INCENTIVES FOR DEVELOPING NEW ENERGY SOURCES

HEARINGS

BEFORE THE

SUBCOMMITTEE ON ENERGY AND FOUNDATIONS

OF THE

COMMITTEE ON FINANCE

UNITED STATES SENATE

NINETY-FIFTH CONGRESS

FIRST SESSION

JUNE 20 AND 21, 1977

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INCENTIVES FOR DEVELOPING NEW ENERGY SOURCES

MONDAY, JUNE 20, 1977

U.S. SENATE,
SUBCOMMITTEE ON ENERGY AND FOUNDATIONS OF THE
COMMITTEE ON FINANCE,
Washington, D.C.

The subcommittee met, pursuant to notice, at 9:30 a.m. in room 2221, Dirksen Senate Office Building, Hon. Mike Gravel (chairman of the subcommittee) presiding.

Present: Senators Long, Gravel, Hansen, and Packwood.

Senator GRAVEL. The hearing will come to order.

[The committee press release announcing these hearings follows:]

[PRESS RELEASE]

SUBCOMMITTEE ON ENERGY AND FOUNDATIONS ANNOUNCES HEARINGS ON INCENTIVES FOR DEVELOPING NEW ENERGY SOURCES

Subcommittee Chairman Mike Gravel (D-Alaska) announced today that the Subcommittee on Energy and Foundations will hold hearings June 20 and 21 on federal incentives for developing new energy sources. The Subcommittee intends to focus on the development of conventional fossil fuel resources and the commercialization of new energy techniques.

The hearings will begin at 9:30 a.m., in room 2221, Dirksen Senate Office Building.

"Much attention has been given in recent months to the scarcity of our fossil fuels," Senator Gravel said. "The President has called for stringent conservation measures on the part of the American people, but he predicts continued reliance on imported oil to fill domestic energy needs. The Subcommittee hopes to explore how this American energy gap might be narrowed by reliance on our own untapped resources."

Noting the conflicting assessments of oil and gas reserves Senator Gravel said, "We intend to explore whether the President's Energy Program provides sufficient incentives in terms of pricing and taxation to encourage the development of untapped and undiscovered resources. An important part of our national energy program, according to Gravel, must be the development of our untapped energy resources in the United States. "I believe that in order to have a balanced energy program we must encourage production of our energy resources as well as encouraging conservation," said Gravel.

The Subcommittee will also inquire into the development of energy technologies which are in varying stages of commercial feasibility. These new energy sources, which include solar, geothermal, tertiary oil production, frontier outer continental shelf drilling, and coal gasification, can be important ways to augment conventional energy supplies. Senator Gravel said the Subcommittee would examine how close these new technologies are to the market and what incentives could bring them closer to commercialization.

The following witnesses have been scheduled to testify on Monday, June 20:

John H. O'Leary, Administrator, Federal Energy Administration.
Edwin Edwards, Governor of Louisiana.
Barry Commoner, Washington University.
Joseph Lindmayer, President, Solarex Corporation.
Paul Jones, Louisiana State University.

Witnesses for June 21 will be announced at a later date.

Senator GRAVEL. We are here today to discuss the President's energy bill, the opening volley in Mr. Carter's "moral equivalent of war." It is an historic occasion for a number of reasons. First, today oil will begin to flow through the Trans-Alaska Pipeline. That pipeline will deliver up to 1.2 million barrels of oil per day starting in October, and when at full capacity will deliver some 12 percent of our Nation's oil needs.

Projects like the Prudhoe Bay oilfield and TAPS line must become the rule, not the exception, if we are to meet our energy needs and decrease our dependency on foreign supplies. The companies which have participated in this project, the largest single project financed completely with private capital in the world, are to be complimented for their efforts and perseverance. The men and women who have worked on the pipeline have made their place in the history of American labor. This is a day for all Alaskans and all Americans to be proud.

These hearings, the first on this topic before the Senate Finance Committee Subcommittee on Energy and Foundations, will address the question of incentives for the production of oil and gas, as well as incentives for the development of alternative sources of energy. We have many distinguished witnesses who will be here to present their views on the President's proposal as they relate to energy sources such as oil and gas, coal gas, oil shale, nuclear and solar. We will hear from representatives of the administration, State government, universities, and industry.

The President deserves a lot of credit. He has taken a leadership role in the formation of energy policy in the United States. He has developed a package which he feels will resolve our long-term energy problems. He has called for sacrifices and is courageous in standing by that call. He has addressed the major areas of concern as he perceives them. He has recognized the important interrelationship between our needs for energy and our Nation's commitment to a healthy and clean environment.

But, the President's plan has raised concern for the development of our energy resources. The President himself has said that over the 3 or 4 months during which the energy package was being developed, before it came to us here on Capitol Hill, that there were many differences of opinion. He acknowledged that some of the judgments were quite closely called.

It is our function here to review some of the closely called judgments for ourselves to determine whether we agree with the call. Questions concerning the President's energy proposal have been raised which require answers before legislation can be adopted to deal effectively with our long-term energy situation.

For example, does the plan "write off" the oil industry as a short-term source of supply for our domestic energy needs? How many more Prudhoe Bays do we have in this country? Prudhoe Bays that if not for the provision of adequate incentives for exploration and development may never be brought to market.

By paying the true replacement costs of oil and gas, might we not find ourselves with a greater domestic supply and a decreased dependence on foreign sources? Does the rebate system really encourage consumers to decrease their use of energy? What are the environmental consequences of committing ourselves to using increased amounts of coal and nuclear energy as a short-term solution?

Many people are concerned about the long-term answers to the energy problem. Does the energy plan provide sufficient incentive to the development of alternative sources to energy such as solar, geothermal, hydropower, and the like?

Many of us are not sure it does. We will hear from some of them today. Perhaps there are additional significant supplies of domestic oil and gas, oil shale and methanol which can be produced if adequate prices for those products can be obtained, and if the replacement cost or Btu equivalent is permitted to be obtained.

Perhaps additional amounts and types of incentives should be provided to assure developments of clean, long-term sources of energy. I think so. Perhaps there should be additional incentives to encourage recycling of materials and to further our efforts to conserve existing sources.

There are a number of mechanisms that can be employed to help us meet our reasonable energy needs. The President has put forth some of those. Many of them have merit, in my opinion. Others of us would rather employ alternative mechanisms such as deregulation and creation of excess profits taxes to assure that increased revenues to the industry are used for increased exploration and development.

In addition, many of us would like to increase our Nation's emphasis on conservation and recycling. There are other approaches still, some of which may well be presented in these hearings and in any hearings we hold subsequently.

And that, of course, is the purpose of our being here today. We need to hear from all sectors of the "energy community." We need to define the problems in production and to understand the alternatives available to us in solving our energy supply problem.

We must understand the consequences of our choices in order to leave for our children and grandchildren a legacy of responsible use of our natural resources. We must take the time now to answer difficult questions so that we may adopt a unified, effective, long-range energy program that takes into account the realities of our world.

Let no one say that we have gathered here to destroy the President's energy program. If we should disagree with the President in approach, let me assure you that we do not disagree in objective. I, for one, wish to take up the President's challenge in this moral equivalent of war, to prove the ability of the President and the Congress to govern.

I think that it is important that we bring our efforts today into focus on this very, very serious and important subject.

Before going to our first witness, I would like to ask my colleague, who we are happy to have present, the chairman of the full Finance Committee, if he may have an opening statement.

Senator LONG. No; I think that was a very fine opening statement, Senator.

Senator GRAVEL. Senator Bellmon is our first witness.

Would you please proceed?

STATEMENT OF HON. HENRY BELLMON, A U.S. SENATOR FROM THE STATE OF OKLAHOMA

Senator BELLMON. Thank you.

Mr. Chairman, I would like to begin by congratulating the chairman of the subcommittee for holding these hearings, particularly on

this day which marks the beginning of the use of the Alaskan pipeline. This is certainly one of the most significant developments in our country's history as far as energy is concerned. I hope it will be only the first of many similar developments that we will see happen before the end of the century.

There is no question in my mind that the energy problem is going to be remembered by historians years hence as one of the greatest challenges in our governmental experience. It is a challenge that we should face squarely, Mr. Chairman. If it is a war, it is a war we can win—and a war we should win, because we have the resource base, the technology, and the trained manpower.

What is needed is the will and the means.

I have before me a newspaper story that was published in Oklahoma in The Daily Oklahoman on January 23 of this year, and the thrust of it is "State Wildcatters Tap Mother Lode."

There are a lot of people who have come to the conclusion that we do not have any oil left to be found in this country. This newspaper story turns out, in calendar year 1976—and before I give these figures, remember in Oklahoma, we have been producing oil now for almost 70 years. We have had over 300,000 wells drilled in the State, over 80,000 of them still producing.

Yet, last year, in calendar year 1976, there were 83 new oil and gas fields found in our State. Here is an old oil province that has been thoroughly picked over, yet last year there were 83 new oil and gas fields found.

These are the results of wildcatting activities. We have a success ration of finding new fields of 34-plus percent.

If you look back over the years, you find that percentage has been generally a little lower than that, sometimes about the same, the point being that there is still a lot more oil and gas to be found, even in the older provinces, such as Oklahoma. I am sure in the newer areas like Alaska, there is a tremendous amount of oil and gas to be developed if we can develop the means for the developers to go after it.

This is true in the offshore areas as well. The drilling has not gone on as long. The activity has not been as intense.

Mr. Chairman, President Carter has performed a valuable service by convincing a majority of the American people that the energy crisis does exist and by insisting that the problem and its solutions be debated now.

The President's objectives of reducing fuel use, of improving energy efficiency and of avoiding shortages in the future are sound. To obtain these objectives, the President has offered a program based on the conservation of energy by altering fundamental methods used in operating this country and conversion to an alternate fossil fuel—coal—which is bountiful but which is not yet available for use on the grand scale envisioned. His ultimate goal is the development of energy sources whch are replaceable or essentially unlimited.

I support this general concent; however, I fear that a significant defect of omission in the President's plan will produce the eventual failure of the program.

Recently, Phillips University, near my home in Oklahoma, conducted an energy forum attended by a diverse group of concerned

citizens representing varied ideologies. Among those attending was a staff member from the Workshop on Alternative Energy Strategies at the Massachusetts Institute of Technology. The staff member, William F. Martin, reported the MIT group had studied the energy situation and ascertained this:

> We conclude that, despite efforts in the next 25 years to reduce energy demand and shift to other fuels, the United States will be faced with oil imports of 10 million barrels daily by the year 2000.

This conclusion is basically the same assessment made in May by Dr. Hans H. Landsberg, an economist and senior fellow at Resources for the Future here in Washington. This conclusion is similar to those made by many analysts of the President's energy package.

The package presented to Congress contains no mechanism that would help to increase domestic production of oil and thereby reduce American purchases of crude oil in the world market. Taking into account the different conversion and conservation proposals forwarded by the President and hoping for their unparalleled success, we must still admit that the United States, without increased domestic oil production, will exert a tremendous pressure on the world market price.

If the United States chooses only two of the three strategies it must follow to develop true energy efficiency, then the country will be forced to buy gargantuan volumes of foreign crude, driving the world oil price to new, higher levels and creating disaster for the economies of Western Europe, Japan, and the developing countries.

The current shortage of oil and gas results not from exhaustion of the resource base but from an economic environment which has been discouraging development for the past 25 years and which encourages consumer waste today and may encourage waste in the future.

The President has proposed returning the cost of oil to its true replacement cost, and I agree with that. He has proposed using tax revenues from his plan for rebates to protect low- and middle-income Americans, and I agree with that.

It is possible to have people conserve enough energy that their energy bill will not go up. It might go down.

Last week, I introduced S. 1707 to provide a supplement to the President's crude oil equalization tax. The bill provides that the crude oil equalization tax be applied as a wellhead tax on oil. The bill further provides that this tax be imposed in the full amount immediately and that its collection be enforced by the Internal Revenue Service.

The tax would be assessed on each producing property and equal the difference—if any—between the current regulated price on a property and the posted stripper oil price for that property. The tax would be collected monthly and be remitted by the purchasers of crude oil. There are 137 purchasers who would remit and approximately 20,000 purchasers from whom the tax of some $16 billion would be collected.

The tax would be reduced by 2 percent of the original amount each month until it expires at the end of 50 months. This year, the Treasury will get roughly $16 billion from this tax. By reducing it at the rate of 2 percent a month over a course of 50 months, that tax would decline and finally end. At the end of the time, the producers would be getting the full replacement cost of the oil they were selling.

Provisions are made in the law that during these 50 months any of the "released" revenues that are not spent in the energy business—that are not plowed back—would be taxed away.

The tax revenues would be spent selectively to protect Americans from higher energy costs. This protection is designed to reduce domestic energy requirements so that as the transition ends, individual monthly energy bills will be less even though the units cost of fuel will be greater.

This would result in something like a 7- or 8- or 9-cent a gallon increase in the cost of energy to consumers.

Although the program for rebates of the wellhead tax is only now being reduced to legislative language, it is contemplated that distribution of energy tax proceeds would be made among four recipient groups: (a) home insulation tax credit; (b) fuel cost subsidy; (c) Federal purchase of fuel inefficient automobiles; and (d) subsidy for transport of foodstuffs.

I will not go into details. I have it as a part of the statement and I ask that it all be included in the record. The idea is to use these revenues to help insulate homes, pay the extra cost of heating and other types of energy and for the retirement of service of automobiles, to use the President's term "gas guzzlers" as well as the subsidies for those who transport foodstuffs. Foodstuffs are in a special category. There is no way for increased costs to be passed on, since producers do not set the price.

This proposal is meant as a supplement to the package offered by the President. I believe it will provide the economic climate to allow consumers to make rational decisions. Also, it will induce a reduction in energy use through the enhancement of the economics of energy saving measures and provide funds to make the transition possible.

Most important, the bill will help increase supply for the intermediate term before alternate sources become widely available, avoid shortages of conservation materials and get gas guzzlers off the road. In the long term this proposal will reduce U.S. dependence upon costly, insecure imports and provide thousands of energy related jobs for American workers.

Thus, as I said at the beginning, President Carter has performed a valuable service by raising the degree of public awareness of the Nation's energy situation. His emphasis on conservation is in the national interest. The one missing element in the President's program which will doom the entire thing to failure is lack of plans to increase energy production.

We still have ample fossil fuel sources, but until a method to bring these resources into production in a timely fashion is added to the President's program, the effort cannot succeed.

Using the wellhead tax as a method for enhancing conservation, at the same time providing additional capital in an orderly way for drilling more wells, opening more mines and producing more oil from existing as well as new sources will be the best means of going toward expanded energy production.

To conclude, Mr. Chairman, I have these attachments as a part of my statement. On January 1, 1970, in Oklahoma, we had, at that time, 1.39 billion barrels of oil in our proven reserves. Between January 1, 1970 and January 1, 1976 production in Oklahoma amounted to almost

1.2 billion barrels. In other words, we produced almost as much oil during that 5-year period as we had at the beginning, but reserves on January 1, 1976 were 1.24 billion barrels.

What really happened during that 5-year period of time in an oil-producing State like Oklahoma, we found almost as much oil as we produced, so we could not lower our reserves significantly. Much of this period was a time when oil prices were low, the level of activity was significantly down, and there was not a maximum effort being made to find the oil.

The point here is that there is a lot of oil left to be found in the country. I believe if we would provide the means for the industry to continue the high level of activities, we could become less dependent on imports.

I do not want to offer the impression that this offers us any permanent or lasting solution. We have to shift over to coal and oil shale and other forms of energy.

In the short term, between now and the end of the century, we can do a great deal to increase our oil production from our own domestic resources. I feel it will strengthen the President's program as I recommended to reach that objective.

Senator GRAVEL. Thank you very much.

Why is it you chose to present the 2-percent rate?

Senator BELLMON. That gives the industry the additional revenues at a rate that, after having discussed it with many leaders in the industry, at a rate that probably can be used, without touching off excessive costs in rigs or chemicals or other materials that go into the drilling of new wells.

In other words, this change will produce $16 billion a year increase in returns from oil. This goes to the Treasury, phasing in, as we do, that total amount would be available for drilling new wells and new mines. If you did it all immediately, it would touch off tremendous inflation in the cost of drilling or the cost of other energy activities; by using the 50-month period, it is generally felt that the industry can absorb capital at that rate without causing inflation or shortages.

Senator GRAVEL. Would you favor deregulating natural gas at the same time?

Senator BELLMON. The deregulation of natural gas will mean $1 billion a year to the producers. That can probably be absorbed, in addition to the amount of funds that comes from deregulating crude oil.

That is a different problem. I do not cover it in the legislation I have introduced. It does not present the problem of too much capital too soon that we have in decontrolled oil.

Senator GRAVEL. Have you given any consideration to the fact that all the money that you are handling here, the 2 percent, is going back to industry? The perception of the American public is that the industry is ripping it off presently.

Did you give any thoughts to an excess profits tax that may abate that perception?

Senator BELLMON. We have provision here for a plowback. That money has to be put back into development supplies, or it is taxed.

Senator GRAVEL. You have built in an excess-profits tax?

Senator BELLMON. That is right.

Senator GRAVEL. What percentage is involved?

Senator BELLMON. It is complete. It is either reinvested or all taxed.

Senator GRAVEL. That would come into being progressively as we move up to the full 100 percent?

Senator BELLMON. That is right.

We would go further. It is not a part of the bill, but in discussions since the bill was introduced, I would be agreeable to seeing the tax continue for 10 years to make certain that the industry continued maximum efforts in developing new supplies.

Senator GRAVEL. I am impressed with the escalating feature of this, and how it deals with the problems there would be with inflation.

Senator Long?

Senator LONG. Thank you very much, Senator Bellmon. The Senator made a very thoughtful statement.

Senator BELLMON. Mr. Chairman, there are other attachments, and I would like to make them a part of the record.

Senator GRAVEL. They will all be printed, along with your statement.

Senator BELLMON. Let me say one final thing. I was reading this morning in the "Oil and Gas Journal." In the week of June 3d this year, we had 1,990 rigs running, up 481 rigs from last year, or 31.8 percent. It shows that there are a lot of people who believe that we can find and produce more oil if we give it more resources.

We will see that amount of rigs doubled.

Senator LONG. I think I will ask one question.

Senator, as I understand it, we should be doing everything that we can to increase the production of coal and to expand production in other areas, solar, atomic—even though that may be more debatable. Is it not true that if we are going to expand our production of energy in the short run, the next 3 or 4 years, most of it is going to have to come from the increased production of oil and gas?

Senator BELLMON. Senator, there are only two places to get the energy we need—you say 4 or 5 years. I would say for the next 15 years—either by drilling at a rapid rate for oil and gas, or from imports.

We can never be sure we can depend on our imports. We might not be able to afford them.

To me, the only logical thing to do would be for us to vastly expand the development of our own energy resource base, which is still abundant and can be brought on quickly.

Senator LONG. In most of the areas where we are producing a lot of energy—I mention Louisiana because we have a similar problem to what you have in Oklahoma—the drilling has gone down to about 10,000 feet. But it is a rather new thing to drill down to 15,000 to 20,000 feet, although it is being done. Is that not correct?

Senator BELLMON. Senator Long, we have a well in Oklahoma that is 30,600 feet deep. It produces gas—what you say is true.

There are enormous possibilities for deeper drilling, but only when we have available the capital to pay the costs. Those deep wells, I might say, cost up to $6 million apiece.

Senator GRAVEL. If you would yield?

We just finished a well in Alaska that was 17,000 feet. It was capped and cost $27 million.

Senator LONG. That is the kind of thing that people are not fully aware of at this point. I can recall the days when my family, my

mother leading the charge, and my uncle on my mother's side, learned the oil business the way a lot of people did, without much education, but as roughnecks on the rig. When we thought we should put some of our money into a well and we looked at a cost of $50,000, we thought that was a pretty expensive well.

If you were going to go down deeper, perhaps $250,000 worth, we had to try to go in with a group, in order to finance going down to that depth.

Those wells, even then, at $250,000, were going down 7,000, 8,000 feet, but now, to go for the deeper production that is below that, people are drilling at about $2.5 million per well.

Even allowing for the change in the purchasing power of money, it is a far greater expense to go down to 15,000, 18,000, or 20,000 feet in search of the same oil and gas; deposits down there on the average are not better than at the shallower depth. You just have to go down deeper in trying to find them.

Does that not mean, in effect, that if you want this energy produced, you will have to make it sufficiently attractive for people to take the risk? The Congress, I am sure, with all good intentions, has tried to protect the public from a higher price for energy, and I am sure the public wants to be protected. Nobody wants to pay 1 penny extra for a gallon of gasoline beyond that which is absolutely necessary.

When people tell me we have already done a great deal, that we have 30 percent more rigs working than we did when this energy crisis began, it does not impress me at all. It seems that we should have at least 800 percent more rigs.

Is that your thought?

Senator BELLMON. Mr. Chairman, you are exactly right. It is like this year, 1977, there will be about 40,000 wells, oil and gas wells drilled in the United States. That is going to probably be enough wells to sort of hold us where we are. We may drop a little production, but we may gain a little.

We ought to be doing enough to start gaining, not necessarily dramatically, but noticeably in our domestic production and, in this way, begin to cut that kind of level of imports.

As you say, when all we are doing is running at the level now of 1990, we are not going to catch up. We are going to have to do a lot more than we are doing.

The only way to do it, actually two things have to happen: One, the price has to be an incentive; in addition, there has to be a lot of capital output to pay for these costs.

The industry is using all the capital they can get their hands on, including what they make plus what they can borrow. It is not possible to borrow money to go out and drill wildcats. You can get money after you are ready to drill and go into production.

No person who loans other people's money can afford to loan on wildcats. Those costs have to be paid out of profits.

Senator LONG. Let us look, for a moment, at the absolutely unthinkable alternative that this Nation rejected because it absolutely could not be done, one could not even think about it. Though it be heresy, let us just think about it for a moment.

Suppose, when the Arabs put the boycott on us, we had done with oil what we did with sugar when we thought ourselves in a tight

market with sugar. If we had let nature take its course, the price would have gone up to a point where everyone from the consumer point of view would have viewed it as unconscionable.

If that had happened, the industry would have made tremendous profits. It would have been perhaps right to describe them as windfall profits, but the profits would have remained in the industry. We have seen the same thing happen down through history: when some people make a large sum of money, the same charges and countercharges are heard.

But what would have happened to the profit?

Senator BELLMON. It would have gone back into mines, drilling, energy production.

Senator LONG. It is not likely that you would see Mobil taking its profit and investing in Montgomery Ward at that point. Anybody who puts money into an industry wants to get into it because of the freeflow of capital, which is fundamental to the free enterprise system. Anybody with money to invest would invest where the biggest profits were, so investment would go into production. There would be a lot less consumption of product because people would think that the price was too high. Is that a fair statement?

Senator BELLMON. That is exactly right.

Senator LONG. They would start carpooling, riding the bus, doing whatever they could to reduce the consumption of energy, using less of it in the home, and the price would go back down again. Is that fair?

Senator BELLMON. That is true, although it probably will take a little longer to increase our supply of oil and gas than it took to increase sugar supplies. We are talking about probably a 10- to 20-year period here.

Senator LONG. I recall when the sugar situation got out of hand; in short order it was clear that farmers were going to plant more sugar. The feeling was that if you were going to make some money on sugar, you had better get to it in a hurry, because everybody was making money in the sugar business. There was a big increase in production. Although the price went up to an unconscionable point, about 60 cents a pound, the result was that all our farmers planted more sugar, farmers around the world planted more sugar, the price went up to about $1 a pound. Now, it is back to 10 cents a pound.

That is how the free enterprise system tends to operate when left alone. When a very profitable activity develops, people go into it to produce more.

Are you aware of the fact that it has taken us until about a year ago to get the profits of the oil and gas industry above the average profits for all manufacturing?

Senator BELLMON. Mr. Chairman, that is true. In addition to that, if you take the price of old oil that companies are now getting from the wells that were in operation before the embargo, take out the royalty, that amounts to 75 cents a barrel, private tax, income tax, operating costs, that leaves the producer only $1.85 a barrel left over from the oil in these old wells. It costs $6 a barrel to find a new source of new supply of oil.

Every time a company produces and sells a barrel of old oil, it gets only enough revenue to find a third that much. That is one thing that is causing difficulty. There just is not a sufficient cashflow to do

all the drilling that has to be done to not only hold our own, but start gaining.

Senator LONG. I just want to make it clear that I voted for a number of bills—I think you did too, Mr. Bellmon—that prevented the free enterprise system from making available unconscionable profits for oil and gas producers. But when we look at how the system would have worked and what we went to as an alternative, one would have thought that at a minimum we would have tried to provide enough incentive that the people who were in that business would make enough profit to provide us with answers to our problem, by attracting capital from other areas into the oil industry.

My question is, have we made it sufficiently attractive to persuade people to go into the oil business rather than into other activities?

Senator BELLMON. Mr. Chairman, we have not. When you look at the number of rigs running, the 1990 level, more than it was when the embargo hit, you might get the impression that we have done enough. A lot of those rigs are drilling gas wells for the intrastate gas market, which we both know is three times as high as the interstate price. And even though the 1990 is an increase, it is still not enough. We have to double that again to get where we need to be.

The answer to your question is, we have not done enough, either in providing the price incentive or providing the capital that industry has to have to get the job done.

Senator LONG. Thank you very much.

Senator GRAVEL. Thank you, Senator Bellmon.

[The prepared statements and attachments of Senator Bellmon follow. [Oral testimony continues on p. 29.]

STATEMENT OF SENATOR HENRY BELLMON

Mr. Chairman, the energy problem undoubtedly will be remembered by historians years hence as one of the great challenges in our governmental experience begun 201 years ago.

President Carter has performed a valuable service by convincing a majority of the American people that the energy crisis does exist and by insisting that the problem and its solutions be debated now.

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I support this general concept; however, I fear that a significant defect of omission in the President's plan will produce the eventual failure of the program.

Recently, Phillips University near my home in Oklahoma conducted an energy forum attended by a diverse group of concerned citizens representing varied ideologies. Among those attending was a staff member from the Workshop on Alternative Energy Strategies at the Massachusetts Institute of Technology. The staff member, William F. Martin, reported the MIT group had studied the energy situation and ascertained this:

"We conclude that, despite efforts in the next 25 years to reduce energy demand and shift to other fuels, the U.S. will be faced with oil imports of 10 million barrels daily by the year 2000."

This conclusion is basically the same assessment made in May by Dr. Hans H. Landsberg, an economist and senior fellow at Resources for the Future here in Washington. This conclusion is similar to those made by many analysts of the President's energy package.

The package presented to Congress contains no mechanism that would help to increase domestic production of oil and thereby reduce American purchases of

crude oil in the world market. Taking into account the different conversion and conservation proposals forwarded by the President and hoping for their unparalleled success, we must still admit that the United States, without increased domestic oil production, will exert a tremendous pressure on the world market price.

If the United States chooses only two of the three strategies it must follow to develop true energy efficiency, then the country will be forced to buy gargantuan volumes of foreign crude, driving the oil price to new, higher levels and creating disaster for the economies of Western Europe, Japan and the developing countries.

The current shortage of oil and gas results not from exhaustion of the resource base but from an economic environment which has been discouraging development for the past 25 years and which encourages consumer waste today and may encourage waste in the future.

The President has proposed returning the cost of oil to its true replacement cost, and I agree with that. He has proposed using tax revenues from his plan for rebates to protect low and middle income Americans, and I agree with that.

Using these basic ideas, I introduced a bill (S. 1707) to provide a supplement to the President's "Crude Oil Equalization Tax."

The bill provides that the Crude Oil Equalization Tax be applied as a wellhead tax on oil. The bill further provides that this tax be imposed in the full amount immediately and that its collection be enforced by the Internal Revenue Service.

The tax would be assessed on each producing property and equal the difference—if any—between the current regulated price on a property and the posted stripper oil price for that property. The tax would be collected monthly and be remitted by the purchasers of crude oil. There are 137 purchasers who would remit by the purchasers of crude oil. There are 137 purchasers who would remit and approximately 20,000 producers from whom the tax of some $16 billion would be collected.

The tax would be reduced by two percent of the original amount each month until it expires at the end of 50 months.

Proyisions are made in the law that during these 50 months any of the "released" revenues that are not spent in the energy business—that are not plowed back—would be taxed away.

The tax revenues would be spent selectively to protect Americans from higher energy costs. This protection is designed to reduce domestic energy requirements so that as the transition ends, individual monthly energy bills will be less even though the unit cost of fuel will be greater.

Athough the program for rebates of the wellhead tax is only now being reduced to legislative language, it is contemplated that distribution of energy tax proceeds would be made among four recipient groups:

A. home insulation tax credit;
B. fuel cost subsidy;
C. Federal purchase of fuel inefficient automobiles; and
D. subsidy for transport of foodstuffs.

A. Home Insulations Tax Credit

Section 1101 of the Administration's energy proposal allows a tax credit for qualified residential energy conservation expenditures of 25 percent of the first $800 expended and 15 percent of the next $1,400 for a maximum credit of $410. The credit would be nonrefundable, i.e., could not exceed a taxpayer's tax liability. The proposal covers cooperative housing but not condominiums.

The Belmon proposal differs from the Administration's proposal in the following major ways.

1. The Federal government will pay 90 percent of the first $1,000 and 50 percent of the next $1,500 of qualified home energy saving devices for individuals in the $7,000 and below adjusted gross income class. The Federal government will allow credits of 50 percent of the first $1,000 and 25 percent of the next $1,500 for individuals in the $7–15 thousand adjusted gross income class. The Federal

government will allow a credit of 30 percent of the first $1,000 and 20 percent of the next $1,500 for individuals above $15,000 of gross income. Qualified energy saving devices are: (1) attic insulation, (2) wall insulation, (3) floor insulation, (4) duct insulation in unheated areas, (5) storm windows, (6) storm doors, (7) weather stripping, (8) vapor barriers, (9) clock thermostats, (10) flue dampers, and (11) burner modifications.

The need for the progressive nature of the benefits is indicated in Tables 1 and 2 attached (prepared by the Joint Committee on Taxation for the House Ways and Means Committee). Note that:

(a) Response by lower income tax brackets is markedly less than higher brackets.

(b) It will require considerable financial inducement in the lower brackets to encourage such expenditures.

(c) CBO has indicated little additional responsiveness to insulation credits. However, any responsiveness will be gained at the lower end of the income scale.

(d) Even so, some payment is required to reduce the prospect of unnecessary expenditures.

The regional breakdown of home ownership by income class within and outside metropolitan areas is shown in Table 3.

2. The payment is refundable, that is, can be made in excess of tax liability. For certain home owners in lower income tax brackets, it would be impossible to provide adequate weatherization without payment should the cost of the weatherization exceed what they owe in taxes and, thus, under the Administration proposal, payment not be made. This adds only moderately to the cost of the program.

3. The Bellmon proposal would allow the credit for condominium home owners, as well as single detached and cooperative housing units.

4. Under the Bellmon proposal, individuals making qualified weatherization expenditures on rental property would receive a tax credit of 30 percent of the first $1,000 and 20 percent of the next $1.500 of qualified weatherization expenditure. This tax credit would be refundable.

The increased utilization of the credit under the progressive credit system, broadened coverage, and the expanded benefits under the program would considerably increase monies rebated through the weatherization program under this proposal.

Rough staff estimates are:

Tax expenditure 1978–82 for weatherization

[In millions of dollars]

1978	550
1979	650
1980	675
1981	700
1982	725
1978–82	3300

B. FUEL COST SUBSIDY

Low-income families are hit particularly hard by increased fuel costs. The Bellmon proposal would grant a refundable tax credit to families based upon electric, utility gas, tank gas, fuel oil, or coal utility bills. The payment would equal 25 percent of the home owner's utility bills. Renters whose utility costs are included in rent would be allowed 7 percent of their annual rental payments. Both credits would have a maximum of $150. The payments could be phased out proportionately over a range of $10,000 to $20,000 of adjusted gross income.

The cost would be about $5.2 billion in the year in which the program commenced, and would escalate depending upon utility costs and participation about $500 million/year thereafter. However, the program is phased out over a 50 month period. Full benefits would accrue the first year, 75 percent benefits the second, 50 percent benefits the third, and 25 percent benefits the fourth. Total tax expenditures would thus be:

Fuel cost subsidy 1978–82

	Billions
1978	$5.2
1979	4.3
1980	3.2
1981	1.7
1982	
1978–82	14.4

C. FEDERAL PURCHASE OF FUEL INEFFICIENT AUTOMOBILES

Fuel efficiency for automobiles over eight years old is considerably less on average than newer cars. Table 5 indicates the diminishing fuel economy of new through 1974 cars. Untuned or high mileage used cars would have considerably less efficiency now.

A federal purchase and disposal of eight year or older automobiles and trucks assuming 50 percent participation in the program and an average blue book value of $700/auto would entail a one-time Federal expenditure of $10.1 billion. For automobiles five years old having a general blue book value of $800, the cost would be $22.8 billion. Viable guidelines would have to be instituted should this amount be excessive. The sale of scrap and miscellaneous parts would offset as much as one-fourth of this outflow, however.

It is obvious that the government will be unable to purchase all of the "gas guzzlers" and the program will be concentrated on those which consume the most gasoline.

D. SUBSIDY OF PRODUCTION AND TRANSPORT FOR FOODSTUFFS

Raw and processed foods have a unique production distributional problem. Transportation and fuel costs are a large portion of producer, hence consumer, costs. Because of the necessity of a plentiful and well-apportioned supply, producers and transporters will require some subsidy to soften the inflationary impact in product markets. The Bellmon proposal allows a tax credit against corporate and individual tax liabilities for bonafide foodstuff production and transportation of 8¢/gal. (or equivalent Btu usage) in the first year; 6¢/gal. in the second; 4¢/gal. in the third, and 2¢/gal. in the fourth. The attached Tables 6 and 7 show agricultural usage and total projected petroleum usage used in cost estimates.

The tax expenditure estimates themselves are shown below:

Subsidy for food stuffs production and transport

	Billions
1978	$1.2
1979	0.9
1980	0.6
1981	0.3
1982	
1978–82	3.0

This proposal is meant only as a supplement to the package offered by the President. I believe it will provide the economic climate to allow consumers to make rational decisions. Also, it will induce a reduction in energy use through the enhancement of the economics of energy saving measures and provide funds to make the transition possible. Most important, the bill will help increase supply for the intermediate term before alternate sources become widely available, avoid shortages of conservation materials and get gas guzzlers off the road. In the long term this proposal will reduce U.S. dependence upon costly, insecure imports and provide thousands of energy related jobs for American workers.

SECTION-BY-SECTION ANALYSIS OF S. 1707

(The Bill is an amendment to the Internal Revenue Code of 1954 and the Emergency Petroleum Allocation Act of 1973.)

Section 1. Wellhead tax on domestic production of crude oil

"Sec. 4991. Imposition of tax.

Provides for the imposition of an excise tax at the wellhead for domestic crude oil production.

Tax is imposed on the person entitled to the deduction for depletion.

Tax is to be collected and remitted by the purchaser of crude oil.

"Sec. 4992. Amount of tax.

The tax is the lesser of (1) the difference between the current posted stripper oil price and the controlled price on the property, or (2) the difference between the stripper oil price in the month of determination and the current controlled price on the property. [Example.]

(1) Current stripper price	12.00
Controlled price	5.00
Indicated tax	7.00
(2) Future stripper price	14.00
Controlled price	5.00
Indicated tax	9.00

Therefore the tax is (1) $7.00/barrel since it is the lesser.

The tax is reduced at the rate of 2 percent of the original amount each month until it is extinguished in 50 months.

Leases on the North Slope of Alaska are exempt from the tax.

Properties which become productive after the date of this legislation will be treated as though they were "new" properties on April 20, 1977, i.e. priced at about $11.28/barrel, and the tax adjusted according to the phased tax schedule.

"Sec. 4993. Plowback requirement.

It is required that the owners of the operating mineral interest reinvest all of the difference between the tax which would have been paid if the tax had not been phased down and the tax actually paid (subject to adjustments for increased royalty payments, taxes, and operating costs) in the development of energy sources. If not so spent the tax is increased by the unspent amount.

A carryforward and carryback provision is provided. The Carryforward cannot extend past January 1, 1983.

If insufficient money was spent in 1978, generating a tax, then that tax could be offset in later years by spending more funds than were required in that year. Carryback.

If too much money was spent in 1978, creating a surplus for the purposes of the plowback, then that credit could be a CARRYFORWARD to future years to reduce expenditures in that year and still avoid the Plowback tax.

"Sec. 4994: Definitions and Special Rules.

Section defines: Base Price, Removal Price, Posted Stripper Oil Price, Crude Oil, Domestic, Barrel, United States, Possession of the United States, Offshore, Members of Affiliated Group Treated as One Person, and Liability for Tax in Case of Certain Production Payments.

"Sec. 4995. Record and Information; Regulations.

Records and Information must be maintained by the person liable for the tax.

Regulations will be established by the Secretary.

"Sec. 6076. Time for Filing Return of Tax.

Quarterly tax return will be filed no later than 45 days following end of the quarter.

"Sec. 6050. Information Furnished by Purchaser and Operator Regarding Wellhead Tax on Domestic Oil.

The purchaser of the crude oil is required to furnish information to the owners of the tax collected and paid for the property, the volumes of oil removed from the property, and any other information required by the Secretary. Criminal penalties are provided, for failure to comply.

"Sec. 7242. Willful Failure to Furnish Certain Information Regarding Wellhead Tax on Domestic Crude Oil.

Provides penalties for willful failure to provide timely information.

"Sec. 6050C. Information to be Furnished to Partners and to Beneficiaries of Estates and Trusts.

Requires any necessary information requested by Secretary.

Section 2. Termination of authority to specify prices, or to prescribe a manner for determination of prices of crude oil.

The authority of the President to specify prices or to prescribe the manner for determining prices, for crude oil, residual fuel oil, and refined petroleum products produced in (or imported into) the United States under section 4 of the Emergency Petroleum Allocation Act of 1973 and the authority to establish ceiling prices or the manner for determining ceiling prices for first sales of crude oil produced in the United States under section 8 of such Act may not be exercised after December 31, 1977.

OKLAHOMA

DRILLING

Since the beginning of the Oil Industry in Oklahoma there have been 302,473 wells drilled. Of these 188,524 were oil wells, 26,815 were gas wells, and 87,134 were dry holes.

On January 1, 1976, 72,543 of the oil wells were still producing, as were 10,436 of the gas wells.

As was shown elsewhere the oil reserves in the State have been maintained with only a slight reduction since January 1, 1970. The production rate has declined due to the loss of the flush production on secondary units, and a drilling rate below the optimum.

A tabulation of drilling and oil prices is interesting.

Year	Total	Service	Dry	Gas	Oil	Oil price
1976	4,024	174	1,027	711	1,827	9.00
1975	3,429	131	1,142	573	1,583	8.00
1974	2,767	120	1,027	654	966	6.74
1973	2,101	103	745	461	792	3.89

There is a direct correlation between the rising price of crude oil and the increased drilling rate. Likewise as the number of wells drilled has increased the success ratio has improved.

This increase in activity, and the increase in success are largely responsible for the ability to maintain reserves, and slow production decline.

One thing which must be remembered is that the peak drilling year in Oklahoma was 1920 when 9,097 wells were drilled, and again in 1954 when 8,786 wells were drilled. Of interest is that the price of crude oil in 1920 was $3.07/barrel. That peak was not reached again until 1969. The excess production developed in the formerly free market successfully reduced price.

ANNUAL ADDITIONAL INDUSTRY REVENUE FROM THE PHASED OUT WELLHEAD TAX

FORMULA

Old oil volume (stripper price-old oil price) (1-average tax rate) (364 Days) = Gross industry revenue from old oil
New oil volume (stripper price-new oil price) (1-average tax rate) (365 Days) = Gross industry revenue from new oil

	Billions
Year 1:	
3.640 times (13.50–5.05) (.12) (365)	$1.347
3.500 times (13.50–11.25) (.12) (365)	.345
Total	1.692
Year 2:	
3.420 times (13.50–5.05) (.36) (365)	3.797
3.890 times (13.50–11.25) (.36) (365)	1.150
Total	4.947
Year 3:	
3.210 times (13.50–5.05) (.60) (365)	5.940
4.260 times (13.50–11.25) (.60) (365)	2.009
Total	8.039
Year 4:	
3.020 times (13.50–5.05) (.84) (365)	7.824
4.610 times (13.50–11.25) (.84) (365)	3.180
Total	11.004
Year 5 (2 Mos.):	
2.840 times (13.50–5.05) (.98) (60)	1.411
4.930 times (13.50–11.25) (.98) (60)	.652
Total	2.063
Total 50 months	27.745

ADDITIONAL NET REVENUE TO INDUSTRY AFTER ROYALTY, STATE AND LOCAL TAXES (ESTIMATED)

	Billions
Year 1: 1.692 (.74)	$1.252
Year 2: 4.947 (.74)	3.661
Year 3: 8.039 (.74)	5.949
Year 4: 11.004 (.74)	8.143
Year 5: 2.063 (.74)	1.527
Total	20.532
Year 5 (10 months)	7.640
Year 6	9.160
Year 7	9.160
Year 8	9.160
Total January 1, 1978 to January 1, 1986	55.650

OKLAHOMA

RESERVES

On January 1, 1970 the estimate of recoverable reserves was 1.390 Billion Barrels for the State.

Between that date and December 31, 1975 production from the State totaled 1.177 Billion Barrels.

Reserves estimated on January 1, 1976 were 1.240 Billion Barrels.

A tabulation of these facts result in:

	Billion barrels
Reserves Jan. 1, 1970	1.390
Production 1970–75	−1.177
Reserve additions	+1.027
Reserves Jan. 1, 1970	1.240

There are reserves left to be found in even the old mature producing areas of the United States.

The drilling rate must be increased to improve the producing rate with new "flush" production.

Efforts toward Tertiary (Enhanced Oil Recovery) oil have not yet been effective in increasing either Oil Reserves or Oil Producing rates.

One of the factors that might be noted is that if the Industry had stopped in their drilling efforts in 1969 the State of Oklahoma would have no oil reserves remaining today. This is an oversimplification, but is indicative of the point.

ANALYSIS OF PRODUCTION

[In millions of barrels of oil per day]

	1977	1978	1979	1980	1981	1982	1983	1984	1985
Administration:									
Old	3.870	3.490	3.130	2.790	2.470	2.180	1.900	1.640	1.390
New	3.090	2.900	2.730	2.570	2.420	2.270	1.130	2.010	1.890
New-new		.400	.760	1.080	1.370	1.630	1.870	2.080	2.270
Stripper	1.000	1.150	1.300	1.450	1.600	1.750	1.900	2.050	2.200
Prudhoe	.500	1.300	1.800	2.000	2.000	2.000	1.900	1.800	1.700
Total	8.460	9.140	9.720	9.890	9.860	9.830	9.700	8.580	9.450
Bellmon amendment:									
Old	3.870	3.640	3.420	3.210	3.020	2.840	2.670	2.510	2.460
New	3.090	3.500	3.890	4.260	4.610	4.930	5.230	5.520	5.790
New-new									
Stripper	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Prudhoe	.500	1.200	1.800	2.000	2.000	2.000	1.900	1.800	1.700
Total	8.460	9.340	10.110	10.470	10.630	10.770	10.800	10.830	10.850
Additional		.200	.390	.580	.770	.940	1.100	1.250	1.400
Annual additional (billions of barrels)[1]		.073	.142	.212	.281	.343	.402	.456	.511

[1] This represents the daily production increase in the United States from the Bellmon amendment.

	Billion barrels
Total savings 1978–85	2.420
Future savings for discovered reserves	4.600
Total reduction in imports	7.020

	Billions
Value of imports at $13.50	$94.770
Cost* (Cost/Barrell=$7.93)	55.650

*Assumes all exploration stops at Jan. 1, 1986.

