economic, and regulatory impediments.

As stated on page 52 of our report, we concluded that: "Given ERDA's basic objective and the present economic unattractiveness of first-generation synthetic fuel technology, we believe that, in lieu of providing Federal loan guarantees for billion dollar size 'commercial' plants, efforts should be directed to research and development of improved synthetic fuels technologies and to meeting ERDA's objective of identifying and resolving socio-economic, environmental, and regulatory problems. To meet this latter objective, it appears possible to gain adequate information from smaller plants under Government control. At the point in time that commercialization of the technology becomes the prime objective, we believe consideration also should be given to the 'commercial pull' approach of gaining private industry interest in commercialization."

We also believe there are uncertainties which make a ratio of the type contemplated by your question difficult to compute at this time. Commercial size synthetic fuel plants have not been built or operated in this country. While ERDA has

taken the position that the default ratio on loan guarantees for such plants would probably not exceed 25 percent, we have consistently taken the position that because of the small number of large loan guarantees involved and difficulties in predicting the likelihood of default, the total amount approved for loan guarantees should be shown in the budget.

Also, we believe that potential costs resulting from program additions beyond those shown in H.R. 12112 are uncertain and bear consideration. ERDA and the Administration to our knowledge have consistently taken the position that H.R. 12112 is the start of a needed \$6 billion synthetic fuels demonstration program which will ultimately be folded into the still larger concept of an Energy Independence Authority. Thus, the potential for price supports or other forms of subsidies to support plants where the output is not likely to be competitive with competing fuels sources must also be considered.

Question 2. Does the GAO response that their analysis would not be affected by the \$13.27 price of imported oil mean that the GAO analysis is insensitive to price changes? At what price of imported oil would the analysis be affected?

Answer. Our analysis of various technologies was based on the energy contribution they could make and on their cost effectiveness when compared to competing fuel sources. Thus, it is not insensitive to price changes and, as regards synthetic fuels, would be affected when the price of imported oil approximated the price of synthetic fuels.

Our price comparisons for synthetic fuels were made in current dollars, using \$12 as the price for imported oil. As discussed during the hearings, FEA has reported that in March 1976, the price of a barrel of imported oil ranged from \$11.71 to \$13.94 with an unweighted average price of \$13.22. While recognizing that the inclusion of this range and average price in our report would have been useful, the use of a \$13.22 figure would not have changed our conclusions regarding the cost effectiveness of synthetic fuels.

We should also note that certain cost estimates included in our report for synthetic fuels also were probably conservative. For example, on page 36, we cite the Synfuels Interagency Task Force's estimate of the regulated price of high-Btu synthetic gas of \$2.61 to \$3.02 per thousand cubic feet (MCF). More recent ERDA estimates in their March 1976 Fact Book on the Proposed Synthetic Fuels Commercial Demonstration Program estimates the cost of high-Btu gas at \$3.28 per MCF (about \$19 a barrel oil equivalent). We have also been made aware of a draft interim report by a consulting firm jointly funded by ERDA and the American Gas Association which shows ranges of estimated costs for various second-generation high-Btu coal gasification projects using Western coal that go considerably higher. However, we have been unable as yet to obtain a copy of the report so that we may review it in detail.

Question 3. How much information does your report have to inform the reader about H.R. 12112? Does the GAO feel that H.R. 12112 is the same as a major commercialization program? Is this distinction made in your report?

Answer. Our report did not focus specifically on H.R. 12112. As discussed in our report, there are a variety of bills before the Congress covering a wide range of objectives and financing techniques. But, no one bill focuses on all emerging energy technologies, considers all costs associated with development, or more importantly, attempts to focus on targets of proposed actions on some consistent priority basis.

We believed such a broad overall focus was needed and tried to provide it with our report. Even with regard to synthetic fuels, we believe it important to recognize that ERDA and the Administration have not changed their view that commitments to commercial size synthetic fuel plants beyond those in H.R. 12112 will be needed and that the program should ultimately become part of the proposed Energy Independence Authority.

Question 4. The GAO concludes that hydrothermal energy, municipal waste combustion systems, solar water and space heating, and tertiary oil recovery are cost-effective (p. 47).

(a) What is the cost-effective basis for each of those technologies?

(b) How much supply do you anticipate from each by 1985; by the year 2000?

Answer. (a) Each technology was compared with its competing energy source, as follows:

Hydrothermal—compared to the cost of electricity (page 32),

Municipal waste combustion compared to the combined cost of otherwise providing energy and disposing of the waste (page 25),

Solar water and space heating compared to electricity, and

Tertiary oil recovery compared to imported oil (page 29).

(b) In our report, we cite anticipated supply figures for each energy source from Scenario V in ERDA's National Plan (ERDA-48)—ERDA's most optimistic scenario regarding the potential of energy supply technologies.

Question 5. The GAO report recognizes that the industrial sector is the Nation's largest energy consumer. It also recognizes that the savings potential of this sector is more than double that of the residential sector (p. 18). The analysis does not appear to indicate, however, if the GAO feels that its conservation proposal will supply this sector with sufficient energy needed in the years ahead. What does the GAO propose for those industries which rely on dwindling supplies of natural gas?

Answer. In our conservation chapter we discussed the estimated savings to be captured by legislation and describe further opportunities for savings beyond those programs now in effect. Current GAO work in the conservation area indicates that only a small amount of the opportunities (including price induced conservation) for energy savings have been captured. To increase this savings many changes will be required such as restructuring utility rates and incentives for reducing industrial wastefulness. We also indicated that additional studies on a comprehensive across the board basis to further refine economic detail and identify favorable conservation actions seem desirable. We pointed out on page 13 of our report that the Executive Branch had contemplated at least two such studies but that one was not completed and one was not funded.

Our report, "Implications of Deregulating the Price of Natural Gas," OSP-76-11, January 14, 1976, pages 35-53, discusses in some detail the substitution potential for natural gas over the longer run. We believe there is significant potential for substitution and do not believe that any decrease in supply from an existing gas source must automatically be accompanied by an increase in reliance on synthetic fuels or liquid natural gas (LNG).

We also point out that synthetic natural gas under ERDA's most optimistic scenario, is expected to provide only 3.5 quads in 2000 out of a total gas demand of about 26 quads. If LNG were substituted for this under current Energy Resource Council guidelines (LNG not to exceed 10 percent of domestic gas production) it would virtually eliminate the need for high-Btu gas from coal. The remainder, about 1 quad or 4 percent of total gas supply, could easily be covered by substitutability steps (such as banning gas for boiler fuel use) over the next 20 years.

Question 6. Why did the GAO use a world oil price of \$12 (see page 36) rather than the present price for landed oil of \$13.50?

Answer. See our response to question 2.

Question 7. Would not a higher price affect some of your cost-benefit results and make some synthetic fuel technologies competitive?

Answer. See our response to question 2.

Question 8. Did you consider inflation and the favorable competitive effect which the large capital component of the synthetic fuel price will have? Because of the larger fixed capital component of the synthetic fuels prices, inflation will not increase that price as rapidly as other energy prices, such as oil.

Answer. We used current price estimates to compare synthetic fuels with competing energy sources of imported oil and liquified natural gas.

Estimates of the cost of providing synthetic fuels have risen substantially since the oil embargo. Further, as indicated in our answer to question 2, there still seems to be considerable uncertainty as to how high the cost of high-Btu gas from coal will go. In any case, it is unclear that a high capital cost is a benefit to fighting inflation. Synthetic fuels plants will be built over the years and will capture the inflation present at that time, exactly as any other plant would. Further, the recent trends in inflation have been disproportional, there being much greater inflation in capital intensive building than in the economy as a whole. Since synthetic fuels plants are highly capital intensive, this may further aggravate the disproportional inflationary effects.

Question 9. (a) Did the GAO use a figure of 5.8 (the conversion figure on a Btu basis) to compare prices of imported oil with substitute natural gas?

(b) If so, why did you not consider using the figure of "4" which the Office of Economics at the Federal Power Commission uses in comparing prices of oil with gas? (This lower figure reflects the premium which the marketplace puts on natural gas due to its versatility.)