ANNUAL FEDERAL-TAX FROM THE PHASED OUT WELLHEAD TAX

FORMULA

Old oil volume (stripper price—old oil price) (average tax rate) (365 days) = tax revenues from old oil

New oil volume (stripper price—new oil price) (average tax rate) (365 days= tax revenues from new oil

	Billions
Year 1:	
3.640 × (13.50–5.05) (.88) ×365	$9.879
3.500 × (13.50–11.25) (.88) ×365	2.529
Total	12.408
Year 2:	
3.420 × (13.50–5.05) (.64) ×365	6.751
3.890 × (13.50–11.25) (.64) ×365	2.045
Total	8.796
Year 3:	
3.210 × (13.50)–5.05) (.40) ×365	3.960
4.260 × (13.50–11.25) (.40) ×365	1.399
Total	5.359
Year 4:	
3.020 × (13.50–5.05) (.16) ×365	1.490
4.610 × (13.50–11.25) (.16) ×365	.606
Total	2.096
Year 5:	
(2 mos.)	
2.840 × (13.50–5.05) (.02) ×60	.029
4.930 × 13.50–11.25) (.02) ×60	.013
Total	.042
Total 50 months	28.701

Disposition of wellhead tax revenues

	Billions
Full home insulation credit	$3.000
Fuel subsidy cost	14.000
Purchase of fuel inefficient autos*	8.000
Transport and foodstuffs subsidy	3.000
Total	28.700

Energy savings million barrels/year

The savings represent the full effect of the program with the understanding that some of the savings would have occured in any event.

	Millions of barrels/year
Full home insulation credit	180.0
Fuel subsidy cost	0
Purchase of fuel inefficient autos	71.4
Transport of foodstuffs subsidy	0
	Years
Total	251.4
Value	$3.4
	Billions
Time required to return national investment	8.4

*Assumes purchase of 8 million cars with average 12 mpg, at $1,000 each, with replacement by cars with 22 mpg, both driving 10,000 miles per year.

[From the Sunday Oklahoman, Jan. 23, 1977]

STATES' WILDCATTERS TAP 'MOTHER LODE'

(By Suzanne West)

Oklahoma wildcatters tapped the mother lode in 83 pools during 1976 to score a 34-plus per cent success ratio, The Sunday Oklahoman's annual survey shows. Of the 243 exploratory operations tried, 31 opened new oil pools, 52 found gas and 160 were abandoned.

The year was better than 1975. Last year, 222 exploratory operations were completed resulting in 24 new gas pools and 27 oil pools. The other 161 tries were abandoned.

During 1974 there were 209 wildcats drilled with 59 pools opened. And, in 1973, 174 wildcats were completed with 62 new pools opened.

In Beckham County, MRT Exploration Co. opened the Southwest New Liberty field with completion of its No. 1 Kirtley Unit in C NE SE of 19–10n–24w.

The pool opener was drilled to 24,482 feet and completed for 8,288,000 cubic feet of gas per day through a 13–64-inch choke from perforations in the Upper Morrow at 15,877 to 16,305. feet.

Perforations in the Hunton at 24,042 to 25,304 feet were treated but due to mechanical difficulties failed to produce. The Hunton was plugged off and the St. Genevieve was opened at 21,706–710 feet as well as the St. Louis at 21,964–984 feet but nothing productive was found.

A final plug back of 16,721 feet was made for the Upper Morrow completion.

MRT is now active at a west confirmation to its discovery.

The MRT discovery was one of two tries made in Beckham County. The other was on 18,500-foot failure.

Of note in Wheeler County, Tex., was a new pay horizon opened in the Mills Ranch field by Chevron Oil Co. at its No. 1 James in 20 L, J. M. Lindsey survey. The Arbuckle (new pay) was perforated at 22,928 to 23,938 feet to make an absolute open flow potential of 31 million cubic feet of gas, per day. The regular pay for the field, the Hunton, was perforated at 20,749 to 21,330 feet to make an open flow of 72 million cubic feet of gas per day.

The other three western Oklahoma counties of Roger Mills, Custer and Washita tallied five failures and 10 gas discoveries.

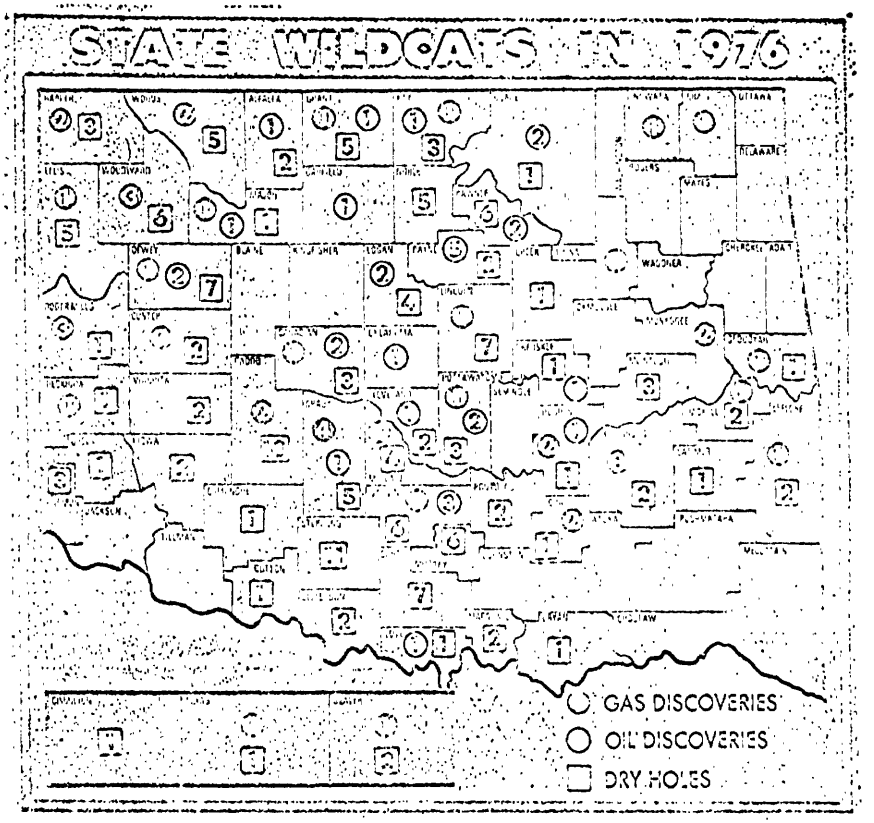
Both tries in Washita County were abandoned. One of the failures was Forest Oil's No. 1 Bob White Unit in NW SW NE SW of 16–8n–16w, about three miles north of the Northwest Gotebo field. The operation was abandoned at 22,665 feet. The hole had been whipstocked more than once, and finally had to be abandoned when casing parted.

Of the nine tries made in Custer County, two were abandoned. The other seven made gas wells.

One of the best of the Custer County discoveries was Michigan Wisconsin Pipe Line's No. 1 Bates in C NW of 20–14n–16w, which opened the Southeast Anthon field. Perforations in the Springer at 13,438–468 feet flowed 7,300,000 cubic feet of gas per day through a 12–64-inch choke. The zone also produced nine barrels of condensate and three barrels of load water.

Roger Mills County totaled three gas wells and one deep well temporarily abandoned.

The West Cheyenne field was opened with Helmerich & Payne's No. 1 Lester Unit in C SW of 9–13n–24w, about three miles southwest of Northwest Cheyenne.



Balancing the 1985 Energy Accounts

(By Hans H. Landsberg[1])

Only now that the government has released its pamphlet entitled "The National Energy Plan" is it possible to learn how the energy accounts are to come into balance by 1985. While it is a highly readable booklet, those in a hurry can go to the 96th of its 103 pages and find it all spelled out in a handy little statistical table. What they will discover is not quite what the government presentations, beginning with the President's April 18 television address, had led them to expect.

Three noteworthy findings emerge. First, while widely proclaimed as relying mainly on conservation, the plan is not all that conserving. Without it, energy consumption by 1985 would rise by 31 percent; with it, by 25 percent. The difference could be made good by importing an extra 2 million barrels of oil per day.

Second, the soul of the plan is not so much to shift from using more to using less energy, as from burning oil and gas to burning coal.

[1] Dr. Landsberg is an economist and senior fellow at Resources for the Future, a nonprofit research organization in Washington.

Third, while one would expect it to stress measures to boost coal production, the plan contents itself with the statement that coal production is principally demand-limited and directs most of its effort at reducing oil and gas use.

Now let us dig a little deeper. The administration's statistics show energy demand to rise from 74 quadrillion Btu's, or "Quads," to 93 Quads in 1985—an average annual rate of growth of just over 2.5 percent. That's not an implausible figure, given long-term historic growth rates around 3.5 percent, though the exponential growth, given enough time, even fractions of 1 percent have quite a kick. Thus small differences in assumptions can have large consequences, especially when so much turns on hitting the plan's 1985 bull's eye: oil imports held down to 7, or hopefully 6, million barrels per day.

On the supply side, the plan's center ring is occupied by coal. Between 1976 and 1985 production is expected to increase to about 1,225 million tons, up from 665 million tons in 1976; probably by more, if, as is likely, the share of low-Btu Western coal increases substantially. Raising coal output in the next nine years by 560 million tons will require more than ordering utilities and industry generally to burn coal or making it costly for them not to do so.

Similar past efforts have come to naught in the face of the companies' resistance, based on environmental, technological, and economic grounds. The plan hopes to cope with this by reversing the burden of proof; that is, the utilities must show cause why they cannot shift to coal. It is easy to foresee that enough of them will engage in prolonged and quite possible successful efforts to show such cause as to frustrate the objective.

It is worth noting that in its long history the bituminous coal industry has never produced more than it did in 1976. Its previous peak output year was 1947 when it mined 631 million tons of coal. Now every added ton produced sets a new record. Consequently, not only must mining companies grow, but all facilities associated with coal, including, prominently, transportation and manpower, must grow apace. State/federal conflicts must be resolved, the aspirations of the Indian tribes controlling large amounts of Western coal have to be reconciled, land-use and restoration practices must be established, and so on.

That, in this context, the coal industry can raise output by an annual average of 60 million tons is highly unlikely, if not outright impossible. That the energy plan fails to even address these issues is a major flaw. That its success rides on achieving something close to the announced goal is certain.

Three more domestic supply items are specified to help meet 1985 demand. Domestic oil production, in decline since reaching a peak in 1970, must rise by 12 percent; natural gas production, in decline since 1974, must not dip by more than 7.5 percent; and nuclear energy must nearly quadruple. What are the chances of all this coming true?

For oil, the hopes are pinned on output from Alaska, from the Outer Continental Shelf, and from so-called enhanced recovery, that is, squeezing out oil from old reservoirs. The top Alaskan oil supply cannot be more than the pipeline can carry, that is, 2 million barrels per day. Net additions from Outer Continental Shelf reservoirs will depend on the pace and volume of leasing in the next two or three years. Leasing beyond that time will not produce much by 1985. Expectations from enhanced recovery have traditionally been high and achievements low. There are some 300 billion barrels of oil left over in old reservoirs, but technology has for decades failed to come to their rescue.

For natural gas, the principal source to supplement depleting gas reservoirs is the Outer Continental Shelf. Therefore, the postulated decline of less than 8 percent appears optimistic. We will do well to slip no faster.

The plan's nuclear objective is not within reach. It takes 10 years or more to get a nuclear power plant on the line. Thus, no plant not now at least on the order books of the equipment manufacturer can be counted into the 1985 capacity. At most 130,000 megawatts (up from 42,000 at the end of 1976) is a reasonable guess. The plan figure is high by 20 to 25 percent, or about 1.5 Quads.

In summary, the chances of achieving domestic targets so that the accounts can be balanced by oil importation of no more than 14 Quads—7 or, if demand can be further compressed, 6 million barrels per day—are about nil. Coal and nuclear are bound to fall short of their targets perhaps by as much as a combined 6 Quads, and lagging oil production is almost sure to raise that figure by another Quad or two. Thus, the plan will easily need an extra 7 to 8 Quads.

Barring much more drastic conservation measures, such as import quotas and/or rationing, they can come only from additional oil imports: 3.5 to 4 million barrels per day of oil above and beyond the target, or total 1985 oil import volume of 10.5 to 11 million barrels—if we are lucky, that is.

Once the proposed 1 billion barrels of oil have been placed into strategic storage, this is not a "wrong" outcome. Rather, what is wrong is not to face the near certainty that the target cannot be reached within the plan's time frame and with the measures proposed.

If Congress can stop staring at the gasoline tax, it might usefully focus on the demand/supply balance sheet of 1985. In the process it might decide that 7 million barrels a day is not an immutable objective and, equally important, that 1985 is awfully close, especially since much of 1977 will be consumed in writing legislation. Though curbing demand might get tougher after the mid-80s when the short-term conservation measures have been put in place, supply expansion calls for a longer time perspective.

The 1985 time frame coupled to the 7 million barrel import target is a self-imposed straitjacket. Loosening it could lead to a more realistic assessment.

President Carter's energy plan in numbers

	1976 Quads*	1985 Quads*
Demand	74.0	92.8
Supply:		
Domestic:		
Oil, including NGL	19.4	12.2
Natural gas	19.0	17.6
Coal	15.8	29.0
Nuclear	2.0	7.6
Hydro, refinery gain, etc	3.8	4.6
Total	60.0	80.0
Imports (net):		
Oil	14.6	14.0
Natural gas	1.0	1.2
Coal	—1.6	—2.4
Total	14.0	12.8

*1 Quad=1 quadrillion British thermal units. Converted from million barrels of oil per day as in "The National Energy Plan," p. 96.

[S. ——, 95th Cong., 1st sess.]

A BILL To amend the Internal Revenue Code of 1954 to provide a wellhead tax on oil

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. WELLHEAD TAX ON DOMESTIC PRODUCTION OF CRUDE OIL.

(a) IN GENERAL—

(1) Amendment of subtitle D.—Subtitle D (relating to miscellaneous excise taxes) is amended by adding at the end thereof the following new chapter:

"Sec. 4991. Imposition of tax.
"Sec. 4992. Amount of tax.
"Sec. 4993 Plowback requirement.
"Sec. 4994. Definitions and special rules.
"Sec. 4995. Records and information; regulations.

"SEC. 4991. IMPOSITION OF TAX.

"(a) IMPOSITION OF TAX.—There is hereby imposed on the domestic production of taxable crude oil removed from the premises during each taxable period an excise tax as provided in this chapter.

"(b) BY WHOM PAID.—Except as provided in section 4994(f) (relating to production payments), the tax imposed by this section shall be paid by the person entitled to the deduction under section 611 for depletion with respect to the crude oil, as the case may be.

"SEC. 4992. AMOUNT OF TAX.

"(a) GENERAL RULE.—

"(1) AMOUNT.—The amount of the tax imposed by section 4991 for each of the 50 calendar months beginning after December 31, 1977, is the product of—

"(A) the amount determined by multiplying a fraction, the numerator of which is 50 minus the number of calendar months ending after

"(1) IN GENERAL.—The number of barrels of crude oil to which the tax is being made, and the denominator of which is 50, by the lesser of—

"(i) the excess of the posted stripper oil price for the property for the month of April, 1977, over the base price for the property for the month of December, 1977 or

"(ii) the excess of posted stripper oil price for the property for the month for which the determination is being made over the base price for the property for the month of December, 1977,

multiplied by

"(B) the number of barrels of taxable crude oil removed from the property in such month.

"(2) TAXABLE PRODUCTION.—Paragraph (1) shall be applied separately with respect to the taxable crude oil production from each property.

"(b) FRACTIONAL PART OF BARREL.—In the case of a fraction of a barrel, the tax imposed by section 4991 shall be the like fraction of the amount of such tax imposed on a whole barrel.

"(c) TAXABLE CRUDE OIL.—

"(1) IN GENERAL.—The number of barrels of crude oil to which the tax imposed by section 4991 applies for any calendar month shall be the number of barrels removed (or deemed removed) from the premises for such month.

"(2) TAXABLE CRUDE OIL LIMITED TO CERTAIN DOMESTIC CRUDE OIL.—For purposes of this subsection, crude oil which—

"(A) is not domestic crude oil, or

"(B) is produced from a property located north of the Brooks Range in, or offshore of, Alaska, shall not be treated as taxable crude oil.

"(d) NEW OIL PRODUCTION.—Subsection (a) shall be applied to taxable crude oil which is new production (within the meaning of section 212.72 of title 10, Code of Federal Regulations, as such section was in effect on April 20, 1977), and which did not exist on April 20, 1977, by treating such oil as if it were taxable crude oil produced from a field which was in production in the month of April, 1977, the base price and posted stripper oil price of which were, under regulations prescribed by the Secretary, the prices which would have been the appropriate prices for the location of the field and the grade and quality of the oil.

"SEC. 4993. PLOWBACK REQUIREMENT.

"(a) GENERAL RULE.—The tax liability of a taxpayer under this chapter for a taxable year shall be increased by the amount by which his net qualified investment for the taxable year (adjusted under subsection (d)) is exceeded by the difference between—

"(1) the amount of tax for which he would have been liable under section 4991 for months ending with or within the taxable year if—

"(A) the numerator of the fraction described in section 4992 (a) were 50 for each of such months, and

"(B) taxable crude oil which is new production (within the meaning of section 4992(d)) were not taken into account, and

"(2) the amount of the tax actually paid by the taxpayer for the taxable year under such section.

"(b) APPLICABILITY OF REQUIREMENT.—The provisions of this section apply only to the extent that the tax liability of the taxpayer under section 4991 is attributable to an operating mineral interest (as defined in section 614 (d)) of the taxpayer. In the case of a taxpayer whose liability for tax under section 4991 is partially attributable to such an interest and partially attributable to a nonoperating mineral interest (as defined in section 614 (e)(2)), this section shall be applied, under regulations prescribed by the Secretary, only with respect to such tax liability, such investment items, and such other items as are properly allocable to the operating mineral interest.

"(c) QUALIFIED INVESTMENT.—For purposes of this section, a taxpayer's qualified investment for any taxable year is the amount paid or incurred by such person during such taxable year (with respect to areas within the United States or a possession of the United States) for—

"(1) intangible drilling and development costs, or geological and geophysical costs of oil and gas wells and geothermal deposits or wells,

"(2) the construction, reconstruction, erection, or acquisition of the following items but only if the original use of such items begins with such person:

"(A) depreciable assets used for—

"(i) the exploration for or the development or production of coal, oil, or gas (including development or production from oil shale),

"(ii) converting oil shale, coal, or liquid hydrocarbons into oil or gas, or

"(iii) refining oil or gas (but not beyond the primary product stage),

"(B) pipelines for gathering, transmitting, or distributing oil or gas, and facilities (such as pumping stations) directly related to the use of such pipelines,

"(3) secondary or tertiary recovery of oil and gas,

"(4) the acquisition of oil, gas, or coal leases (other than producing leases), and

"(5) the discovery, development, or utilization of any other energy source (including amounts paid or incurred for the acquisition of depreciable assets and for the construction, reconstruction, or erection of facilities in connection therewith).

"(d) NET QUALIFIED INVESTMENT.—For purposes of this section, the term 'net qualified investment' means the amount by which the qualified investment of the taxpayer for the taxable year exceeds the average qualified investment of the taxpayer for the three preceding taxable years.

"(e) ADJUSTMENTS TO NET QUALIFIED INVESTMENT.—

"(1) IN GENERAL.—For purposes of subsection (a), the net qualified investment of the taxpayer for the taxable year shall be increased by the sum of—

"(A) the sum of the additional amounts paid or incurred by the taxpayer as royalty, severance, property, or similar taxes attributable solely to the amount by which the removal price of taxable crude oil removed from the property of the taxpayer during the taxable year exceeded the base price with respect to which the amount of tax for the property for months ending within or with the taxable year was computed under section 4992 (a), and

"(B) the product of—

"(i) the number of barrels of taxable crude oil other than oil which was new production (within the meaning of section 4992 (d) or which was production from a stripper well property (as defined in section 212.54 (c) of title 10, Code of Federal Regulations, as such section was in effect on April 20, 1977)) removed from the property during months ending with or within the taxable year, multiplied by

"(ii) the monthly inflation adjustment for the property for the taxable year.

"(2) MONTHLY INFLATION ADJUSTMENTS.—For purposes of this subsection, the term 'monthly inflation adjustment' means—

"(A) with respect to any taxable crude oil which is old crude oil (within the meaning of section 212.72 of title 10, Code of Federal Regulations, as such section was in effect on April 20, 1977), one-third of one percent of the base price for the property, and

"(B) with respect to new crude oil (within the meaning of such section as in effect on such date), one-sixth of one percent of the base price for the property, multiplied by the number of calendar months which have ended since December 31, 1977, and before the month for which the inflation adjustment is being made.

"(f) CARRYOVER AND CARRYBACK OF QUALIFIED INVESTMENT.—If the amount of a taxpayer's net qualified investment (adjusted under subsection (d)) for any taxable year ending after December 31, 1977, and before January 1, 1983, exceeds the amount necessary to reduce his liability for the year under section 4993 (a) to zero, the excess shall be—

"(1) a net qualified investment carryback to any preceding taxable year ending less than 24 months before the year in which excess occurs, and

"(2) a net qualified investment carryover to any subsequent taxable year ending before January 1, 1983.

Any such excess shall be carried to the earliest taxable year to which it may be carried, and shall be treated, without further adjustment under subsection (d), as net qualified investment for that taxable year.

"SEC. 4994. DEFINITIONS AND SPECIAL RULES.

"(a) BASE PRICE.—For purposes of this chapter, the term 'base price' means, with respect to any property, the average removal price per barrel of crude oil removed from the property in the month of December, 1977, determined by dividing the total removal price of all crude oil removed from the property in such month by the total number of barrels of crude oil removed from the property in that month. If the removal and sale of crude oil from a property for the month of December, 1977, was de minimus, or otherwise atypical for the property or insufficient for the establishment of a base price for the property, data from the last previous month of normal production and sales shall be substituted for the data from the month of December.

"(b) REMOVAL PRICE.—For the purpose of this chapter—

"(1) IN GENERAL.—Except as otherwise provided in this chapter, the term 'removal price' means the amount for which the barrel is sold.

"(2) SALES BETWEEN RELATED PERSONS.—In the case of a sale between related persons, the removal price shall be not less than the constructive sales price for purposes of determining gross income from the property under section 613.

"(3) OIL REMOVED FROM PREMISES BEFORE SALE.—If crude oil is removed from the premises before it is sold, the removal price shall be the constructive sales price for purposes of determining gross income from the property under section 613.

"(4) REFINING BEGUN ON PREMISES.—If the manufacture or conversion of crude oil into refined products begins before such oil is removed from the premises—

"(A) such oil shall be treated as removed on the day such manufacture or conversion begins, and

"(B) the removal price shall be the constructive sales price for purposes of determining gross income from the property under section 613.

"(5) MEANING OF TERMS.—As used in this subsection, the terms 'premises' and 'refined product' have the same meaning as when used for purposes of determining gross income from the property under section 613.

"(c) POSTED STRIPPER OIL PRICE.—For purposes of this chapter, the term 'posted stripper oil price' means—

"(1) for purposes of clause (i) of section 4992 (a) (1) (A), with respect to a stripper well property (as defined in section 212.54 (c) of title 10, Code of Federal Regulations (as such section was in effect on April 20, 1977)), the removal price of crude oil removed from the property on April 20, 1977, or the most recent previous date on which crude oil was removed from the property if none was removed on April 20, 1977, and

"(2) for purposes of clause (ii) of such section, with respect to such a property, the posted stripper oil price as determined under traditional business methods prevailing in the industry.

"(d) OTHER DEFINITIONS.—For purposes of this chapter—

"(1) CRUDE OIL.—The term 'crude oil' includes a natural gas liquid recovered from a gas well in lease separators or field facilities.

"(2) DOMESTIC.—The term 'domestic', when used with respect to crude oil, means crude oil produced from an oil well located in, or offshore of, the United States or in, or offshore of, a possession of the United States.

"(3) BARREL.—The term 'barrel' means 42 United States gallons.

"(4) UNITED STATES.—The term 'United States' has the meaning given to such term by paragraph (1) of section 638 (relating to Continental Shelf areas).

"(5) POSSESSION OF THE UNITED STATES.—The term 'possession of the United States' has the meaning given to such term by paragraph (2) of section 638.

"(6) OFFSHORE.—The term 'offshore' means the area of the United States, or a possession of the United States, which extends seaward (or into the Gulf of Mexico) from—

"(A) the line of ordinary low water along that portion of the coast which is in direct contact with the open sea (or the Gulf of Mexico), or

"(B) the line marking the seaward limit of inland waters (or such waters' boundary with the Gulf of Mexico).

For purposes of the preceding sentence, the line of ordinary low water shall be such line as heretofore or hereafter modified by accretion, erosion, or reliction.

"(e) MEMBERS OF AFFILIATED GROUP TREATED AS ONE PERSON.—If two or more corporations are members of an affiliated group making a consolidated return with respect to the tax imposed by chapter 1 for a taxable year or years which include any entire month, such corporations shall be treated as one person for purposes of the tax imposed by section 4991, and the plowback requirement of section 4993, for such month.

"(f) LIABILITY FOR TAX IN CASE OF CERTAIN PRODUCTION PAYMENTS.—If a portion of the crude oil removed from a property is applied during the taxable year in partial or complete discharge of a production payment which—

"(1) qualifies as an economic interest in the property, and

"(2) is not limited by time or to a specified number of barrels, but will be fully discharged only when a specified dollar amount (plus interest or other charges, if any) has been received by the holder of the production payment,

then the tax imposed by section 4991 on such portion of the crude oil shall be paid by the operator of the property and not by the holder of the production payment.

"SEC. 4995. RECORDS AND INFORMATION; REGULATIONS.

"(a) RECORDS AND INFORMATION.—Each person liable for tax under section 4991, each partnership, trust, or estate producing domestic crude oil, each purchaser of domestic crude oil, and each operator of a well from which domestic crude oil was produced, shall keep such records, make such returns, and furnish such information with respect to such oil as the Secretary may by regulations prescribe.

"(b) REGULATIONS.—The Secretary shall prescribe such regulations as may be necessary to carry out the purposes of this chapter."

(2) CLERICAL AMENDMENT.—The table of chapters for subtitle D of such Code is amended by adding at the end thereof the following new item:

"Chapter 45. Wellhead tax on domestic crude oil.".

(b) TECHNICAL AMENDMENTS.—

(1) The first sentence of section 164(a) of such Code (relating to deduction for taxes) is amended by inserting after paragraph (5) the following new paragraph:

"(6) The wellhead tax imposed by section 4991.".

(2) The first sentence of section 613(a) of such Code (relating to percentage depletion) is amended by inserting before the period at the end thereof a comma and the following: "and (in the case of oil wells) reducing such gross income by the amount of the tax imposed by section 4991 (relating to wellhead tax.).".

(c) TIME FOR FILING RETURN OF WELLHEAD TAX.—

(1) Part V of subchapter A of chapter 61 of such Code (relating to time for filing returns and other documents) is amended by adding at the end thereof the following new section:

"SEC. 6076. TIME FOR FILING RETURN OF TAX.

"Each return of the tax imposed by section 4991 (relating to wellhead tax) for any calendar month shall be filed not later than the 45th day following the close of the calendar quarter for such month.".

(2) The table of sections for such part V is amended by adding at the end thereof the following new item:

"Sec. 6076. Time for filing return of wellhead tax.".

(d) CERTAIN INFORMATION REQUIRED TO BE FURNISHED.—

(1) GENERAL RULE.—Subpart B of part III of subchapter A of chapter 61 of such Code (relating to information concerning transactions with other persons) is amended by adding at the end thereof the following new section:

"SEC. 6050B. INFORMATION FURNISHED BY PURCHASER AND OPERATOR REGARDING WELLHEAD TAX ON DOMESTIC CRUDE OIL.

"(a) CERTAIN INFORMATION FURNISHED BY PURCHASER.—Under regulations prescribed by the Secretary, the purchaser of domestic crude oil (within the meaning of section 4994(d)) shall furnish to the person liable for tax under

section 4991 with respect to such oil or gas a monthly statement showing the following:

"(1) the amount of taxable domestic crude oil and natural gas purchased from such person during such month,

"(2) the amount of such person's liability for tax under section 4991 with respect to such oil and gas, and

"(3) such other information as may be required by regulations prescribed by the Secretary.

"(b) INFORMATION FURNISHED BY OPERATOR.—Unless regulations prescribed by the Secretary, if the purchaser of domestic crude oil and the operator of the well from which such crude oil was produced make a joint election under this subsection, the monthly statement required to be furnished by the purchaser under subsection (a) shall be furnished by such operator.

"(c) TIME FOR FILING MONTHLY STATEMENT.—Each monthly statement required to be furnished under subsection (a) or (b) for any month shall be furnished before the first day of the second month which begins after the close of such month.

"(d) CERTIFICATION FURNISHED BY OPERATOR.—Under regulations prescribed by the Secretary, the operator of the well from which crude oil subject to the tax imposed under section 4991 was produced shall certify (at such time and in such manner as the Secretary shall by regulations prescribe) to the purchaser the base price (within the meaning of section 4994(a)) with respect to such crude oil. For purposes of section 6652(b) (relating

"(c) CROSS REFERENCES.—

"(1) For additions to tax for failure to furnish information required under this section, see section 6652(a).

"(2) For penalty for willful failure to supply information required under this section, see section 7242.".

(2) TECHNICAL AND CONFORMING AMENDMENTS.—

(A) Subsection (a) of section 6652 of such Code is amended—

(i) by striking out "or" at the end of paragraph (2),

(ii) by inserting "or" at the end of paragraph (3),

(iii) by inserting after paragraph (3) the following new paragraph:

"(4) to furnish a statement, information, or a certification under section 6050B (relating to information furnished by purchaser and operator regarding wellhead tax on domestic crude oil) or section 6050C (relating to information to be furnished to partners and to beneficiaries of estates and trusts), as the case may be,", and

(iv) by inserting after "paragraph (2) or (3)," the following: "or failing to furnish a statement, information, or a certification referred to in paragraph (4),".

(B) The table of sections for subpart B of part III of subchapter A of chapter 61 of such Code is amended by adding at the end thereof the following new item:

"Sec. 6050B. Information furnished by purchaser and operator regarding wellhead tax on domestic crude oil.".

(e) CRIMINAL PENALTY FOR FAILURE TO FURNISH CERTAIN INFORMATION.—

(1) IN GENERAL.—Part II of subchapter A of chapter 75 of such Code (relating to penalties applicable to certain taxes) is amended by adding at the end thereof the following new section:

"SEC. 7242. WILLFUL FAILURE TO FURNISH CERTAIN INFORMATION REGARDING WELLHEAD TAX ON DOMESTIC CRUDE OIL.

"Any person who is required under section 6050B (or regulations thereunder) to furnish any statement, information, or certification to any other person and who willfully fails to furnish such statement, information, or certification at the time or times required by law or regulations, shall, in addition to other penalties provided by law, be guilty of a misdemeanor and upon conviction thereof, shall be fined not more than $1,000, or imprisoned not more than 1 year, or both.".

(2) Clerical amendment.—The table of sections for such part II is amended by adding at the end thereof the following new item:

"Sec. 7242. Willful failure to furnish certain information regarding wellhead tax on domestic crude oil.".

(f) INFORMATION FURNISHED BY PARTNERSHIP, TRUSTS, AND ESTATES.—

(1) Information to be furnished to partners and to beneficiaries of estates and trusts.—Subpart B of part III of subchapter A of chapter 61 of such Code is amended by adding at the end thereof the following new section:

"SEC. 6050C. INFORMATION TO BE FURNISHED TO PARTNERS AND TO BENEFICIARIES OF ESTATES AND TRUSTS.

"(a) REQUIREMENT.—Under regulations prescribed by the Secretary, each partnership, estate, and trust required to file a return pursuant to section 4995 for any taxable period shall furnish to each partner or beneficiary, as the case may be, a written statement showing the following:

"(1) the name of such partner or beneficiary,

"(2) information received by the partnership, trust, or estate pursuant to section 6050B,

"(3) such partner's or beneficiary's distributive share of the items referred to in paragraph (2), and

"(4) such other information as may be required by regulations prescribed by the Secretary.

"(b) TIME FOR FURNISHING WRITTEN STATEMENT.—Each written statement required to be furnished under this section with respect to any month shall be furnished before the first day of the second month following the close of the calendar quarter.".

(2) Clerical amendment.—The table of sections for such subpart B is amended by adding at the end thereof the following new item:

"Sec. 6050C. Information to be furnished to partners and to beneficiaries of estates and trusts.".

(g) EFFECTIVE DATE.—The amendments made by this section shall take effect on January 1, 1978.

SEC. 2. TERMINATION OF AUTHORITY TO SPECIFY PRICES, OR TO PRESCRIBE A MANNER FOR DETERMINING PRICES FOR CRUDE OIL.

The authority of the President to specify prices or to prescribe the manner for determining prices, for crude oil, residual fuel oil, and refined petroleum products produced in (or imported into) the United States under section 4 of the Emergency Petroleum Allocation Act of 1973 and the authority to establish ceiling prices or the manner for determining ceiling prices for first sales of crude oil produced in the United States under section 8 of such Act may not be exercised after December 31, 1977.

Senator GRAVEL. Our next witness is Mr. John O'Leary, Administrator of Energy, Federal Energy Administration.

Mr. O'Leary?

STATEMENT OF JOHN H. O'LEARY, ADMINISTRATOR, FEDERAL ENERGY ADMINISTRATION

Mr. O'LEARY. Mr. Chairman, I have a relatively lengthy statement that I would like to submit for the record, if I may, and I would like to brief it in just a few minutes.

First of all, there has been a great deal of criticism of the President's national energy plan on the basis that was just repeated. It stresses the conservation side, the fuel efficiency side, does not provide sufficient incentives for the development of additional resources we are going to need, we know we are going to need, in the near and, indeed, the midterm.

Those criticisms are not well-founded. Indeed, as we take a look through the plan, we find that there is a very, very substantial set of incentives for the development of additional coal production in this country. You know the coal conversion program, you know the tax incentives that will be used in order to achieve this objective.

There are plans afoot to increase significantly the role of nuclear power over time. Of course, there is implicit in the plan a very substantial effort now going forward under the auspices of ERDA to bring on major new technologies—I am thinking of solar, biomass, windpower, as well as refinements in existing technologies, liquefaction of coal, the production of liquids from oil shale, the production of gases from coal, high and low Btu.

Mr. Chairman, I think that we have given strong attention to the supply side of the equation. I regard this as an evening up or redressing the balance where too long this country has talked about supply incentives without talking about the conservation initiative. I think we are going to find this absolutely essential to us in the next 15 years.

Mr. Chairman, I am particularly concerned with the generally felt view that there are insufficient incentives for the production of oil and gas. I would like to spend a few minutes on a discussion of that here.

If we look back over the history that we just recounted with Senator Bellman, we do find activity is substantially above what it was 5 or 6 years ago. As a matter of fact, it is running just under 2,000 rigs active, about 90 percent, roughly, of available rigs. Given downtime, repairs, and shifts from job to job, that represents essentially 100 percent of the capacity for the rig industry.

That has gone up from about a count of ninety 5 years ago. We have doubled, essentially, the number of active rigs in the last 5 years.

We have found with that, Mr. Chairman, a little bit better than a doubling of cost. I was talking to a producer on Friday. He was telling me, for example, that workover rigs 18 months ago cost $35 an hour; today, they are $100 an hour because of the usual supply-and-demand imbalance, a limited supply of rigs, manpower, and a very strong demand. Indeed, as we look across the industry we find there is differential inflation proceeding in the oil industry now. Rates are going up 15 to 20 percent, even 25 percent a year, depending on what you want to measure.

Mr. Chairman, I think there is every sign right now that the existing set of incentives are such to elicit just about all the activity, all the expansion of activity that you can have in an orderly structure here. I think we should bear that in mind when we address the elements of the plan that deal with incentives of oil and gas reserves.

At today's price of gas and oil, it brings out all of the activity that the current infrastructure of the oil industry can stand. In our discussions with people who manufacture rigs, there is a planned expansion between 200, 250 rigs annually. We will be going up at quite a rapid rate in rig activity, so long as those incentives were permitted to stand.

Mr. Chairman, we then have to look at the nature of the current investment in the oil industry. Unfortunately, it tends to be quite conservative.

There is a very high rate of successful completions that indicates a conservative investment policy is being practiced by the industry. We are finding, for example, that a good deal of current activity is going toward resources that were discovered, in fact, some years ago. For example, here again, I was talking to some gas producers in Texas who were describing the sorts of targets they are going after now. They are going after a quarter billion feet, a half billion feet, that were found in the course of exploratory activity 10, 15, 20 years ago and

not economic. You could not complete them at then prices of 15 to 17 cents Mcf. People knew where they were. They are going back to get them right now. They contracted intrastate prices particularly to connect those.

You can run through a small deposit of that nature, a line spur that will pick them up. That is the investment we are finding on the one hand.

On the other, in my own State of New Mexico, we are finding the 7070 was upheld by Judge Leventhal's decision last week. We will find a tremendous increase in infill drilling in the San Juan basin. This will not add to overall production over time. It will cause producability in the short run to increase. It will not make significant additions to reserves. It is very useful to have that additional producability.

But, Mr. Chairman, that really does not run to the heart of our problem to find additional reserves. For that reason, Mr. Chairman, we have sought even further incentives than those that are incorporated in the present system and are eliciting this very high level of activity, which is to say we are suggesting in addition to the attractive price that is incorporated of a roughly $1.50 Mcf, for any sort of new gas that comes down, for the so-called new-new gas, gas from new wells, from new fields as denominated by the 2½-mile thousand-foot rule, the price will be $1.75; and for oil from new fields to meet that same definition it will be the world price.

From the standpoint of incentives, we can argue whether the gas price should really be $2, where it is at the highest in the contracts in the interstate markets; or $1.75, which reflects the average of prices in the interstate market in recent years, and we can ask ourselves whether or not we should continue to follow OPEC for oil instead of taking the $13.50 now, and only going up at the rate of inflation.

But I think, Mr. Chairman, you have to conclude that those two initiatives in the President's energy plan represent additional strong incentives in a market that is already characterized by extremely high incentives.

I want to put those points very clearly on the record, Mr. Chairman. I think there is simply no evidence to show that there is either today a lack of incentive for drilling generally, witnessing the fact that everything that we have is running wide open, or lack of cash flow, in order to support drilling rates.

I was interested in Senator Bellmon's proposal for scaling up, for example, the amount of money that would be shifted under his scheme of deregulation from consumers to producers. There was implicit recognition in that scale up of the point that I am making. The infrastruc- currently cannot accomodate additional large blocks of money. There is every indication now, were we to put another $5 to $15 billion into the producers hands, they would simply bid up the prices of these limited factors of production, as indeed they have been significantly bidding them up for the last few years.

What we should really concentrate on here is not the philosophy; should we, or should we not have a decontrolled environment; everything else being equal, all of us would vote for decontrol, if it did not have very serious side effects. But rather, with an analytical approach of what is happening in the oil industry today and what should be happening.

In answer to the last question, what should be happening is we should be going as far as we can as fast as we can to develop these new oil and gas resources that we are going to need over the next few years. Indeed, as far ahead as we can see and of course, the point that has been made before, there is still plenty out there to be found. We agree with that. We think there is at least as much to be found as we have found already. There is an enormous target out there. The administration's plan provides the incentives to do it.

The second question, in addition to the incentives, are there sufficient moneys in the industry to make the necessary drilling possible? The answer to that, I believe, Mr. Chairman, is that there is simply no evidence, zero evidence today, that cash flow difficulties today are constraining activity in the oil and gas producing business, rather the lack on the one hand of targets, particularly on the Outer Continental Shelf areas where, for one reason or another, we have not been able to get to frontier areas—it is true in your own State of Alaska as well and, on the other hand, a lack of the necessary infrastructure, the trained manpower and the rigs, to permit the conventional offshore drilling to continue at desirable rates.

I think the plan addresses both of those problems and, in a summary, it is just about right to meet the Nation's energy requirements.

Thank you for that. I will be glad to answer any questions you may wish to ask.

Senator GRAVEL. Thank you very much, Mr. O'Leary. I certainly hold you in personal high esteem. I think most Members of Congress first give that statement when they are about to disagree with a person, and certainly the statements I make are not a reflection of the high esteem that I do hold you in.

If I were to take your statement at face value, that everything is just rosy, then that belies actually what is happening in the Nation today, that every day that goes forward, we are importing more and more from abroad.

I wonder if you agree with that basic tenet that there is a lot of oil and gas yet to be discovered and it is not being pursued vigorously enough. Unfortunately you come to us with the figures on rig counts that I think can be very self-serving to any policy you want.

Where we are at difference is over philosophy. When we use the words "analytical approach," I think what you are saying is that persons in Government like yourself are sincerely, with their best efforts, trying to analyze all of the various possibilities that could occur in the entire energy industry.

Then you sit there and make a judgment as to what you think is right and what you think is wrong.

It is a judgment sincerely made, but the tragedy is that it nowhere can be anywhere near the possibility of correctness, because there is no human being on Earth, or group of human beings, who can make all of the judgments that could be made in the market situation for a country of 200-plus million people. Just impossible.

If you had 20,000 computers, you could not make all those judgments that could be made in that regard.

Senator Long earlier pointed out about what happened with sugar. It is interesting to compare our situation with Germany and Taiwan. When the boycott hit, what they did was let the market work its will, which was very painful for a short period of time. We chose the long, Chinese torture method, continuing to mutilate our economic system over the years rather than let the market go ahead and clear itself, and I see us in this mutilation going forward.

I am chagrined to see us come forward with a status quo situation, everything is right, we are going at optimum ability. We are not going at optimum ability; we need more rigs. If you are telling me that we are manufacturing enough rigs, you should look at the returns to the steel industry, and you have to appreciate that we are just coming out of a recession.

I recall 6 months ago when most of those rigs were stacked. Now they are being utilized, a good portion.

Let me ask you this fundamental question. Why is it that if I were a president of an oil company sitting at a board of directors' meeting, why would I recommend my oil company to drill for one drop of oil anywhere in the United States when I could take the resources of my company and go drill in Indonesia, or in any foreign country and sell it to you without even a smidgen of regulation?

Why, as the president of a corporation, would I recommend my board of directors to drill in Alaska, drill in Louisiana, Texas when I am always going to be caught a day late and a dollar short at what I am going to be able to sell my product for, when instead, if I took the same dollars and drilled in Indonesia, I could sell it to you at whatever the traffic will bear, or whatever I, as a member of a cartel, am prepared to lay on top of you.

Why would I recommend that investment in the United States as opposed to aboad?

Mr. O'LEARY. I am glad you asked that question, Senator Gravel.

Indeed, if you were in that board room making that choice, the people who would advise you would say, in the United States, if you were to go down and be successful and go into the $13.50 price, get the new discovery that you would be looking for in either case, you could make out of that something on the order of $4.50.

If you went to Indonesia, here is what you would be doing: You would be able to sell it for $13.44. The Government taxes would be $11.46 on that price, production costs, 55 cents. The company margin would be about $1.44.

The reason you would choose, as indeed the industry does choose, to put that dollar here first is because the returns are higher in the United States than any other place in the world.

Senator GRAVEL. We will get some items for the record.

Mr. O'LEARY. I would like to submit some material.

Senator GRAVEL. I would like to have all of those computations for the record. I would find that at variance with some of the computations I have seen. I would be happy to be edified as to who is correct in that regard.

[The following was subsequently supplied for the record:]

REPRESENTATIVE PER BARREL MARGINS FOR U.S. COMPANIES LIFTING FOREIGN OIL[1]

	First quarter government sales price	Government take	Production cost	Company margin
Country:				
Saudi Arabia	$12.09	$11.74	$0.27	$0.24
Nigeria	14.29	13.45	1.07	.36
Indonesia	13.44	11.46	.56	1.44
Iran	12.81	12.43	.16	.22
Cabinda	13.06	(2)	.54	(2)
Abu Dhabi	12.50	11.56	.31	.25
Canada	9.75	5.21	.90	.64
North Sea	14.20	7.20	5.00	2.00
Gabon	13 00	6.77	4.25	1.48
Ecuador (4th quarter, 1976)	11.46	10.40	.60	.65

[1] A higher actual new oil price would increase companies' per barrel margins. Estimated margins vary with operating costs and capital expenses.
[2] Not available.

Note: Representative margins per barrel for U.S. companies lifting newly discovered domestic oil: Assumed new oil price, $13.50; estimated margin, $2.40 to $4.40.

Senator GRAVEL. Just using the pricing established for Alaskan oil, why would anybody want to invest in Alaska right now, where he might discover new Prudhoe Bay as opposed to drilling in Oklahoma or Texas?

Mr. O'LEARY. He has a possibility of developing new Prudhoe Bay—one of the things we found, the efficiency of drilling in terms of reserve found has gone down very substantially in the Lower 48.