Answer. We used the 5.8 conversion factor. We considered using a figure which would reflect the premium nature of natural gas, but concluded that be-

cause the comparison is between marginal supplies, actual Btu factors should be the major concern.

Fuel substitutability is also important. Since oil can in most instances substitute for natural gas the actual Btu factors provide in our view a more useful comparison.

Question 10. (a) On page 27, your report indicates that 1.5 million barrels per day may be provided by tertiary recovery. How current is this figure? In ERDA 76-1 (Vol. II, p. 37), this figure is listed as 500,000 barrels, or $\frac{1}{3}$ the GAO assumption.

(b) Since there is a 1 million B/D difference, how will this affect your conclusions as to the sufficiency of conservation and enhanced recovery to meet our National energy needs?

Answer. We consistently used in our report the estimates of potential impact of all new energy technologies from Scenario V of ERDA's National Plan (ERDA-48). Scenario V states a potential of 1.5 million barrels a day from tertiary recovery by 1985. In Volume 2 of ERDA's National Plan (ERDA-76-1), ERDA quotes a figure of an additional 500,000 barrels a day from tertiary recovery by 1985. Considering the almost 300,000 barrels a day now being recovered through tertiary recovery, this would bring total tertiary oil recovery by 1985 to close to 800,000 barrels a day.

The figures we quoted from ERDA-48 Scenario V (ERDA's most optimistic scenario) represents boundary or limiting case conditions. We used this optimistic scenario, which ERDA states is idealistic, to illustrate the estimates for the various technologies under the best of circumstances. ERDA-76 does not contain the complete information that ERDA-48 does. ERDA has stated that it is updating all figures on the potential of new technologies and hopes to include the updated figures in ERDA-77.

Further, there are other recent actions which are designed to stimulate tertiary production which would apparently affect future estimates. For example, in the recently passed Energy Conservation and Production Act, Congress revised the production incentive to the domestic composite crude oil price and directed that FEA, when applying the adjustment, give priority to providing additional price incentives for the bonafide application of tertiary enhancement technologies. FEA's most recent estimate of tertiary recovered oil in 1985 is 900,000 barrels a day. We understand that FEA is in the process of revising that number.

Question 11. You assume that incremental pricing is the best way to deal with all emerging energy technologies equally. However, the uses to which this fuel will be put may not be equal. For example, energy uses could be classified as substitutable, optional, expansional, and non-substitutable. Was a combination approach considered by GAO? That is, rolled-in prices for non-substitutable uses or to keep the pipelines full and then incremental prices for fuel devoted to substitutable or expansional uses?

Answer. We utilized the incremental pricing method as a yardstick to judge the various technologies on a priority basis for Government financial assistance and did not advocate either method for the actual product pricing.

We did not consider a combination approach in our report. We believe that in the timeframe considered in our report there exists potential for fuel substitution, particularly in the natural gas area. (See also the second and third paragraphs of our response to question 5.)

Question 12. Your report briefly mentions that price is an important concept in achieving effective energy conservation. You also stress the importance of explicit Government actions. If a price rise occurs, how do you see this interacting with the Government conservation programs already in place? Are you currently evaluating or estimating the relative importance of price induced conservation? Are such studies already available?

Answer. Obviously, energy price increases would increase the incentive for energy conservation. There are many uncertainties, however, about the exact effect of price increases due largely to a lack of hard evidence regarding the elasticity of demand for various types of energy.

In our discussion of energy conservation, we used the work of the Ford Foundation because it is still the most comprehensive assessment of energy available. The conservation estimates in the Technical Fix Scenario of that report were built up on an engineering basis, technology by technology, sector by sector, independent of overall supply and demand considerations. With only some minor modification, the conservation estimates could be overlaid on any supply/demand scenario and still remain valid. We have also strongly recommended that more up-to-date

comprehensive conservation studies be conducted. We have indicated in our report two such studies which the Executive Branch failed to complete or fund.

We currently have two major conservation efforts underway. One explores, among other things, various potential actions for additional conservation savings by Government contractors.

The other review is expected to address the following major questions: (1) are conservation programs working, (2) what additional incentives are needed by various sectors of the economy to effectively conserve, and (3) what the Federal role should be in establishing energy conservation policy and priorities. The report is also expected to discuss energy pricing as one incentive to achieving energy conservation.