We are finding, for example, for every million feet we are drilling now, a quarter of what we found prior to 1950, half of what we found during the 1950's.

Really, if you are looking for elephants—and the big oil companies want to look for elephants—you do not look at places like new Mexico. To a degree, you do not look except very deep, in places like Oklahoma. You do look in Louisiana, the offshore particularly. There are still some very substantial finds there.

Essentially, we worked pretty hard the onshore shallow resources of this country. There is a great deal more in depth. We are going to find in the next 20 years, as the incentives develop for people to go in depth, the enormous targets in places like your State.

If you can go up there, even with the adverse climate, the very severe environmental concerns, if you strike it rich, you could do very well. Prudhoe Bay is living proof of that.

Indeed, you were referring to the very large expenditure for the well drilled in the Bay of Alaska. That will not end that kind of investment. Eventually it will pay out.

SPEAKING FOR THE OIL INDUSTRY NOW, IN ALASKA

Senator GRAVEL. If we could return somewhere between $4, $4.50, $4.75 per barrel—how would they fare if they drilled in Texas? Forgetting the possibility of the big discovery.

Mr. O'LEARY. That makes a difference.

Senator GRAVEL. If we are looking at prices, are you providing a lesser incentive for drilling in difficult areas or a greater incentive?

Mr. O'LEARY. Mr. Chairman, you know, the President's energy plan has indicated the world price for Alaskan oil. I do not think you can really do better than that.

Senator GRAVEL. As I understand it, the world price is $13.50. The price you give me in Alaska is $11.28.

Mr. O'LEARY. The price—actually, the price that will be paid for Alaskan oil by refiners in the lower 48 is $13.50. They will back off at that, the transportation costs.

The ceiling applies to prices at the wellhead. The $11.28 is not applicable inasmuch as the price at the wellhead, as we compute it, will not exceed $8.

The $11.28 is not a constraint on price; $8 is about what the producers will receive under the President's energy plan.

Senator GRAVEL. Eight dollars is what the producers will receive in Alaska for their oil?

Mr. O'LEARY. Yes.

Senator GRAVEL. Would you run by that computation again?

Mr. O'LEARY. The world price less the transportation costs.

Senator GRAVEL. The transportation costs is what?

Mr. O'LEARY. The initial transportation costs would be $6.50, $7.50; after the first 4 or 5 months that will be reduced to the point taking another dollar off of it.

Senator GRAVEL. You are telling me that the price they will receive for oil in Alaska is going to be greater than if they made a similar discovery in Texas?

Mr. O'LEARY. I am saying the thing that attracts the producers——

Senator GRAVEL. But——

Mr. O'LEARY. If you are to find a new Prudhoe Bay in Texas, the realization to the producers would be $11.28, today $10.50.

Senator GRAVEL. Taking aside a transportation differential, are you giving the industry an incentive to drill in difficult areas?

Mr. O'LEARY. Mr. Gravel, with regard to the policy relative to Alaska, it is the world price for future discoveries. How can you provide further incentives?

Senator GRAVEL. The difficulty I have is in understanding the way you enforce the world price and the machinations that you go through. Suppose you deregulated completely. That, to me, would be world price—no regulation on Alaskan oil at all; it comes in just like foreign oil. Then we are not going through a charade, in our own lingo, as to what are the code words to what we are saying.

Under the present plan that you have, let me restate the question again: Why would a person go drill in cold Alaska where the costs are considerably higher if he can get more out of a discovery, distance aside, transportation differential aside, why would he do that in Alaska, as opposed to Texas?

What you are not clearly stating—and I asked it before—will the person get an incentive for drilling in tougher areas?

Mr. O'LEARY. Mr. Gravel, the refiners will not pay more than $13.50. Our plan contemplates the refiners to pay $13.50 and back off transportation costs. Despite the semantics, the oil companies are fully aware of this. The reason they go to Alaska in preference to going onshore in Texas is because they can find another Prudhoe Bay, with higher probability than onshore Texas and make a lot of money.

Senator GRAVEL. That statement you just made, I would like a more simple response to my question, without using the code words.

Transportation costs aside, does a person have more or less incentive to drill in a higher cost area like Alaska than Texas?

Mr. O'LEARY. Today, the majors would prefer to drill in frontier areas, such as Alaska.

Senator GRAVEL. You are making an interpretation judgment as though you were sitting on the board. I would rather you make an interpretation judgment as to your position.

My question is, are you providing, as a Government official, as a part of the Carter package, are you providing more incentive to drill in Alaska and again, transportation costs aside, for Alaska than in Texas?

Mr. O'LEARY. Evidently—quite evidently—we are. The fact is the industry would prefer, the majors particularly, would prefer to put their money into a frontier area such as Alaska than they would to onshore drilling in Texas, despite the fact that in Alaska, because of the transportation element that you would like us to put aside but, of course, the market cannot——

Senator GRAVEL. For the sake of comparison. Not to put aside. I cannot seem to elicit a response.

Mr. O'LEARY. Mr. Chairman, I think the situation is this: The $8 that you can realize as a cost on crude is a good deal more attractive than the $10.50 you can realize on the much smaller find that probabilistically you would find if you were drilling in the lower 48.

Senator GRAVEL. In response to my question, if we do not have any assistance, then the market may have some incentives, but the Government does not have any incentives. That is the point that I am driving at.

Mr. O'LEARY. Mr. Chairman, it appears, in light of the willingness of people to put the money up there, that additional incentives are simply not necessary. That does not appear to be the constraint of the development of Alaskan crude.

Senator GRAVEL. Again, these are judgments that you can make. I think that the record of the Nation today will bear out that judgment.

Mr. O'LEARY. I really would like to learn what further we could do other than having a better process for making those lands available.

Senator GRAVEL. I will tell you one thing you could do. If the administration would take deregulation, let the market work its will, put an excess profits tax to guarantee that there would be no rip-off. Then we would not be dealing in transfer payments, we would not be trying to regulate every facet of an industry which is impossible to do.

Mr. O'LEARY. Mr. Chairman, that would not influence by as much as a penny on the realized price on new, exploratory activity in the State of Alaska.

Senator GRAVEL. I beg to differ with you on that, I really do.

I yield to my colleague.

Senator LONG. Let me explore a matter with you. You are saying that it is more profitable today to invest money in oil in the United States than it is in foreign countries. I am looking at a chart on the comparative profitability of the oil industry. Is it not true, that the main reason it is more profitable in the United States is that foreign countries have nationalized those investments?

Mr. O'LEARY. Or have very high taxes.

Senator LONG. Taxing somebody's profits is the same thing as nationalizing.

I have a chart here—I asked our committee staff to give us, year by year, a statement of what the profits picture seems to be in the oil industry compared with other industries, because that is a matter of constant interest. I would commend it to you. These figures were taken from such sources as the Federal Trade Commission, whatever published sources we could find.

We also asked the 10 major companies to provide us with relevant information and compiled it. Two or three things are apparent: one of them is that the companies are investing to try to find more energy and to give us more energy in the United States than they are making in cash flow. Are you aware of that?

Mr. O'LEARY. In expensing their profits, not what they are making in cash flow.

Senator LONG. Let's check that. My impression is that they are putting more money in——

Mr. O'LEARY. Than they are taking out?

Senator LONG. Than they are making in cash flow. In trying to provide more energy, their investment is exceeding their cash flow.

Mr. O'LEARY. No, I do not think that you would find that to be true, Mr. Chairman. Let me submit something for the record on that point.

Senator LONG. We will submit our information, you submit yours. Let us see. The facts are something that we should not have to debate about. What you do with them is something else.

The facts, we should be able to agree on.

[The following was subsequently supplied for the record:]

MR. O'LEARY'S SUBMISSION

	1976	1975	1974	1973
Total industry expenditures estimated by JAS for:				
Exploration	NA	5.78	8.90	5.86
Development	NA	6.98	4.48	3.26
Production	NA	6.68	5.68	4.24
Total		19.44	19.06	13.36
Capital and exploration expenditures for 40 largest petroleum companies	28.83	26.93	25.75	16.33
Cash flow for 40 largest petroleum companies (billions):				
Net income (after taxes)	$13.80	$11.56	$15.94	$11.80
Depreciation and depletion	14.82	11.26	13.00	10.54
Cash flow	28.62	22.82	28.94	22.34

TABLE 6.—SELECTED FINANCIAL DATA, DIVIDED INTO DOMESTIC AND FOREIGN OPERATIONS OF 19 MAJOR OIL COMPANIES FOR 1975 AND FOR 10-YEAR PERIOD, 1965-74

[In millions of dollars]

	Capital expenditures and exploration expense (1)	Net income (2)	Exploration expense (3)	Adjusted earnings (2+3) (4)	Capital recovery (5)	Dividends paid [1] (6)	Adjusted cash flow (4+5−6) [9] (7)	Capital expenditures and exploration e pense as percent of—: Adjusted earnings (1÷4) (8)	Adjusted cash flow) (1÷7) (9)
1975									
Exxon, total [2]	3,582	2,308	356	2,664	1,418	1,031	3,051	134.5	117.4
United States	1,932	1,107	174	1,281	664	494	1,451	150.8	133.1
Foreign	1,650	1,201	182	1,383	754	537	1,600	119.3	103.1
Gulf, total	1,448	700	317	1,017	628	331	1,314	142.4	110.2
United States	957	478	163	641	404	226	819	149.3	116.8
Foreign	491	222	154	376	224	105	495	130.6	99.2
Mobil, total	1,449	810	243	1,053	708	346	1,475	137.6	98.2
United States	700	306	118	424	541	131	834	165.1	83.9
Foreign	749	504	125	629	227	215	641	119.1	116.9
Phillips, total [3]	720	254	[3] 38	292	292	90	494	246.6	145.6
United States	371	174	18	192	169	6	299	193.2	142.2
Foreign	349	80	20	100	123	28	195	439.0	178.9
Shell, total	1,227	515	152	667	597	221	1,043	184.0	118.0
United States	1,114	541	122	663	546	221	988	168.0	113.0
Foreign	113	(26)	30	4	51	----------	55	----------	205.0
Standard of California, total [4]	1,728	773	227	1,000	585	339	1,246	172.8	138.7
United States	1,230	240	123	363	478	105	736	338.4	167.1
Foreign	498	533	104	637	107	234	510	78.2	97.8
Standard of Indiana, total [5]	1,580	761	350	1,111	551	284	1,378	142.2	114.7
United States	924	549	177	726	398	205	919	127.3	100.5
Foreign	656	212	173	385	153	79	459	170.4	142.9

Standard of Ohio, total [2]	1,599	49	5	54	65	20	99	2,961.1	1,615.2
United States	1,599	46	5	51	65	19	97	3,135.3	1,648.5
Foreign		3		3		1	2		
Sun Co., total [3]	613	216	143	359	280	76	563	170.8	109.0
United States [6]	394	240	68	308	192	76	424	127.9	93.0
Foreign	219	(24)	75	51	88		139	429.4	158.1
Texaco, total	1,674	831	262	1,092	653	543	1,202	153.3	139.3
United States	978	449	132	581	466	294	752	168.3	130.1
Foreign	696	382	130	511	187	249	450	136.2	154.7
10-company, total	15,620	7,217	2,093	9,309	5,837	3,281	11,865	167.8	131.6
United States	10,199	4,130	1,100	5,230	3,923	1,833	7,319	195.0	139.3
Foreign	5,421	3,087	993	4,079	1,914	1,448	4,546	132.9	119.2
1965–74									
Exxon, total [3]	19,332	14,775	2,330	17,105	8,552	7,953	17,704	113.0	109.2
United States	7,738	6,284	1,262	7,546	3,558	3,426	7,678	102.5	100.8
Foreign	11,594	8,491	1,068	9,559	4,994	4,527	10,026	121.3	115.6
Gulf, total	9,766	6,160	1,305	7,465	4,700	2,811	9,354	130.8	104.4
United States	5,442	3,528	571	4,099	2,957	1,690	5,366	132.8	101.4
Foreign	4,324	2,632	734	3,366	1,743	1,121	3,988	128.5	108.4
Mobil, total	9,501	5,443	1,257	6,700	3,880	2,328	8,252	141.8	115.1
United States	5,458	2,392	620	3,012	2,330	1,023	4,319	181.2	126.4
Foreign	4,043	3,051	637	3,688	1,550	1,305	3,933	109.6	102.8
Phillips, total [3]	3,147	1,421	[3] 149	1,570	1,657	802	2,426	200.4	129.7
United States	2,032	1,194	91	1,285	1,239	690	1,834	158.1	110.8
Foreign	1,115	227	58	285	418	112	592	391.2	188.5
Shell, total	7,019	3,073	936	4,009	3,549	1,473	6,085	175.1	115.3
United States	6,747	3,186	822	4,008	3,413	1,473	5,948	168.3	113.4
Foreign	272	(113)	114	1	136		137		198.5
Standard of California, total [4]	8,021	5,380	1,304	6,684	3,348	2,323	7,709	120.0	104.1
United States	5,621	2,101	832	2,933	2,728	948	4,713	191.6	119.3
Foreign	2,400	3,279	472	3,751	620	1,375	2,996	64.0	80.1

See footnotes at end of table.

TABLE 6.—SELECTED FINANCIAL DATA, DIVIDED INTO DOMESTIC AND FOREIGN OPERATIONS OF 10 MAJOR OIL COMPANIES FOR 1975 AND FOR 10-YEAR PERIOD, 1965–74—Continued

[In millions of dollars]

	Capital expenditures and exploration expense (1)	Net income (2)	Exploration expense (3)	Adjusted earnings (2+3) (4)	Capital recovery (5)	Dividends paid [1] (6)	Adjusted cash flow (4+5–6) [9] (7)	Capital expenditures and exploration expense as percent of— Adjusted earnings (1÷4) (8)	Adjusted cash flow (1÷7) (9)
Standard of Indiana, total [2]	7,784	3,658	1,701	5,359	3,269	1,502	7,126	145.3	109.2
United States	5,353	3,050	1,034	4,084	2,702	1,268	5,518	131.1	97.0
Foreign	2,431	608	667	1,275	567	234	1,608	190.7	151.2
Standard of Ohio, total [3]	1,761	517	40	557	415	244	728	316.2	241.9
United States	1,740	460	32	492	397	217	672	353.7	258.9
Foreign	21	57	8	65	18	27	56	32.3	37.5
Sun Co., total [2] [5]	2,780	1,358	395	1,753	1,046	472	2,327	158.6	119.5
United States [7]	2,044	1,165	283	1,448	866	409	1,905	141.2	107.3
Foreign	736	193	112	305	180	63	422	241.3	174.5
Texaco., total [8]	5,654	4,441	718	5,159	1,866	1,928	5,097	109.6	110.9
United States	3,673	1,689	412	2,101	1,308	733	2,675	174.8	137.3
Foreign	1,981	2,752	306	3,058	558	1,195	2,422	64.8	81.8
10-company, total	74,765	46,226	10,135	55,361	32,282	21,836	66,808	132.7	111.9
United States	45,848	25,049	5,959	31,008	21,498	11,877	40,628	147.9	112.8
Foreign	28,917	21,177	4,176	25,353	10,784	9,959	26,180	114.1	110.5

[1] Dividends are allocated between U.S. and foreign income on substantially the same basis as income is allocated between U.S. and foreign operations.
[2] Data for petroleum operations only.
[3] Net of tax benefit.
[4] Data other than net income is for company and majority owned subsidiaries only.
[5] 7 yr total, 1968–74.
[6] Includes Puerto Rico.
[7] Includes Puerto Rico after 1973.
[8] 4 yr total, 1971–74
[9] Adjusted cash flow represents the amount available for Capital expenditures and the additional working capital associated with such capital expansion.

Note: Cash flow must cover not only capital expenditures, but also the working capital needs.
Source: Responses from the 10 oil companies listed above to a questionnaire from the Senate Finance Committee. The question was stated "What is the total of exploration expense and capital investment in petroleum assets, in dollars, year by year? What is the ratio between your total cash income (generated by earnings, depreciation, depletion allowance, etc.) and your total investment in petroleum assets, including exploration expense?"

Senator LONG. Just recently, a man come to my office who tries to interest people in the New York market and in investing money in independent oil and gas activities.

What he was telling me that all things considered, it is very difficult to persuade a businessman to put money into it. And it looks as though all factors considered, that a man would probably, if he were in an upper tax bracket, be better off to invest his money in tax-exempt State and municipal bonds than he would be putting it into oil and gas.

Are you aware of that?

Mr. O'LEARY. I am aware of those contentions. I am also aware that there is simply no evidence, as I testified earlier, Senator Long, to substantiate the claim, that there are insufficient funds within the industry to drive the system at a very, very rapid rate.

Senator LONG. All I am saying is, No. 1—and I will provide the information and I would like to have yours—my information is that the companies are investing more money than they are making in this country. The fact is that they are trying to find more energy, No. 1

No. 2, the information I am receiving is that people trying to sell oil and gas investments to investors find it is more profitable for their customers to put their money into something else.

I also hear the same thing from the independents who are seeking these investments. They would hope to attract some investors to put some money into oil and gas drilling. You are fully aware of that. It has been a matter of joke and jest through the years, oil companies going down and trying to sell interests in oil wells. I remember the old days when people had to beware of somebody trying to sell an interest in the well. As a practical matter, a fellow who knew how to drill a well, by working on one, did not know much about the business. He would go get himself some leases and sell an interest in the well.

That is called poor boying the well. It involves selling an interest in the well, drilling down until you are out of money and then selling some more. After awhile, he will sell even more. It was not unusual for some local fellow out there trying to poor boy his well and to find out by the time he discovered the oil he had sold more than 100 percent interest and he could not afford to produce the oil. He had sold more than 100 percent of his well.

Nowadays, legitimate, reputable people try to go out and persuade people to go in on wells. What they try to do is to sell interests in their leases, to cover their expenses. If they can put the deal together, they will be paid something for their trouble and have a percentage of the profits in return for putting the whole undertaking together.

Independents complain to me that they are having difficulty trying to recapture their investments. That is part of what the President was addressing himself to when he recommended that we do something about the intangible drilling expenses. I would ask if you would agree with me that we ought to make it sufficiently profitable so that the independents and the majors can find the money they need for new investments.

Mr. O'LEARY. I agree thoroughly and I believe that objective is being accomplished, Senator Long.

Senator LONG. I have been told—this may not be true; if it is true, I may as well find it out for sure—the Federal Government has under

its control about 50 percent of the acreage that could be drilled. I would assume that would include the land out in the Atlantic as well as the land under Federal control in the Gulf of Mexico and off Alaska as well as the land owned and controlled by the Department of Interior and other Federal agencies. Only 5 percent of the drilling has been done on the 50 percent of the land that the Federal Government controls, and the other 95 percent has been on land that is mostly under private ownership, or private plus State ownership; is that your understanding?

Mr. O'LEARY. Those figures might be a little old, but essentially they are correct. The reason for that, Senator Long, is that we have been working onshore for about 120 years now; we have been working offshore, in the Federal offshore, only since about 1961.

In fact, if you will look at the development offshore Louisiana, as you can see, that is about leased out now. I would imagine, if we can get through the *Judge Weinstein* decision and get to the Atlantic over the next 15 or 20 years, that will be leased up.

This is a part of, not so much a policy, but of vintaging. We did not start into the Federal offshore, the bulk of this 50 percent controlled by the Federal Government, until 100 years after we had begun on the onshore.

Senator LONG. There is a great deal of land that is not beneath water, in the Western States, particularly.

Mr. O'LEARY. That has been very heavily worked over. The Government, ever since 1921, had a very forward-looking lease policy with regard to its onshore resources. As Senator Hansen would tell you, in Wyoming, for example, a public land State, it has been thoroughly explored, heavily explored—not thoroughly, but heavily explored on the lands, the constraint being the willingness of producers to nominate and bid for the lands, not the willingness of the Government to put the lands up for bid.

Senator LONG. I also have heard representations to the effect that this Government has various policies to safeguard the environment and, at the time a person applies for a lease until the time he is able to drill, almost 4 years are involved.

Could you give me the figures on that?

Mr. O'LEARY. I think that is probably fair with regard to offshore leases. I do not think it is a good number on the onshore leases. The turnover there on onshore is pretty rapid. It is a safe proposition. The environmental concerns have been pretty well met.

It is a very long and very chancy business to attempt to lease offshore, particularly in a new area.

Senator LONG. We have had a lot of experience with offshore drilling in Louisiana. I do not like an oil spill any better than you do, or anybody else. I know you are aware of the fact that the precautions that we take in offshore drilling now are about 10 times what they were when those early wells were drilled off Louisiana and Texas. Even so no one can find any indication of permanent damage as a result of the experience although there were some blow-outs and difficulties in that regard.

Is that correct?

Mr. O'LEARY. Senator, I think that we have now developed technology, given the benefits out of this business, would provide every

reason for us to go ahead and lease at a responsible, rapid rate, our full Outer Continental Shelf resources. Yes; that is true.

Senator LONG. Someone showed me a fold-out chart illustrating the more than 40 steps that had to be taken in order to drill on these lands. I presume it would be even more complicated in the Atlantic.

At that time, it was complained that even more steps were being suggested.

If these people do have to go through 40 or 50 steps in order to satisfy all of the decisionmaking that the Government requires, can we, at least, get the Government to make one decision every week? In so doing, we can get a clear decision within 1 year, rather than the 4 to 6 years it now takes to make it proper for a person to drill on a lease that he has?

Mr. O'LEARY. I think that we probably could do a lot better than we have been doing. You know the administration is supporting revision to the Outer Continental Shelf Lands Act that are in part aimed at the observed fact that we are having great trouble, even after all of the executive branch's permitting is done, actually going ahead with development because of the position of the courts that say we have not done things right.

I think what we have to do is pay a good deal of attention to this permitting process, in this and many other areas, and if we cannot shorten it down, make it more efficient, at the same time, provide all of the procedural safeguards for intervenors that we now have in law.

Senator LONG. Thank you.

Senator GRAVEL. Senator Packwood?

Senator PACKWOOD. I came in late, although I have read your entire statement. Do I presume from what you say on page 6, which is stated somewhat differently, as the price of energy increases you can expect that some resources, not now economically recoverable, will become price competitive and therefore would become added to the supply availability, and what you say about oil shale and oil gasification later on in your statement, at a price, there is no energy shortage in this country?

Mr. O'LEARY. That is absolutely true, Senator. I have described the present difficulties that our States and the world is encountering in this area as a stupidity crisis, not a resource crisis.

Senator PACKWOOD. In order to become domestically secure, if we did nothing else but put up a tariff or barrier on oil in the market, it would put up local energy prices to a point?

Mr. O'LEARY. You could have a certain significant increase in what are considered exotic alternatives, simple bludgeoning of the market by putting on a large import tax.

Senator PACKWOOD. The key thing, the image is we are indeed running out of energy. You simply add, at a low price.

Mr. O'LEARY. We are running out of cheap energy.

Senator PACKWOOD. Coal liquification, coal and oil, using it for petroleum—is that what Germany did during World War II?

Mr. O'LEARY. Indeed, they began, in 1936, to develop the technology——

Senator PACKWOOD. Is that what South Africa is using?

Mr. O'LEARY. No; the so-called Lurgie process. It is, first of all, a gasification; later, a liquefaction.

Senator PACKWOOD. That is another option, at price?

Mr. O'LEARY. Yes.

Senator PACKWOOD. Page 10, you talk about oil and gas pricing policy. The last sentence on that page:

> In addition, oil and natural gas prices should reflect the economic fact that the true value of a depleting resource is the cost of replacing it.

Mr. O'LEARY. You really ought to say to people—of course, this is directed at the consumer side of the economy—you ought to say to yourself, in a world where we are importing $13.50 oil, we should not tell the fellow consuming the oil, this will be only $10 to you, and that is precisely what we are doing now. In a world where the gas—where we are finding on the margin is worth $1.75, according to plan, we really should not whisper in the ear of the industrial consumer of gas, to you, it is 65 cents as we are doing now.

Senator PACKWOOD. You lost me. Maybe I misunderstand what you said.

You indicate that it is unfair that the oil companies keep its profit when they discover oil at $3 and $4 a barrel and the price goes up to world price. They are not responsible for the price going up, they should not be entitled to this profit.

Mr. O'LEARY. They should be entitled to a profit to the degree it serves a useful economic service. We see no purpose, sir, by permitting them to take this amount of what we refer to as economic rent from the consumers and hand it to producers. That is quite right.

Senator PACKWOOD. In that sense, it is a regulating—the utility concept.

Mr. O'LEARY. In fact, we have had a regulated utility concept for gas production in this country for the last generation.

Senator PACKWOOD. Later on you talk about the way to force coal conversion. If, by chance, that were to drive up the coal price way beyond the price of production, should the coal companies be subject to a limit on price also?

Mr. O'LEARY. I do not think I would ever find myself, short of a national emergency, where we should influence the principles in the market.

Senator PACKWOOD. If they are the unwitting beneficiaries of a dramatic price rise of forced conversion to coal, why should they get to keep this profit that they had nothing to do with?

Mr. O'LEARY. Senator Packwood, generally speaking, coal contracts—there is no such thing as a coal market. You have to say, in contradistinction to the oil and gas business, you do not have a national market for coal. What you have are a series of cost-plus contracts that cover probably 70, 75 percent of the coal production in the United States.

These are arrived at by negotiation between the buyers and a utility and the coal company. They may involve front-end payments by the utility to open them up. Then they have a series of clauses in the contract calling for escalation should productivity fall, labor costs rise, steel costs rise, explosive cost rise, and what have you.

It is, in effect, a cost-plus contract, running over a good many years.

Because of the fact that you are not in a national market, the utility industry has already proven that they are quite capable of keeping prices down to a fairly close variance of cost.

If you own a utility with an old contract that might have been entered into when cost of constructions for coal mines were quite low, 10 years ago, you might be getting your coal today delivered to your plant for $15. Nobody is challenging the $15 price.

If you went to the same producer today, with what has happened to the cost of construction of the mine and opened a new one tomorrow morning, the same coal from the adjacent seam from the same company or the same producer might deliver in at $30.

That is the way the contracts run.

In contrast, what we find in the gas business, if you have an old contract for 15 cents, you enter into a new contract with the same producer from the same gas supply source, the same well, perhaps a different zone of completion, for a dollar. Then you go back to the first contract and raise that to a dollar.

That is the distinction between having a more or less national market for a commodity and an individually contracted negotiated market.

Senator PACKWOOD. It seems to me you are going to come closer to forcing a national market and maybe do it with your regulatory and tax policies.

Mr. O'LEARY. I really do not think so. You have to understand, the cost of coal production within a county varies all over the lot and the utility industry practice here has been not to buy coal—in recent years, not to buy coal at a price. It has been to buy a long term deliverability at a contract price tailored to the individual conditions of that particular market. The condition is present for Government allocation. I am not sure that you are favoring Government price control over the coal industry. I think that the conditions that led to Government control back in the 1930's initially over the oil price, in 1954 over the gas price, simply do not exist in the coal market.

Senator PACKWOOD. Coal is a limited market. You have two big boys able to market at arms length selling the utilities who are strong, but the utilities, for some reason, cannot make those same kinds of contracts with oil companies if the oil prices go up.

Mr. O'LEARY. The fact is, oil in this country has never been sold on a contract basis, always on a spot basis.

Senator PACKWOOD. Is that your difference in your philosophy?

Mr. O'LEARY. There is another fundamental difference, the ubiquitous nature of coal resources. We have a tremendous amount of coal in this country. The startling number to me is 13 percent of the land in the United States is underlaid with coal of some order, some of it very bad, some of it very good.

The unique element in the availability of coal is really not the resource size, as it is in oil and gas. It is the market.

Senator PACKWOOD. We have almost an unlimited supply of oil in one form or another at a price.

Mr. O'LEARY. Indeed, the difference that characterizes coal versus oil is the coal is just a mite cheaper, prospectively.

Senator PACKWOOD. Why not take the price regulation off altogether?

Mr. O'Leary. Of what?

Senator PACKWOOD. Off oil, off gas. Apparently, this market would go to coal, if it was a lot cheaper.

Mr. O'LEARY. What we are trying to do is get that effect without the deleterious effect that would go from decontrol.

Senator PACKWOOD. What are the deleterious effects if coal is infinitely cheaper? Not many industries would stick with oil if they can buy coal cheaper.

Mr. O'LEARY. If you have an industrial plant built 15 years ago and it has 20 years to go, and a boiler system based on oil, a change in the price of oil is really not going to throw you over a fence to coal. You have to look at tearing out large segments of the plant, sectors of the plant, finding storage equipment, finding a supplier, combating the local air quality regulations, an awful lot of other ancillary parts.

We simply have demonstrated that, in spite the fact that almost in any part of the country you today can get coal for half, or less than half, of the delivered price of oil, people will continue to stay wih oil.

Senator PACKWOOD. What you are saying, you need a short-term regulatory system until this equalizes?

Mr. O'LEARY. We need what we hope will be a short-term regulatory system, not certainly equality. I hate to see we are going to a world where the coal price gets to the level of the oil price, but until the very long-term maleffects on the market of Government involvement that goes back to the 1930's are worked out. It is worth noting, Senator, that the Government, the Federal Government, the State governments, has been in the oil business now from the standpoint of regulating the environment in which the oil companies work ever since the NRA days of the early 1930's.

They got in first when there was a lot of oil, a short-term glut of oil when east Texas came in and some fields of Oklahoma; oil was selling for 10 cents a barrel at that time. The Federal Government moved in, under the National Recovery Act, and stabilized production, stabilizing the price as well.

The next year the NRA was, as you know, declared unconstitutional. The States then moved in with a proration market demand concept.

This was elaborated until finally in the 1950's and 1960's we were in the oil import control program, a corollary provision to the proration market demand. The effect of this—we should not lose sight of this—during the 1950's and 1960's when the world price was at about $1 a barrel, the U.S. price was $3 a barrel. At that time we were not getting hit over the head to get out of the oil or stop interfering with the market by the producers. Consumers were hitting us over the head.

What we were doing was adverse to the short-run interests of consumers, keeping the price well above the world oil price and regarded by consumers as overly generous to the producers.

Now the shoe has come around the other way. The imposition of Government, prompted by very much the considerations that got us in the business in the 1930's, is stabilizing. That imposition tends to keep the U.S. price for a certain class of oil below the world price. We hear consumers are quite happy, as they were unhappy with this in the 1950's and 1960's. The producers were unhappy with the regime because they could get more from the market, were permitted to go to the world price.

In the long scheme, in history, I think what we have seen is that Government does have a very strong interest in the price of these basic fuels, that probably its interference and intervention in these markets over time would become greater rather than less.

This will be done, not by a greedy Executive, but actions by the Congress, congressional passage of EPCA that puts my agency in its present role as a rate-price regulatory for the oil industry.

Senator PACKWOOD. What is your personal conclusion, that there is enough energy at a price and the ultimate policy should be the deregulation of all energy prices?

Mr. O'LEARY. In the abstract, it should be. Deregulation—again, if we are going to have a cartel setting the price of energy in the United States—and that is the case, at least in the short run—it seems to me that we simply do not want to put ourselves in the position where we will follow OPEC wherever it leads us with regards to pricing.

There is no question if the price incentives were there: for example, if we were willing to pay $50 a barrel or $100 a barrel, I am sure that we would find enough conventional or nonconventional oil to meet all of our needs.

Senator PACKWOOD. Thank you.

Senator GRAVEL. Senator Hansen?

Senator HANSEN. Mr. O'Leary, I am sorry I was not able to be here in order to hear your statement. I tried to scan it. I am certain it is all very worthwhile reading; I regret that I have not had the time.

Mr. O'LEARY. There is one thing we can say for it, it is long.

Senator HANSEN. As anyone in the energy business looks back upon the actions of this Government in the last couple of years, what reason is there to assure him that we will not do this year or next year what we have done in the past 2 years? I refer to our having rolled back oil prices. I refer to our having changed some tax laws to make retroactive to the beginning of last year the application of the minimum tax?

What assurance does the industry have that that is not going to happen again?

Mr. O'LEARY. None, Senator.

Both of these, of course, were done neither by nor pursuant to acts of Congress. There is no way which you can bind your successors any more than we in the executive branch.

What we intend to do is establish a more orderly regime with a strong philosophy behind it that will be a little less prone to variance than the regime that we have had in the past.

I think, as far as a provision of certainty to the oil industry or the transportation industry—indeed, to anyone—we cannot do it because we cannot bind—either you or we—cannot bind our successors.

Senator HANSEN. I appreciate your forthright response.

Despite whatever else might characterize the Congress, we certainly seem to be very anti-oil these days.

There is that additional disincentive to make the investment that most economists agree has to be made if we are even going to start reducing our dependence on foreign sources of supply.

I have a couple of follow-on questions to page 10 of your testimony.

Insofar as replacement costs are concerned, is it your feeling that we should not permit oil to be sold today at its added replacement cost?

Mr. O'LEARY. It is my feeling that we should get the price of oil up to the point of consumption after replacement costs, Senator Hansen.

Senator HANSEN. That is what the administration proposes to do with this tax?

Mr. O'LEARY. We would do that with the tax.

Senator HANSEN. How long would this tax stay on?

Mr. O'LEARY. It appears to us that you get to the point, as a result of rollover, that is to say bringing in no oil over time, and moving the very old oil to stripper status. It appears to us that you achieve most of the purpose getting out to a deregulated market.

We would all like to get there by the late 1980's.

Senator HANSEN. You are talking about a tax that could stay on for maybe a 10-year period?

Mr. O'LEARY. It may well stay on for a 10-year period. Right now abrupt deregulation of oil and gas would result in a massive transfer of wealth from consumers to producers on the order of $35 billion.

Hopefully, we will get to the point in the next 8 to 10 years where you will do that at a very much smaller transfer cost and be out of this business of regulation.

Senator HANSEN. In the meantime, I gather that in order to avoid the predictable diminution of economic activities that would result if this tax were to go into the Treasury and spent by members of Congress, it would be better to be redistributed? Is that the idea?

Would it be redistributed? I think you say the rebate is a flat per capita tax credit which is refundable only for those who are eligible for the earned income credit on the individual income tax.

Mr. O'LEARY. Yes.

We would regard the sticky-fingers syndrome here by an executive branch as being a very bad policy. It seem when we are dealing with volumes of money at this magnitude that it could have severe deflationary effects, or inflationary effects, if we could manipulate the funds. Consequently, our treatment should be neutral.

As we receive, we should plow back immediately.

Senator HANSEN. What have we accomplished in the immediate future by the imposition of the tax and the refunding of that tax to certain selected taxpayers?

Mr. O'LEARY. What we have said to the person who buys that car, you are now buying gasoline at essentially the replacement costs. I imagine his driving habits, to the degree they are influenced by price, would be influenced by the increment that would go on his gasoline as a result of this treatment.

At the same time, he is receiving, in the form of less income tax obligation, more disposable income that hopefully will be used for other things other than replacing that gasoline.

Senator HANSEN. As a matter of psychology—and I am no psychologist—I cannot see why the person who otherwise feels the pinch of higher prices, might not continue those same habits that he displays now. What reason is there to assume that a person in a rather low income bracket, if he is to get back as much as, or even more, than he would otherwise have been obliged to pay, is going to redirect his spending so as not to place a greater demand for energy as a consequence of his buying habits? Will he actually make other purchases in the marketplace?

Why do you think that will happen?

Mr. O'LEARY. What we will find, as he drives to the pump, he will be influenced—instead of costing him $12 to fill his tank it will cost $15 to fill his tank. On the other hand, the per capita income rebate will be an increase in disposable income. With that, he will decide that he will buy more food or better quality food or better quality housing or whatever people do with it.

I do not think we find a direct correlation between disposable income and, for example, driving habits. Driving habits appear to have a very indirect correlation to disposable income.

I really feel quite comfortable with this. You can look upon this as two separate transactions. On the one hand, on all the things that consumers use that employ natural gas and oil will tend to go up to this replacement cost. On the other hand, the rebate will take the form of increased personal disposable income on the part of the taxpayer, and I think that probably we will see a significant change in the purchasing habits as a result of the tax and rebate treatment.

Senator HANSEN. I appreciate your rationale. I am not sure I have reached the same conclusion that you have. It is my understanding that Americans, whether our diets are good or bad, have a greater variety of foods available. I assume we eat better than any other nation in the world. We are spending 17 percent of our disposable income for food these days.

I happen to be in the cow business. I would like to see the price of beef go up, but that is a feeling I suspect is not shared by most Americans. It is for me, because we are going broke, you see. It makes a difference.

Mr. O'LEARY. Senator, let me put it in these terms. Let us say we did not impose this sort of tax treatment, that we simply——

Let's say if we got the market clearing prices or replacement costs simply by letting the price go free, on the one hand, and let us say on the other hand that we decided that we would give a substantial payment to each individual taxpayer in this country.

I really do not think that the taxpayer, who is the beneficiary of the rebate and of course, the nonbeneficiary of the increased market bearing costs for the product would join those two things.

I do not think he would restore precisely the consumption pattern before the changes in prices and tax policy were made.

It is fair to say we will not find that under the administration's scheme. Really, what we will see here is an increase in disposable income, as though the fellow had gotten a raise on the one hand, and an increase in price, as he perceives it, for the things that he purchases that employ oil and gas on the other.

I think that these will be sufficiently disassociated. He will not say, I am not really paying 70 cents per gallon for my gasoline, or whatever the price is, consequently I will continue to do as I have done in the past, and then I will pick it up in next month's check from the Treasury.

Senator HANSEN. My time is up.

Senator GRAVEL. Mr. O'Leary, I would like to thank you very much for what I think was a very able presentation.

Mr. O'LEARY. Thank you very much, Mr. Chairman.

Senator HANSEN. I wonder if the FEA could provide the committee with the added replacement costs per barrel of oil without regard to world price.

It seems to me that one of the weaknesses in the administration's proposal—and I find several, I may say—is that when we move up to $13.50 we deny the marketplace a role I think it could play, if we are assuming the OPEC cartel hangs together. If we had a market setting the price there, instead of assuming that everything is going to $13.50, there might be some pressure developing by virtue of the increased production of oil and energy in this country that could trap that down.

Could you please provide the committee with the average replacement costs per barrel of oil without regard to world price?

Mr. O'LEARY. In the United States?

Senator HANSEN. Yes.

Mr. O'LEARY. I think that was alluded to earlier. My understanding of Senator Bellmon's comment on that was $6 a barrel of finding costs. We will get to that.

[The following was subsequently supplied for the record:]

QUESTION SUBMITTED TO MR. O'LEARY BY SENATOR HANSEN WITH REPLY

Question (Senator Hansen). I wonder if the FEA could provide the Committee with the added replacement costs per barrel of oil without regard to world price?

Answer. Estimating the replacement costs for a barrel of domestic oil without regard to world prices is a complex problem. It is extremely difficult to relate exploration, development, and production expenditures to the specific additions of oil reserves and to incremental production of oil.[1]

Estimating the replacement costs is complex and ambiguous because of 3 main problems:

(1) Exploration and production expenditures are incurred for drilling oil and gas. The expenditures may result in a dry hole, oil and/or gas. Allocating the joint costs to successful oil production can only be done on an arbitrary basis which then results in ambiguous conclusions.

(2) The second problem is that time lags occur between making expenditures and finding oil. There is little detailed information available to allow tracking investments for a specific project to oil which is eventually found.

(3) Finally, the assumptions regarding reservoir size and reservoir dispersion are extremely critical and cause the projected recovery cost to vary considerably.

The proposed FEA financial Reporting System for the Petroleum industry and the quarterly financial reporting requirement specified in Sections 503 and 505 of the Energy Policy and Conservation Act of 1975 will provide some new information which will assist in investigating this issue, but some of the fundamental and difficult problems will not be resolved.

The FEA is conducting a study to try to ascertain reasonable projections of the replacement cost of oil and gas by region of the country. The study, which was commenced in 1976 should be completed early next year. We will be pleased to forward a copy of the study for your information when it is completed.

Senator PACKWOOD. If I could ask one last question, I was reading Professor Commoner's statement. He takes total exception to your factual conclusion, your whole premise, as well.

Mr. O'LEARY. I would take the same exception to his.

Senator GRAVEL. Thank you.

[The prepared statement of Mr. O'Leary follows. Oral testimony continues on p. 62.]

[1] One study, commissioned by Robert Nathan Associates, concluded after making a number of assumptions, that the replacement cost of oil was $12.48 per barrel.

STATEMENT OF JOHN F. O'LEARY, ADMINISTRATOR, FEDERAL ENERGY ADMINISTRATION

Mr. Chairman and members of the Energy Subcommittee, I am very pleased to be here today to discuss with you the incentives that will be required in order to produce the Nation's energy requirements for the near and long term. As you know, the proposed National Energy Plan that has been submitted to the Congress by the Administration contains many incentives for increasing development of all forms of domestic energy resources. A discussion of each of these energy resources and their respective incentives is included in this presentation. In addition, various members of the committee staff have asked for specific information on a broad range of topics such as the CIA and UN reports, tax rebates, drilling activity, etc. Accordingly, my testimony discusses these topics.

The demand for energy by the United States consumer has been steadily increasing while the available domestic supply of oil and natural gas has been, with the exception of Alaskan North Slope production, and will continue to be declining. These two factors have caused the United States to turn more and more to imported petroleum, with the result being increased vulnerability to interruptions of supply. Even if the foreign suppliers of petroleum make a maximum effort to increase their production, they make experience difficulty in supplying the needs of the importing nations of the world by the mid-1980's. With the current rate of demand growth, the world demand for OPEC production could reach or exceed 50 million barrels per day by 1985. This situation mandates a reduction in this Nation's dependence on imported petroleum to avoid a world shortage of supply. This can be accomplished by decreasing the rate of growth in energy consumption and providing the required incentives for industry to explore for the petroleum and natural gas resources that remain undiscovered in this Nation.

The goals of public policy, such as economic growth, security from supply interruptions and protection of the environment will affect our level of domestic energy demand, domestic supply and oil imports. A comprehensive energy program must consider the relationship between the use of imported oil and the use of other fuels.

The proposed National Energy Plan addresses the energy problem in a comprehensive way. It proposes measures that would reduce imports to a manageable level instead of incurring the full cost of eliminating them. Effective conservation can be brought about without changing the basic standard of living or interfering with continued economic growth. The proposed Plan would provide generous incentives for new energy production without providing inventory profits unrelated to economic contributions.

Every aspect of American life is touched by the energy crisis. We must have the courage to call for action and support from the American people in making some difficult choices. The Government will have to show skill in bringing about short-term adjustments and vision in planning for the long-term future.

Members of the committee staff have asked that I discuss the oil and gas supply picture. I would like to divide my comments between worldwide resource estimates and supply-demand forecasts and domestic reserve and resource estimates. My discussion will concentrate mainly on crude oil, since it represents the most easily adaptable and transportable source of fuel.

Throughout the history of the petroleum era, experts from many disciplines have made estimates of reserves and resources and forecasts of supply and demand. These estimates and forecasts have varied greatly depending on the basic assumptions, the quality of the data, and the sophistication of the techniques. These variances have caused some to believe that estimators were willfully distorting the facts. In reality, most of the estimates and forecasts have been consistent when viewed in the appropriate context.

Measured or proved reserves, often referred to as reserves, are the most certain estimates of readily available sources of supply. These reserves are known to exist and the rate at which they may be recovered is reasonably certain. Undiscovered recoverable resources, often referred to as resources, are subject to a much wider range of estimates and interpretation because they are made in the absence of hard data. They represent economic resources which may be discovered and recovered using current technology. Their actual existance and rate of discovery, development and production are unknown. Potential re-

sources, often referred to as exotic or unconventional resources, are also subject to a wide range of estimates and interpretation because they are made in the absence of known technology. They are usually known to exist, but no economic recovery techniques exist to convert them into producible reserves.

International estimates

Recently reports appeared in the media about a United Nation's study on world energy resources which appeared to contradict the Administration's statements. The reports were attributable to the U.N. Summary Report of the International Conference on the Future Supply of Nature Made Oil and Gas. The Conference was held on July 5–16, 1976, at Schloss Laxenburg, Austria, at which approximately 60 technical papers were presented.

The U.N. report was a summary of the papers of scientific and technical nature representing the individual efforts of approximately 70 specialists, primarily geologists and engineers. The papers mainly concentrated on the future availability of both undiscovered recoverable and potential resources from conventional and unconventional sources rather than the rate at which these resources could be developed and produced to meet the burgeoning demand.

Two of the significant findings enumerated at the U.N. Conference were:

"Additional petroleum and gas resources would most probably be available *albeit at a substantially higher cost* not only for the next two or three decades but very likely during the period of transition to the use of renewable energy sources even if this transition period should last a hundred years or more;" (emphasis added), and

"The Conference was *acutely aware of the uncertainties* pertaining to technology development as well as to political, institutional and, more and more, environmental constraints in the development of resources." [Emphasis added.]

The U.N. report noted that the Conference "could not in itself produce recommendations, which would allow governments to compare various energy sources and decide on their options, nor did it deal with specific ways and means of overcoming the present constraints to resource development."

We do not believe that there is any fundamental contradiction with the assumptions which underlie the Administration's energy policy or the recent U.N. study.

Media comments that the U.N. report contradicts the President on the future availability of oil and gas reflect an incorrect interpretation of the Conference findings. For example, the general consensus that "reserves of oil and gas from conventional sources will be sufficient to last well beyond the end of the Century" is predicated on the assumption of "high" energy prices for the foreseeable future. Stated somewhat differently—as the price of energy increases, we can expect that some resources not now economically recoverable would become price competitive and therefore would be added to the supply availability.

The supply shortfall envisaged by the CIA study, and supported by independent FEA analysis, would result from insufficient production (not ultimately recoverable resources) at world oil prices rising only at the world inflation rate or from the lack of adequate energy conservation and conversion steps being taken by consuming nations.

In testimony before the Subcommittee on Energy Manpower of the House Committee on Interstate and Foreign Commerce on April 25, 1977, Admiral Turner, the Director of the CIA, said,

"In preparing our analysis we drew on a broad spectrum of energy-related disciplines such as geology and petroleum engineering which have no fixed home in either government, business or academia. And, of course, in some very important areas we have access to material not available to other energy forecasters. As a matter of course we consult frequently with other U.S. Government agencies including FEA, State, Interior and ERDA and have done so over the many years we have been doing in-depth analysis on the international energy scene. As such, publication of the report represents a normal part of our analytical production process."

The CIA reported on the worldwide supply-demand outlook for crude oil through 1985. The report was in no way to be considered an assessment of the world resources potential. Considering the rapidly increasing demand for oil not only in the United States and the free world but also in the Communist countries, the CIA report presents a realistic view of the potential inability of oil exporting countries to produce at a rate great enough to satisfy the demand at constant real world oil prices by the mid-1980's. Under these circumstances, they project prices will rise sharply to ration the available supplies.

The CIA report does not predict that the world's crude oil resources will be exhausted in the 1980's. However, it does predict that in the absence of greatly increased energy conservation, projected world demand for oil will substantially exceed producing capacity by 1985.

Domestic estimates

Domestic reserve and resource estimates are subject to the same variation and interpretation as international estimates. However, domestic estimates are generally developed from a larger and more complete data base.

In compliance with Section 15(b) of the FEA Act of 1974, FEA submitted to the Congress and the President its estimate of domestic crude oil and natural gas proved reserves. Based on a survey of all oil and gas field operators in the United States, estimated domestic proved reserves as of December 31, 1974, were 38.0 billion barrels of crude oil and 240.2 trillion cubic feet of natural gas. The American Petroleum Institute report showed comparable crude oil reserves of 34.2 billion barrels, 10 percent less than the FEA survey. The American Gas Association estimated comparable natural gas reserves of 233.2 trillion cubic feet (after deducting 3.9 trillion cubic feet that was in underground storage), 2 percent less than the FEA survey. These estimates vary no more than might be expected when comparing estimates from different sources. More recent estimates indicate that as of December 31, 1976, crude oil reserves are 30.9 billion barrels and natural gas reserves are 212 trillion cubic feet (after deducting 4 trillion cubic feet in underground storage).

In conjunction with the FEA reserve study, the USGS prepared its most sophisticated and current geological estimate of undiscovered recoverable oil and gas resources in the United States (USGS Circular 725). Circular 725 indicated that the best estimate of undiscovered recoverable resources of liquid hydrocarbons in the United States as of December 31, 1974, was 98 billion barrels while measured, indicated, and inferred reserves were approximately 74 billion barrels. The best estimate of undiscovered recoverable resources of natural gas was 484 trillion cubic feet while measured and inferred reserves were approximately 439 trillion cubic feet.

Circular 725 is the resource base from which all FEA projections of future production are developed. The USGS is currently updating its resource estimates and expanding its reporting techniques, but, in the absence of any recent significant discoveries, it believes Circular 725 realistically represents the domestic undiscovered recoverable resources. Resource estimates for the highest priority regions should be available later this year while national estimates should be completed within two years.

According to Circular 725, during the past 100 years, we have discovered approximately 167 billion barrels of liquid hydrocarbons and 718 trillion cubic feet of natural gas.

Our remaining undiscovered recoverable resources and inferred reserves total approximately 127 billion barrels for liquid hydrocarbons and 686 trillion cubic feet for natural gas. The conversion of these undiscovered recoverable resources and inferred reserves to producible reserves will require considerable time regardless of what the prices may be.

Oil and gas pricing policy

Oil and natural gas producers need adequate incentives to develop new resources and are entitled to sufficient profits for exploration and new discoveries. By the same token, they should not be allowed to reap windfall profits as a result of circumstances unrelated to the marketplace or their risk-taking.

The increase in world oil prices from approximately $3.30 per barrel to approximately $13 in the 1973–76 period should not be permitted to create unjustified profits for domestic producers at the consumer's expense. The oil exporting nations have, in effect, increased the value of American oil in existing wells. That increase in value was not the result of the working of a free market or of any risk taking by U.S. producers. A national energy policy should capture this increase in oil value for all of the American people. In addition, oil and natural gas prices should reflect the economic fact that the true value of a depleting resource is the cost of replacing it.

Crude oil pricing

In order to encourage exploration for new oil, it is proposed that the price for such oil would be allowed to rise over a 3-year period to the 1977 world price. Thereafter, the price of newly discovered oil would be adjusted for increases due to inflation.

Stripper well production and incremental tertiary recovery from oil fields would receive the world price. The current price ceilings for previously discovered oil would be allowed to rise at the rate of domestic price increases. A tax will be imposed gradually over the next 3 years at the refinery gate that will cause lower tier and upper tier oil to reach world parity. The tax revenue will be redistributed to each citizen on a per capita basis.

Crude oil equalization tax

The crude oil equalization tax and rebate plan operates by changing the price of petroleum products relative to all other items in the package of consumer expenditures while maintaining the original level of consumer expenditures. The tax simply adds an increment to the price of petroleum and the petroleum content of other goods and services. Faced with a higher relative price of petroleum, consumers will change their purchase package to include less petroleum and petroleum-intensive items and more of other items. The tax changes the relative prices and redirects consumption. A tax, without a rebate or some other method of reintroducing the money into the economy, would reduce the overall level of economic activity.

To insure that the level of economic activity is unaffected by the tax, a per capita rebate has been made an integral part of the proposal. To insure that consumer spending power is undiminished, especially during a period of rising prices, there must be a very short time lag between the collection of the tax and the receipt of the rebate. President Carter's proposed plan provides a concurrent rebate by adjusting the withholding schedule for individual income taxes.

Redistribution of the tax

The rebate is a flat, per capita tax credit which is refundable only for those who are eligible for the earned income credit of the individual income tax. As noted above, the rebate is actually received by taxpayers through adjustments in the withholding schedules. Only the final reconciling is accomplished on the tax form at the time of filing. Those receiving Social Security benefits or retirement checks under a Railroad Retirement Program, will receive a check to cover their per capita rebate. Those receiving payments under the Aid to Families with Dependent Children will also receive a rebate check. Finally, a special energy payments program is established for those not covered by the above. In order to receive a rebate check, they can file a form certifying that they have not already received a rebate, that one has not been received in their behalf, and that they had no taxable income for the year. These last two rebate mechanisms are to be administered by the States.

In addition, there is a special provision for those who use distillate fuel oil for home-heating purposes. Where domestically refined fuel oil is sold at retail for home heating, the retailer will be required to pay the full price (including tax) and he will receive a rebate of the full amount of the tax after he shows evidence that he has reduced the price of the distillate to his customers. In other words, the consumer would never pay the tax. Vendor invoices would show the full tax-paid price and the price less rebate; the latter is paid by the consumer and the former is refunded to the vendor by the Secretary of the Treasury.

The full amount of the net tax revenues will be rebated to consumers, except as necessary to offset State administrative expenses and the special rebate for home-heating oil.

Natural gas pricing

Natural gas still accounts for approximately 30 percent of the Nation's total energy needs. It is essential in meeting the energy needs of millions of consumers. Most of these are residential and commercial consumers, who have little choice but to use natural gas as a fuel.

During the 1960's gas consumption grew at an annual rate of about 5.7 percent. In this period, the average wellhead price for gas was about 17.0 cents per Mcf. Market growth was the order of the day, as the premium value of this clean burning fuel was recognized and an increased national awareness developed with environmental problems. For the past 10 years, reserve additions have not kept up with consumption to the point that in 1976 we added less than one-half of what we consumed.

During the same time, the interstate market has seen its gas supply decline rapidly as producers sought to dedicate new readily available gas reserves to the higher priced, unregulated intrastate market. The distortion in the gas market is due primarily to the controls imposed on interstate prices. Until recently, intra-

state prices were about three times as high as the regulated prices for new intrastate gas.

The Federal Power Commission's pricing methodology is based on historic costs which do not reflect the investment realities of the post-embargo period, which saw the quadrupling of world oil prices and a rapid rate of inflation. The gas industry and other interested supporters argue that the only effective solution in solving the natural gas shortage is to eliminate field price controls for new gas. But, this only deals with one side of the problem, and may not necessarily bring the desired results.

The Administration's gas pricing policy is the most comprehensive program offered to date to effectively deal with natural gas, both as to supply and demand. There are four broad objectives in the proposed energy plan to deal with gas:

1. To provide appropriate incentives for natural gas production through price stability, predictability and assurance of reasonable prices.
2. To protect consumers and the economy from rapidly increasing prices.
3. To eliminate the interstate-intrastate market distinction.
4. To encourage and stimulate conversions from wasteful uses of natural gas in electric power plants and industrial boilers to coal and other more abundant resources.

If we are convinced that the natural gas situation is not merely a question of wellhead pricing, adoption of the above objectives will in time bring into balance what is now a badly distorted market for gas.

Price incentives, as a relevant part of the program, are not ignored but applied where they belong—in the development of new gas supplies as evidenced by the tight definition we propose for new natural gas. To remove the price determination from the time-consuming and complicated FPC pricing methodology, a new commodity value pricing formula is proposed which relates it to the Btu equivalent price of all domestic crude oil. This price will be about $1.75 per Mcf in early 1978. It represents a substantial increase in the wellhead price of new gas, when we realize that only 5 years ago, the price for new gas was about 26 cents per Mcf. The price of $1.75 is above the current ceiling price of $1.45 per Mcf for new interstate gas and about equal to the average unregulated intrastate gas price.

We are not convinced that placing the price any higher is going to increase significantly the supply response we expect from the $1.75 price.

According to the proposed National Energy Plan, the Government would have authority to establish higher incentive pricing levels for specific categories of high cost gas, such as gas from deep drilling and geopressurized zones. One way I envision the implementation of this particular segment of the program would be that a group of people would approach the Government with a drilling plan involving specifically described type of high cost gas production. The Government would review the project, including all relevant information necessary to determine the need for and amount of any incentive price. After such review, the Government could establish a price above the national rate which would be expected to further exploration and development. There would be no guarantees of profit to the exploration group. If the exploration group's effort turned out to be unsuccessful, the group would suffer the loss. If, on the other hand, production was realized, the group could expect to receive the price established by the Government. In either case, the Government would require a complete reporting of all financial data.

We have witnessed in recent years a substantial increase in drilling gas well completions, etc., and yet, the finding rate for new gas is about half of what it was 5 years ago. Most of the production today comes from shallow, easily accessible fields. New supplies must come from remote areas or deep drilling, which require considerable expenditures and time to find, develop, and produce.

This is not to suggest that we cannot foresee an improvement in the production from traditional areas of supplies. The energy program addresses this by proposing new, more flexible standards for determining the price of natural gas produced under existing gas sales contracts. But, it is in the new areas that the potential exists for finding new supplies of any significance.

Drilling activity

The primary measure of whether incentive exists for oil and gas exploration is reflected in the level of drilling activity. I believe the attached graph, Figure 1, will give a good idea of the increase in the active drilling rig count since the Arab embargo in 1973. The drilling effort has increased from approximately

1,350 rigs in 1973 to the current figure of 1,992, an increase of about 48 percent. The number of wells drilled in 1973 was 27,602 versus 43,000 projected for 1977, an increase of about 55 percent.

The effect of price on drilling activity is apparent from an historical analysis. A wellhead price increase for crude oil, from a 1915 level of about 60 cents per barrel to a 1920 price of $2.55, corresponded to an increase in drilling from 14,000 holes in 1915, to 34,000 holes in 1920. As the 1920 price dropped back to 60 cents per barrel in 1931, the number of holes drilled dropped to 12,000. The same response is apparent in the period 1933–1937 (price up from 60 cents to $1.25 and drilling up from 12,000 per year to 31,000 per year) and the 1946–56 decade (prices up from $1.40 to $2.60 and drilling up from 26,000 to 57,000 per year).

The present situation is no exception to this pattern. The price in 1971 was $3.80 per barrel and about 24,000 holes were completed that year. The price of new oil now is about $11.00 and we expect about 43,000 holes to be completed this year.

The availability of rotary drilling rigs can be summarized as follows: The current numerical count of rigs is approximately 2,300. Rotary rig manufacturers have projected their production as 251 for 1977, 246 for 1978, 260 for 1979, and 267 for 1980.

Since 2,000 rigs are presently operating, we are experiencing an 87 percent utilization of available rigs which is about the maximum that can be expected given the need to overhaul rigs and move them to new drilling sites.

It seems reasonable to conclude that the current new oil price, as measured by the level of activity in the drilling segment of the petroleum industry, is acting as a good incentive.

The meaning of new oil and gas

There is a basic need for criteria that will promote the type of exploration we want to encourage without creating an administrative monster and opening the door to unending technical (geological, engineering, and legal) arguments and litigation.

We want to promote imaginative wide-ranging, deep-drilling exploration activity to locate and develop new oil and gas reservoirs.

Current incentives are driving the U.S. drilling industry at a very satisfactory rate, at or near the limit of the short-run equipment and talent available, but the post-embargo history of this increasing drilling effort has indicated that the greatest incentives, (in terms of wellhead prices for crude oil and natural gas), promoted infill oil drilling in old reservoirs and in marginal (stripper) reservoirs.

By January 1976, the end of the first price incentive program, with the new oil price at about $13 per barrel and the old oil price regulated at about $5 per barrel, an infill well in an old reservoir could provide oil that actually returned about $21 a barrel. The oil from a new well on a producing property brought $13 per barrel and released a $5 barrel from old production on that property so it would sell for $13, $8 more than it had been bringing. This naturally directed the efforts of operators who had old leases, on which they could drill new wells, to do just that. The result was that exploratory drilling, which accounted for about 35 percent of total drilling in December of 1973, dropped to about 25 percent of total drilling in February 1975.

The 2½-mile by 1,000-foot onshore definition identifies new oil and gas in three-dimensional terms that take into account the nature of oil and gas occurence. The 1,000-foot-depth separation also implies a fourth dimension, geologic time. The actual numbers (2½ miles and 1,000 feet) were selected after consultation with more than 20 senior petroleum specialists, including geologists, geophysicists, and economists from the U.S. Geological Survey, the Federal Energy Administration, and universities. The majority of those consulted were petroleum geologists.

It was felt that a 2½-mile horizontal separation and a 1,000-foot vertical separation from old (pre April 20, 1977) wells would describe most of the new wells of the type we are encouraging and would not provide a windfall profit for drilling in most old reservoirs.

There is no contention that these criteria will, in every instance, determine with scientific precision whether a new well is completed in a discrete new reservoir or in an old reservoir, but they will definitely provide additional incentive for real wildcat drilling and will not provide additional incentive for infill or close in drilling, for which the incentive is now ample.

The definition for new offshore oil and gas is based on the fact that, on April 20, 1977, an offshore operator who was holding a lease had already evaluated

its potential. He had also calculated a bonus bid and submitted a successful bid based on the economics that existed before that date. This means that the old upper tier price was incentive enough. New leases will receive the new oil and gas price incentive and make possible higher-risk, wildcat operations.

Incentives for coal production

The primary incentive for increased coal production is provided by the extensive plans reflected in the proposed National Energy Plan for the conversion from oil and natural gas in utility and industrial boilers to coal.

To reduce oil imports and increase the availability of natural gas for higher uses, the proposed National Energy Plan calls for a shift to coal in the industrial and utility sectors. Coal, which accounts for 90 percent of our conventional energy reserves, must play a critical role in off-setting the scarce supplies of oil and natural gas.

The proposed National Energy Plan envisions stimulating coal demand in the industrial and utility sectors with a three-pronged approach tailored to each.

The three mechanisms of the industrial coal conversion program include:

A regulatory program aimed primarily at new facilities including:

A flat prohibition of oil and gas in new industrial boilers above 100 million Btu per hour,

Authority to prohibit categories of new non-boilers such as cement kilns and primary smelting furnaces from burning oil and gas, and

Authority to prohibit the use of oil or gas in existing facilities on a case-by-case basis.

A tax program which sets a national value for the price of oil and gas to industry as follows:

The oil tax begins at 15 cents/MM Btu (in real 1975 dollars) in 1979, and rises to 50 cents/MM Btu in 1985, and

The tax on natural gas is a variable tax equal to the difference between the price the user pays for gas and a "target price" for gas keyed to the regional Btu equivalent price of distillate oil. In 1979, the gas "target price" would be $1.05/MM Btu less than the before price of distillate and by 1985, the "target price" of gas would equal the before tax price of distillate.

A rebate which reduces a firm's tax liability by the amount that the firm invests in coal or other non-oil or gas related equipment.

The three mechanisms for replacing oil and gas with coal in the utility sector include:

Conversion of existing oil and gas fired capacity to coal for those units that have the capability to burn coal (an extension and strengthening of current ESECA authority).

Prohibition of construction of new oil-fired and gas-fired capacity for non-peaking purposes.

Replacement of existing oil and gas-fired capacity with new coal-fired (or other energy sources) capacity for units that do not have the capability to burn coal.

In addition, there would be an outright prohibition for the use of natural gas under utility boilers beginning in 1990 and a prohibition against converting from coal or oil to natural gas without a permit.

An incentive tax system would be implemented to encourage coal use by utilities along the following lines:

A tax on oil of 25 cents/MM Btu would begin in 1983.

The tax on natural gas would be pegged to the Btu-equivalent of the price of distillate oil so that the effective after-tax cost of gas is 50 cents per million Btu below the price of distillate in 1983 and increases to the equivalent of distillate in 1988.

The tax rebate would be in the form of a tax credit related to expenditures made by an electric utility for qualified replacement investments using coal or other non-oil/gas fuel.

Nuclear power

Nuclear power, along with coal and solar power, is viewed as an alternative to dependence on costly and uncertain oil and gas imports. The Administration recognizes the benefits to be derived from the utilization of resources in plentiful supply which in turn accelerates the process of moderating use of those in short supply (oil and gas).

Approximately 10 percent of United States electricity is generated by the operation of 63 nuclear plants. This reflects 3 percent of the total energy output. That contribution will, with current planning, be significantly increased.

The benefits afforded by and recognized in favor of nuclear power generation are many. Coal does have economic, environmental, and health and safety limitations. Therefore, the United States must continue on the nuclear power alternative to offset a share of the Nation's energy deficit.

Light water reactors are a proven technology to produce needed electrical power. There is an availability of fuel supply and an emphasis to increase supply.

Nuclear power reduces reliance on foreign oil imports. Increased capacity of U.S. uranium enrichment services will provide a market for U.S. resources as well as encouraging other nations to suspend development of plutonium-based technology and to examine alternative methods of meeting their future energy needs.

In recognizing the incentives to nuclear powered electrical generation, the proposed National Energy Plan was formulated to arrest an invisible crisis which grows more acute and to prepare for the energy demands of the 1980's. Toward these goals, the Government's commitment to safety and waste management will be increased.

Encouragement of converter reactors and fuel cycles will focus on nonproliferation and safety concerns. Initial environmental criteria for waste repositories will be developed by 1978. Licensing of the first repository long-term storage of spent fuel will be completed in 1981 in environmentally safe areas away from power plants.

Emphasis will be given to centrifuge technology in producing enriched uranium which is more energy-efficient and has the potential for producing fuel at a lower cost. The new U.S. enrichment plant will be a centrifuge plant.

With regard to other emerging energy technologies, I have a few observations that may be useful to you, Mr. Chairman. Specifically, I will now discuss shale oil, coal gasification, coal liquefaction, and geothermal energy.

Shale oil

Probably our most difficult energy problem will be to maintain an adequate supply of liquid fuels. Shale oil offers an opportunity to augment our liquid fuel supplies from domestic sources other than conventional petroleum resources.

As you know, Western oil shale deposits are immense, and they represent a large potential supply of liquid fuels. The technical, environmental, and social problems to be solved before a domestic shale oil industry achieves substantial production are challenging.

The technology is available for first generation commercial shale oil plants. The major technical uncertainties are the engineering problems associated with scale up to commercial size and the effectiveness of current environmental pollution control technology on commercial operations. There is ample reason to believe that these uncertainties may be resolved with ongoing research and development efforts coupled with early operating experience gained from commercial size modular plants.

Estimates of the cost of producing a pumpable feedstock shale oil vary from about the world price of oil to as much as $25 a barrel depending on the method of production and the assumptions one uses with regard to financing. The oil produced may be pre-refined to a quality comparable with the best Arabian crudes for an additional $1 to $4 a barrel. The wide range in estimates indicates the uncertainty associated with scaling up the different technologies and the differing grades of oil shale.

There is considerable concern about shale oil production because of environmental impacts associated with shale oil production. Shale country is relatively pristine, semi-arid and sparsely populated region where grazing cattle and sheep is a major use of the land. The development and growth of an oil shale industry will affect the land, water, air quality, and existing social patterns.

Several private firms have indicated they can solve the problems associated with shale oil production and they are willing to proceed. These initial ventures should provide valuable information about the viability of the shale oil industry.

The proposed National Energy Plan recognizes the high risks and costs involved with shale oil development. Therefore, to encourage private shale oil development, the Administration will permit shale oil to be sold at the world price of oil.

Coal gasification

One of the most environmentally acceptable methods of using coal as an energy source is to convert it to a clean gaseous fuel. Essentially, three fuels can be produced, low Btu gas, medium Btu gas, and high Btu gas.

There are no hard and fast rules to distinguish these gases for each other. The following guidelines may be useful. Low Btu gas contains about 100 to 200 Btu per cubic foot and is produced by the partial oxidation of coal with air and steam. Medium Btu gas contains about 300 to 500 Btu per cubic foot and is produced by the partial oxidation of coal with oxygen and steam. The raw gases produced are then cleaned and converted to pipeline quality gas.

Low Btu gas can be used as a feedstock for producing ammonia, alcohols, in the direct reduction of ores and to generate electrical power. Medium Btu gas be used as an industrial fuel and for electrical power generation. With minor modification to burner nozzles, medium Btu gas can be used in many industrial applications using natural gas. High Btu gas can be substituted for natural gas in all its uses for home and industry.

There is adequate coal gasification technology available today for first generation plants. The principal deterrent to increased use of coal gasification technology is uncertainty. There is uncertainty about Federal pricing of natural gas, uncertainty about levels of imports of oil and LNG, and uncertainty about applicable environmental regulations.

Coal gasification processes can make available low Btu or high Btu gas that would have a production cost of about $2.50 to $5.00 per million Btu, respectively. The actual selling price would depend mainly on the type of gas produced, the degree of clean up required, the size of the gasification plant, and the load factor. In all cases, the gas produced has a higher cost than the price of interstate natural gas. Much of the coal-based synthetic gas is priced higher than imported LNG or synthetic gas from imported naphtha.

The Administration and the Congress, can do much to encourage increased use of coal gasification technology by removing the uncertainties mentioned earlier.

In general, we do not seek to subsidize coal gasification technologies. However, it is important to pursue an aggressive research, development, and demonstration program. To accomplish this, we are carrying out a program to demonstrate commercial scale low-Btu technology.

High Btu gas from coal may be available as a substitute for declining natural gas supplies. The Administration has supported generic loan guarantee authority for the Energy Research and Development Administration. One of the potential uses of this authority would be to help ensure that high Btu gas technology has been commercially demonstrated and is available. Decisions to utilize this authority for this or any other purpose will be made on a case-by-case basis.

Coal Liquefaction

Commercially acceptable coal liquefaction technologies are not as well developed as synthetic gas technologies. The Administration supports an active research and development program including pilot plant demonstrations of coal liquefaction technology. For example, in addition to an active research program, we are supporting a 600-ton-per-day coal-to-oil pilot facility in Kentucky.

At this time, we believe that it is premature to proceed beyond the research and development stage with regard to coal liquefaction technologies. The estimated price for coal derived liquid fuels with current technologies is in the $20 to $30 per barrel range. Hopefully, the research and development program will lower these costs.

Geothermal energy

Geothermal energy, the natural heat in the Earth's crust, has a large potential for direct thermal use and for generating electricity. Most of the identified resources are located in the Western United States. While geothermal energy occurs in several forms, only the hydrothermal form is used to a significant extent. Dry geothermal steam from The Geysers in California provides more than 500 MWe of electrical power for northern California.

Hot water geothermal resources, some at temperature high enough to generate electricity, and others at lower temperatures suitable for space heating are found in the West. At present, several hundred buildings use geothermal heat. With expected technological progress, hot water geothermal resources should begin to make contributions to our energy supplies in the 1980's.

Geopressurized geothermal resources located along the Gulf Coast contain large quantities of hot water and dissolved methane. Not much is known about the production potential of these resources. The Administration is pursuing a research program to identify the production potential and to develop some idea of the economics. At this time, commercial development of geopressurized zones is premature.

To stimulate the development of geothermal resources, the Administration is supporting legislation to extend the intangible drilling costs now available for oil and gas to geothermal drilling. Enactment of this legislation would bring about equality of treatment among activities which compete for capital.

Solar energy

The potential uses of solar energy cover a wide range of possible applications. It can be the source for hot water, heating and cooling of individual buildings, manufacturing process heat, direct electric generation by photocells and windmills, and a variety of other mechanical and heat utilizing applications—all in dispersed, on-site applications. Large scale centralized use of solar energy is also possible, such as in the production of electric energy for utility system distribution.

Of all solar energy applications, the supplying of domestic hot water appears to be the most economically viable, followed in turn by space heating and cooling. Even though solar hot water and space heating systems will save the owner money in the long run, the high initial cost is a major obstacle to rapid commercialization. In this regard, various incentives are available which could overcome the initial cost barrier. Grants and tax incentives are two direct means of effectively lowering the initial cost. In response to expanding sales, initial costs will also diminish as industry experience and the economies of large scale production are realized.

In recognition of these market forces, the proposed National Energy Act would provide significant tax credits to encourage the homeowner to utilize solar energy. Other forms of tax benefits are also proposed under the bill to similarly encourage the industrial use of solar energy.

A new program to demonstrate the Federal Government's confidence in solar technology has been proposed. Implementation of this program would more rapidly expand the manufacturing base and achieve economies of scale. To do this the President has proposed that up to $100 million worth of solar systems be procured for installation in Federal buildings over the next 3 years. The President also has proposed two other initiatives: (1) a joint Federal/State consumer education and information program, and (2) a joint Federal/State program of standards development and certification.

In addition to these incentives, we will encourage State governments to pass legislation exempting solar equipment from property taxes and to pass legislation that protects access to solar radiation.

In summary, with respect to solar energy incentives, the President has proposed a number of specific actions:

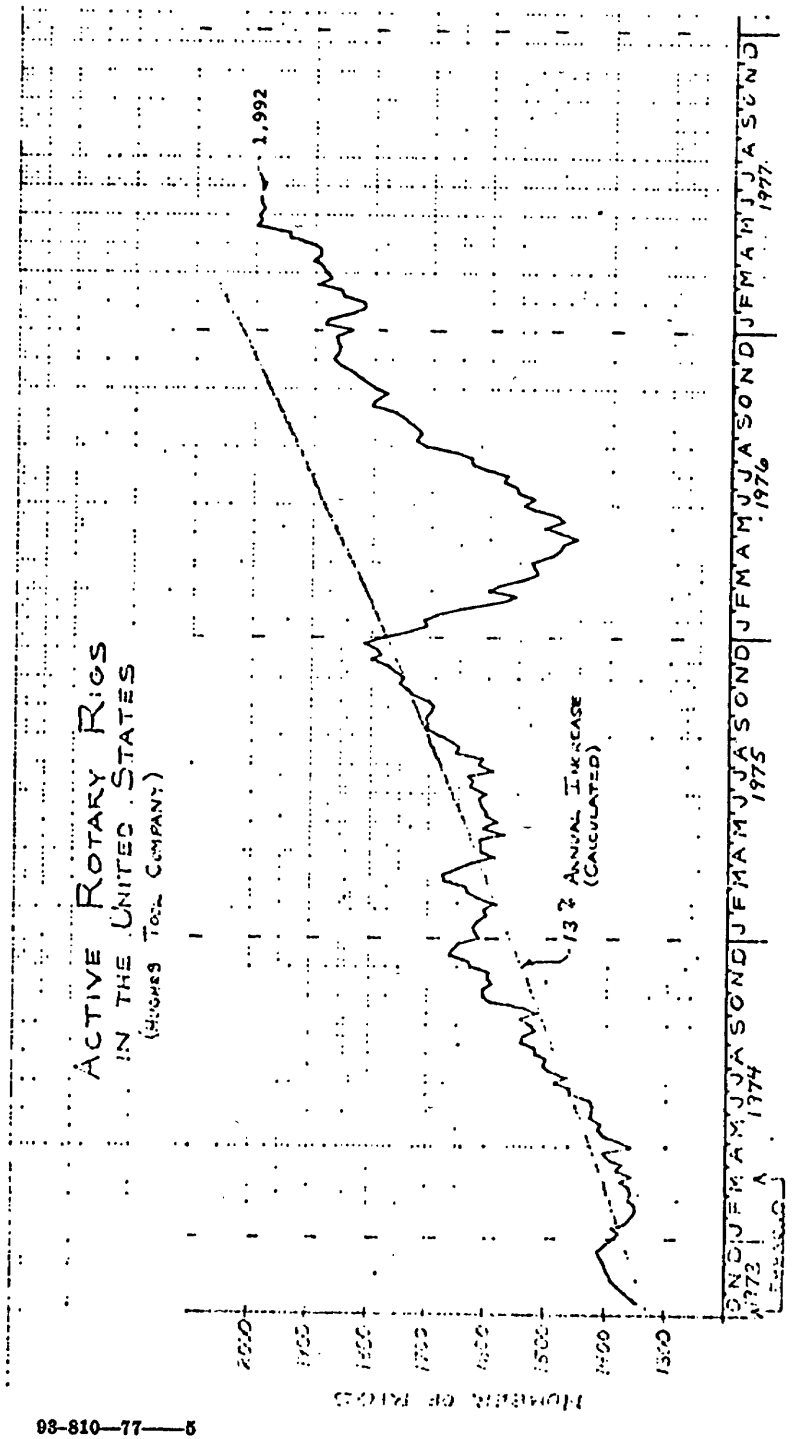
Residential tax credits.
Business tax credits.
Solar in Federal buildings program.
Federal grants to non-profit schools and hospitals (i.e., for conservation, including solar energy systems).
Federal/State program on standards, certification, training, and information gathering and dissemination.

In combination, we believe these incentives will constitute a powerful impetus to the early use of solar energy for heating and cooling.

The analysis of commercialization incentives for other solar energy technologies is not nearly as complete as for solar heating and cooling applications. At the present time, we have underway a variety of studies on centralized and dispersed solar electric generation, biomass, process heat and other solar applications. Based on the findings of these and other studies, a national plan for the accelerated commercialization of solar energy will be developed and forwarded to the Congress for consideration, in accordance with the provisions of the Energy Conservation and Production Act of 1976 (Public Law 94-385).

This presentation has attempted to cover the items requested by the Committee staff. If any other information is required, FEA will be pleased to provide it.

FIGURE 1



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Senator GRAVEL. Our next witness is Prof. Barry Commoner, Washington University. It is a pleasure having you here.

STATEMENT OF PROF. BARRY COMMONER, WASHINGTON UNIVERSITY

Mr. COMMONER. I am glad for the last question. I think this is exactly the issue that Congress confronts.

In my view, there is a basic fault with the entire national energy plan, and that is it is based on a premise which, in my opinion, is factually incorrect. At least the disagreement that exists has not been defended by the administration.

The basic fact is—and I will quote from Mr. Carter's speech to the Nation—he said, "We cannot substantially increase the domestic production of oil." The entire structure of the plan is based on that premise.

Because of that assumption, the plan does not call for a large amount of conservation as is publically believed; that is a minor part of the plan.

The major changes in the plan are a huge increase in the production of coal and of nuclear power; a shift of energy away from consumers to industry; a shift in the use of energy away from direct heat to the use of electricity; finally, a commitment to a nuclear future.

The plan includes the development of a breeder, be it not a plutonium breeder.

What I am saying, if you look at this entire—I was going to say "House that Jack built." I guess that is the wrong name—if you look at the entire construction of the plan, it begins at one point, that we cannot produce more domestic oil and gas than we are now producing. In my opinion, that statement is factually incorrect, and let me go ahead and demonstrate why I believe that to be the case.

There has been, in my opinion, only one detailed analysis of the capability of the United States to produce domestic oil and natural gas and all of the subsequent analyses have been based upon those data. The analysis was the report called "U.S. Energy Outlook, Oil and Gas Availability," published in 1973 by the National Petroleum Council.

That is a 768-page document containing 1,000 tables and charts.

Senator PACKWOOD. What is that?

Mr. COMMONER. The National Petroleum Council is appointed by the Secretary of the Interior. It consists almost exclusively of executives of the American oil industry.

In other words, when people say, well, it is the oil industry that has all the facts, what they mean is, the National Petroleum Council.

I want to submit to you that it is impossible to fudge a thousand pages of tables and graphs. In other words, the data are there and we have to recognize that, and let me very briefly go through with you what that report found.

First, let me report about the methodology. The report analyzes the geophysics of oil production, how you have to find, drill for it, and so on, on the one side; and on the other side, it analyzes the cost of doing all of that, including assumptions about the rate of return on investment.

These two sets of data are combined so to speak in a computer, and out of it comes numbers of the average price at which oil would have to be sold in order to provide sufficient funds to find and produce a given amount of oil.

What that tells you right away—this is the answer to Mr. Packwood's question—the amount of oil that we can produce depends upon how much we are willing to pay for it.

One of the things that disturbed me about Mr. O'Leary's answer to you—which he agreed with you—was that in his printed testimony, he cites figures from the U.S. Geological Survey on how much oil there is in the country. He cites only those figures that represent the amount of oil that could be found at the current economic conditions.

If you look at that same report, No. 725, you will find that my figures disagree with his, because I looked at both parts of the report. In the report, there is a chart showing how much oil can be found. There is a horizontal line. Above the line, the amounts are what are called economic, what can be found under current economic conditions. Below the line is much more oil, that can be found under higher prices. And I think it is unfair, unwise, and misleading for the Government to report only what is above the line because one of the questions that comes up here is: Suppose we decide to change the price situation? Could we have more oil?

The answer is yes, and the Government keeps saying no.

Let us go back to what NPC did. It is very revealing. The National Petroleum Council organized its findings around four cases with some subcases. Case 4 is lowest production and that represents a continuation of the trend which developed in the United States beginning in 1955 for reduced drilling by the industry. I have previously said before this body that the industry deliberately cut back finding oil in the United States in the mid-1950's on the testimony of industry officials themselves.

The reason was that they found it more profitable at that time to go abroad. The profits were twice as high. They simply made the usual business decision.

Case 4, then, is a continuation of the present decline in drilling for oil and also assumes a relatively low finding rate.

Case 1 is at the other extreme. It means a high drilling and high finding rate, and charts in my prepared testimony show how much oil could be produced between 1970 and 1985 in the United States under these various cases. The simple fact is that under case 4—and we will use 1985 as the target year, because that is the target year for the national energy plan—case 4 predicts that 10.4 million barrels a day of oil could be produced in the United States in 1985; that is, continuing the downtrend.

Case 1 predicts 15.5 million barrels per day, a 50-percent larger figure.

For some strange reason, 10.4 is exactly the number that appears in the national energy plan for 1985. If you look at the tables at the end of the plan book that was published by the White House you will find the predicted production of domestic oil in the United States in 1985 is 10.4 million barrels per day.

So the administration has chosen case 4 of the National Petroleum Council report to predict oil production.

On the second half of the methodology chart, in my prepared testimony you see the other side of the computer program. What would it cost?

You notice that the price for case 4 production in 1985 would be $5.20 a barrel. These are all computed in 1970 dollars, in order to take care of inflation.

In case 1, it is $6.69. In other words, for a relatively small increase in price we could raise the amount of domestic oil produced in the United States by 50 percent. What is strange about the national energy plan is that it proposes an even larger increase in the price of oil in 1985.

To put it very simply, the national energy plan adopts the low production figures of case 4, and it adopts the high price of case 1. I think that this is an astonishing thing for any Government agency to propose.

The main point that I want to make is a very simple one. I know of no scientific analysis which has contradicted the work reported by the National Petroleum Council. In fact, you will find that all the FEA reports are based on these data.

I would like to make a fundamental point: the basic factual presumption on which the entire energy plan is founded is, in my opinion, incorrect, and, at the very least, involves a serious disagreement with an unchallenged—and only detailed study—of this problem.

It seems to me that the administration at least has the obligation to say why it disagrees with these other interpretations. I think the administration has got to show where its numbers come from and why they disagree with the extraordinarily detailed report of the National Petroleum Council.

This is something that the Congress really ought to call upon the administration to do.

I have one point I want to make on this, which I find very disturbing. Last week I debated Mr. David Freeman, Dr. Schlesinger's deputy, on these issues before the New York Bar Association, and I discussed the numbers published in back of the national energy plan. I was astonished to discover that Mr. Freeman's defense was that the numbers should not be taken seriously, that they do not have a substantive connection with the plan.

Now, I find that an extraordinary statement. I am accustomed to taking the numbers in Government reports very seriously, at least to find out if they are right or wrong.

It seems to me, again, there is an issue here that Congress needs to look into. I am talking about the tables in the back of the national form plan book, on pages 95 and 96. Those tables tell us that of the energy to be produced between now and 1985 or the demand for energy, the plan would use conservation to meet only 16 percent, whereas nuclear power would be used to meet 23 percent of the demand, and coal to meet 50 percent.

Mr. Carter claims that the corner of the plan is conservation, but the facts indicate that the cornerstone has been mislaid. The plan's foundation is really nuclear power and coal.

Again, there is really a crucial issue here for Congress.

The rest of what I want to say carries this argument somewhat further. You ask how shall we use various energy resources.

What I would like to do is run through, very briefly, the advantages and disadvantages of using oil, natural gas, coal, nuclear power, and solar as the resources for solving the energy crisis.

Let me preface that discussion by redefining the energy crisis. The energy crisis stems from one single fact, and that is that we now base nearly all of our energy use on nonrenewable resources. That is, they are constantly being used up.

Mr. Long, I have to remark to you that sugar is a renewable resource. Sugar represents solar energy.

The market behavior of sugar and petroleum are going to be very different, and the point I am making really is this. There is no way to continue to produce oil and gas without the price rising, no way at all. The law of diminishing returns tells us that.

If you have a limited amount of a resource, the first barrel you extract will always be the cheapest barrel. The moment you begin to use oil, there is a drive toward rising costs and therefore rising prices, and that is what the NPC analysis is all about.

Senator LONG. If I could interrupt you for just one moment, I am not quarreling with the things that you have said here. There is no doubt about it that we have right here, in fossil fuels alone, enough to take care of our needs for the next 500 years. I think between now and then somebody else would show up with a good idea.

It is all a matter of price, as you have been saying all along, as I understand it, so I think that you are making a very significant statement.

When one worries about the fact that we are running out of something, one is not really worrying about the right problem.

Mr. COMMONER. No, the problem is really economic.

Senator LONG. The problem is paying for it. You can have all you want, all you have to do is pay for it.

Mr. COMMONER. Right; but there is a limit.

I would like to make this point. The rate of increase in price prohibits going on that way. The rate of increase in the price, the slope of the curve, has devastating economic effects. Let me give you one.

The price of energy in the United States relative to the price of all commodities, what economists call the real price of energy, is now rising at a rate that is unprecedented in the history of the country.

During the rebuilding of the country after World War II the price of oil was flat. An engineer could predict, if you wanted to build a refinery or any factory, what the cost of fuel would be 5 and 10 years from now so that you could readily compute the bottom line, the expected profit.

One of the things that is holding the economy back today is the uncertainty of industrial investments. One reason is that no one can predict what the price of oil is going to be 5 years from now, because it is rising so fast.

In other words, what I am saying here is that we cannot tolerate continuing to use a nonrenewable resource because it involves a very disruptive economic process, namely a constant and rapid rise in the price.

This hurts industry, this hurts the consumer. As you know, it is the driving force of inflation. Poor people use a much greater part of their budget to buy energy than rich people, so it is a burden on the poor.

In other words, I think the energy crisis is simply this: because we are relying on nonrenewable resources, we have become locked into a devastating rapid rise in the price of energy. That is the problem which has to be solved. I do not mean by bringing the price down, but by stabilizing it.

There is only one way to do that; to shift over to renewable sources. There are only two possible renewable sources. One is solar energy, the other is nuclear power with the breeder. The big issue to be discussed in developing a national energy plan ought to be how are we going to make that shift?

Very briefly let me say that the various available fuels differ very much in their suitability as a transitional source of energy. I think that we can readily shift to either nuclear power plus a breeder, or solar in 50 years. The question is, which fuels should we use in that period of time as we introduce the renewable resource?

The obvious thing to do is to use the fuels in the present balance in which they are used, which means 75 percent oil and natural gas, about 20 percent coal and a trivial amount of nuclear.

Why do I say that? If you make a shift, we are going to have to rebuild the energy-using system, while we are building a completely new energy production system. I do not think the country's economy could stand it. If you look at the energy plan figures, you will discover that huge capital costs are involved only in getting industry to shift over to using coal.

There is another serious disruption. Take domestic use of oil and natural gas, which, according to the plan, is to be cut back. More electricity will be used. Why?

The reason is, that is all you can get out of nuclear power, and it is the easiest thing to get out of coal.

What that means is the rebuilding, so to speak, of the energy using system in domestic and commercial buildings. A whole shift in that market. I think that it will be extremely disruptive, economically.

In other words, when you look at the alternative fuels, that we have to make the transition in the next 50 years, the most sensible thing for us to do is to continue to use fuel roughly in the way we are now, mainly oil and gas. That depends entirely on whether there is going to be enough to carry us through the transitional period as the conventional fuels are phased out.

The figures that come from USGS–725 indicate if we are willing to pay the price, we have got roughly 50 to 75 years' worth of oil. We have even more of natural gas, and since these fuels will be phased out as we make the transition, I think that the present fossil fuels in the United States are sufficient to carry us through a gradual period in which they are phased out and renewable energy is brought in.

My own opinion is that the renewable source ought to be solar, not nuclear—and, incidentally, it makes a difference, right now what you choose. If you choose the nuclear route, then yes, you use coal very heavily as a transitional fuel because the nuclear route means the total electrification of the United States. That is what you can do with coal.

On the other hand, if you choose the solar route, you are much better off continuing to use oil and natural gas while you are phasing them out.

Why? The immediate economically feasible applications of solar energy are for direct heat, which is exactly what you can do with oil and natural gas. In other words, you can simply slip in solar collectors and methane from biogas or organic waste from agriculture. In fact, you could produce methane and begin gradually feeding solar methane into the pipelines as you cut down the use of natural gas.

It is already beginning in Texas where a firm has begun to make methane out of manure and is beginning to put it into the pipeline. Our computations show that California is a favorable State. You can make enough methane from organic wastes or solar energy to take care of the total electric production in the State of California right now, and you could probably do it at a cost that would compete very well with liquid natural gas which they are planning to bring into California.