Question 13. The letter from Dr. Seamans notes that the GAO refers to the production program authorized under H.R. 12112 as choosing or committing the Government to synthetic fuels. This Committee's report on the bill was clear to state that such was not the intent at all. What is the basis for your statement and impression?

Answer. While recognizing the more limited nature of H.R. 12112, it is important to note that ERDA and the Administration's position has not changed in that a large program of loan guarantees and other incentives for synthetic fuels is needed beyond that contained in H.R. 12112 and that this program should ultimately be folded into the proposed Energy Independence Authority.

Still H.R. 12112 would authorize loan guarantees for two commercial-size, high-Btu, coal gasification plants. Once these investments are made, we believe the Government would act to ensure their operation, irrespective of any difficulties encountered. As indicated in our report, we believe there are serious questions regarding such a commitment to uneconomic, high-cost supply technologies which substantially exceed the cost of imported oil. Since H.R. 12112 does not go to the issue of financing commercialization of synthetic oil from coal, additional legislation to stimulate that activity would appear consistent with the Administration's current approach to synthetic gas and oil shale.

Question 14. After concluding, on a cost-effective basis, that synthetic fuels plants should not be built at a commercial scale, the GAO then recommends that the Congress should favorably consider: (1) encouraging the installation of solar heating technologies, and (2) the construction and operation of smaller plants of a size sufficient to meet ERDA's stated goal of obtaining socio-economic, environmental, and regulatory information in a timely fashion.

Why did not the GAO present a similar cost-benefit analysis in urging consideration of their alternatives, as it did in rejecting commercialization of synthetic fuels plants?

Answer. In our report we addressed the cost effectiveness of the technologies in relation to their competing energy sources in order to establish a priority for Federal financial assistance and did not present a cost-benefit analysis as such.

Our conclusion regarding the possible construction of smaller plants was reached giving consideration to (1) ERDA's basic objective of identifying and resolving potential future socio-economic, environmental, and regulatory problems associated with synthetic fuels and (2) the economic unattractiveness of first-generation synthetic fuels technologies. We also recommend expanded research and development in synthetic fuels to improve the technologies.

We should also point out that ERDA's own study regarding the optimum size and mix of plants to meet its stated objectives will not be completed until October 1975. The study is under contract with Stanford Research Institute and represents the type of information which we previously suggested that the Congress should have available before making any decision on Government assistance for synthetic fuels demonstration plants. (See GAO report to Chairman Ken Hechler, House Subcommittee on Energy Research, Development, and Demonstration (Fossil Fuels), Committee on Science and Technology entitled "Comments on the Administration's Proposed Synthetic Fuels Commercialization Program," RED-76-82, 3-19-76.)

Question 15. The GAO names three key factors which should be considered in selecting energy technologies for commercialization. However, the GAO did not consider whether or not: (1) the energy product could be readily used in existing facilities, without extensive modifications; and (2) the relationship, both on an environmental and land use planning basis, of this energy technology to other energy options.

Please explain why these were not considered.

Answer. With regard to the first part of your question, we state our belief on page 46 of our report that the incremental cost standard is the only realistic one for making sound economic judgments and treating all emerging technologies equally. The only other measure which can be used is rolled-in pricing which would serve to average the real cost of a new supply source across a far larger volume of lower priced energy. A rolled-in yardstick would clearly favor synthetic fuels; likewise, it would clearly discriminate against such options as conservation and solar hot water and space heating. Using incremental cost to evaluate alternatives on the other hand, would reduce all of these options to the same test—the actual cost of the output from the new technology—and allow a consistent and rational process of choice on a cost effective basis.

We recognize that arguments regarding the need for high-Btu gas from coal in order to maintain the level of natural gas production in the United States are made. As indicated in a earlier answer to question 5, we believe that considering the timeframe involved there is a significant potential for substitutability as regards natural gas.

With regard to the second part of your question, we did not focus in detail on environmental and land use aspects of any of the technologies. We dealt instead with each of the technologies on the basis of the potential energy contribution in a given timeframe and their cost effectiveness in comparison to competing energy sources.







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