What I am saying is that it would be very important to decide now which renewable source we are heading toward. If you choose nuclear, then you do what the plan is doing, build up light-water reactors and coal and cut down on the use of oil and natural gas. If you were to choose solar, then you would keep the present balance of energy sources during the transition.

A table, included in any prepared testimony, indicates that the solar technologies that are available could over a 50-year period begin to provide most of our needed energy. I think that the national energy plan—well, to put it simply, it is misguided. It is founded on what I regard to be an absolutely false analysis of the availability of domestic fuel, and most of its faults flow from that.

I hope that Congress will take a look at these physical facts that are the foundation of the national energy plan because I think if we go ahead the way we are, we are headed toward economic disaster.

I hope that Congress will help to avoid it.

Thank you.

Senator GRAVEL. I really want to commend you. That was a very complex national issue, bringing it down to a simple denominator.

I hope your statement will be carried forth by the media in that regard.

There is one question I would have. When you first started off, you came out in a reaction to Senator Packwood's question. In showing your charts, you stated the Government is using, as its interpretation, case 1 pricing and its projections for case 4 production.

Mr. COMMONER. Even higher than case 1 pricing.

Senator GRAVEL. What happens in this regard? Is this all eaten up in the transfer process or, if these pricings were truly to realize themselves, would it not translate itself into production by accident—not by intent, but by accident?

Mr. COMMONER. That is a very interesting point. I am going to attach to my statement an article that I published in the Washington Post on May 29 in which I attempted to answer the question, so to speak, what is going on here?* Where is all the money going to go?

I cited in that article the opinion of Mr. Ashley that the rebate aspect of the plan seems to be quite soft. The administration spokesmen speak of flexibility. They may want to use that accumulated tax money in some other way.

*See p. 87.

In other words, if that is true, the answer to your question is quite simple. What the plan envisages is charging the consumer a price which would enable increased production of oil—but using the money for something else.

What I think it is for—yesterday I noticed an interview with Mr. Blumenthal that begins to spell it out. I think Mr. Carter is worried about the need for capital for industrial investment. I have heard figures of $80 billion a year in the 1980's accumulating from fuel taxes. That is a lot of capital.

It may well be that that capital is going to be used to support American industry and perhaps, for example, the nuclear industry. General Electric came to Mr. Schlesinger and said they wanted to get out of making nuclear powerplants because they had been losing money. The only way they are going to stay in is with a subsidy, and it may well be that these accumulated funds are designed to give the administration capital that it can use to shore up what it regards to be the essential parts of our energy industry. In that case, we have come back full cycle to Mr. Ford and Mr. Rockefeller's $100 billion bill. You remember they proposed to take the $100 billion of tax money and dole it out to nuclear power, coal conversion to synthetic fuel, and so on, and for all I know what we have got is exactly that same picture.

In other words, the scenario that the NPC report speaks of, raising the price so that you can get the funds needed to put back into producing more oil, that scenario is not what the administration plans to do.

Senator LONG. If I may interrupt you, you are describing the Nelson Rockefeller plan. I think you mean, when you mention a $100 billion tax bill, that this $100 billion is money that is going to be printed up at the Federal Reserve.

Mr. COMMONER. Extra budget.

Senator LONG. There is a difference.

Mr. COMMONER. That is even worse.

What I am suggesting is, in answer to your question, that we may have in the national energy plan something that was designed to accomplish, not so much an energy purpose, but an economic purpose; namely, to collect taxes.

Senator GRAVEL. The only other question I would have, in dealing with the market forces, in answer to Mr. O'Leary's question of need and what I would do. I responded that I have been on the record for a number of years advocating this approach, going to a free market system and putting a cap on it to guarantee the money is used for what it is supposed to be used for. Of course, that being in the form of an excess profits tax.

But this does have one inefficiency, or one weakness as I see it, and that is the effort of solar energy, although we are just beginning to spurt a little bit now with some of the companies going into solar activities that I find most encouraging.

What would be your thoughts on the advocacy of more of a free market approach as opposed to what I would term the paternalistic approach in the press and the administration, the last two administrations?

Mr. COMMONER. I have done a fair amount of thinking about this. I have discussed it in my prepared testimony in connection with deregulating the price of oil. I see no way of making a rational transfer to renewable sources without what, I would call, social governance.

Society has to have something to say about what is produced and how it is used.

Let me explain that. Take solar energy.

There is a physical fact about solar energy that makes it solely unsuitable for investment by very large companies. All the energy companies are huge companies. They have billions of dollars of capital. Conventional energy is very suitable investment for them, for a physical reason. In all conventional energy production there is what the economists call a big economy of scale; the bigger the operation, the more efficient it is, and that is why nuclear power plants cost $2 billion, refineries cost $1 billion, and so on.

That means that only a company that has big amounts of money can afford to build these big installations and has a competitive advantage over a small company. There is no small nuclear company.

Solar energy is exactly the other way around. There is no economy of scale in solar energy.

For example, if you wanted to have a lot of electricity from photovoltaic cells what you do is put a lot of little ones next to each other.

The efficiency of that array is exactly the same as the efficiency of the little unit that you use to run a flashlight. So if you want to have a big solar installation, you can build it, but it is really going to be no more efficient than a small one.

That means that companies of all sizes can compete equally in solar energy. I think this is perhaps the most important fact that we have to learn about. Solar energy can be entered into by a big company, if it wants to, and also by a man with five friends operating in the back of his garage, building solar collectors.

That means the present huge concentration of capital invested in energy production in the hands of a handful of very big companies must spread out if we are to develop solar energy. I do not see that there is any way out of that.

You cannot rely on very wealthy companies to go into solar energy because they will lose the competitive advantage they would have over million dollar corporations, or even smaller ones.

How that is to be accomplished by the free marketplace, I do not know. I do not think that it will work. I am compelled to remark, with respect to what Mr. Long said earlier, talking to Senator Bellmon, that I think that it would be unwise for us to rely on the free marketplace, to rely on the oil companies to return the rising increase from the price of oil to oil production.

Once that capital is in the hands of the oil companies they have the right to invest it in mail order houses, if they want to. What you suggested was making energy production the most profitable sector of the economy.

Well, I think that would be disastrous, because energy is essential for every single economic operation we have. It would put a tremendous burden on the poor. It would make the entire economy dependent on an exaggerated rate of profit.

There is no way of doing that without disrupting the social structure of the country. I respectfully have to disagree.

Senator LONG. Could I respond and ask you, you have made some very profound statements here, and your statement deserves much further study.

Let me ask you now, in what area do you have your letters? What are your degrees?

Mr. COMMONER. I was trained as a biologist and I have my Ph. D. in biology from Harvard University. I have a number of honorary degrees, including an LL.D., but they do not count.

Senator LONG. Do you have a degree in economics?

Mr. COMMONER. I have no degree in economics. I have never taken an economics course.

Senator LONG. That explains why you are so eminently right in some respects and in errors in others.

Mr. COMMONER. I am going to disagree with you, but go on.

Senator LONG. I was referring to the annual reports on the profitability of the various industries. I will be glad to provide you with a copy, just to show you what the situation is in the industry compared with others.

We have changed the profitability of that industry, even under the Government price control program; the profitability of that industry has been moved up a point.

Mr. COMMONER. The average rate of return for oil companies over the last 25 years or so is about 12 percent as compared to 11 percent for all manufacturers. I did not take a course in economics, but I know some.

Senator LONG. Are you looking at the same chart I am looking at?

Mr. COMMONER. I am talking about the postwar average, not the notes of return as they happen to be just now, or very recently.

Senator LONG. This is what I am looking at. As of now, for the first quarter of 1976, the latest data we have but I think later information will confirm the same thing, the rate of return for all manufacturing corporations was 13.3 percent.

If you get down to comparing the nearest thing to the petroleum and coal products industry, the nondurable manufacturing corporations, the rate of return is 14.3 percent. Petroleum and petroleum products are 14.7 percent.

Mr. COMMONER. A 1-percent difference.

Senator LONG. It is higher. For the major companies in the United States, the 10 major companies, the rate of return is 17 percent. That is equal to the profitability of anything else shown on the chart.

All I am contending is that if you want capital to flow into an industry, you have to make it more profitable than something else. Otherwise, investment is not going to go there, and it will tend to go where it is more profitable. I am not quarreling, doctor, with anything that you said about the desirability of going to solar energy.

I do not quarrel with your argument that solar energy would tend to be something that major companies could not handle because it tends to be decentralized. When it is each household unit producing its own solar energy, I think that is good. From the economic point of view, if it gets to the point where something can do the job better than oil and gas, as far as I can see, have that capital shift to something else.

The free-flow capital theory in free economy is something we all ought to understand and learn to live with. When there is a shortage of something, the price ought to go up. I thought that you were testifying to that very point, in the beginning.

Mr. COMMONER. What I said was that the price of producing a nonrenewable source will inevitably rise. If you want to use it—and I think we should—as a transitional fuel, we have to meet that cost.

Where you and I differ is whether we should rely on the difference in profitability between different sectors of the economy as a way to regulate the flow of capital.

I think that is the long way around to deal with what I regard to be an extremely socially important problem. I think that if there were any argument for nationalizing any industry it would be the energy industry because it has such enormous, pervasive effects on the economy.

Let me give you an example that struck me this winter during the gas shortage. You remember, the Texas interstate producers wanted an extra dollar of profit. Otherwise, they were not going to put the gas in the national pipeline; that was the free economy working.

I think if we went down there with a bunch of $1 bills in our hands, of tax money, and said, here is your dollar, put that gas into the pipeline, the country would have been saved money because the disruption of the economy of the States that were cut off, I think probably cost us much more.

In other words, what I am saying, this particular commodity is of such tremendous importance in our economy as a whole that we cannot afford disruptions, and we have to have, so to speak, social governance at least in this commodity. Otherwise, the rest of the economy will be in deep trouble, and what I am saying is, the very last sector of the economy that I would want to leave to the whim of the market forces is energy. But I think that what we are talking about now is a question of political philosophy, not so much the nature of the national energy plan.

Senator LONG. You made a fine statement. It is extremely well taken in the area where you have your letters.

Mr. COMMONER. I have to remind you I have no degrees in geophysics. In fact, my degrees are all in the study of single living cells and nothing that I have described to you, and you agreed with, derives from that knowledge either.

The other thing I want to remind you of, is that I am not a believer in degrees. I have studied economics. I am quite happy to stick my neck out because I think we all have to take that risk. Both of us.

Senator LONG. It seems to me that we should push as hard as we can to develop solar energy. You are for that, and I agree with you. I still think that unless we are going to find some technology that we do not anticipate, we are going to need the same energy industry that we have right now, if, for nothing else, than to provide us with fuel to put in an automobile tank.

How would you drive your automobile with solar energy?

Mr. COMMONER. That is really quite easy. There is a bus in Provo, Utah, now running on liquid hydrogen. You get liquid hydrogen very easily from solar electricity by running the electricity through a solution that produces hydrogen and oxygen.

Another thing is that you could be making methane out of bagasse in Louisiana, and that methane can be easily converted to methyl alcohol that you can use as a fuel.

Senator LONG. If you can make it on a competitive basis—again, you are talking about price—more power to you.

Mr. COMMONER. It is going to have to happen. What I am saying is that the price of fossil fuels and nuclear power is going up. The price of solar devices is coming down. There will come a point where the two curves cross. There is no way out of it.

What I am saying is that we have to prepare ourselves in the next 50 years for a series of those crossing points. Today, solar collectors and methane are feasible for many parts of the country. Photovoltaic will probably be feasible economically in 10 years. That is the way it will go.

There is no way out. We go that route or the nuclear route. For various reasons, I think that the nuclear route would be a disaster.

If we are going to have a national energy plan, that is what it should be, an understanding that we have got to get someplace 50, 60, or 40 years from now and to take the steps now that will lead in that direction.

Senator LONG. I gain the impression from your statement that you feel that we should have a rapid increase in the production of oil and gas in the short run.

Mr. COMMONER. Yes; absolutely. You see, in the next 10 years we have to have 30 percent more energy just to keep going. The way to supply that is increasing the present pattern of fuel production, but at the same time, we ought to be building solar devices to begin to phase conventional fuels out.

In other words, it makes no sense to impose this artificial restriction on what will happen in the next 10 years—that is, no more increase in domestic oil or gas production.

You cannot allow this to go on forever, because the amounts of these resources are limited and we have got to plan to replace the oil and gas we rely on for our economy. I think the wrong thing to do is undertake a series of drastic changes in the use system, as proposed in the national energy plan.

Senator LONG. You are saying that it is in error to force us to go so far in converting over to coal, just to reconvert again?

Mr. COMMONER. That is right, and nuclear power as well. What that does is to force us in the direction of producing electricity, and in turn that puts a bias into where we can go in the future, which is in the direction of the system that can produce only electricity; namely, nuclear power.

There are hidden jokers in this thing. If I have a complaint about what is happening in Congress, it is that the Congress has been looking at the deuces instead of the jokers. You have been looking at the small fragments of this problem, how much tax here, how much there. But buried in the plan are some very serious changes in our economy, our entire economy, that I think Congress has not looked at adequately.

Senator LONG. Thank you.

Senator GRAVEL. Senator Hansen?

Senator HANSEN. Dr. Commoner, I was greatly impressed with your statement and I must say that I think it makes a significant contribution.

There is a real credibility gap in this country today and for reasons that are perfectly obvious. It occurs to me that any number of witnesses could have said what you said about the potential for development of oil and gas in this country and the relationship between price and supply and it would have been discounted and discredited by the press. You certainly speak for a different constituency. I think your contributions have been particularly valuable.

I am not certain what you are saying in response to a question or observation made by Senator Long. I think I may put words into your mouth as well as the Senator's when I try to recall or try to express what I think Senator Long was saying. Would it not make sense to make the energy industry far more profitable than it is today?

I believe your response indicated that you would be fearful of that approach, that the Government, or the social consciousness should be brought into play some way. Is that essentially what you are saying?

Mr. COMMONER. Absolutely. Let me clear the air a little bit. I will give you my own personal opinion.

Senator HANSEN. Just on that one point, it would be helpful.

Mr. COMMONER. The record shows that the ebb and flow of capital does not follow what is socially needed in this country. For example—I have written about this a good deal—the petrochemical industry is very profitable, and, as a result, we are surrounded by unnecessary chemicals, plastics, and so on, and I think there is a real social problem there.

In other words, I am making a simple point that what is most profitable is not necessarily best for the country. In many cases, it is worse.

What I am saying also is that this particular commodity, energy, of all of the commodities that we have is so essential for the well-being of the rest of the economy that I think we cannot afford to allow it to be governed by anything except direct social interest. In other words, I am in favor of governmental regulation, control of what energy is produced and how it is used.

I realize that this flies in the fact of the great taboo that we must not criticize the private enterprise system. I am a critic of the private enterprise system—in print. That may be a consequence of my not studying economics, but I still think it is not written on golden tablets anywhere that the free marketplace is the only way to live.

So that what I am saying is that you do not have to be an oil company executive to disagree with the national energy plan. I think that, in one sense, what the oil companies are saying is correct, that if there is more money available to invest in it there can be more oil. But I do not trust the oil companies to do what is socially useful with all of that money they would collect.

I think that it is absolutely essential that there be social governance of what is done with it, whether it is by subsidies or by regulations that block excess profits.

I have been speaking against Mr. Long's proposal that you just let everything go and make it extremely profitable. I must say that that would be a very bad thing to do.

Senator HANSEN. Thank you very much, Dr. Commoner. Let me follow on with two points.

What is most profitable is not necessarily best for the country. You talked about the petrochemical industry. I do not argue with you. I agree with you completely. I think that it ought to be noted that given the freedoms that we have in this country, we may want to and indeed, do demand in the marketplace, a lot of plastics, a lot of things that we should not have.

We also smoke tobacco and drink a little whisky on occasion. These are not good for us, but we have found, by bitter experience, that people are that way, they are just that way.

You speak of the desirability of government by direct social interest for precisely the same interests that you have in mind because this is an energy-intensive Nation. Jobs do depend on its availability and, to a certain extent, on its cost as well.

I happen to be a rancher. For every 1 man-hour that is put on in a ranch today, we burn 1.2 gallon of fuel of one kind or another. I do not argue if somebody could come in and mold our brains before we are born, we would want all the good things and avoid all the bad things. We would certainly redirect priorities, but as long as we are human, as long as we like to be bad, as long as we take pleasure in the evils of society, whether it be tobacco or whisky or plastics, I guess the marketplace, in my mind, does a pretty good job of responding.

If we want to change that around, that is something else, because energy is so important. On that point that you and I agree. I do not want to leave it up to the Government. We are looking at an energy plan right now with which you find little merit. I find little merit with it, and I do not know how we are going to have the social interest identified and injected into the marketplace, except as the Government and our politicians decide it should be.

I read what Peter Jay had to say in the Economist, I believe it was. He had some misgivings about the future of England, because given the kind of government that they have. While ours is not exactly a mirror image of it, politicians can get out on the stump and say what they will do for people. We do not often say what we are going to do to them. I do not see how we are going to come around to telling people what really ought to be good for them and what is in their social interests except to let the marketplace say those things.

Mr. COMMONER. Let me give you a quick response.

In the first place, on the factual part, there has been a survey of what people think of plastics. It turns out that most people would be more happy to do away with plastics than anything else, yet we are surrounded by plastics.

Do you know why? It is built into the economy of the petrochemical industry.

For example, one reason why acrylic fiber rugs and acrylic soda bottles were produced was because it happens to be a byproduct of making polyethylene film. So the fact that people buy meat wrapped in polyethylene means that wool is going to be driven off the market by cheap acrylic rugs. Nobody asked for it.

My favorite example against the argument that industry only produces what consumers want is socks. You go into a store now and you cannot buy a sock that fits your foot. Is that what consumers want? I do not know any consumer that has feet that are so variable in size that he has to have a sock that fits everybody. That is not a consumer-motivated change. That is a change motivated by the profitability of the industry.

I think, if you look at a number of things, you will see the same sort of thing going on.

That is one point. On the fundamental point that you are raising, I have to express a feeling—there is a way for the people of this country to decide democratically what is socially useful and to see to it that it is reflected in the workings of our economic system. In my own experience, when people understand the facts—that is what is missing very often—they begin to see what is best for themselves and best for society and learn how to match those things up.

The main problem with the debate on the energy plan is that the facts have not come out: for example, that Government does not believe its own facts, if Mr. Freeman is correct, that has not come out.

I think that once we get the facts out so that people understand them, a lot of your worries about whether democracy works or not will be relieved. I think it will work. I even have confidence in most politicians. We may disagree there.

Senator HANSEN. I appreciate that on a very personal basis. Thank you very much.

Senator GRAVEL. Senator Long?

Senator LONG. When I first read Adam Smith's writings back in 1938, I was not the least bit impressed with him. The inspirational language I found in the manifesto of Marx and Engels just rang a bell with me as a college student. It took me a long time to find out that the idea of the Government doing everything for us just does not work.

The more I see of it, the more I have become convinced that Mr. Reagan was right when he said on television that Washington is not the solution to this energy problem; Washington is the problem.

This Nation proceeded on the theory that we would do best to rely on the pure economics of the world economy and on foreign oil for our Nation's energy needs. We made a decision to let the Nation's energy industry deteriorate so that it was not capable of supplying all of our needs. Although the disaster that one could have predicted occurred, we have yet to adopt policies that would bring about production for our own needs. Our policies are temporized, rather than being based on every sort of expediency possible.

I think the performance of Government, and its failure to make the hard choices and to tell the Nation the difficult truth that energy is going to have to cost us a lot more and that we have no choice but to become self-sufficient in the national interest, indicates to me that the Government is just not the answer to the problem. Politicians have a difficult time doing something that is so unpopular, even though it is necessary.

People do not want to pay anything more for gasoline at the pumps. If you tell somebody he has to pay an extra 5 cents a gallon for gas, you are lucky to get out of that conversation without an argument.

There is a great need for the free enterprise system. I think it has done a better job than any other system. You have shown us something that I was not aware of, that is, the potential of providing for our needs in the short run now is far more than anyone predicted.

Senator GRAVEL. I would like to associate myself with those remarks.

[The prepared statement of Mr. Commoner follows. Oral testimony continues on p. 112.]

STATEMENT OF BARRY COMMONER,* DIRECTOR, CENTER FOR THE BIOLOGY OF NATURAL SYSTEMS

SUMMARY

The National Energy Plan has been proposed as a means of dealing with the energy crisis by restricting demand through conservation. However, when the role of energy *supplies* in solving the energy crisis is examined, grave faults can be discerned in the Plan. It is evident from the Plan's apparent data base that it in fact accomplishes relatively little energy conservation and that its largest effect is to sharply increase the future use of coal and nuclear power and to reduce the use of oil and natural gas. This approach is based on the Administration's claim that domestic oil and natural gas production cannot be increased beyond their present levels. However, this conclusion is directly contradicted by the most comprehensive study of future oil and natural gas production in the U.S. This study, published by the National Petroleum Council in 1973 shows that production of domestic oil and natural gas could readily be increased enough to meet the increase in demand for energy between now and 1985 without the Plan-mandated rise in coal and nuclear power production and without increasing oil imports. According to the study, the higher costs required to accomplish this increase could be met by price increases that are *less* than those mandated by the Plan. Thus, the crucial assumption of the Plan, on which its entire strategy for dealing with the energy crisis is based, appears to be unfounded in fact.

Since the energy crisis is basically due to our present dependence on nonrenewable fuels it can only be solved by accomplishing a transition to a renewable energy system—either solar energy or a nuclear/breeder system. The sharp changes in the patterns of energy production and use proposed by the Plan would inevitably lead to dependence on the nuclear/breeder system—an eventuality which is, in fact, provided for in the Plan. Apart from the serious biological, economic and political hazards involved in a nuclear energy system, the changes mandated by the Plan would involve very high capital costs and leave the national energy system vulnerable to disruptions. On the other hand, if solar energy is chosen as the basis for a renewable energy system, then oil and natural gas are very suitable transitional fuels which, according to the NPC analysis are available in sufficient amounts to support a transitional period of about 50 years, without seriously disrupting the present energy patterns. Thus, the National Energy Plan would lead to short term effects that would be seriously disruptive of the national economy and which would inevitably commit us to a nuclear, rather than solar, future. An understanding of energy supplies which is more accurate than that reflected in the Plan shows that existing oil and natural gas resources, together with moderate use of coal could sustain a rational, gradual transition to a renewable, solar energy system.

THE NATIONAL ENERGY PLAN

Considered in relation to the question of energy supply, the National Energy Plan is in my view profoundly and fatally faulted. To begin with, despite the claim that the Plan is basically a scheme to control energy demand rather than supply, in fact the reverse is true. Although President Carter has claimed that

*This testimony was prepared with the assistance of Michele Prichard and Robert E. Scott of the CBNS Staff.

the "cornerstone" of the Plan is conservation, the data provided in support of the Plan show that conservation would meet only 16 percent of the added demand for energy between 1976 and 1985. This is less than the proportion of the demand which, according to the Plan, is to be met by nuclear power (23 percent) and much less than 50 percent contribution of coal; the expected contribution of solar energy is vanishingly small (1.0–1.6 percent). Thus the Plan's basic strategy is to meet most of the new demand for energy not by reducing it but by sharp increases in coal and nuclear power production, increases which represent a sharp shift from recent trends.

The greatly increased role of these two sources of energy supply is predicated on Mr. Carter's claim that "we can't substantially increase the domestic production of oil" and, indeed, according to the statistics provided in the National Energy Plan published by the White House on April 23, 1977, domestic production of the two chief present sources of energy—oil and natural gas—would increase by less than one percent by 1985, under the Plan. The sharp increase in coal and nuclear power production is designed to meet the projected increases in total demand, while holding constant the level of oil imports and the production of domestic oil and natural gas.

Thus the entire National Energy Plan is based on an assumption about energy supply: that, in contrast to coal and nuclear power, domestic oil and natural gas production cannot be increased. In my opinion this fundamental precept, on which the entire strategy of the Plan is based, is, in fact, unfounded.

THE NPC ANALYSIS OF DOMESTIC PRODUCTION OF OIL AND NATURAL GAS

With regard to the anticipated production of domestic oil, the National Energy Plan states:

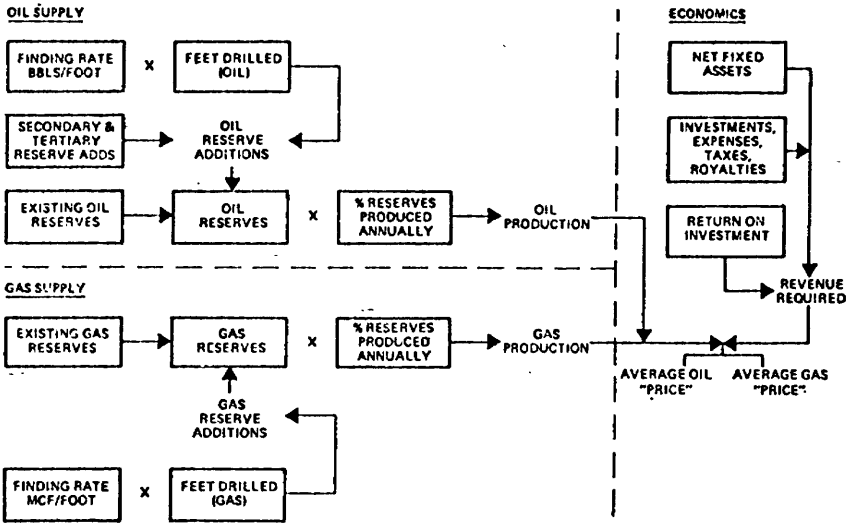
"U.S. domestic oil production has been declining since 1970. New production from Alaska, the deep Outer Continental Shelf, and new recovery methods should reverse the decline, *but will be unable to satisfy the projected growth in U.S. demand. Other major additions to domestic oil supply are unlikely.*" [*Italics added.*]

"Current domestic production [of oil] is 10 million barrels per day. With rising prices the model [i.e. the mathematical projections on which the Plan is based] projects total U.S. production of around 11 million barrels per day in 1985, assuming a new contribution of about 3 million barrels a day from Alaskan oil, Outer Continental Shelf development, and tertiary recovery."

This conclusion sharply conflicts with other analyses of the availability of domestic oil, in particular the National Petroleum Council (NPC) report "U.S. Energy Outlook; Oil and Gas Availability", published in 1973. (This report appears to be the basis for subsequent analyses made by FEA.) This report is a 768-page document containing nearly one thousand tables and charts. It is by far the most detailed and complete analysis of the amounts of domestic oil and natural gas that could be produced up to 1985, and the economic requirements necessary to achieve various rates of production.

The analytical methodology is described in figure 1, which is taken from the NPC report. First, the analysis considers the geophysical factors that determine the ultimate rate of oil production; the amount of new oil discovered (which is in turn determined by the amount of exploratory drilling, multiplied by the "finding rate", which is the amount of oil found per foot of drilling) and the effect of secondary and tertiary recovery methods on production of oil from the known reserves. Second, the analysis considers the expected costs of discovery, development and production, the required fixed assets, and the desired rate of return on the necessary investment, to determine the revenue required to finance various rates of oil production. By combining the geophysical factors with the economic requirements, the analysis arrives at an "average oil (or gas) price", at which the output would need to be sold (at the wellhead) in order to achieve various rates of oil production between 1971 and 1985. The analysis reflects the fact that oil and natural gas are nonrenewable resources, so that as the limited deposits are exploited, production becomes increasingly costly; unit production costs generally rise exponentially with increasing production.

FIGURE 1.—NPC economic methodology for estimating oil and gas supply



From U.S. Energy Outlook: Oil and gas availability, p. 33.

The NPC analysis considers four basic cases, ranging from case I, which would yield the highest rate of production, to case IV, which would yield the lowest. Case IV represents a continuation, through 1985, of the falling rate of drilling which characterized U.S. oil and gas production in the period 1955–70 (when many companies preferred to shift their operations to more profitable, foreign oil and gas fields). Case I represents a deliberate reversal of this trend, resulting in a sharp increase in the annual rate of oil and gas production. Case IV assumes a relatively low finding rate and case I assumes a relatively high finding rate. The other cases have intermediate characteristics.

The outcome of the NPC analysis is summarized in the report as follows:

"The industry has been in a phase of diminishing activity for several years. With positive incentive and areas to explore, the petroleum industry can reverse its recent trend of declining drilling activity and begin expanding to rates achieved in the post World War II decade. * * * In addition to increased exploration activity, adequate incentives could stimulate the oil industry to expand its application of secondary and tertiary oil recovery processes. By 1985, these additional recovery methods might account for about half of the oil production from the lower 48 states."

The report also explains clearly what is meant by the term "incentive":

"The most effective economic incentive would be to allow prices to increase to the level at which the industry can attract and internally generate risk capital needed to expand activity to its maximum capability."

Simply stated, then, the NPC report indicates the future rates of domestic oil and natural gas production that could be achieved by establishing different levels of increased price.

Table I summarizes the outcome of the analyses of the four basic cases of oil production. If the downward trend in domestic oil industry activity were to continue to 1985 (case IV), production would then amount to only 10.4 million barrels per day (MMBD). However, if a high drilling rate were established and the finding rate of new oil was high, then in 1985, 15.5 MMBD of oil could be produced. (If the drilling rate were high and the finding rate low [case IA] production would be 13.1 MMBD. The required "average prices" are also summarized in table I. To produce only 10.4 MMBD in 1985 (case IV) the price (in 1970 dollars) would need to be $5.28 per barrel; to produce 15.5 MMBD in 1985 (case I) the price would need to be $6.69 per barrel. Thus, to achieve a 49 percent increase in oil production, the price would need to be increased by 27 percent. To achieve the high rate of production characteristic of case I, the average price of oil would

need to be 110 percent higher than the 1970 price of $3.18 per barrel. Table II shows that similar effects could be achieved in natural gas production: In case I, 1985 gas production would be 43 percent higher than the actual production in 1970 and more than double the amount produced under case IV, with the required price being 13 percent higher than it would be in case IV, and 155 percent higher than the 1970 price.

TABLE I.—SUMMARY OF WELLHEAD PRODUCTION AND PRICES FOR PETROLEUM LIQUIDS

[As projected in U.S. Energy Outlook: Oil and Gas Availability]

	Production [1] (millions of barrels per day)						Crude oil price [2] (dollars per barrel)					
		Projected [3]						Projected [3]				
	Actual	Case I	Case IA	Case II	Case III	Case IV	Actual	Case I	Case IA	Case II	Case III	Case IV
1970	11.1						3.18					
1975	10.0	10.2	9.8	10.2	9.8	9.6	4.85	3.65	3.70	3.63	3.67	3.57
1980		13.6	12.1	12.9	11.6	8.9		4.90	5.16	4.73	4.95	4.39
1985		15.5	13.1	13.9	11.8	10.4		6.69	7.21	6.18	6.60	5.28

[1] Includes crude oil and natural gas liquids in the total United States.
[2] Average "required price," projected at 15 percent return on net fixed assets, constant 1970 dollars, for the lower 48 States.
[3] The cases are defined as follows:

Variable	Highest supply, I	IA	II	III	IVA	Lowest supply IV
Finding rate	High	Low	High	Low	High	Low.
Drilling rate	High growth.	High growth.	Medium growth.	Medium growth.	Current downtrend.	Current downtrend.
North Slope production starts:						
Oil	1976	1976	1976	1976	1981	1981.
Gas	1978	1978	1978	1978	1983	1983.

TABLE II.—SUMMARY OF WELLHEAD PRODUCTION AND PRICES FOR TOTAL NATUAL GAS

[As projected in U.S. Energy Outlook: Oil and Gas Availability]

	Production [1] (thousand cubic feet per year)						Gas field prices [2] (cents per million cubic feet)					
		Projected [3]						Projected [3]				
	Actual	Case I	Case IA	Case II	Case III	Case IV	Actual	Case I	Case IA	Case II	Case III	Case IV
1970	22.3						17.1					
1975	19.2	23.7	22.8	23.6	22.0	21.8	28.2	26.7	28.5	26.2	27.9	26.6
1980		26.1	23.5	24.4	20.5	17.3		33.7	40.9	31.8	37.8	31.6
1985		31.9	28.1	27.3	21.2	15.0		43.6	59.4	39.8	53.0	38.7

[1] Total United States.
[2] Average required price, projected at 15 percent return on net fixed assets, constant 1970 dollars, for the lower 48 States.
[3] The cases are defined as follows:

Variable	Highest supply, I	IA	II	III	IVA	Lowest supply, IV
Finding rates	High	Low	High	Low	High	Low.
Drilling rate	High growth.	High growth.	Medium growth.	Medium growth.	Current downtrend.	Current downtrend.
North Slope production starts:						
Oil	1976	1976	1976	1976	1981	1981.
Gas	1978	1978	1978	1978	1983	1983.

The NPC analysis shows that if the down-trend in drilling rate continued to 1985, annual production of oil, in that year, could be maintained at about the same level as 1975 if the price were to increase by 50 percent over the expected price in 1975.[1] On the other hand, if the price were to increase by about 85 percent, production in 1985 could be more than 50 percent greater than it was in 1975. A similar situation exists with respect to the price and production of natural gas. As noted in the National Energy plan, the total demand for energy in 1985 is expected to increase by about the equivalent of 11.3 MMBD of oil over the demand of 1976. From Tables I and II it is evident that domestic production of oil and natural gas could, together, increase by an amount equivalent to 9.2 MMBD of oil between 1975 and 1985 (under the conditions of case I). Increased domestic production of oil and natural gas could meet about 80 percent of the new demand for energy; these domestic fuels presently meet about 52 percent of the national energy demand.

Thus, contrary to President Carter's claim, increased production of domestic oil and natural gas, together with a relatively small increase in coal production could meet the 1985 demand without any increase in oil imports or in nuclear power production. In sum, the NPC analysis shows that the sharp increase in coal and nuclear power production that is mandated by the National Energy plan is unnecessary to achieve the chief aim of the plan—no further increase in the amount of imported oil. It shows that the United States has the physical capability of increasing domestic oil and natural gas provided that the average price of domestic oil were to increase by about 40 percent in 1985, relative to the actual price of oil in 1975, with a comparable increase of about 55 percent in the price of natural gas.

PRICE AND PRODUCTION LIMITS UNDER THE NATIONAL ENERGY PLAN

When the foregoing conclusions are compared with those which appear to be the basis of the National Energy plan, a strange disparity emerges. The strategy of the plan is to raise the price of domestic oil and natural gas to match the world price of oil—an increase which would be well above that required, according to the NPC analysis, to fund increased domestic oil and natural gas production sufficient to accomplish the purposes of the plan. Yet the plan is based on the assumption that domestic oil and natural gas production cannot increase. In effect, the plan adopts the low production figures of the NPC case IV (the plan's figure for domestic oil production in 1985 is identical with that of case IV) and the high price figures of the NPC case I without acknowledging the increased production which that price can, according to the NPC analysis, support. This disparity leads to two conclusions about the National Energy Plan:

First, the crucial assumption on which the entire Plan is based—that domestic production of oil and natural gas cannot be increased between now and 1985—sharply conflicts with the most comprehensive analysis of the problem; i.e., that made by the NPC.

Second, the price pattern which the Administration envisions, coupled with the NPC conclusions regarding the physical production capabilities for domestic oil and natural gas, show that it would be possible to meet the expected energy demand in 1985 without the sharp increase in coal and nuclear power production that the Plan calls for.

In my view, these conclusions raise very serious questions about the data on energy supply and demand which are reported on pages 95 and 96 of the National Energy Plan. According to these tables, only a one percent increase in the production of domestic oil and natural gas is possible between now and 1985, but the factual basis for these data is given nowhere in any of the Plan documentation. Even more disturbing is that in a recent discussion before the New York Bar Association, in which differing views of the energy crisis were presented by Mr. David Freeman, of the White House energy staff, and myself, Mr. Freeman asserted that one should ignore the numerical tables in the National Energy Plan because they bear no substantive relation to the design of the Plan itself. This astonishing statement raises very grave questions about the entire factual basis of the entire Plan and may explain the serious disparities between what the Plan proposes, in its prose, to accomplish and what—on the basis of the actual data—it would accomplish. (See the attached articles

[1] As shown in table I, the actual price of oil in 1975 was about 30 percent higher than the price predicted when the NPC report was prepared in 1971.

from the May 29, 1977 issue of The Washington Post and the report published by the National League of Cities, which describe these disparities.)

Congress is presently making a series of changes in the elaborate economic provisions of the National Energy Plan that are designed to govern energy demand, apparently accepting the Plan's underlying assumptions about energy supply. Since the Plan's provisions for restraining demand, and for massively increasing coal and nuclear power production rest on its assumption regarding the supply of domestic oil and natural gas, Congress is in danger of altering only the more superficial, dependent parts of the Plan, without knowing whether the factual basis of the Plan is valid.

THE ROLES OF VARIOUS ENERGY SOURCES IN NATIONAL ENERGY POLICY

In order to develop an approach that would enable the Congress to develop a comprehensive national energy program that could provide a more rational means of solving the energy crisis we need to examine the possible roles of various sources of energy.

To begin with we need to recognize that the energy crisis stems from the fact that all of our present major energy sources—oil, natural gas, coal and uranium—are nonrenewable. As these resources are depleted, further production becomes increasingly costly; as one barrel of oil is extracted from the ground, the next one becomes more difficult to produce, and costs rise exponentially with continued production.

All of the serious difficulties associated with the energy crisis stem from this one basic fact. Energy conservation can temporarily alleviate the intensity of the crisis but it cannot solve it. That requires a shift to renewable energy, a transition which will take time—of the order of 50 years or so. The immediate question then, is to determine which of the existing sources of energy can effectively sustain us during this transition. And, as shown below, this also requires that we determine, in advance, what renewable source we expect to sustain us in the future.

The plan itself recognizes the need to shift to a renewable source of energy, although it does not overtly propose how this transition is to occur. The plan is apparently designed, at least on the surface, only as a temporary measure, to gain time by reducing demand and reliance on imported oil, in order to facilitate a later transition to a renewable source. And, as already indicated, the administration plans to rely on coal and uranium used by light water reactors as the chief transition fuels. In general, then, in evaluating the plan we need to examine the efficacy of these fuels, in comparison with alternative ones, as the sources of energy in a transitional period between the present, and the time at which the national energy budget can become largely supplied by renewable energy.

It is useful, at this point, to consider what features are desirable in a transitional fuel. These may be summarized as follows:

(1) The fuel should be physically produceable at an economically feasible price in an amount sufficient to carry us through the transition period.

(2) Since the new renewable energy system will itself need to be created during the transition period, and will require very heavy capital expenditures (which is expected to be in short supply), the production and use of the transitional fuel should demand minimal capital expenditures.

(3) One of the most serious hazards of the energy crisis is that it introduces disruptions in energy supply which are likely to have serious economic consequences (as occurred, for example, during last winter's natural gas shortage in certain states). The production and use of a transitional fuel should minimize rather than contribute to such disruptions.

(4) A transitional fuel should minimize the environmental impact of energy production.

(5) A transitional fuel should be compatible with the pattern of energy use characteristic of the renewable source that ultimately supports the national energy system.

The domestic fuels which need to be examined against these criteria in order to evaluate their relative effectiveness in the transition to a renewable energy system are oil, natural gas, coal and uranium.

1. *Availability.*—The NPC analysis shows that domestic oil and natural gas are feasible fuels for at least the initial phase of a transitional period, up to 1985. To my knowledge, no similiar analysis has been made for longer periods of time.

However, it is known, from the most recent survey of the U.S. Geological Survey that the remaining domestic oil which could be produced—albeit at the increased costs required for tertiary recovery and for deeper wells—is between 276 and 440 billion barrels. This is enough to meet the entire present demand for oil (about 6.5 billion barrels per year) for between 42 and 68 years, or the present demand for domestic oil (about 3.5 billion barrels) for between 78 and 126 years. We have no estimates of how rapidly the price of oil would need to increase in the post-1985 period to fund the continued exploitation of this resource. However, from the NPC data it would appear that for the most active rate of production (case I), the real price of oil (i.e., eliminating the effect of general inflation) increases at about 5 percent per year, which until actual analyses are made might be expected as indicative of future trends. In any case, it is the purpose of the transition to replace the transitional fuel with a renewable one, which will gradually reduce the total amount of transitional fuel needed each year, and thus counteract the inevitable rise in its price.

Until and unless the Administration is able to show that the NPC computations are incorrect, and that the U.S.G.S. report grossly overestimates the actual physical reserves of domestic oil, this source must be regarded as qualifying as a transitional fuel.

Parallel considerations lead to the same conclusion regarding natural gas. In fact, recent evidence suggests that the total reserves of natural gas are even larger than the U.S.G.S. estimate (890–1,290 trillion cubic feet, or enough to meet present demand for about 46–65 years), based on its availability from geopressurized sources. With respect to availability, then, we can regard oil, natural gas, and coal (reserves are generally acknowledged to represent a several hundred year supply) as suitable transitional fuels, on the expectation that the transition would probably require a period of the order of 50 years. Uranium must be excluded as an alternative unless the breeder is introduced, for according to a recent ERDA report the domestic supplies would serve the expected demand from light water reactors for a period of only 20–25 years.

2. *Capital requirements.*—Table III lists the capital required to produce energy from various sources. Although the capital requirements for producing oil (and natural gas) will of course increase as the source is exploited, it is nevertheless certain to remain considerably smaller than the capital requirements for producing the same amount of energy from coal. If coal is used to produce synthetic gas or oil, the capital requirements rise by a factor of ten compared to the direct use of coal. If coal is used to produce electricity (its most suitable use) then the capital requirements become exceedingly high. As to nuclear power, its capital requirements are, of course, the largest among all means of producing energy.

TABLE III.—*Capital productivity of alternative energy sources*

[Btu's per year per dollar of capital invested]

Crude oil production [1]:	
1974 (actual)	16, 800, 000
1988 (projected)	4, 480, 000
Coal (strip mined) [2]	2, 000, 000
Shale oil production [3]	420, 000
Synthetic fuel from coal (liquid)	254, 000
Coal gasification [3]	160, 000
Coal-fired electricity generation ($800 per kilowatt) [4]	28, 683
Nuclear electricity generation ($1,000 per kilowatt) [4]	22, 423

[1] The capital productivity of oil production was derived from information in Oil: Possible Levels of Future Production, Final Task Force Report, Project Independence, FEA (Washington, D.C., November 1974), pp. IV–2 and IV–21.

[2] The capital investment required to produce 1 ton of coal was obtained from U.S. Energy Outlook: Coal Availability (Washington, D.C.: National Petroleum Council, 1973), p. 38.

[3] The capital investment required to produce different synthetic fuels was obtained from the Project Independence Task Force Report on Synthetic Fuels From Coal, p. 35, and also the Task Force Report on Oil Shale, p. 65. FEA, U.S. Department of the Interior, Washington, D.C.: U.S. Government Printing Office, November 1974.

[4] The estimates for coal-fired and nuclear powerplants are for base load power generation, operating at 75 percent of capacity for 1 year.

Thus from capital considerations it is evident that domestic oil and natural gas are by far the most suitable transitional fuels.

3. *Minimizing disruptions.*—The 1973 oil embargo and the natural gas shortage last winter are reminders of the serious economic consequences caused by

energy supply disruptions. Because energy is essential to all production processes, it must be continuously available if serious economic difficulties are to be avoided. For this very simple, yet basic reason, the transitional fuel, its pattern of distribution, and its pattern of use, must be capable of sustaining, without disruption, a gradual shift in which the nonrenewable transitional energy source is progressively replaced by a renewable source.

The major way to avoid economic and distribution disruptions is to minimize the number and degree of changes in the nation's energy-using system during the transitional period. Consider, for example, the problems created by the plan-mandated shift from industrial use of oil and natural gas to coal. This shift requires not only that industries design, build and install new energy-using systems, but also that the timing of the new energy-distributing patterns (increased coal production and reductions in oil and natural gas) be closely synchronized with the rising demand. Any failure in the precise timing of these processes will disrupt the essential flow of energy to the production system, leading to plant-shutdowns, unemployment and the ensuing economic difficulties. It should be evident, then, that in the transitional period, disruptions can best be avoided by minimizing changes in the relations between specific fuels, their distribution and specific energy-using processes.

One of the most serious faults of the National Energy plan is that it calls for drastic shifts in the energy use-pattern, which induce major changes in the present balance between industrial and consumer use of energy; between the use of energy for direct heat and electricity; and in the relative availability of oil/natural gas and electricity in the residential and commercial sector. Thus, whereas the present energy budget assigns equal fractions (37 percent) to industry and to consumers (the residential and commercial sector), the plan would assign 68 percent of the energy increment between now and 1985 to industry and only 20 percent to consumers. While in 1976, 46 percent of the energy budget was used for direct heat and 28 percent as electricity, according to the plan, of the energy added in 1976–85, 53 percent would be assigned to production of electricity and only 36 percent to direct heat. This shift would have a large and serious effect in the residential/commercial sector. Unless oil and natural gas supplies were carefully geared to demand, heating systems that use these fuels would need to be replaced by electric ones, at considerable cost and at much lower fuel-efficiencies. At the same time the Plan requires that industrial users of oil and natural gas convert to coal at an estimated cost of about $45 billion. These shifts, and the resultant risk of disruptions could be avoided if oil and natural gas rather than coal and nuclear power (as the plan mandates) were used as transitional fuels. It is noteworthy too, that the one change in energy use-patterns that would improve efficiency—the development of electrified mass transit and railroad systems—is totally absent from the plan.

4. *Environmental impact.*—It is widely recognized that the environmental impact of different energy sources increases in the order: conservation and solar energy; natural gas; oil; coal and nuclear power. Of the energy demand added in the period 1976–85, the plan would rely on conservation to meet 16 percent of demand, and on solar energy for about 1 percent, on coal for 50 percent, on nuclear power for 27 percent, on oil for 7 percent. The plan's displacement of oil and natural gas by coal and nuclear power would make the maintenance of environmental quality much more difficult than it is at present. Rather than emphasizing those energy sources that are most benign in their effect on the environment, conservation and solar energy, the plan promotes those sources, coal and nuclear power, that are most harmful.

5. *Relation to renewable energy sources.*—If the purpose of a transitional energy source is to enable us to phase out the use of present nonrenewable fuels, and replace them with long-term renewable sources of energy, then clearly the transitional fuel should be compatible with the pattern of energy use that will be determined by the ultimate renewable source. In practical terms, we must choose between a future renewable energy system based on either solar energy, or breeder-based nuclear power.

These two energy sources imply very different relations to the energy-using patterns of the energy system. For example, a nuclear power system produces energy in only one useable form, electricity, and is inappropriate for most tasks requiring direct heat. In contrast, solar energy is applicable as direct heat, by means of a solar collector or by the production of methane from sewage, garbage and other organic wastes. These processes are now technologically and economically feasible in many parts of the country. Clearly, if the nuclear power/

breeder becomes the basis of a long term, renewable energy system, sources—such as coal and light-water reactors—which foster the development and use of electricity rather than direct heat are suitable as transitional fuels. On the other hand, if solar energy is to become the long-term renewable source, transitional fuels that can be used for direct heat—such as oil and natural gas—are the most appropriate.

As already noted, the Plan heavily favors coal and nuclear power over oil and natural gas, and in this sense structures the transitional period toward the ultimate choice of nuclear power, rather than solar energy. Unfortunately, this bias does not appear fortuitous, for the Plan in fact states that the Administration proposes to develop a breeder as the "next generation of nuclear power". Contrary to popular impression, President Carter has not opposed the breeder concept itself, but only the plutonium-breeder, proposing in the Plan to reduce funding for that type of breeder and "* * * to redirect it toward evaluation of alternative breeders * * *", apparently referring to a thorium-based breeder. It would seem, then, that the Plan is intended to establish breeder-supported nuclear power as the ultimate, renewable source of energy. The Plan's heavy emphasis on coal and light-water nuclear reactors, over the use of oil and natural gas, favors this direction over the alternative choice of solar energy as a renewable energy source.

THE ALTERNATIVES FOR A RENEWABLE ENERGY SYSTEM

1. *Nuclear power.*—As indicated in the previous section, the success of immediate plans for developing a transitional energy source will depend a great deal on what is chosen as the ultimate, renewable energy source. Only two energy sources are *in being* which could possibly serve this purpose. One is solar energy which is, of course, essentially infinitely renewable. The other is breeder-supported nuclear power which could probably be sustained by available natural fuels for a period of 1,000–2,000 years. Thus, the question before us is to decide which of the available sources of energy, either nuclear power or solar energy, can best relieve, or solve the energy crisis.

While the Administration proposes to speed up the licensing and construction of nuclear power plants, it has failed to address the chief factor which has resulted in the recent decline in new orders for nuclear power plants: the massive, and rapidly rising demand for capital for construction of such plants. As a result, it is now evident that nuclear power has failed to live up to its promised advantage as an energy source—that it could produce cheap electric power. The basic reason for the rapidly rising capital cost of nuclear power plants (which has been increasing three times faster than the cost of a comparable coal-fired plant) is the need to make unexpected design and construction changes as newly discovered environmental and safety problems arise. It is unlikely that this generic problem will be remedied without sacrificing environmental quality or safety—an expedient which the Administration has pledged to avoid. There is no evidence that this problem can be resolved in the near future, because of the environmental and safety problems associated with the reprocessing of spent fuel, and the disposal of high-level waste that are yet to be solved. If and when these problems are solved, it will undoubtedly occur through further capital and operational costs, adding to the industry's already heavy economic burden.

It should be noted that the two major U.S. suppliers of nuclear powerplants, General Electric and Westinghouse have found this enterprise unprofitable in recent years, and that General Electric has already indicated an interest in abandoning the field if it does not soon become profitable. It is likely, therefore, that the further expansion of light-water reactors mandated by the National Energy plan will not take place without direct government subsidies to the plant manufacturers, the utilities, or both. Thus the already considerable investment of public funds in nuclear power would need to be substantially increased if the plan's proposed expansion of nuclear power production is carried out.

According to the most recent ERDA analysis, the present nuclear power system is likely to run out of its fuel, uranium, around 2010–2020. Since uranium, like all nonrenewable fuels, will escalate in price as supplies are diminished, the conventional nuclear power system will begin to replicate the present pattern of spiraling energy costs (beyond those costs already incurred through safety controls). Unless plutonium reprocessing, and a breeder is introduced, the

country will again be confronted, in the near future, with an energy crisis—this time stemming from limited uranium supplies, rather than limited oil and natural gas supplies. Thus, on these grounds alone, the present nuclear power system is a poor candidate for alleviating or solving the energy crisis in a long-term way. Only if it is a prelude to the introduction of some form of nuclear breeder, which, as already indicated, the Administration seems to be planning, will conventional nuclear power serve as a long-term renewable energy source.

2. *Solar energy.*—There has been a good deal of misunderstanding about the feasibility of solar energy both in the near-term and as the basis of a long-term system of renewable energy. Recent studies by CBNS for the area of St. Louis, and an ERDA sponsored Mitre Corporation study for a number of diverse geographic regions have demonstrated that solar collectors, used in conjunction with conventional electric space heat to about 50 percent of the overall heat requirements, are already economically advantageous in many parts of the country. Another solar technology, now technically feasible, and in some cases economically advantageous, is methane production from sewage, garbage and other organic wastes. Methods of producing electricity from solar energy—directly by means of photocolatalic cells, or indirectly by windmills or thermal difference in the oceans—are also technically feasible, but not yet economical. The key factor in understanding the potential of solar energy is that as the price of conventional fuels, particularly electricity, continues to rise, coupled with the more efficient production of solar devices, solar energy—including the generation of electricity—is certain to become the most economical source of energy. The most detailed projection, made by the Report of Solar Subpanel IX (prepared for the 1973 report, The Nation's Energy Future), predicts that photovoltaic power systems of 100-megawatt capacity would be economical for use in towns and power networks by 1990.

The economic requirements for applying these potential solar sources to the national energy budget are varied. As shown in the attached document (published in American Banker, Dec. 7, 1976) the massive application of solar collectors for space heat, hot water and (shortly) air-conditioning (all representing about 25–30 percent of the total national energy budget) require only the establishment of local "energy banks" to provide the necessary financing. This could be accelerated by establishing a system of Federal loan guarantees and equipment performance standards to support the local programs. With such strong Federal initiative behind local programs, solar collectors could be immediately introduced in the central latitudes of the country, and eventually in most of it, with considerable economic advantages to householders and commercial operators.

The essential financial requirement for the immediate application of methane-production technology is the allocation of public-works funds for the reconstruction of appropriate municipal solid waste, garbage- and sewage-handling systems. The necessary technology is well-developed, and when applied to municipal waste-handling systems, is certain to be economically advantageous—aside from the important job-creating features of such a program. As such systems are expanded to include organic wastes from feedlots and other agricultural sources, canning factories, and lumbering operations, it will become technically and economically feasible to incorporate them into the national natural-gas pipeline system.

For the remaining solar energy technologies, rapid development efforts are required to reduce production costs. If the present ERDA budget were largely devoted to solar energy research and development—instead of nuclear power—most of these applications would become economically competitive in about a decade.

The extent to which solar energy sources could contribute to the national energy budget in the immediate future is estimated in Table IV. This shows that solar collectors and methane production, which are immediately available could supply the equivalent of about 15 MMBD of oil by 2020, and all of the technologies together could provide about 35 MMBD. Although these figures are rather conservative, they would represent 35 percent to 70 percent of the total demand for energy in that year, depending on how that demand is estimated. In this period of time solar technologies could produce not only electricity but also liquid fuels for transportation by chemical conversion of methane or of hydrogen produced by electrolysis of water, using solar-generated electricity. However approximate, these estimates support the belief that with sufficient effort the national energy budget could be largely based on solar energy following a 50-year transitional period.

TABLE IV.—ESTIMATED SOLAR ENERGY SUPPLIED IN 1985, 2000 AND 2020[1]

[Quadrillion Btu's (quads)[2]]

Source	Year		
	1985	2000	2020
Biomass	2	5	11
Solar heating, residential and commercial	3	9	18
Solar heating, industrial	0	0	4
Solar electricity[3]	0	1	11
Wind	6	15	26
Total	11	30	70

[1] The estimate for potential use of wind energy is extrapolated from a recent study by Lockheed (Solar Energy Intelligence Report, 1976), which estimates that wind could contribute as much as 12 quads by 1995. All other estimates are from Solar Energy in America's Future: A Preliminary Assessment prepared by Stanford Research Institute for the Energy Research and Development Administration (January 1977). Their solar emphasis scenario for maximum development of this resource is presented in this table.

[2] 1 quadrillion Btu's is approximately equal to ½ million barrels of oil per day for 1 yr.

[3] The Stanford and Lockheed studies did not estimate the potential for producing electricity from ocean thermal electric conversion (OTEC) plants. These are also a major potential source of solar energy.

THE TRANSITION TO A RENEWABLE ENERGY SYSTEM

From these considerations it is evident that the solution to the energy crisis, which requires a transition from nonrenewable to renewable energy sources, can follow only one of two routes: to a nuclear/breeder system or a solar energy system. Apart from their more obvious differences—that compared with solar energy, nuclear power involves very considerable environmental risks; domestic and international political problems; huge financial investments, leading to concentrated control; the necessity of military protection of installations—these alternative renewable sources present very different transitional problems. If—as seems inherent in the National Energy plan—the transitional phase is directed toward nuclear/breeder renewable energy systems, profound changes in the existing structure of the energy-use system will be required. Energy-using installations based on direct heat are now supplied by oil and natural gas. These would need to be replaced by electrically operated devices (which in many instances will operate at a reduced efficiency), and additional power grids would need to be constructed to replace existing pipeline distribution systems. Since a complex, nuclear system could not possibly be built rapidly enough to achieve the desired reduction in the use of oil and natural gas, coal production would need to be intensified in the interim, (as the Plan calls for.) All of these efforts would involve extremely high demands for capital relative to the expected output of energy, and would aggravate the expected shortage of capital for industrial investment.

In contrast, solar energy would require very little change in the present structure of the system of energy *use*. Immediately, and over a period of the next decade, solar collectors and methane production could be used to meet the demand for direct heat (for space heat and hot water), thus reducing the demand for oil and natural gas that now largely satisfies these tasks. As this initial transition is completed, solar-powered electricity would begin to become economical, thus phasing out the present sources of electric power—coal-, oil-fired, and nuclear power plants. Apart from the development and production of solar devices, the only new capital investments would be those for converting land transportation, as completely as possible, to electric power (which is, thermodynamically, the most efficient energy source for transportation); for producing liquid fuel from hydrogen for air transport (the use of which could be restricted to relatively long distance travel, as a national high-speed electrified railroad system is built); and for developing fuel cells to enable power production from stored hydrogen during periods of darkness. There would be relatively little need for new power grids, since most solar electricity installations would be decentralized, operating only at the place of use. Existing power lines would be used only to supply power when local generation is inadequate, or to receive power from local sources when they provide power in excess of local energy needs.

If most of such a transition to a solar system could be achieved in, let us say a period of 50 years—a reasonable estimate on both technological and economic grounds—we could rely on the present pattern of energy production

during the transitional period (i.e., with oil and natural gas providing about 75 percent of the energy budget, coal about 20 percent, and a marginal contribution from nuclear power, probably requiring no new plants beyond those now constructed.) As the appropriate form of solar energy becomes available, beginning immediately with the replacement of oil and natural gas for direct heat by solar collectors and methane, the use of each of these conventional fuels could be gradually reduced. Even if we allowed for a small average annual growth rate in energy demand over the next 50-year period, it seems evident that existing nonrenewable supplies of fuel would be sufficient to tide us over without resorting to increased reliance on coal or nuclear power. As already explained, light water reactors would exhaust present fuel supplies about halfway through the transitional period, so that solar-electric installations would be used preferentially, at first, to replace nuclear power. Where that is impossible, electric power would be produced transitionally from coal, since there is no supply problem, provided this fuel is used in its present proportion (20 percent) in the national energy budget.

While this discussion has concentrated on the technical feasibility of a rational transition to a renewable, solar energy system, we should not lose sight of the political problems that are involved. Among them perhaps the most crucial relates to the role of the oil companies.

The oil industry has responded to the National Energy plan by calling for deregulation of oil and natural gas prices. Industry spokesmen claim that this would provide the "incentives" needed to increase domestic oil and natural gas production—that the added income from higher prices would enable the industry to meet the higher cost of increased exploration and production. The administration seems to oppose this approach because it would inequitably increase oil company profits. But this response only begs the issue.

For the reasons already discussed, there is no doubt that increased domestic oil and natural gas production, which would facilitate the most effective transition to a renewable energy system, would inevitably mean higher costs, and therefore higher prices. However, if the added funds generated by higher prices were left in the hands of the oil industry, there is no assurance that the funds would in fact be used to produce more oil. The principles of private enterprise give the oil companies the right to govern the investment of their own capital in whatever way enhances their own interests—which are generally defined as profit. Recent oil company investments in mail-order houses and mineral production warn us that they are prepared to use that right in ways that do not foster enhanced oil and gas production. In a word, an effective transition based on oil and natural gas will require the introduction of some form of social governance to ensure that the rising prices of these fuels will lead to enhance production.

In sum, if we choose the solar route to a national renewable energy system, the transition could be accomplished gradually, with minimum disruption of the present structure of energy production, distribution and use. But it would require, for the sake of the nation's future, that we at last learn how to govern the production and use of our essential energy resource in keeping with social, rather than private interests.

[From the Washington Post, Sunday, May 29, 1977]

THE HIDDEN JOKERS IN CARTER'S ENERGY DECK

(By Barry Commoner)

The popular response to the National Energy Plan is that, although President Carter deserves credit for confronting the long-neglected energy crisis, his plan has many faults. In Congress, most of its numerous provisions have already come under attack. Presumably, the surviving fragments will eventually be patched together to legislate the great national effort which Carter has urged upon us as "the moral equivalent of war."

But such piece-by-piece criticism will miss the plan's most serious fault: that, wittingly or not, it is a deception, an exercise in political sleight-of-hand in which the words about what the plan is supposed to achieve say one thing and the numerical facts about what it would achieve often tell us the opposite.

The plan claims to be an equitable program of energy conservation, but in fact saves little energy and heavily favors industry over consumers and the rich over the poor.

Carter has promised to use nuclear power as only a "last resort," but the plan proposes a sharp increase in nuclear power plant construction.

The plan claims to ". . . stimulate the development of a large solar market," but would in fact block solar energy from the markets that it could now enter.

The plan is supposed to be a means of gaining time before we decide how to make the inevitable transition to a long-term renewable energy sources, but in fact it covertly makes that choice and commits us to a nuclear future.

And all this raises a final question: If the plan is not what it seems to be, then what is it really?

According to Carter, ". . . the cornerstone of our policy is to reduce demand through conservation," encouraging the popular impression that the plan is primarily a way of meeting the crisis by shrinking energy demand rather than by increasing supplies. It comes as something of a surprise, therefore, to discover from the National Energy Plan (the detailed 103-page description recently released by the White House) that in 1985, the plan's target year, total U.S. energy demand would be the equivalent of 48.3 million barrels of oil per day without the plan and 46.4 million barrels of oil per day if the plan is implemented. This amounts to only a 4 per cent reduction in total demand.

However, it must be kept in mind that the total energy demand expected in 1985 is made up of the present actual demand plus the increase in demand anticipated in the next 8 years. The new plan can, of course, only affect this future period, so that it is pertinent to judge the plan by how it would meet the increase in energy demand that is expected to occur between now and 1985. According to the plan, between 1976 and 1985, 16 per cent of the additional demand would be met through conservation and 84 per cent of increasing the energy supply. Coal would meet 50 percent of the added energy demand; nuclear power, 23 percent; domestic oil, 9 percent; and solar energy, 1.6 percent. Oil imports would remain essentially unchanged.

Judged by these numbers, rather than by its prose, the plan would rely more on nuclear power (23 percent) than on conservation (16 percent) to meet new demand. The plan's "cornerstone" would appear to be mislaid.

The administration's rhetoric is concentrated on the voluntary "sacrifices" needed to cut energy demands and on the plan's goal of equitably distributing this burden among different sectors of society. In fact, the main stress of the plan is to redistribute energy supply—and to do so inequitably.

BLOW TO THE CONSUMER

Consider, for example, how energy supply would be shared between consumers and industry. Their relative shares can be estimated from the division of demand among the three conventional energy categories: residential and commercial (which supports consumers and the sale of consumer goods); industrial (which supports industrial production) and transportation (which is divided between consumer passenger traffic and the industrial freight).

In 1976, each of the first two sectors received about 37 percent of the total energy budget and transportation received 26 percent. With the plan in effect, only 15 percent of the energy added during 1976–85 would be allotted to residential/commercial demand and 74 percent to industrial demand, with transportation receiving 11 percent.

In mandating this drastic shift in energy allotments, the administration technicians have changed the ground rules that usually govern computations of future energy demand, which are customarily based on past trends. For the last 10 years, the share of the national energy budget devoted to residential and commercial uses has increased steadily while the share used by industry has declined. The projections on which the plan is based sharply reverse this trend. As a result, whereas the plan assigns 74 percent of the increase in demand in 1976–85 to industry, the comparable figure projected by the Federal Energy Administration on the basis of past trends is 44 percent, with the residential/commercial sector receiving 56 percent and transportation no increase at all. Although this shift in favor of industrial energy consumption is not attributed to the plan in the administration documents, it is in fact incorporated in it and is just as much a policy decision as the plan's other proposals.

The shift in demand projected by the plan would have serious consequences for consumers, who, under the plan, would be alloted much less energy than they would expect to receive in the next 8 years on the basis of other projections, such as FEA's. This amounts to a form of rationing, with all the problems en-

tailed when involuntary restrictions are imposed on an economic good as essential to one's living standard as energy. Further, the plan imposes a much heavier burden of voluntary conservation on the residential/commercial sector than on the industrial sector, relative to their shares of added energy. Far from equitably distributing the burdens of the 1976–85 period of energy restrictions, the plan would heavily favor industry, assigning most of the burden to consumers.

Among the plan's more elaborate features are several for taxing fuel. Recognizing that the resultant increase in the price of energy would place an especially heavy burden on low-income families (energy costs take a relatively large part of their budgets), the plan envisages a system of rebates to relieve this burden. However, the complex bureaucratic machinery that would be created to administer such schemes would only encroach on the funds available for other government social programs—given that Carter plans to balance the budget—on which the poor most heavily depend. Thus, the plan's acknowledged cost to the poor would only be transferred from one pocket to another, with the likelihood that the poor will only suffer in the process.

Once more, the plan's words and its proposed actions are in conflict. The plan speaks of equitably sharing the burden of conservation—of voluntary reductions in demand—but the real inequity of the plan lies elsewhere: in a thus-far unmentioned diversion of scarce energy supplies from consumers to industry and in a new bureaucracy that would further jeopardize the financial insecurity of the poor.

The plan, we are told, is supposed to solve energy problems ". . . while protecting jobs, avoiding rampant inflation and maintaining economic growth." Here again, the plan's promising words point in one direction and its actions in another. It is widely recognized that the sharply increased energy prices mandated by the plan would only accelerate the current, unprecedented escalation of energy prices, which is already responsible for much of the recent increase in the rate of inflation. Also, since the sharp rise in energy prices makes predictions of future costs highly uncertain, it considerably increases the investment risks involved in building new industrial plants, contributing to the present lag in industrial capital investment.

WASTING CAPITAL

The plan, too, would reduce the efficiency with which capital is used to produce energy and therefore tend to worsen the shortage of investment capital. Capital invested in domestic oil production yielded annually (in 1974) about 17 million BTU (British thermal units) per dollar; about 2 million BTU per dollar when invested in strip-mined coal; 29,000 BTU per dollar for coal-fired electric power; and only 22,000 BTU per dollar for nuclear power. In general, the capital efficiency of energy production technologies is highest when fuels are used for direct heating and lowest when fuels are used to produce electricity. Yet, perversely, according to the National Energy Plan, 53 percent of the energy added in 1976–85 would be used for electricity and 36 percent for direct heat, in contrast with 1976 when only 28 percent of the national energy budget was used for electricity and 46 percent for direct heat. This shift would sharply increase the average amount of capital needed to produce a unit of energy.

If the plan is implemented, in 1985 about 54 percent of U.S. electricity would be produced by coal-fired plants, 25 percent by nuclear power plants, 12 percent by oil- and gas-fired plants and 10 percent by renewable sources, chiefly hydroelectric power. This results from a plan-mandated shift from oil and natural gas to coal and nuclear power. Since the capital requirements of power plants fueled by oil or gas are relatively low, somewhat higher for coal-fired plants and highest for nuclear plants, the plan would reduce the overall efficiency with which invested capital produces electricity.

Thus, the plan would intensify the demand for capital for energy production, draining capital from other investments, so that the energy sector would be impeding the economic development of its own customers.

Moreover, by diverting energy supplies preferentially to industry, the administration's program would encourage the post-war trend toward energy-intensive industries (that is, those with a low economic yield relative to the amount of energy used). Inasmuch as industries that are energy-intensive are also capital-intensive, this aspect of the plan would also increase the overall industrial demand for capital. Since in the next decade the economy is expected to be nearly 30 percent short of needed investment capital, the plan's heavy impact on the demand for capital is hardly a good way to "maintain economic growth."

Contrary to its claim of maintaining employment levels, the plan is likely to do the reverse. Many of the industrial sectors which use energy and capital intensively tend to be correspondingly low in their demand for labor. The outstanding example is the petrochemical industry, which not only burns energy but uses it as raw materials, flooding markets previously held by energy-conserving natural materials (such as leather, cotton and wool) with synthetics. As the energy-conserving, labor-intensive industries are displaced, technological unemployment—which now accounts for about half of the unemployment rates—is bound to increase. Thus, rather than encouraging economic growth, the plan would affect the industrial uses of energy, capital and labor in ways that would worsen the basic problems that now threaten the economy—unemployment, inflation and the shortage of investment capital.

A HIDDEN NUCLEAR COMMITMENT

Finally, we come to the climax of this exercise in political conjuring, in which the plan—ostensibly a program to trim the fat out of the U.S. energy budget in order to facilitate a later shift to renewable sources of energy—turns into something quite different: a long-term commitment to breeder-supported nuclear power.

The plan acknowledges the well-known fact that the root cause of the energy crisis is our present, almost exclusive dependence on non-renewable energy sources. As supplies decrease, the law of diminishing returns takes hold and energy becomes ever more costly to produce, driving prices upward at an escalating rate. Obviously—as the plan also acknowledges—a transition from our present non-renewable energy sources to renewable sources is the only long-term solution.

In practical terms, only two renewable energy sources are *in being* and would be available at the turn of the century when, at the very latest, the transition would need to begin. One choice is solar energy. The other option is nuclear power, with breeder reactors used to extend the life of the non-renewable fissionable fuels—which would otherwise run out in 20 to 30 years—for perhaps 1,000 years or more.

As long-term solutions to the energy crisis, the nuclear and solar options are mutually exclusive. Nuclear power requires a highly centralized energy system, based on a relatively few very large and extremely expensive installations; it would produce only electricity for powergrid distribution. An energy system based on solar energy would be highly decentralized, consisting of numerous relatively small units; at present, it would produce only direct heat, and later, when solar electric power becomes economic, much of it will be produced directly where it is being used.

As a result, each source would require its own kind of national system with very little overlap; the nation, already short of capital, could afford to build only one of these systems. If the plan is indeed designed to gain time before the choice between two options is made, clearly it ought not foreclose one or the other of them.

As already indicated, the plan mandates the massive introduction of light water nuclear reactors at a rate far exceeding the pace achieved in the last few years. Although only a few nuclear plants have been ordered in the last two years, the 70–90 new 1,000-megawatt plants that the plan requires would need to be built in the next 8 years. By the turn of the century, nuclear power plants would generate a major part of the nation's power, and since we would then heavily depend on electricity, there would be no choice but to continue the nuclear fission systems. With uranium supplies depleting and rapidly rising in price, it would then be necessary to extend the supply of fissionable fuels—by adding breeders to the system.

In keeping with its proclivity for beguiling us with one goal while in fact moving toward another, the plan's commitment to a breeder-based nuclear program is as promised by this statement, an "alternative breeder" would be ready to feed is widely regarded as anti-breeder: "It is the President's policy to defer any commitment to advanced nuclear technologies that are based on the use of plutonium while the United States seeks a better approach to the next generation of nuclear power than is provided by plutonium recycling in the plutonium breeder . . . The President has proposed to reduce the funding for the existing breeder program, *and to redirect it toward evaluation of alternative breeders, advanced converter reactors and other fuel cycles.*" (Emphasis added) By the turn of the century then, the nation would heavily depend on fuel-short nuclear reactors and, as promised by this statement, an "alternative breeder" would be ready to feed them for a thousand or more years.

Meanwhile, the plan would have effectively foreclosed the choice of the solar route. For one thing, research on alternative breeders—perhaps based on thorium rather than plutonium—would, like the present development of the plutonium breeder, be so expensive as to preclude all but minor research on other energy systems. Moreover, as anticipated by the National Energy Plan, electricity would heavily replace oil and natural gas in the residential/commercial sector—where the largest, unsaturated market for electrical appliances is in space heat, hot water and air-conditioning. This would effectively block solar energy from the one market that is presently open to it, which, as it happens, is also space heat, hot water and (shortly) air-conditioning. Thus, if we adopt the National Energy Plan, at the turn of the century, when the nation would have to choose its renewable energy source, we would find that this crucial decision had already, long ago, been made.

The decision is portentous. The nuclear route would saddle the country with the risks of radiation for thousands of years. It would concentrate the nation's energy system in a few, necessarily huge and expensive units that would inevitably fall under the control of either mammoth corportion or the government. The enormous damage that could be inflicted by even a few handfuls of stolen nuclear fuel—turned into homemade bombs, or even used deliberately to contaminate the environment—would, with equal inevitability, place nuclear installations under military control. The nuclear route could easily end with the nation's energy system, and therefore its entire life, dominated by whatever economic, political or military force could capture control of its few, central generating stations.

The solar route goes the other way. Because sunshine falls everywhere and small solar installations are as efficient as large ones, solar energy is inherently decentralized; there is no economy of scale in most solar operations and businesses of all sizes could compete equally. Solar energy can be directly controlled by those who use it. The solar route fosters democracy.

The nation's future hangs on the choice between these two routes. We cannot afford to make the choice in the dark, without open, public debate. But that is what would happen if the National Energy Plan were adopted as it now stands.

BUSINESSMAN'S BONANZA

How can we explain the striking disparities between what the plan says it would do and what it would actually do? The least interesting explanation would be that it is very difficult for a newly appointed staff in only three months to produce an consistent plan to reorganize the nation's fearfully complex energy system. It is more interesting to work backward from the real effects of the plan (as distinct from its claims) in trying to discover what unexpressed goal it might serve.

A major clue is that the plan would heavily divert energy supplies toward industry, while simultaneously worsening the shortage of investment capital, thereby severely limiting the ability of industrial development to absorb the new supply. However, another outstanding feature of the plan can resolve this seeming inconsistency: the missing capital could be provided by the huge amounts of new taxes—estimated at $80 billion per year by 1988—that, according to the plan, would be collected largely from consumers. Despite original claims that these funds would be returned to the people as rebates, the chairman of the House Energy Committee, Rep Thomas L. Ashley (D-Ohio), has said that ". . . in this area, as in others he [Carter] has been soft."

Given the "flexibility" which Carter wants, the tax funds could be diverted to industry, Lockheed-type. A likely recipient of such subsidies might be the nuclear power industry. General Electric has already informed the administration that, because of continued unprofitability, it may abandon its nuclear operations. Government subsidies could be justified as a means of avoiding the demise of a major supplier of nuclear plants when the plan calls for building them at an unprecedented rate.

Such an approach would nicely fit a prescription for meeting the capital shortage that has been frequently voiced in business circles: to cut consumer spending so that savings will grow and produce more investment capital. As a New York Stock Exchange report has put it, "Essentially, the task of accumulating enough capital means that people must save more and consume less."

The plan's energy tax program could respond to this admonition in two ways: If, as the administration hopes, the stand-by gasoline tax successfully reduces con-

sumption and the resulting savings were not devoured by inflation, they could be accumulated by the banks and thus increase the supply of investment capital. On the other hand, if the gasoline conservation program failed, and the tax was imposed, the resulting funds, accumulated by the government, could be used as subsidies for the capital-short energy industry.

This would bring us full circle, back to President Ford's proposal to spend $100 billion of tax money to subsidize nuclear power, synthetic oil and other capital-intensive energy operations. The new administration's energy plan could accomplish the same thing, but this time under the banner of conservation—a way of convincing the public "to save more and consume less" that might be regarded less suspiciously than if its origins in the business community were more apparent.

This hypothesis might also explain one of the plan's most puzzling features—that support for mass transit and the railroads is wholly absent from the plan, although they are four to 10 times more fuel-efficient than autos, planes and trucks—far more effective ways to conserve energy than most of the plan's measures. This would require huge capita expenditures that would benefit *consumers* rather than industrial production. But that is not what the business community has in mind, for the capital shortage about which businessmen complain is for investment in profit-making enterprises, among which mass transit and most railroad operations are rarely included.

Behind these considerations lies a fundamental problem of the U.S. economic system—that its rate of investment in new productive machinery is lagging far behind the rest of the industrialized world. In the United States between 1960 and 1973, 13.6 percent of the gross national product was devoted to industrial investment, less than Italy's 14.4 percent and far less than our main competitors in word trade. Japan (29 percent) and West Germany (20 percent). This deficiency could be readily eliminated if the United States were to reduce the military budget's share of the GNP to match that of the losers of World War II.

As a result, in the last decade labor productivity (output per man hour) in U.S. manufacturing industry has increased at an average annual rate of only 2 percent, compared to Japan's 9.5 percent, Italy's 5.7 percent and West Germany's 5.3 percent. Thus, the capital shortage threatens the long-held U.S. dominance of world markets for manufactured goods—a spectre which is likely to haunt the halls not only of the Chase Manhattan Bank but of the White House as well. Perhaps the National Energy Plan is really a response to this crisis, which in some quarters might be regarded as the more ominous threat.

All this suggests that the plan must be scrutinized more profoundly than it has been thus far. While its numerous, smaller defects can be corrected in Congress, there is one fundamental generic fault which cannot be reconciled by piecemeal modification: The plan would commit the country, without its consent, to an ominous nuclear future and deprive the people of the United States of their democratic right to direct the only step that can solve the energy crisis rather than delay it—the transition to renewable energy. The answer is to begin an open public debate on these, the real issues of the energy crisis.

THE NATIONAL ENERGY PLAN

A CRITIQUE

by Barry Commoner, Director
Chairman of the Board
Scientists' Institute for Public Information

presented at

National League of Cities
Task Force on Energy Meeting

Washington, D.C.

On May 10, 1977, Dr. Barry Commoner addressed the Energy Task Force of the National League of Cities, in criticism of President Carter's energy plan. His objections were:

"*First,* it should be clear that, despite claims to the contrary, the plan does very little to foster the introduction of solar energy, either operationally, or in terms of research. We have shown that according to the plan, solar energy would constitute only 1.5 percent of the additional energy supplies that would be needed to meet the additional demand generated in the 1976-85 period. Moreover, the plan would devote very little of the proposed energy research budget to the solar option.

"*Second,* the plan mandates the massive introduction of light water reactors at a rate far exceeding the pace achieved in the last few years. By the turn of the century, nuclear power plants would represent a major part (perhaps one-half) of the nation's generating capacity.

"*Third,* it would appear that the plan already envisages a future commitment to breeder-supported nuclear power.

"Thus, if we become committed to the plan, at the turn of the century when the nation would have to choose its renewable source of energy, we would find that this crucial decision had already been made."

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There is no simple solution to the energy problem, but there is a sensible one. That solution is to reduce our dependence on foreign oil supplies, thereby lessening our vulnerability to foreign price manipulations, while working toward the long-term goal of balancing our domestic energy demand and supply. Such an approach to energy policy would require serious study of ways to use energy more efficiently as well as ways to use less energy; it would require development of alternate sources of energy as well as new sources of conventional energy; it would require that the development and use of all types of energy be consistent with the need and desire to protect the environment.

A national energy policy that meets the needs of this country and all of its people cannot be created without widespread debate, understanding, and support. Without information, however, debate will be pointless, understanding faulty, and support lacking.

The National League of Cities is pleased to offer the participants in this vital national debate the following paper, prepared for, and presented at, a meeting of our Energy Task Force on May 10, 1977, by the distinguished scientist and author, Dr. Barry Commoner, chairman of the board of the Scientists' Institute for Public Information.

The views in this publication do not necessarily represent official policy of the National League of Cities; they are the views of the author. Our intent in publishing and distributing these views is to provide information that will make public debate, and the resulting energy policy, more meaningful and more effective for all Americans.

Neil Goldschmidt
Ruby Hunt
Co-chairpersons, Energy Task Force

Alan Beals
Executive Vice President

Barry Commoner is director of the Center for the Biology of Natural Systems, Washington University in St. Louis, Missouri, and chairperson of the Board of Directors of the Scientists' Institute for Public Information in New York City.

The National Energy Plan confronts the people of the United States with an unprecedented challenge. The President has urged Congress to speedily adopt the Plan, without substantial change, asserting that "...the alternative may be a national catastrophe." Under the pressure of Mr. Carter's sonorous imperatives, there is a tendency to go along with his definition of the crisis and with his conviction that the Plan—apparently an exact product of computer science—is inexorably, undebatably sound.

Yet, both the energy crisis and the Plan which seeks to solve it are extraordinarily complex, with pervasive but poorly understood effects on nearly every aspect of national life. We would be wise, therefore, to resist the pressure to acquiesce, or the temptation to be content with modifying a few, particularly troublesome features of the Plan. Instead we must take on the difficult task of understanding the problem as a whole, of evaluating the logic of the proposed solution, and of deciding, for ourselves, whether this course of action, or an entirely different one, will best serve the nation's welfare.

The Plan's goals and the strategies for reaching them have been set forth by President Carter in two recent speeches,[1] and an extensive document, *The National Energy Plan*.[2] describes its effects. Briefly, the Plan has the following main objectives:

- Significantly reduce oil imports
- Reduce the demand for energy by conservation measures
- Equitably distribute the necessary "sacrifices"
- Continue economic growth, despite the economic adjustments mandated by the energy plan
- Protect environmental quality from the effects of intensified energy production
- Overall, to gain time and to prepare for a transition from our present nonrenewable fuels to renewable sources of energy.

Each of these individual goals is meritorious and deserves support. But when the Plan is considered as a whole, difficulties arise. Can conservation measures based largely on sharp price increases actually be carried out equitably, and without hindering economic growth? Can energy supplies be adjusted without causing serious economic problems and environmental degradation? Will the Plan change the structure of the national energy system in ways that foreclose certain options for the future transition to renewable energy?

To answer these questions and the many similar ones that have arisen since the Plan was introduced, we need to delineate the logical design of the Plan and determine whether it is likely to accomplish its stated objectives.

Although the Administration has not yet told us how the Plan's specific proposals were derived from the basic facts about the energy crisis, we have been given a summary of their overall effects on the national energy situation. These are described in *The National Energy Plan* in a series of tables which list, under various categories, the amounts of energy produced, consumed and imported by the U.S. in 1976 and the comparable figures for 1985, with and without the Plan in effect.[3] The last two sets of figures are, of course, predictions, and we are told in *The National Energy Plan* that these are based on a computerized mathematical "model" of the U.S. energy system. Presumably, the effects of the Plan on the U.S. energy system were determined by instructing the computer to work out how the energy model would respond to the Administration's intentions—for example, that oil imports anticipated in 1985 should be reduced by half. Given the numerical end results, it is possible to evaluate how well the Plan's effects match its stated objectives, and from this evaluation to obtain some insight into its logical design.

THE PLAN'S CONTRIBUTION TO ENERGY CONSERVATION

According to *The National Energy Plan*, in 1985, without the Plan in effect, the total U.S. energy demand would be 48.3 MMBD (that is, the energy equivalent of 48.3 million barrels of oil per day) while with the Plan in effect, demand would be 46.3 MMBD. Thus the conservation efforts proposed in the Plan would reduce demand by about 4 percent of what would otherwise be expected in 1985.

However, while the Plan was in effect, U.S. energy demand would necessarily increase, so that it is relevant to examine how the Plan would affect the *increment* in energy supply that might occur between 1976 (the last year for which energy statistics are available) and 1985. In that period, according to the Administration's model, the supply of coal, nuclear power, domestic petroleum and solar energy is expected to increase by a total of 12.3 MMBD without the Plan and by 10.3 MMBD[4] with the Plan in effect. The difference, 2.0 MMBD, would be met by the Plan's conservation measures. Thus, conservation would reduce demand in that period of time by 16 percent.

According to the Plan, the remaining 84 percent of the total increment in energy demand in 1985 would be met by supplies of various forms of energy. Coal would provide 50 percent of the needed energy increment; nuclear power, 23 percent; domestic oil, 9 percent; and solar energy, 2 percent (see Figure 1). Thus, contrary to the popular impression that the Plan would respond to the mandated reduction in oil imports primarily by reducing demand, through conservation, the main effect of the Plan would be quite the reverse. Conservation measures would account for only 1/6 of the rise in demand between 1976 and 1985 while 5/6 would be met by increased domestic energy supplies. About one-half of the increased energy supply would come from coal, and nearly one-fourth from a source which according to Mr. Carter should be used only as a "last resort"—nuclear power. This pattern represents a striking change from the structure of the present energy budget (see Figure 2).

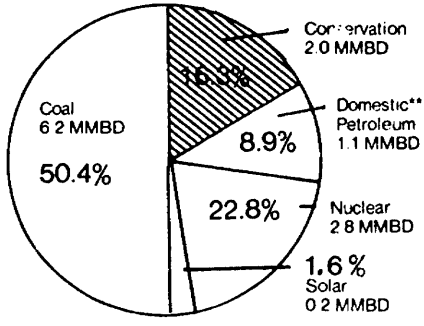
One option for increasing the energy supply has been ruled out by Mr. Carter's assertion that ". . . we can't substantially increase our domestic [oil] production."[5] Nevertheless, according to an FEA analysis,[6] domestic oil production could be increased about 50 percent by allowing the price to rise from $7 to $11 (expressed in 1972 dollars) per barrel, or approximately to the world oil price, in order to provide the necessary investment funds. Thus, Mr. Carter's statement would appear to be a policy decision rather than a fact of nature. However, since the Plan does provide for a general increase in the price of oil to world price levels, the Administration has apparently also decided that funds accumulated through taxes and higher energy prices would be used not to increase domestic oil production, but for other purposes.

On these grounds it would appear—contrary to the general impression—that *the National Energy Plan is not primarily a program of energy conservation.* It appears to be designed not so much to reduce demand as to govern how the supply of energy is to be increased.

Figure 1

The National Energy Plan

How the 1976-1985 Increment In Energy Demand (12 3 Million Barrels of Oil/Day) Would Be Met*



*During this period natural gas and imported oil supplies decline, and therefore do not contribute to meeting the increment in demand

**Includes recovery gain

Figure 2

The 1976 Energy Budget

Total: 37 Million Barrels of Oil/Day (MMBD)

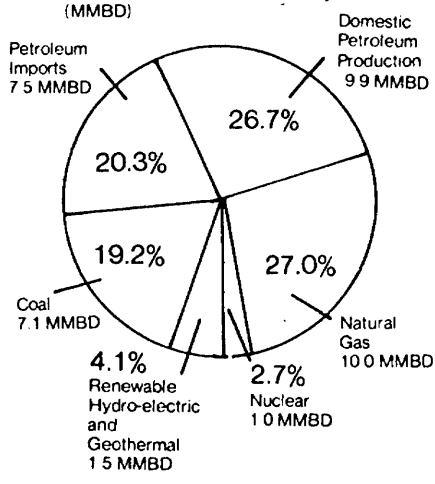


Figure 3

The National Energy Plan

Increments in Annual Net Fuel Supply to Major Consuming Sectors: 1976-1985

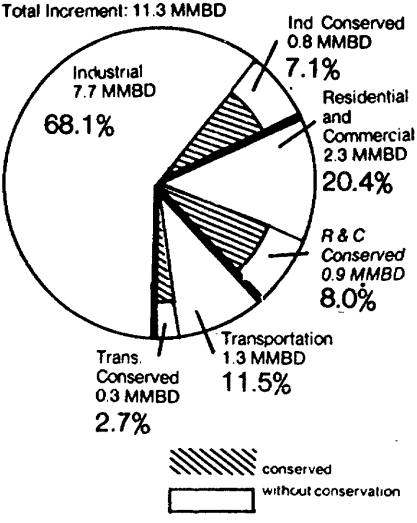


Figure 4

Energy Use In Major Consuming Sectors—1976

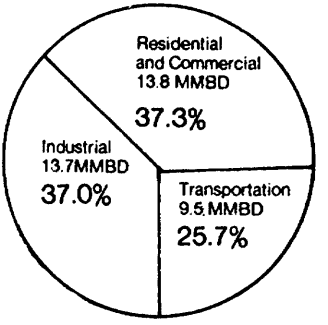
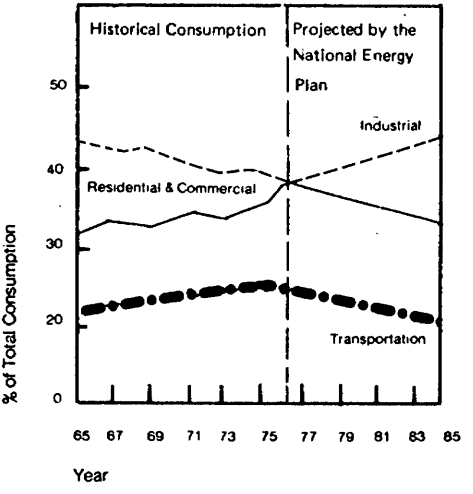


Figure 5

Energy Use In Industrial, Transportation and Residential and Commercial Sectors, 1965-1985.



THE EQUITY OF THE PLAN'S EFFECTS

Although the Plan's conservation measures would play only a relatively small part in the changes due to the reduced oil imports, Mr. Carter has stressed the importance of the equitable distribution of the resulting "sacrifices" among different segments of society. However, equity applies not only to the demand side of the problem, but also to the distribution of the available *supplies*. Given that energy supplies would be limited in the 1976-1985 period by the Plan's intention to drastically reduce oil imports, different sectors of society will be in intense competition for them. Since energy is essential to support the activities of all sectors, any sector with enhanced access to energy supplies will enjoy a distinct economic advantage. The social equity of the Plan will be determined not only by the distribution of the conservation burden, but even more by the distribution of available energy supplies.

Perhaps the most fundamental social division is that between the consuming and producing sectors. The relative amounts of energy which the Plan would make available to these two sectors can be estimated from the division of demand among the three conventional categories: residential and commercial; industrial; and transportation. The energy share for the residential/commercial sector is roughly equivalent to the energy share of consumers, since residential energy use is devoted to personal consumption and commercial energy use is largely devoted to the sale of consumer goods. The energy share of industrial producers is equivalent to demand of the industrial category. Although transportation involves both consumption (e.g. personal autos) and production (e.g. freight traffic), we shall see that the effect of the Plan on this category of demand is minimal.

The burden of the Plan's energy conservation measures is distributed among these three categories of demand as follows: of the total of 2.0 MMBD of oil that would be saved through conservation measures in 1985, 45 percent would occur in the residential/commercial demand, 40 percent in the industrial demand, and 15 percent in transportation. Thus, the Plan does not distribute the burden of conservation equitably—consumers would carry the larger share of the conservation burden, relative to their share of the energy supply, which, according to the Plan, would be less than the industrial share in 1985 (see Figures 3 and 5).

The Plan would achieve a surprisingly small saving of energy in transportation—only 15 percent of the total saving due to conservation, or a net saving of 3 percent. Nevertheless, a very large part of the Plan's elaborate administrative proposals (such as gasoline and car taxes, rebates, and so forth) is devoted to achieving this very small effect.

The Plan would be even more inequitable in its distribution of available energy supplies between the consuming and producing sectors. At present, each sector receives 37 percent of the total energy budget (see Figure 4). In contrast, the Plan would allot only 20 percent of the *added* energy made available in the 1976-85 period to the residential/commercial demand and 68 percent to industrial demand, with transportation receiving 11 percent (see Figure 3).

In order to appreciate the force of these proposals, it is useful to compare the Plan's intended effects with recent trends in energy distribution (see Figure

5). Between 1965 and 1976, the proportion of the national energy budget devoted to the consuming sector (residential/commercial) increased steadily, from 33.5 percent to 37.0 percent. The National Energy Plan would reverse this trend, reducing the residential/commercial share of the energy budget to 32.9 percent by 1985. In contrast, the industrial energy share fell from 41.6 percent in 1965 to 37.3 percent in 1976. The Administration expects to reverse this trend as well, so that the industrial energy share would rise to 43 percent in 1985.[7]

It seems evident, then, that the Plan represents a policy of shifting the present balance of energy between consumers and producers heavily in favor of industrial production. In the 1976-85 energy-short period, industrial production, which previously had about the same energy share as consumers, would be allotted five times the consumers' share of the added energy, and bear a disproportionately small part of the burden of energy conservation. Far from equitably distribution the advantages and burdens of the 1976-85 period of energy stringency, the National Energy Plan would impose most of the burden and least of the advantages on consumers.

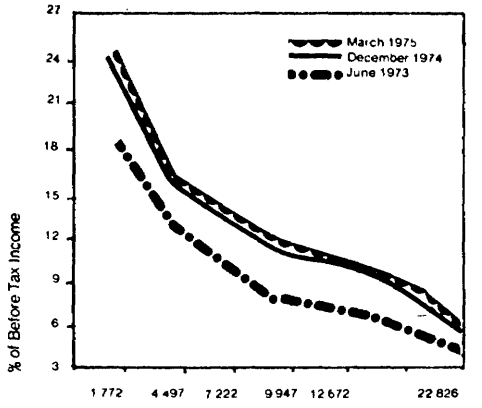
It has been widely recognized that the increasing price of energy would create even more serious inequities between poor families and wealthier ones, since energy expenditures represent a much higher proportion of a poor family's living costs (see Figure 6). The Administration has attempted to correct this inequity by means of a complex system of transfer payments. However, the elaborate bureaucratic machinery needed to implement these transfer payments would itself represent a new social cost with inequitable effects on the rich and the poor. The welfare of poor people depends heavily on government-administered programs, and these are likely to suffer from the additional administrative expenses generated by the Plan, especially since President Carter has asserted that military expenditures are to be maintained, and the budget balanced. In one form or another the poor are likely to carry the larger burden of the elevated energy prices proposed in the Plan.

Finally, it is important to note that the cost of energy enters into personal and business income taxes in very different ways. Businesses can deduct energy expenditures from taxable income, but residential energy expenditures are not deductible. The net effect is that the tax schedule reduces by nearly one-half the burden of the increased cost of energy to business, while consumers must meet the full cost.

From these considerations it becomes evident that, contrary to President Carter's claim, the National Energy Plan would lead to a major social inequity: consumers generally, and the poor in particular, would bear the greatest share of the burden that the Plan would impose on the nation. The Plan would impose on consumers much more than their fair share of the burden of conservation, and give them much less than their fair share of the limited supplies of energy. And despite the transfer payments that are supposed to equalize the effects of the rising price of energy that is mandated by the Plan, this burden too would inevitably be borne most heavily by the poor. In contrast, industrial production—and therefore the relatively small segment of society represented by investors in industrial production—would benefit most from the effects of the Plan.

Figure 6

% of Before Tax Income Spent on Energy by Urban & Rural Families & Single Consumers



Source Calculations made from BLS consumer expenditure data for 1972-73 and adjusted to December 1974 and March 1975 prices

Figure 7

Relative Price of Energy, 1900-1976.

Source: *Survey of Current Business*, Department of Commerce, Washington, D C , various years

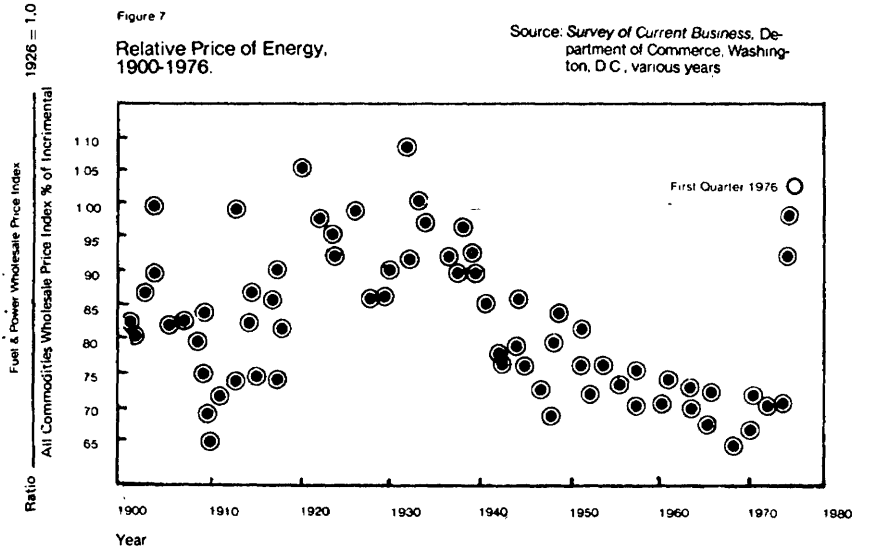
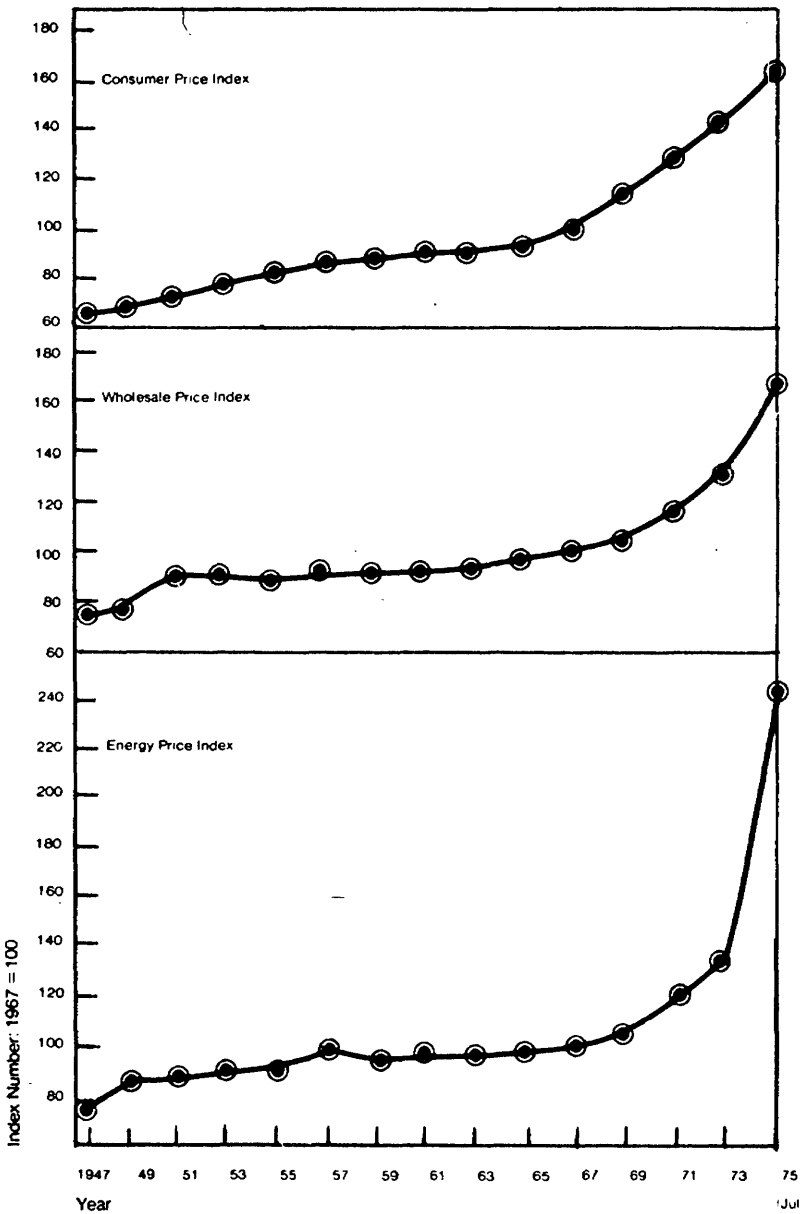


Figure 8



Source. *Survey of Current Business*, Business Statistics 1974 (Annual Edition) and edition for December 1975.

THE PLAN'S IMPACT ON THE ECONOMY

No one needs to be reminded that the Plan, if implemented, would have a very complex, and as yet poorly understood, effect on the economy. Within a few days after the Plan was announced, Mr. Lance was compelled to correct what he regarded as an overly optimistic assessment of its economic effects. And even an economist as prominent as Arthur Burns of the Federal Reserve has asserted that he does not understand the National Energy Plan—a prerequisite that would seem essential to gauging its economic effects. But even with these disclaimers in mind, it is nevertheless possible to make a preliminary evaluation of how the Plan might affect some of the large-scale economic factors.

Several important factors link the energy system to the economic system:

First, because energy is an essential input to the production of all goods and services and to the maintenance of households, its price greatly affects the cost of living.

Second, since the machinery required to produce energy—oil rigs, refineries, nuclear and conventional power plants—is complex and expensive, energy production is a heavy drain on available investment capital.

Third, the production processes that make particularly heavy use of energy—such as steel and paper mills, the petrochemical industry, and highly automated factories—also involve complex and expensive machinery, and therefore create a particularly heavy demand for capital.

Fourth, the introduction of new production technology—in the form of energy-driven, capital-intensive machinery—nearly always reduces the amount of labor needed per unit of output.

Each of these links between energy and the economic system would be strongly affected by the Plan, with results that are likely to disrupt and harm the economy.

The effect of the Plan on energy prices.

The Plan is deliberately designed to sharply increase the price of energy, on the challengeable assumption that this would significantly reduce demand and conserve energy (although Dr. Schlesinger has recently been quoted as claiming that the aim of these increases is "psychological"). The present escalation of energy prices, which began in 1973, is unprecedented in U.S. history (see Figure 7) and is clearly responsible for much of the recent increase in the rate of inflation (see Figure 8). The Plan would further accelerate the already powerful inflationary impact of the present upward trend in energy prices and worsen the effects on the poor. Since a rapid rise in energy prices makes predictions of future costs highly uncertain, it considerably increases the risks involved in investments in new energy-intensive production machinery—and contributes to the lag in industrial capital investment. It seems evident, then, that the Plan's proposals to increase the price of energy would further accelerate the already harmful effects of rising energy prices on the economy.

The effect of the Plan on the energy industry's demand for capital.

The efficiency with which invested capital can yield energy (that is, the productivity of capital, generally

expressed as BTU's produced annually per dollar invested) varies considerably among the different energy-producing technologies (see Table I). Thus, whereas capital invested in domestic oil production yielded (in 1974) about 17,000,000 BTU's per dollar invested, the corresponding figure for strip-mined coal was 2,000,000 BTU's, 160,000,000 BTU's for coal gasification, 29,000 BTU's for coal-fired electric power, and 22,000 BTU's for nuclear power. In general, the efficiency with which capital is used to produce energy is highest for fuels used for direct heating, and is lowest when the fuels are used to produce electricity.

It is important, therefore, to determine how the Plan would alter the balance between the use of fuel for direct heat as compared with electricity. In 1976, 45.9 percent of the national energy budget was used for direct heat, 28.4 percent for conversion to electricity, and 25.7 percent for transportation (see Figure 9). In contrast, under the Plan the relative shares of these three sectors in the energy to be *added* in the period 1976-85 are 36.2 percent, 53.2 percent, and 10.6 percent (see Figure 10). Thus, the Plan calls for a strong shift from direct heat applications to the production of electricity. It therefore implies an overall reduction in the productivity of capital used in energy production, for as pointed out earlier, productivity is much lower in electricity production than it is in direct heat.

The Plan would also significantly change the present balance of the different fuels used in generating electricity by sharply reducing the use of oil and natural gas and increasing the use of coal and nuclear power. If the Plan is implemented, in 1985 about 54 percent of U.S. electricity would be produced by coal-fired plants, 25 percent by nuclear power plants, 11 percent by oil- and gas-fired plants, and 10 percent by renewable sources such as hydroelectric power (see Figure 11). Compared to the 1976 energy budget, this would represent a gain in the share of power production of about 8 percent for coal and about 15 percent for nuclear power, and a loss of about 18 percent for oil- and gas-fired generators. Since the capital requirements of different types of power plants of the same capacity increase in the order: oil and gas < coal < nuclear, the net effect of this shift would be to reduce the overall productivity of capital used for the generation of electricity. Electric utilities are already the most capital-intensive enterprises in the economy and have been seriously hampered by shortages of capital. If it is implemented, the Plan would considerably worsen this economic problem.

In sum, relative to the energy that it would add to the national energy budget, the adoption of the Plan would result in a disproportionately increased demand for capital for energy production. This would tend to drain capital from other investments, in a period that is expected to suffer from a serious shortage of investment capital. The energy sector would, in effect, be interfering with the economic development of its own customers.

The effect of the Plan on the demand for industrial capital

A similar problem arises in connection with the *uses* to which energy is put in industry. The Plan's strong tendency to redistribute the national shares of energy to favor industrial production would inevitably make it easier for energy-intensive industries such as the petrochemical industry, or other highly automated operations, to obtain the energy that they need. Since there is a close correlation between the energy productivities (value added per BTU) and capital productivities (value added per dollar invested) of different industrial sectors, the Plan would encourage the further expansion of precisely those sectors of industry which not only have a high demand for

TABLE 1

Capital Productivity of Alternative Energy Sources

Energy Source	Capital Productivity (BTUs per year per dollar of capital invested)
Crude Oil Production[1]	
1974 actual	16 800 000
1988 projected	4 480 000
Coal strip mined	2 000 000
Shale oil production	420 000
Synthetic fuel from coal liquid	254 000
Coal gasification[3]	160 000
Coal-fired electricity generation $800/kw[4]	28 683
Nuclear electricity generation $1 000 kw/[4]	22 423

[1]The capital productivity of oil production was derived from information in *Oil: Possible Levels of Future Production*. Final Task Force Report Project Independence. FEA. Washington, D.C. November 1974. pp. IV-2 and IV-21.

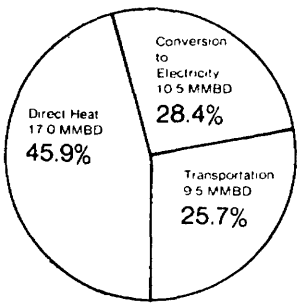
[2]The capital investment required to produce one ton of coal was obtained from *U.S. Energy Outlook: Coal Availability*. Washington, D.C. National Petroleum Council. 1973. p. 38.

[3]The capital investment required to produce different synthetic fuels was obtained from the *Project Independence Task Force Report on Synthetic Fuels from Coal*, p. 35, and also the *Task Force Report on Oil Shale*, p. 65. FEA. U.S. Dept. of the Interior. Washington, D.C. U.S. Government Printing Office. November 1974.

[4]The estimates for coal-fired and nuclear power plants are for base load power generation operating at 75% of capacity for 1 year.

Figure 9

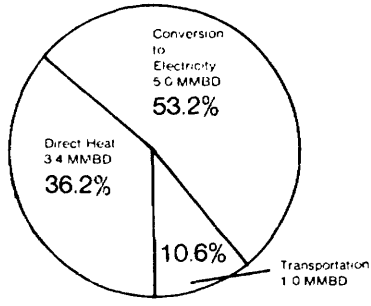
The Pattern Of Energy Use In 1976



Total Increment 37.0 MMBD

Figure 10

The National Energy Plan



Increments in Energy Use 1976-1985, With Conservation in Effect

Total Increment 9.4 MMBD

Figure 11

Relative Shares of All Fuels Used in Producing Electricity

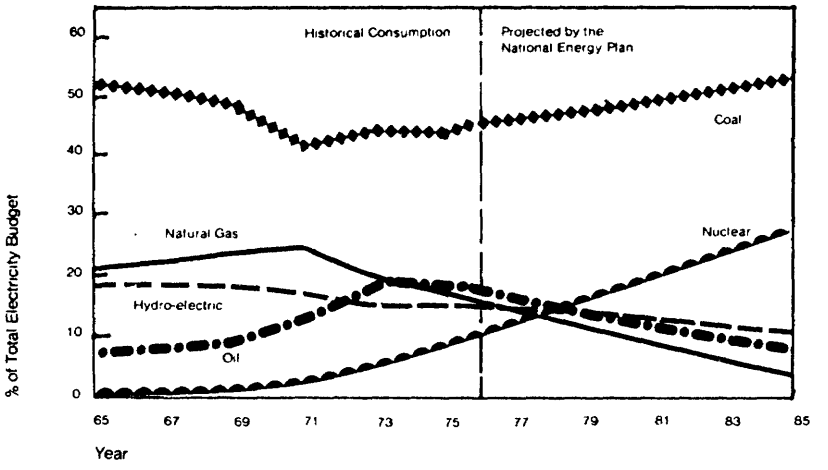
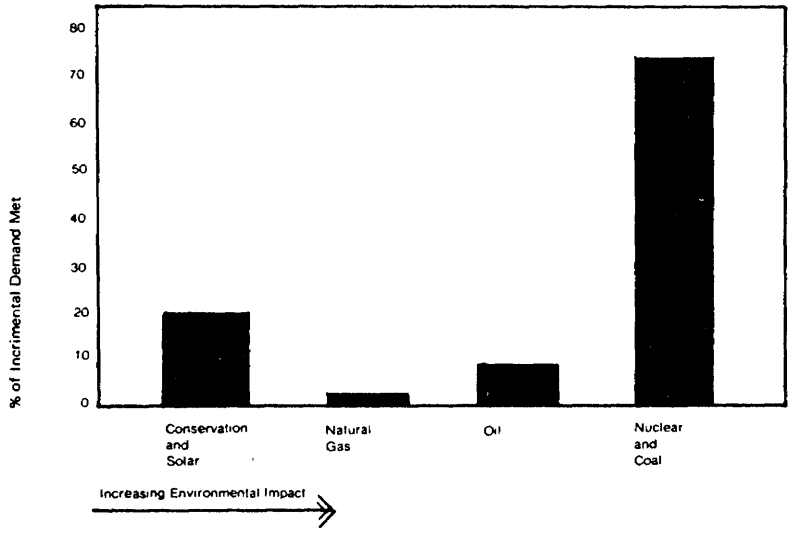


Figure 12

Environmental Impact of The National Energy Plan



energy, but also generate a high demand for capital. This effect would further intensify the Plan's impact on the growing shortage of capital for industrial investment.

The effect of the Plan on employment.

Many of the industrial sectors characterized by low energy and capital productivities tend to have correspondingly high *labor* productivities (value added per man-hour). For example, while the energy productivity and the capital productivity of the petrochemical industry are relatively low compared to most other industries, its labor productivity is the highest among all industrial sectors. Since the Plan would allot a disproportionately large share of energy to industry, thereby relieving intra-industrial competition for energy, it would enable energy-intensive industries, such as petrochemicals, to continue invading markets previously held by less energy- and capital-intensive industries, such as those which produce natural materials. In turn this would foster the displacement of industrial sectors that tend to use relatively more labor per unit output, and technological unemployment would rise. In sum, the Plan would tend to favor those industries, such as petrochemicals, which most seriously aggravate not only the shortage of energy, but also the shortage of capital and of jobs.

These considerations suggest that the Plan would affect the crucial relations among the industrial roles of energy, capital and labor in ways that would considerably worsen the basic problems that now trouble the economy—unemployment, inflation and the shortage of investment capital.

THE PLAN'S IMPACT ON ENVIRONMENTAL QUALITY

Although President Carter has expressed the conviction that the National Energy Plan would not reduce environmental quality, it is not clear how that goal could be achieved and at what cost. The Plan calls for the installation of sulfurdioxide scrubbers in coal-fired plants and for "measures to increase the safety of light-water reactors." The Plan document mentions that conservation measures reduce the environmental impact that is always associated with energy production to zero, and that environmental quality would be enhanced through what it terms the Plan's "...emphasis on solar energy."

However, from what we have already pointed out about the Plan's effect on the national energy system, it is evident that it would, in fact, have an untoward effect on the environment. The various options for meeting the demand for energy have very different impacts on the environment. In general, the various energy options would increase, in their environmental impact, in the order: conservation and solar energy; natural gas; oil; coal and nuclear power. As already noted, the Plan would emphasize those sources at the upper end of this scale; coal and nuclear would together meet about 72 percent of the demand added in 1976-85, while conservation would meet 17 percent and solar 1.6 percent (see Figure 12).

The Plan's mandate to hasten the licensing of nuclear power plants is also likely to increase the risk of environmental damage. A detailed study by Bupp[8] of the impact of licensing procedures on the nuclear power industry shows that their duration is closely related to the introduction of environmental improvements. These hearings are often extended because of issues raised by environmentalists—frequently persuading the government to improve safety requirements, such as earthquake-proof construction, emergency core cooling systems and more stringent emission standards. Efforts to hasten the licensing procedures are likely to make it more difficult to consider such improvements in safety and environmental standards. If this process is brought under the jurisdiction of the National Energy Plan, there would be a constant danger of pressure to minimize the importance of environmental problems in order to avoid delays in implementing the overriding Plan. There would probably be similar pressures to relax the stringent efforts needed to control the numerous environmental hazards involved in mining and burning coal.

In sum, although the Plan does aim to maintain environmental quality, its effects on the pattern of energy production will make the accomplishment of that aim increasingly difficult.

THE LONG-TERM EFFECTS OF THE PLAN

The National Energy Plan acknowledges that the root cause of the energy crisis is our present, almost exclusive, dependence on nonrenewable energy sources. While the Administration's statements on how rapidly world oil supplies are being depleted, and on our falling production of domestic oil are highly debatable, the basic fact remains that these supplies *are* nonrenewable and are the fundamental source of the crisis. It is obvious then, as the Plan notes, that the only long-term solution is to replace the present nonrenewable energy sources with renewable ones.

However, the Plan itself is not designed even to *begin* the transition to renewable energy, but is instead designed only to delay the anticipated crisis between supply and demand. Presumably, the time gained by reducing oil imports, conserving energy and developing our relatively large reserves of coal would help to facilitate the transition when it is eventually made.

This strategy presupposes that the Plan will not hinder our freedom to choose one or more renewable sources of energy in the future. In practical terms, only two renewable energy sources are *in being* and would be available at the latest time (roughly around the turn of the century) when the transition would need to be begun. One choice is solar energy. This includes the production of space heat and hot water and the production of methane from organic wastes (applications which are now available and economically competitive); wind power (available, and in some areas economically competitive); photovoltaic cells (available, but not yet competitive); and power generation from thermal differences in the ocean

(not yet available). The other option is nuclear power, with breeder reactors used to extend the life of the nonrenewable fissionable fuels for perhaps 1 2,000 years. What is at issue, then, is to determine whether the Plan, if implemented, would favor or foreclose one of these options.

A review of the relevant features of the Plan indicates that it would strongly hinder the solar option and make the choice of the nuclear option nearly inevitable. This is evident from the following:

First, it should be clear that, despite claims to the contrary, the Plan does very little to foster the introduction of solar energy, either operationally, or in terms of research. We have shown that according to the Plan, solar energy would constitute only 1.5 percent of the additional energy supplies that would be needed to meet the additional demand generated in the 1976-85 period. Moreover, the Plan would devote very little of the proposed energy research budget to the solar option, concentrating instead on the development of a nonplutonium breeder —an effort which, like the present breeder research program, would be so expensive as to preclude all but minor research efforts on other energy systems.

Second, the Plan mandates the massive introduction of light water reactors at a rate far exceeding the pace achieved in the last few years. By the turn of the century, nuclear power plants would represent a major part (perhaps one-half) of the nation's generating capacity, and since the nation would by that time heavily depend on electricity, there would be no choice but to continue the nuclear fission system. With uranium supplies depleted and escalating in price, it would then be necessary to extend the supply of fissionable fuel—by adding breeders to the system.

Third, it would appear that the Plan already envisages a future commitment to breeder-supported nuclear power. *The National Energy Plan* states that:

"It is the President's policy to defer any commitment to advanced nuclear technologies that are based on the use of plutonium while the United States seeks a better approach to the next generation of nuclear power than is provided by plutonium recycling and the plutonium breeder. . . . The President has proposed to reduce the funding for the existing breeder program and to redirect it toward evaluation of alternative breeders, *advanced convertor reactors, and other fuel cycles."*

(Emphasis added)

Dr. Schlesinger has recently confirmed this approach. A recent news report describes his position on this matter as follows:

"After the first decade, new energy technology, including perhaps even the breeder reactor, will begin to take up the slack caused by depletion of domestic natural gas and oil supplies."

(Time magazine, April 25, 1977, p. 27)

Thus, if we become committed to the Plan, at the turn of the century when the nation would have to choose its renewable source of energy, we would find that this crucial decision had already been made. By implementing the Plan we would have made an unwitting choice—which may already be anticipated in the thinking of its authors—to pursue the nuclear route.

What can we learn from this examination of the National Energy Plan? Clearly, no justification exists for swallowing the Plan whole, for its effects fail to meet the goals which it claims to pursue. Tested against its stated effects, the Plan slightly reduces the demand for energy, but powerfully manipulates the supply; it generates inequities that favor producers over consumers and the rich over the poor; it intrudes heavily upon the relations among energy, capital and labor and worsens the problems that trouble these crucial sectors of the economy;

it will make the task of environmental protection more difficult.

Can these faults be corrected by piecemeal modification of the Plan? I think not, for the Plan's basic fault is generic: It would prevent the nation from considering—through open debate rather than covert implications—the one course of action that can solve rather than delay the energy crisis: transition to a renewable source of energy.

The National Energy Plan is not a suitable vehicle for making such a momentous decision. We hardly need to be reminded of the enormous hazards inherent in the nuclear route: the very great radiological risks; the economic difficulties arising from its extreme capital intensiveness; the political problems inherent in not only nuclear proliferation, but also in the inevitable super-centralization of the nation's power system. At the same time the nation has hardly begun to realize that solar energy can, beginning today, deliver significant amounts of energy, at economically competitive costs. Certainly we could, in the next ten years, install enough solar collectors and methane generators to supply perhaps one-fifth of the energy budget. At that time solar electricity could begin to be economical. And as solar electricity is introduced, solar hydrogen production becomes possible and opens the way to the production of a wide range of solar fuels. We could then create a renewable, solar economy—an economy that would be strengthened by the decentralized structure of solar energy, by its stimulus to small business rather than big business, by the numerous jobs it would create, by its ability to combat inflation.

What is called for, I believe, is a new beginning, a wholly new effort. We should debate, right now, the relative merits of the nuclear and solar paths, and decide where we are headed before we work out the means of getting there. Such a debate would help us discover how to develop renewable sources of energy *and* protect the environment, how to solve the energy crisis *and* rebuild the economy, how to remake the nation's energy system *and* protect its democratic heritage. Most important, such a debate would help to restore our people's faith in their own power to decide, for themselves, the nation's future.

NOTES

1. President Carter, Address to the Nation, April 18, 1977, and Address to Congress, April 20, 1977 (as reported in *The New York Times*, April 19 and 21, 1977).
2. Executive Office of the President, Energy Policy and Planning, *The National Energy Plan* (Washington, D.C.: U.S. Government Printing Office; April 29, 1977).
3. *ibid.*, pp. 95, 96.
4. *ibid.*, derived from Table IX-1, p. 96.
5. President Carter, Address to the Nation, April 18, 1977.
6. Federal Energy Administration, *Oil: Possible Levels of Future Production*, Final Task Force Report, Project Independence (Washington, D.C.: U.S. Government Printing Office; 1974).
7. It is significant that the FEA's program for development of the energy budget in 1976-85 projects the 1965-75 trends, so that the distribution of energy added to the national budget in that period is shared out in the proportion 56% Residential and Commercial, 36% Industrial and 8% Transportation. The projections arising from the model used in developing the Plan represent a considerable departure from the FEA estimates.
8. The analysis of the impact of licensing procedures on the nuclear power industry is part of a study by Irvin C. Bupp, *et. al.*, which was reported in "The Economics of Nuclear Power," *Technology Review*, February 1975, p. 15 +.

REFERENCES FOR FIGURES

All data in the figures are derived from the following sources, except where directly noted on the figures:

1976 actual and 1985 projected energy consumption patterns, with and without the Plan: Executive Office of the President, Energy Policy and Planning, *The National Energy Plan* (Washington, D.C.: U.S. Government Printing Office; April 29, 1977).

Historical energy consumption patterns (1965 to 1975): U.S. Department of the Interior, *Energy Perspectives II* (Washington, D.C.: U.S. Government Printing Office; 1976).

FEA energy consumption projections: U.S. Federal Energy Administration, *Project Independence Task Force: Summary Report* (Washington, D.C.: U.S. Government Printing Office; 1974).

Senator GRAVEL. I would like to adjourn the hearing now and reconvene at 2 o'clock. We have two other fine witnesses to be heard this afternoon, Joseph Lindmayer and Prof. Paul Jones.

[Whereupon, at 12:15 p.m. the hearing in the above-entitled matter was recessed to reconvene at 2 p.m. this same day.]

AFTER RECESS

Senator GRAVEL. The hearing will be in order.

Our first witness is Dr. Lindmayer. It is a pleasure having you back before us. You have not testified before us since 1974.

Please proceed as is most comfortable for you.

STATEMENT OF JOSEPH LINDMAYER, PRESIDENT, SOLAREX CORP.

Mr. LINDMAYER. Thank you.

Mr. Chairman, I am here today to discuss the effect that the administration's proposed national energy plan will have on the production of alternate energy devices, specifically photovoltaic energy systems or solar cells as they are more commonly known; and to recommend Government initiatives that would rapidly develop photovoltaic production capacity.

As you probably know, there are different solar energies. The most commonly known one is that of solar heat. That is the source of energy that most people are experienced with.

When we come to photovoltaics, unfortunately we are talking about a physical phenomenon that is far away from human experience and therefore, it is much more difficult to transmit what it can do. Nevertheless, I will try.

My comments on the energy plan itself will be quite brief, inasmuch as there is nothing specific in the plan about the production of energy from photovoltaic devices to comment about. The plan, however, does recognize and I quote:

> Photovoltaic systems . . . have a potential for dramatic price reductions that would make them economical for a broader range of applications. Increased funding is proposed to accelerate the development of economic photovoltaic systems.

Unfortunately, not enough attention is being paid to this readily available electric energy source. I would like to discuss briefly how this technology works, why it should be developed and where we are today.

Solar energy for most people today means heat. In being preoccupied with solar heat, we tend to forget that most of the Sun's energy is arriving in the form of light. Solar light arrives in so-called photon units which are particles of energy. These incoming photons are responsible for the support of most living things, and for most of our present energy supply include gas, oil, and coal.

As far back as the last century, people have observed that in the boundary layers of different materials, electricity can be generated, when these boundaries are illuminated by light. This observation led to the term "photovoltaic effect"—meaning light-generated electricity.

Solar cells are semiconductor devices that utilize this "photovoltaic effect" to convert light energy directly into electric energy. The most efficient and inexpensive solar cells available today are made of silicon. Thin wafers of silicon create electricity by transferring units of light

energy, called photons, into positive and negative charges, thus causing an electric current to flow and a voltage to develop.

This phenomenon is best understood by actual demonstration; and I have brought along a television set that is powered by a small solar panel that I would now like to demonstrate.

Mr. CLIFFORD. Here we have a small solar cell panel a foot square and a small television set. The only connection is between the panel and the set, and if we illuminate it with a light source, you will see direct conversion of light. There is no magic to it, just move the light away and bring it back, and you have a television set operating.

While this light may look somewhat bright, it is roughly equivalent of a single sun.

Mr. LINDMAYER. As you say, there is a direct conversion of light into electric power and this is basically accomplished by these simple silicon discs. With the bigger panel that I have here—this happens to be approximately 25 watts, and in principle, one can identify a manufacturable basic building block that can be used to build any size system, whether it is for the home or some other area application.

About 600 square feet of panels similar to the one powering this television set would provide all the basic electric power needed for a typical house.

Senator GRAVEL. How many panels like that would you say it would take to heat up the average house, or power for the average home?

Mr. LINDMAYER. I was referring to the electric needs of a house. That was 600 square feet; 125 or so such panels.

As the television display just showed, photovoltaic electricity possesses many of the attributes of an ideal energy source. Solar cell systems operate without moving parts and without pollution. Fuel for the systems—sunlight—is free and universally available. The major raw material in solar cells—silicon—makes up 27 percent of the Earth's crust.

It is not only plentiful, it is not being used up in the process.

Moreover, the technology is completely safe. There are no worries about radiation leakage or possible misuse of the technology for weapons development.

At present, America possesses world leadership in solar cell technology. Rapid development of the technology would offer tremendous export potential. It would also free our fossil fuel reserves for more valuable uses.

Moreover, the technology places minimal demands on our Nation's water supply and other valuable resources. Distribution is also simple—we are not shipping energy but only the converting device to the user.

Large scale use of solar cells could significantly restore the energy independence of individual Americans, as well as the Nation as a whole. Rooftop solar cell systems could provide all the electricity required by an individual home.

Larger systems can easily meet the needs of entire communities. Such on-site and community use of solar cells would restore a measure of energy independence. Even today radio equipment, microwave relays, and irrigation through pumping represent applications with actually energy independence.

In fact, the many letters we have received at Solarex and the many audiences we have addressed have convinced us that a major motivation for the growing popular support of solar energy is related to the question of energy independence.

While everyone is impressed by the energy we have provided for the many industrial users—they can hardly wait to have it for themselves—it does require detailed explanation for why such a clearly operating solar energy source is not produced in larger quantities, at a lower price, and why it is not distributed widely. Invariably, the average person complains that the Government is not serious about supporting solar energy.

It is now more than 3 years since I first discussed solar cells on Capitol Hill in front of this committee in January of 1974. In reviewing my testimony from that time, I can draw both deep satisfaction from the progress in photovoltaic development that has been made; and, at the same time, be rather dismayed when I compare this progress to the potential that is inherent in this technology.

Some significant accomplishments since 1974 are:

One, prices for solar cell panels have dropped from early 1974 prices of $50 to $75 a peak watt to $13 to $15 today.

Two, photovoltaic manufacturing is becoming a serious industry. There are now six companies active in manufacturing.

Three, the technology's technical feasibility and potential for cost competitiveness is no longer seriously disputed.

Senator GRAVEL. Could you give a comparison of what it costs per peak watt today for oil-fired furnaces in the house?

Mr. LINDMAYER. Peak watt in this case means the energy that is delivered in full sunlight, or the power that is delivered in full sunlight. The equivalence, for the proper reference, is that the utility now charges 50 cents, 60 cents per peak watt.

Senator GRAVEL. Peak watt 50 to 60 cents?

Mr. LINDMAYER. That is the equivalent level. The comparison is difficult because we are dealing with average energy out of this panel rather than continuous energy, but that is the established level.

For that reason, it is said to be 50 cents a watt by 1985.

Senator GRAVEL. What is that?

Mr. LINDMAYER. To develop the industry to the point that it can develop solar panels of 50 cents a watt by 1985.

In the past 3 years, prices have dropped rapidly; solar cells have come into common use in many remote applications and most solar cell scientists, solar industry leaders, and Government solar officials agree that solar cells will become cost-competitive with conventional sources of power.

This is probably an important development because it is only lately that this conclusion has been reached.

With this as background, I would now like to discuss what it will take to bring the industry from its current price levels to cost competitiveness—the 50 cents to $1 per watt region. The keys to rapid cost reduction include: One, automation of production facilities; and two, rapid penetration of megawatt markets.

Senator GRAVEL. Would you expand upon rapid penetration of megawatt markets?

Mr. LINDMAYER. In a few minutes, I was going to talk about this chicken-and-egg problem.

Senator GRAVEL. If you will develop that further, just hold off.

Mr. LINDMAYER. I will come to that.

You may have noticed that I have not mentioned any technological barriers to rapid cost reduction. We do not need basic technological breakthroughs for cheap solar cells—only the less risky, but no less demanding, challenges of actually automating available technologies. This is not to say that no additional solar cell research is needed, rather it is to suggest that the focus must change.

The scientific challenge in the solar cell field today is to transfer technologies from the laboratory to the production floor in an automated setting.

In other words, we have a technology backlog—and this backlog should be exploited in a cheap production setting so that quantities of solar systems could be distributed to the waiting public.

Today, the photovoltaic industry is in the midst of the classical "chicken and egg" industrial development problem. Simply stated, to reduce prices you must automate; but to justify automation you must have very large markets; but you cannot sell to very large markets unless you automate, train a new generation of personnel in this revolutionary new field.

We have found markets very easily. These have been in the areas of communication, mostly in remote areas, microwave repeaters, irrigation systems, and so on, have used these systems because the price is already cost competitive in those situations. But we have to find the ever larger market at ever lower cost.

This is why we say the market development is very important in a fuel-oriented society. You have to finance the installation of new technologies in an automated setting and develop trained manpower.

All of these factors can be dramatically impacted by Government policy.

The Congress right now can give a tremendous boost to photovoltaic development by favorably considering two pieces of legislation currently being proposed.

Title II of the solar energy Government building program, S. 672, provides for the purchase of some 150 megawatts of solar cells for Department of Defense use and for $25 million a year for 5 years for engineering support. Passage of this bill will rapidly stimulate development because:

One, the DOD provides a large, multimegawatt cost-competitive market for solar cell array.

Two, the size of this market and the prospect for a guaranteed market over a multiyear period will provide solar cell manufacturers with the incentive to automate.

Three, the prospect of a large market will make financial institutions and investors much more willing to put their money into solar cell companies.

Four, the $25 million a year will provide for any engineering support necessary to adapt and install automation techniques that will be truly required to support the proposed growth rate.

Second, Congress should extend the tax credits proposed for solar hot water and space heating technology to include photovoltaics. At

present, I believe this would serve as a psychological boost for the industry for it would be an indication of congressional commitment to cheap solar cells.

It would also serve as a means of making the public more aware of the potential of the technology. Lastly, in a few years, when solar cells are nearing cost competitiveness, individuals will begin to put them on rooftops. Market development at that time will proceed more rapidly if individuals can take advantage of existing legislation.

Passage of these two pieces of legislation will provide the incentives that the photovoltaics industry needs to rapidly bring down prices. They will also serve another important purpose. They will provide the administration with needed guidance in the formulation of their photovoltaic development programs.

One comment that I heard at a conference in 1973 and relayed to the committee in my previous testimony is even truer in 1977 than it was in 1974. At that time, someone sarcastically said, "If we would burn all the papers written about solar energy, the energy crisis would be over." ERDA's photovoltaic programs to date have been characterized by a plethora of paper studies, nearly a shotgun approach to technological research, little effort in transferring the technology from the laboratory to an industrial setting and an insufficient market support.

In recent conversations with ERDA officials, I have been told that ERDA programs will become more oriented toward industry development. I hope this is really the case. However, I would feel much more confident if Congress directed such a change in program emphasis.

In conclusion, I would like to relay a historical analogy about the role of the Department of Defense in the development of the transistor and integrated circuit industries. Early DOD support led to rapid price drops, production volume increases and commercial development of these semiconductor industries. Defense markets, defense production support and defense-related research and development were the basic catalytic efforts in the development of these now major industries.

The March 1977 issue of Science magazine was devoted to electronics. One article entitled "Intellectual and Economic Fuel for the Electronics Revolution" detailed the Government role in development of the transistor and integrated circuit industries. It reads in part:

> The importance of the transistor to defense electronics was immediately obvious. Army, Navy, and Air Force agencies immediately began the support of transistor electronics for the defense need. The pursuit of excellence was intense; competition developed among the various defense agencies to support the best ideas and the best teams in the various industrial laboratories and in the universities. Moreover, the commonality of interest among the contractors to the Federal Government promoted the high diffusion rate of new information in semiconductor electronics.

In 1962, defense production was 100 percent of a $1 million IC market. Six years later, the market had grown to over $300 million, prices had dropped by a factor of 25, and defense production was only about 30 percent of the market. At this point it is largely consumer oriented.

Gentlemen, the same scenario can hold for the solar cell industry. However, we need a level of Government support and commitment

comparable to the DOD's catalytic support of the transistor and integrated circuit industries.

This type of support and commitment is embodied in the two pieces of legislation I discussed today. With some redirection of the present R. & D. programs toward industrialization together with proper legislation the day will not be far off when the solar cell industry is installing cost-competitive solar electric systems on the rooftops of your constituents.

Senator GRAVEL. Thank you very much, Doctor. Let me recap the points that you are recommending. One, the 672 which goes to the military use of DOD, I might add in that regard, have you had any meetings with the military or the people of the Pentagon about the ramifications of this type of packaged energy?

Mr. LINDMAYER. Yes; we have. They are very enthusiastic about it. In fact, a number of studies have been made at all levels of what is the cost of a kilowatt hour. It turns out in many military situations you do not have to think in terms of 5 cents a kilowatt hour. Frequently, it is up to 50 cents and even $1 a kilowatt hour, depending on the situation, and that is a level at which we can start competing today and they have use for it.

There are already a number of demonstrations in use at the present time.

Senator GRAVEL. Do you know if within their budgetary process they themselves are trying to increase that budget in additional to what efforts are being made on the Hill? I believe that Senator Humphrey's bill, S. 6728——

Mr. LINDMAYER. Yes; I think they are primarily looking for separate legislation for a separate budget to do this work.

Senator GRAVEL. The second point was the tax credit, putting it in with other forms of energy. One point that you mentioned privately to me, and I would like to have you bring it up now, is the comparability to the benefits that existing utility companies get, the tax preference—apparently they get 20 percent off the top from an investment and expanded investment. Is that correct?

Mr. LINDMAYER. I think so.

The tax benefits, as well as tax benefits for the potential user, are both important because it will only be a few more years before these will actually appear in homes.

Senator GRAVEL. You are right on that. If the progress you made from January 1974 to today was going down from $50 and $60 to $13, then if we wait another 3 years and have another hearing, you would have made considerable progress, with or without our help.

Mr. LINDMAYER. You are right, Senator. As compared to the conventional energy sources that continue to go up in price, here we start to live with the idea that it has to go down.

Senator GRAVEL. Let us hope that we can give you some support to accelerate that.

Mr. LINDMAYER. We would appreciate it.

Senator GRAVEL. I want to thank you very much, Doctor, for coming forward. We appreciate your testimony. It would be valuable, and I can assure you in my own case I will make every effort to try to get some more changes in the law, as I have in the past in this regard.

Mr. LINDMAYER. Thank you.

Senator GRAVEL. Before we go on to our next witness, I would like to take a short break.

[A brief recess was taken.]

Senator GRAVEL. Our next witness is Prof. Paul Jones, Louisiana State University.

Professor Jones?

STATEMENT OF PROF. PAUL JONES, LOUISIANA STATE UNIVERSITY

Dr. JONES. Thank you, Mr. Chairman. I must apologize for not having a written testimony to give to the committee at this time. I have submitted three of my published reports that deal with the subject of geopressured geothermal resources* and I would like to have the opportunity first to discuss the general characteristics of the geothermal resource, prior to identifying some of the facts that would be very important in accelerating the commercial development of the resource, and expanding that development.

Geothermal resources are Earth-heat resources and, in the present technology, they are essentially hot groundwater resources, either in the form of liquid water or in geothermal steam.

People in the United States may be familiar with the geothermal steam field about 60 miles from San Francisco which produces half the electricity requirements of the San Francisco area. This derives from a volcanic origin (a heat source close by) and the small amounts of water in the rock formations.

A second class of geothermal energy is the so-called hot water convectional systems that are associated with igneous intrusions or molten (liquid) rock in the Earth's crust at considerable depth, perhaps 6 to 10 miles below the zone where the geothermal resource is tapped by wells.

A third class of geothermal resources, the one I would like to talk about today, is geopressured geothermal resources. These occur in the gulf coast of Texas and Louisiana, onshore and offshore, and underlie an area of some 150,000 square miles. These resources are peculiar in that the water in the rocks actually supports part or all of the weight of the overlying rocks. They are, in effect, in a sealed container. In the sealed container there are interbedded layers of sand and clay, these layers being continuous over broad areas. Geothermal heat flow has been retarded by these layers because water is a very poor conductor of heat, and has a very high specific heat—I should say thermal capacity—and thus causes these beds to be excellent heat insulators. The specific heat of water is some five times of that of the rocks in which it occurs.

Where geopressured rocks underlie the gulf coast, parts of Wyoming, Colorado, and California (the Los Angeles basin) we find these geopressured geothermal resources. None of them have been studied in great detail. The most intensive studies have been made in the gulf coast, where electric logs are available for more than 300,000 wells that penetrate the deposits—more than 10,000 of which penetrate the geopressured zone.

*See p. 125.

The 6,600 gas reservoirs of the geopressure zone in southern Louisiana yield about 5½ trillion cubic feet per year, from the sandbed aquifer systems that also include the geothermal reservoirs. The questions that must be addressed are, first, who owns the energy resources (heat, hydraulic energy, and dissolved gas) in the geopressured geothermal reservoirs? Second, how can these energy resources be produced? and third, what will be the consequences of large-scale energy production from geopressured geothermal reservoirs?

ERDA has addressed these problems and, in the past year, has spent about $6.5 million on investigations, including paper studies at the University of Texas, field studies by the Texas Bureau of Economic Geology, field studies by the Petroleum Engineering Department at Louisiana State University, and field demonstration of the energy potential of the resource in Louisiana at Tigre Lagoon, for which you may have seen a press release during the past week.

Regarding the nature of the resource, it is hot water under high pressure, containing dissolved methane. A well designed to tap this resource at a depth of 15,000 feet, with the top of the geopressure zone at 12,000 feet, would, according to general conditions that we can define, produce some 3,000 gallons of water per minute with a flowing pressure of about 3,000 pounds per square inch. If the water were at 325° F., and if the waters were at saturation in methane—which we are convinced is the case—the flow of water through a turbine at the wellhead could generate about 8 megawatts electricity; the heat energy could generate about 6 megawatts of electricity using a vapor turbine and heat exchanger to convert the heat energy to electricity; and the gas exsolved from produced water could be used to produce about 8 megawatts of electricity using a conventional gas turbine—or it could be sold, of course, to a pipeline company. Recognizing the importance of this resource, the Federal Power Commission has established a study group to appraise the resource in southern Louisiana, both onshore and offshore. I am chairman of Task Force I, Gas Dissolved in Water. Our study concerns deposits above a depth of 16,000 feet, for which we have the necessary field data.

The State of Louisiana, recognizing the importance of these resources, has passed the Geopressured Geothermal Resources Act of 1976 which makes the resource the property of the landowner; and the dissolved gas, as well as the dissolved solids in the water, belong to the landowner and are not covered by existing oil and gas leases on the land. This is a very important factor in the development of the resource; the State of Louisiana will issue the administrative code in August or September of this year. Lands are now being leased in Louisiana for the development of geopressured geothermal resources.

A couple of points about the development of this resource must be considered. First, development will involve production of hot salty water at very high rates—far greater than anyone has ever before produced salty water from subsurface sources. Today, in Louisiana, about 300 billion gallons of fresh water is pumped from wells, to irrigate rice and for industrial and municipal consumption. In order to produce 2 to 2½ trillion cubic feet of natural gas from the geopressured zone, it would be necessary to flow 2,000 billion gallons of salty water per year, something like seven times as much as the present discharge of fresh water.

Second, no one has yet constructed a water well 15,000 feet deep to produce at the rates that I am talking about. However, there are no serious technological problems or impediments to this production that have been identified at this time. Water wells would require large diameter casings, and screens in the aquifer sands. Wells would be located in places where the oil and gas developers would not drill; they should not be on structural "high."

For large sustained yield and long life, water wells should be located as far as possible from zones of structural deformation—faults, or barriers to flow. Wells should not be near salt dome structures, nor near growth faults, principal targets in oil prospecting. In other words, the areas that are the most attractive for the development of geopressured geothermal resources are areas in which the oil companies have little interest, and herein lies a major difficulty. Because the reservoirs which contain this resources are not mapped by the oil companies, a new approach to resource assessment and development must be formulated and applied. With this in mind, ERDA has had in progress for about 2 years a comprehensive aquifer mapping study. The size of the dissolved natural gas resource in the geopressured zone, which I have estimated using a model based on many geological cross sections through the area between the Rio Grande and the Mississippi River, is enormous. Between the top of the geopressured zone and a depth of 25,000 feet, sand bed aquifers contain some 49,000 trillion cubic feet of dissolved methane.

Reservoirs in the geopressure zone contain water that supports the rock overburden load. This means that, in the sand beds, the pressures are very high, and the temperatures are moderately high. Gas solubility increases exponentially with pressure, and oil is also soluble in the formation water under these conditions. Thus we have inadvertently, in defining the occurrence of geothermal resources, identified the principal factors which control the occurrence of commerial deposits of oil and natural gas.

The geopressure zone is now known to be the place where oil is formed from kerogen in the clay beds. It is also known to be a natural catalytic cracker, where all of the oil that is formed by the thermal conversion of the kerogen (organic matter) is gradually converted to natural gas, unless it goes into water solution and escapes from the geopressure zone. Leakage is mainly upward through fault zones during loading by subsequent depositional cycles.

Methane formed by the natural cracking of petroleum goes into water solution as it is produced, in the conditions of high pressure and high temperature of the geopressure zone. All of the waters in sand bed aquifers in the zone become saturated with methane; and then, because more methane is produced by this process than can go into water solution, gas begins to accumulate in vapor form. The 8,200 producing gas reservoirs of the geopressure zone originated in this way. Individual wells that tap these reservoirs may produce up to 20 million cubic feet of gas per day.

These wells are very, very costly. Such a well was recently completed near Baton Rouge at a depth of 22,000 feet.

Senator GRAVEL. That means that you would produce exactly what we consume as a nation?

Dr. JONES. The total volume of production from a single well is 20 million, a maximum of 20 million cubic feet per day. Several such wells have been completed within the last 6 months in Louisiana. A well to produce gas from 22,000 feet in Louisiana—say near Baton Rouge—would cost $6.5 million at today's prices. To design and construct a water well, to flow high-pressure water to the land surface for gas extraction, from a depth of 20,000 feet, would be an extremely interesting and important step to take at this time.

Recognizing the potential value of this resource, a company interested in developing the deep gas reservoirs tested an aquifer at a depth of 20,000 feet in the vicinity of Baton Rouge within the last 6 weeks. The water temperature was 425° F. The sand bed was 180 feet thick. The reservoir pressure was 16,000 pounds per square inch. The dissolved salts were 12,000 milligrams per liter. The gas content was 107 cubic feet of gas per barrel of water, or about 2½ cubic feet of gas in each gallon of water. This gas content is exactly what the Russian solubility curves predict.

The well was produced for 50 hours at a rate of 100 barrels of water per hour, and the gas content of 107 cubic feet per barrel is based on this 5,000 barrels. This test demonstrates first, that methane gas does occur in formation waters at this pressure and temperature and is not broken down into carbon dioxide and water under these conditions, as some petroleum engineers and geologists believe. Second, it tends to support my estimate, published by the National Academy of Sciences in 1976, of the total amount of gas dissolved in the geopressure zone aquifers above a depth of 25,000 feet.

The figure derived with the geologic model that I mentioned a moment ago, is 49,000 trillion cubic feet of gas. I was skeptical of it, and had it checked by two competent engineers. If one accepts the model, then this is approximately what we are looking at in terms of the resource base. How much of that could be produced is a matter of conjecture, but I have estimated between 5 and 10 percent.

The U.S. Geological Survey estimates that 24,000 trillion cubic feet of methane is dissolved in sand bed aquifers of the geopressure zone above a depth of 19,000 feet, onshore, in Texas and Louisiana. We have, then, a geopressured geothermal resource that can yield three kinds of energy at the wellhead: kinetic energy, natural gas, and thermal energy in the water. Temperatures will range from 300° to 500° F. with most of the temperatures in the range of 300° to 400° F. These temperatures are not high enough to be interesting to geothermal energy developers of our Western States.

The ERDA well at Tigre Lagoon has a temperature of about 240° F. at a depth of 12,800 feet. The well was recompleted to flow water simply by perforating the casing in a water sand. It flowed up to 10,000 barrels of water per day, and produced 1,000,000 to about 1,800,000 standard cubic feet of gas each day for the first several days. The sand bed tapped was less than 200 feet thick and the electric log showed it to be a water sand, with no gas in the vapor phase.

Interestingly, a considerable amount of distillate was produced with the water. The formation pressure was 11,000 pounds per square inch. Steam was flashing on the way to the land surface, and gas was coming out of solution. This gives us two points, one at a depth of about 20,000 feet and one at 12,800 feet with methane-saturated formation

water. Actually, the water was saturated in gas and the gas came out of solution with pressure drop as the water rose to the land surface.

The maximum amount of methane in produced water at Tigre Lagoon was 18 standard cubic feet per barrel. The water was saltier than expected, and laboratory solubility tests in the water confirmed field observations. Salinity increase reduces gas solubility.

The press release of ERDA describes the conditions found in the well at Tigre Lagoon to be an extremely important discovery. It is a very important step, as far as I am concerned, in the appraisal of the resource.

Water that escapes upward from the geopressure zone carries gas at saturation, and is hot enough to be useful for industrial processing purposes, and space heating or air-conditioning. Temperatures range from 180° to 220° F. Wells 3,000 to 5,000 feet deep that tap aquifers that overlie the geopressured zone have produced, for as long as 7 years, water at saturation, with methane content ranging from 14 to 15 standard cubic feet per barrel. These wells are located just offshore from Grand Isle.

Regarding development offshore, the Federal Government now has no legal basis for leasing geopressured geothermal resources beneath the Outer Continental Shelf, and the question of royalty payment that was raised with regard to the gases produced by the four wells mentioned above was resolved by the Government by considering this gas, to be produced by an oil well on the same platform.

So, what do we do? In order to increase, let us say, the rate of development of the resource, in order to get this 2 to 4 trillion cubic feet of gas that could be produced each year by approximately 2,500 wells in South Louisiana, at locations which can be identified at this time—what do we do to make this possible?

First, we should consider this gas new gas: actually, it should be producible at an uncontrolled price because the value of the gas could offset the cost of developing geothermal well technology. No one has built a well to produce this water at these rates, so therefore there are a lot of unknowns in the cost.

The second thing, of course, is the depletion allowance. This geopressured geothermal resource development is a depletion process and for tax purposes should go under the same classification as oil and gas; and, third, steps should be taken to modify the Geothermal Steam Act of 1970 to make possible the leasing of the Outer Continental Shelf for development of the geopressured geothermal resource.

As far as the ERDA program is concerned, it will be increased to about $15 million next year, but this should be doubled. Contracts have been awarded for the construction of two geothermal wells in the Texas coast. There are plans to construct a geopressured geothermal well in Louisiana, but they are not definite at this time.

The value of the resource I have indicated, in terms of the 2 to 4 trillion cubic feet a year, could be produced by some 2,500 wells installed in carefully located well fields. This is only the beginning. The greatest value of the resource can be realized by the generation of gas caps within the reservoirs by skillful designs of well fields to produce geothermal water. Gas wells would be installed to tap created gas caps using brightspot seismic methods.

All geothermal waters in the geopressured zone are salty and must be disposed of underground after the heat, dissolved gas, and kinetic energy are derived. This is a costly operation, but it is not prohibitively costly because, in a large part of the area of development, beneath coastal Louisiana, very thick and extensive salt-water aquifers could be tapped. Disposal in those areas would not be a serious problem.

The permeability of geothermal reservoirs in Louisiana is perhaps 10 times greater than the average of those in Texas; this is partly because the deposits are geologically younger and are less hot, also.

Senator GRAVEL. What is a gas cap?

Dr. JONES. If one reduces the pressure in the sand bed aquifer which has a slight domal character, by constructing a wellfield, a circular wellfield, for example, around the structural high, and produces water from the wells at high rates, the fluid pressure in that reservoir will be reduced. Dissolved gas will exsolve and accumulate in the upper part of the aquifer, producing an artificial gas reservoir, a so-called gas cap. A well, or several wells, tapping that artificial reservoir would produce gas without water.

Senator GRAVEL. The water has to be produced from the other wells?

Dr. JONES. Production of water serves to generate the gas cap. Once the gas cap is formed, gas is produced at a rate that is sufficient to maintain reduced pressure, and the gas will exsolve from and move upward through formation waters surrounding and underlying the gas cap.

We take off a certain amount of water to create the gas cap, maintain the pressure drop by producing gas at high rates causing exsolution of the gas from the associated waters. It is well known that the 8,200 geopressured gas reservoirs that are now in production produce far more gas than the reservoirs could have contained at the time they were first tapped, and the question has always been. "Where did the extra gas come from?" or "How was the pressure sustained?" The plot of cumulative production from the geopressure reservoir versus the so-called PZ/curve—showing pressure declining with time—does not give a curve that conforms with the natural gas law, the PV relationship of the conventional gas reservoirs.

The question has always been, "What is the pressure maintenance system?" Over the years, it has been attributed to shale water influx—water in the adjacent shales is believed to have moved the sandbed as a consequence of progressive reduction of pressure in the reservoir. It has also been thought that perhaps the reservoir was compacted and crushed and the porosity reduced as the pore pressure was reduced.

There is no published paper except mine that attributes maintenace of gas reservoir pressure to exsolution and recovery of dissolved gas from the associated formation waters. The validity of the assertion that the sandbed aquifers of the geopressure zones are saturated with gas is still questioned by many.

We have a very special geothermal resource in the Gulf Coastal Plain; it has the advantage of also being a very large natural gas resource. The waters are not generally hot enough to be suitable for the production of electricity, but ERDA has, at present, ongoing research of geopressured geothermal resources in Louisiana for use in food processing, petrochemical industries, oil refining, and other industrial

purposes, as well as for air conditioning and space heating; we are moving along, but I think we could move a great deal more rapidly.

ERDA has projected that a significant contribution to the gas resources of the country will occur only after 1985, and estimates production will be 2 to 4 trillion cubic feet per year by the year 2000. As has been said, there are no barriers to the development of this resource at this time. In fact, private industry efforts to lease and develop the resource are underway, and the funding of these efforts from private sources looks promising. This resource will be developed by the private sector before ERDA does it, in the present prospect.

Senator GRAVEL. That is par for the course.

Dr. JONES. Yes. This has been a longwinded discourse. But even the oil companies do not understand much about the resource, so we had to talk a little about its characteristics.

Senator GRAVEL. I think in the process you have answered most of the questions that I had. This is a new discovery, as far as I am concerned, with respect to energy potential in this country, and I am glad both the Government and the private sector have focused on it and I am sure that, as soon as there is more economic interest, the State of Texas will address itself to some legislation.

I have always seen it happen. If there is a buck to be made, the laws will quickly follow.

Dr. JONES. I agree with you. At least the number of phone calls of interest that I have been getting suggest it will not be long.

There are, as I mentioned, no technological barriers—there are some institutional barriers—and, of course, a legal barrier outside of Louisiana?

Senator GRAVEL. There is no legal barrier in Louisiana?

Dr. JONES. No.

Senator GRAVEL. There already is some private, so I think the success of that will expand very rapidly.

Dr. JONES. One point that I did not make. The gas pipelines needed to develop this resource are all in the right place right now, and most of the subsurface geopressured reservoirs are crossed by existing pipelines.

Senator GRAVEL. Are not a fair amount of these pipelines underutilized?

Dr. JONES. Oh, yes, this past year they were.

Senator GRAVEL. This would fill a gap?

Dr. JONES. This would fill a gap. A careful selection must be made of reservoirs to be produced because, of course, this is a ground-water resource; the well fields will have to be designed accordingly.

Senator GRAVEL. Is there anything that we could do in the way of legislation that might add an incentive to go after this?

Dr. JONES. I think the most important thing would be to decontrol the price of gas produced in the development of the geopressured geothermal resource. If the price of gas were decontrolled, we would see a very rapid development of this gas and, if the initial gas could be used to make up the shortage of the pipeline gas, interstate.

Senator GRAVEL. Interstate?

Dr. JONES. Interstate.

Senator GRAVEL. Unregulated?

Dr. JONES. Unregulated. This would be a boon.

Senator GRAVEL. I think that is a very, very good suggestion. Maybe, since this is something new, those people who have more control in the Congress may focus on it, and we may be able to get through an obvious demonstration later if we are prepared to pay the price. We will get as much natural gas as we need.

What you are saying, you estimate 49 million cubic feet in quantity?

Dr. JONES. 49,000 trillion. An absolutely stupendous figure.

Senator GRAVEL. What is the natural reserve right now?

Dr. JONES. About 234 trillion. Proven reserves.

By the way, the Russians, in the past 2 months, have appraised the dissolved methane resource in five of their sedimentary basins. Their largest basin has 36,000 trillion in water solution. They are looking at it as an extremely important addition to their own reserves.

Another point, when I said 2 to 4 trillion cubic feet per year, I am not giving you the figure that this resource can be developed at, just giving you a figure for a reasonable target within the next 5 to 7 years. There is no reason why large advances could not be made in developing this resource within a year or two if the rigs were available and if an aggressive program of support could be given, cost underwriting or a guaranteed loan program.

There is a guaranteed loan program that only has $1.5 million in it.

Senator GRAVEL. If this were deregulated, what effect would it have?

Dr. JONES. If the price of gas were deregulated, we would not need a loan program, I believe.

Senator GRAVEL. Doctor, thank you very much. You have made an outstanding contribution.

Dr. JONES. Thank you.

[Dr. Jones' report "Natural Gas from Unconventional Geologic Sources" follows. The reports "Natural Gas Production from Geothermal Geopressured Aquifers"; "Gas in Geopressure Zones"; "Proceedings, Second United Nations Symposium on the Development and Use of Geothermal Resources"; "Geothermal Resources of the Northern Gulf of Mexico Basin"; Geothermal and Hydrocarbon Regimes, Northern Gulf of Mexico Basin" were made a part of the official committee files.]

NATURAL GAS FROM UNCONVENTIONAL GEOLOGIC SOURCES

BOARD OF MINERAL RESOURCES, COMMISSION ON NATURAL RESOURCES, NATIONAL ACADEMY OF SCIENCES, WASHINGTON, D.C. 1976, BY DR. PAUL H. JONES, DEPARTMENT OF GEOLOGY, LOUISIANA STATE UNIVERSITY, BATON ROUGE, LA.

CHAPTER 1

NATURAL GAS RESOURCES OF THE GEOPRESSURED ZONES IN THE NORTHERN GULF OF MEXICO BASIN

(By Paul H. Jones)

INTRODUCTION

The world's natural gas resources occur within or adjacent to petroliferous sedimentary basins, but most of the gas is not found associated with oil. More than 80 percent of the natural gas produced in Louisiana in 1972, and 82 percent of the reserves, were classified as nonassociated (Carleton 1974: 10–11). Methane, the principal constituent of natural gas, is a stable end-product of the thermal diagenesis of petroleum hydrocarbons in the zone of abnormally high

interstitial fluid pressure—generally known as the geopressured zone. At depths where the temperature exceeds 300° F. (150° C.) very little petroleum is found; this is the domain of natural gas (Fertl and Timko, 1972).

Wherever methane gas is associated with reservoir waters, those waters are saturated in dissolved methane. Saturated formation waters associated with the more than 8,000 producing gas reservoirs in the geopressured zone of the Gulf Coast occur in a depth range from about 9,000 to 22,000 ft. (about 3 to 7 km). The solubility of methane in water is a function of temperature, pressure, and water salinity; the methane content of formation waters in any reservoir at saturation can be estimated if data on these parameters are available (Dodson and Standing 1944: 173–179, Culberson and McKetta 1951: 223–226).

The maturation of petroleum hydrocarbons (or more properly the conversion of insoluble organic matter known as kerogen to water-soluble hydrocarbons), is primarily a temperature-controlled process (LaPlante 1974: 1288). In young, deep sedimentary basins filled primarily by noncarbonate clastic rocks (sand and clay) where the sediments are being exposed to geothermal heat for the first time, the conversion of kerogen to petroleum hydrocarbons progresses with increasing depth of burial, at a rate controlled by the geothermal gradient. At a depth where the "threshold" conversion temperature is exceeded, petroleum maturation accelerates. At some greater depth (and higher pressure and temperature) natural catalytic cracking of trapped liquid hydrocarbons begins. And at even greater depth, pressure, and temperature, all but the heaviest (tar) molecules have been converted to methane (Fertl and Timko 1972).

If the amount of hydrocarbon generated by maturation of kerogen is great enough, and if the escape of petroleum liquids is sufficiently retarded, then this natural cracking process yields sufficient methane to saturate all of the formation waters in the geopressured zone, and more. The excess methane in reservoir rocks collects in structural highs, forming the gas reservoirs commonly tapped by wells for commercial production. Most of the gas occurs in reservoirs having pressure gradients greater than 0.7 pounds per square inch per foot of depth (psi/ft) (FPC 1966 unpublished data, Meyerhoff 1968, Perry 1969).

Methane-saturated formation waters of the geopressured zone escape upward into the hydropressured zone (Stuart 1970: 2) and out of the sedimentary basin as natural compaction and consolidation of the sediments occurs. As these waters move to shallower depths and zones where the temperature is lower and the confining pressure is less, gas comes out of solution. This gas collects in reservoir rocks or escapes at outcrop.

Extensive studies of the dissolved hydrocarbons in subsurface waters in the hydropressured zone of the Gulf Coast, reported by Buckley et al. (1958), show that "the concentration of dissolved hydrocarbons in a particular formation increases with depth and increases basinward up to a certain degree" (p. 850), and that "throughout the region sampled the Frio water . . . [was] either saturated or nearly saturated with dissolved (methane) gas in nearly every well sampled" (p. 868). The bubble point of Frio water increased linearly with depth over the interval from 3,700 to 8,000 feet (1.15 to 2.5 km) and closely followed the hydrostatic pressure in the formation. No anomalous local enrichment of methane content was observed in samples taken in close proximity to Frio oil or gas fields.

More recently (1972), water from an aquifer at a depth of 3,200 ft. (1 km), pumped from an offshore water-supply well in Block 16, Grand Isle, Louisiana, was found to contain 14.1 cubic feet (cf) of methane per barrel—its saturation content at the situ pressure and temperature of the aquifer. At a pumping rate of 900 gallons per minute (gpm), this well produced some 400,000 scf/day.

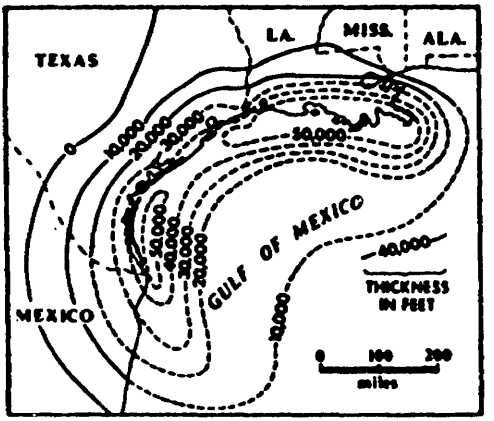
All subsurface waters below a depth of about 3,000 ft. (about 1 km) in Cenozoic deposits of the Gulf of Mexico Basin are probably saturated in methane.

Nature and Physical Dimensions of Beds Containing Source of Gas

Cenozoic deposits, mainly sand and clay of alluvial or deltaic origin, fill the Gulf Coast geosyncline (Figure 1.1) to depths greater than 50,000 feet (about 15 km) (Hardin 1962:1). Geopressure (Stuart 1970:2) occurs below depths of about 9,600 to 16,000 ft. (3 to 5 km) beneath an area greater than 150,000 mi² (388,000 km²) (Jones 1975:1), and it probably extends downward to the base of the Cenozoic deposits (Figure 3.6). Growth-faulted sand and clay bed systems, formed as prograding deltas encroached upon the northwestern margin of the Gulf, extend to depths averaging about 25,000 feet or about 8 km (Figure 1.2)

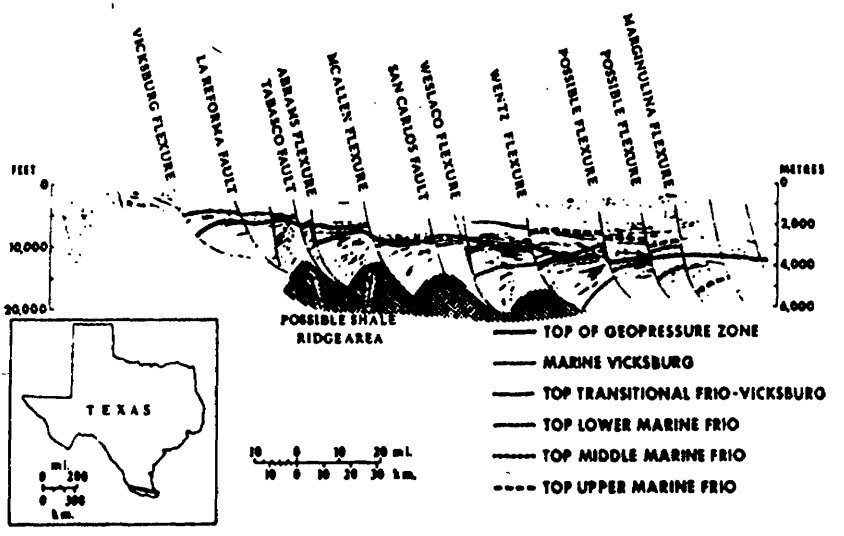
(Ocamb 1961:139, Jones 1975:32). "Stacked" sand-bed aquifers in growth-faulted blocks are the reservoirs to be tapped by wells designed to produce the hot, high pressure water and its dissolved methane.

FIGURE 1.1.—Thickness of Cenozoic Deposits in the Gulf Coast Geosyncline.



SOURCE. Hardin (1962).

FIGURE 1.2.—Relation of Growth Fault System to Occurrence of Geopressure in the Lower Rio Grande Embayment in Texas.



SOURCE. Jones (1975).

The areal extent of growth-faulted blocks (Figure 1.2) ranges from about 120 to 400 mi² (about 300 to 1,000 km²), but they may be grouped geologically into larger areas for purposes of resource assessment (USGS 1975:126). Within each block, the sand-bed reservoirs are commonly 50 to 160 ft (about 15 to 50 m) thick, and their cumulative thickness is perhaps half the total vertical thickness of the fault block. Between linear fault-block trends, in long ridges subparallel to the Gulf margin, are "whalebacks" of geopressured shale (Figure 1.2). Separat-

ing major delta fault-block systems are subembayment shale wedges which tongue landward between them, transverse to the Gulf margin. These shale deposits underlie perhaps 30 percent of the area of the geopressured system described in the previous paragraph.

Detailed mapping of "stacked" sand-bed sequences in each of the major Cenozoic deltaic systems will be necessary to enable definition of potential reservoirs for development. Sediment facies maps should be made, in addition to cumulative sand-bed thickness maps, for each major prograding delta system. These maps, together with detailed structure maps of the same units, will be necessary for well design and well-field layout. Information is readily available for the mapping, and it should be done at appropriate scale—perhaps 1 : 250,000.

Faulting of host beds may cut off sand-bed reservoirs, resulting in hydraulic barriers and reduced yield from wells. Thermal diagenesis of the clay mineral montmorillonite releases water containing large amounts of silica, and this precipitates where pressure and temperature drop. Flush of the waters of diagenesis from clay beds and the cementation and consolidation of sand beds have greatly reduced the permeability and porosity of reservoirs, especially where large amounts of high-temperature water have escaped through them—as in parts of the lower Rio Grande Embayment of Texas. Modification of permeability distribution in hoost beds by natural processes must be analyzed, and the most suitable zones for development must be identified and mapped.

EXTENT OF RESOURCE (GAS IN PLACE)

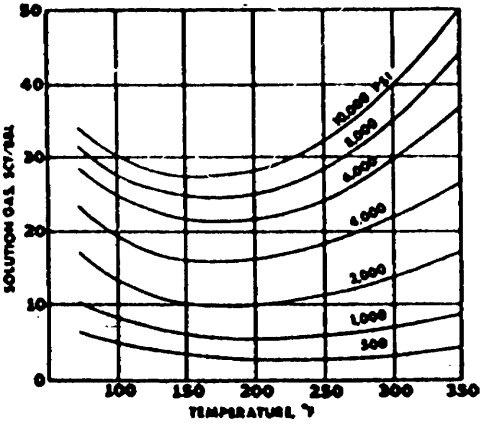
The amount of gas dissolved in geopressured zone formation waters in Cenozoic deposits of the Gulf Coast can be estimated, using the following assumptions:

1. All formation waters of the geopressured zone are saturated in methane;
2. The top of the geopressured zone can be mapped;
3. The total volume and depth distribution of sand-bed reservoirs and associated shale deposits in the geopressured zone can be calculated (areal extent and cumulative thickness);
4. The porosity of sand-bed reservoirs and associated shale deposits can be described numerically, with reference to depth below the top of the geopressure zone; and
5. The pressure, temperature, and salinity of formation waters can be described with reference to depth below the top of the geopressured zone.

These assumptions enable calculation of (1) the gas content of sand-bed formation water at selected depths, with reference to the top of the geopressured zone, and (2) estimation of the total amount of gas in solution in sand-bed formation waters. Factors involved in the calculations include the following:

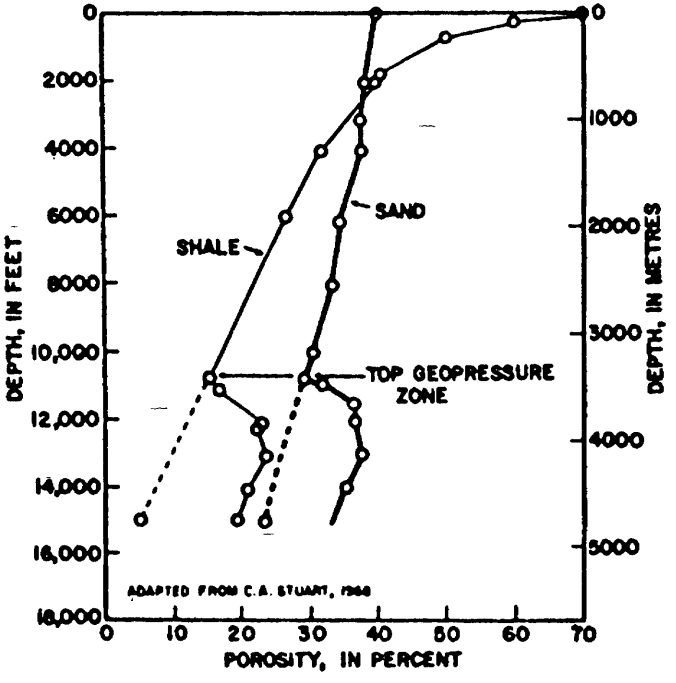
1. The methane content of fresh water at saturation, for pressures ranging up to 10,000 psi and temperatures up to 350° F. (177° C.), is described by the curves of Culberson and McKetta (1951:226), illustrated in Figure 1.3. These curves must be extrapolated to about 25,000 psi and 525° F. (273° C.) for conditions in the geopressured zone to a depth of 25,000 ft (about 8 km).
2. The depth to the top of the geopressured zone onshore has been mapped by the U.S. Geological Survey (USGS), for Cenozoic deposits of the Gulf Coast. The average depth, given for subareas identified by Popadopulos, Wallace, Wesselman, and Taylor ranges from about 6,000 to 12,700 ft (1.82 to 3.88 km) (USGS 1975:fig. 15, p. 126, and table 21, p. 128).
3. The cumulative thickness of sand beds between the top of the geopressured zone and the deepest part of each growth-faulted block in the subareas mapped by the USGS as described above has not been determined. Information on representative dip sections and a proved rationale for assignment of regional sediment facies distributions were used to develop the numbers used in making the following estimate.
4. Porosity determinations have been made and reported for many thousands of sand-bed reservoirs in the geopressured zone (in rate-case hearings of the Federal Power Commission 1962; 1966; 1972). A generalized plot of porosity at indicated depths is shown in Figure 1.4 (Stuart 1970), for sand beds and shale beds. In the following estimate, only porosity data for sand-bed reservoirs in the geopressured zone are used; Stuart's curve has been extrapolated to 25,000 ft (7.8 km), where porosity of sand beds may be expected to average about 15 percent. The decrease of porosity with increasing depth, from 37 percent at 13,000 ft to 15 percent at 25,000 ft (22 percent in 12,000 ft) amounts to 1.83 percent per 1,000 ft, or 5.85 percent per kilometer of depth.

FIGURE 1.3.—Solubility of methane in fresh water as a function of pressure and temperature.



SOURCE: Culberson and McKetta (1951).

FIGURE 1.4.—Relation of porosity to depth for sand and clay deposits in the gulf basin, in the hydropressured zone in the geopressured zone.



SOURCE: Stuart (1970).

5. Pressure and temperature gradients in the geopressured zone range widely, from area to area as well as locally; reliable estimation of the dissolved methane content of formation waters requires detailed pressure gradient maps and isothermal maps. For this purpose, regional maps of the 0.6, 0.7, 0.8, and 0.9

psi/ft isopressure surfaces will be required for each major geopressured deltaic system. The 212°F (100°C), 250°F (120°C), 302°F (150°C), 356°F (180°C), 392°F (200°C), 428°F (220°C), and 482°F (250°C) isotherm maps will also be needed for each such system. Formation water salinity must be mapped wherever it exceeds about 20,000 mg/l because methane solubility decreases appreciably as dissolved solids increase (Dodson and Standing 1944: 173).

Although the pressure, temperature, and water salinity maps described above are not available at this time, reasonable generalizations of them can be made using available maps and knowledge of gradients and regional trends (Jones 1975: figs. 18–21, 24, 25, 32, 34–40, 45, 47–49). Popadopulos et al. (USGS 1975: fig. 15 and table 21) estimate the total reservoir thickness of the geopressured zone onshore to be 9,840 to 13,120 feet (3 to 4 km), sandbed porosity to range from 18 to 21 percent, and shale-bed porosity to range from 9 to 12 percent. They estimate the total amount of methane in water solution in these sediments to be 236.18 x 10^{14} cubic feet, or 669.3 x 10^{12} cubic meters (USGS 1975: 132, table 24).

This figure, 236.18 x 10^{14} cf, or 23,618 Tcf of methane in formation water solution, is a conservative estimate for the onshore area of the geopressured zone in Cenozoic deposits of the Gulf Coast. The thickness of the zone for development is probably 13,120 to 19,680 ft (4 to 6 km) rather than 9,840 to 13,120 ft (3 to 4 km); and the average porosity of sand beds is probably close to 25 percent, rather than 18 to 21 percent. But only about 50 percent of the area is underlain by deltaic or delta-front deposits which contain sand beds that would serve to drain the shales.

The calculation in Table 1.1 of the methane dissolved in sand-bed formation waters beneath one square mile of Subarea DT–2 (USGS 1975: fig. 15, p. 126) illustrates the method used in making the estimate given in this paper. Extrapolation of the gas saturation curves of Culberson and McKetta (1951: 4) may be open to question, as no experimental data are available to support it; and the effects of water salinity on methane solubility at high temperature and pressure are unknown. The temperature and pressure gradients in Subarea DT–2 can be closely approximated, however, and the calculated methane contents are believed reasonable.

TABLE 1.1.—Methane dissolved in sandbed formation waters.

Depth	∆P	Pressure[1]	Temperature	Gas in Solution[2]	Sandbed Porosity[3]	Cumulative Thickness of Sand	Volume of Water	Water	Gas in Solution
ft x 10^3	psi/ft	psi x 10^3	°F	scf/bbl	Percent	ft	ft^3 x 10^6	bbl/mi^2 x 10^6	scf/mi^2 x 10^{10}
8	0.55	4.4	194	10.0	?	--	--	--	--
9	0.60	5.4	199	20.0	27.0	200	1,505	268	0.537
10	0.70	7.0	212	22.7	30.0	300	2,509	448	1.061
11	0.75	8.2	237	27.9	32.5	400	3,724	667	1.835
12	0.80	9.6	261	32.1	34.0	500	4,739	846	2.716
13	0.85	11.0	285	39.0	36.96	600	6,182	1,103	4.305
14	0.90	12.6	307	46.8	35.13	600	5,876	1,049	4.910
15	0.92	13.8	331	55.0	33.30	600	5,570	994	5.470
16	0.93	15.2	354	64.0	31.47	600	4,386	783	5.013
17	0.95	16.1	378	73.0	29.64	600	3,305	592	4.308
18	0.96	17.2	397	82.0	27.71	300	2,317	413	3.388
19	0.97	18.4	414	92.0	25.98	400	2,897	517	4.759
20	0.97	19.4	434	103.0	24.15	500	3,366	601	6.191
21	0.97	20.3	450	114.0	22.32	500	3,111	555	6.332
22	0.97	21.3	466	125.0	20.49	400	2,286	408	5.100
23	0.98	22.5	480	137.0	18.66	300	1,568	279	3.817
24	0.98	23.5	500	150.0	16.83	200	938	137	2.513
25	0.98	24.5	520	164.0	15.0	100	418	74	1.224
									63.455

[1] Ferti and Timko (1972).
[2] Culberson and McKetta (1951) curves extrapolated by Jones (this volume).
[3] Stuart (1970).

According to these calculations, the amount of methane dissolved in sand-bed formation waters of the geopressured zone beneath each square mile of Subarea DT–2, above a depth of 25,000 feet, is 634 billion cubic feet (Bcf). The total area of Subarea DT–2 is 5,155 km^2, or 1,902.95 mi^2. The dissolved gas resource of this subarea is estimated to be about 1,200 Tcf. About 70 percent of the onshore geopressure zone in Cenozoic deposits of the Gulf Coast is believed to be underlain by deltaic and/or delta-front sandbed systems, and perhaps 30 percent of

the area of these systems is underlain by high-pressure shale ridges subparallel to the Gulf shoreline (Bruce 1973: 879). The onshore area underlain by sand-bed systems in which the dissolved methane resource occurs is therefore about half of the 145,265 km² (53,624 mi²) of the onshore geopressure zone, or about 26,812 mi². The onshore resource is, on this basis, about 17,100 Tcf of dissolved methane. If conditions onshore are comparable, sand-bed systems underlie about 50,000 mi², and the dissolved methane in them amounts to some 31,900 Tcf. The total estimated dissolved methane resource in Cenozoic geopressured sand-bed systems of the northern Gulf of Mexico basin is, on this basis, about 49,000 Tcf. A comparable volume of methane-saturated water is present in the associated geopressured shales, an appreciable part of which might migrate into pressure-depleted sand-bed reservoirs as production occurs. Pehaps 100,000 Tcf of dissolved methane is pesent in Cenozoic deposits of the geopressure zone in the northern Gulf of Mexico basin.

Additional critical data needed to establish the extent of the resource include:

1. Dissolved methane gas content, as well as temperature, pressure, and dissolved solids of formation waters of the geopressured zone; sand and clay bed texture, porosity, and permeability determinations; geologic studies of the sediments; and hydraulic test data for aquifer systems, to enable calculation of production characteristics of reservoirs.
2. Detailed maps of sediment facies, isothermal surfaces, pressure gradients, and salinity of formation waters, with respect to depth and sediment facies distribution.
3. Representative information on sediment facies and mineralogy, geologic structure, temperature, pressure, and formation water dissolved solids and gases sufficient for processing into computer data banks; and a mathematical model of the basin adequate to define its structural, hydrologic, geothermal, and hydrochemical evolution.

No serious geologic uncertainties need be overcome to create recoverable reserves from this resource base.

RECOVERY

Recoverable reserves of dissolved methane from the geopressured zone of the northern Gulf of Mexico basin are believed to exceed 258.2 Tcf, the proved domestic natural gas reserves as of Dec. 31, 1970, reported in 1973 in the publication National Gas Reserves Study (FPC 1973). They could very well exceed 1,146 Tcf, the potential U.S. natural gas supply estimated in 1972 by the Potential Gas Committee (FPC 1975: 218, Table 9–2). The "dissolved-in-water" source was not included in either estimate.

This estimate of recoverable gas dissolved in geopressure zone formation water is based upon a development concept involving the installation of thousands of large-capacity wells flowing hot, gas-saturated water through turbines and gas separators.

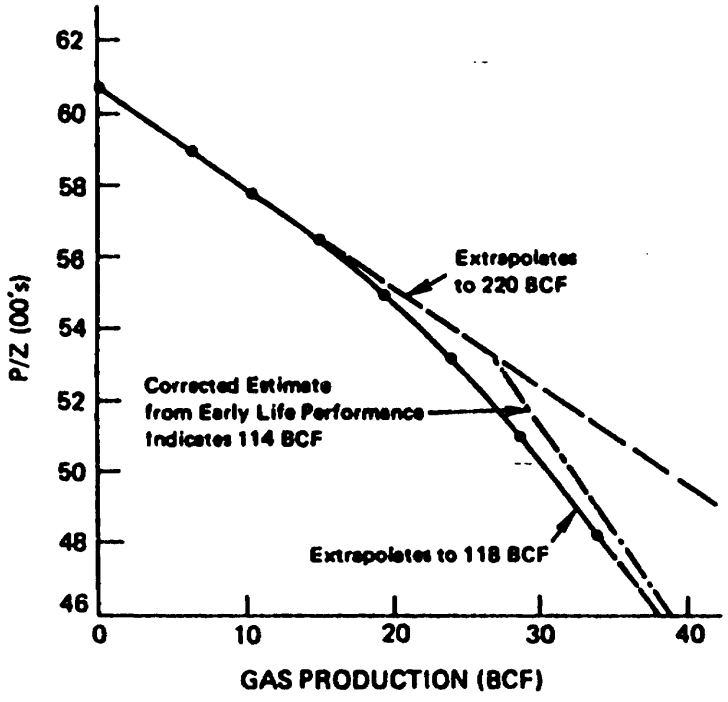
All geopressured gas reservoirs now in production derive much of their gas from this "dissolved-in-water" source (Figure 1.5); exsolution of methane from associated formation waters occurs with gas production and resulting reservoir pressure decline; exsolved gas moves to the gas cap. No water wells have yet tapped the geopressured zone, but wells pumping gas-saturated aquifer waters from the overlying hydropressured zone produce gas. Production technology is well advanced, but as yet unproved; it could probably be proved in less than one year.

Ultimate volumes and flow characteristics of a single project that might be carried out are limited only by water well production rates. A reasonable facility might include 20 water wells, each flowing 50,000 barrels per day (bpd) at 30 cf/bbl, producing 30 million cf/day of methane. Installations ten times this size are believed possible in some areas.

A project of 20 wells could be on stream in less than 2 years; if in a "crash program", in less than 1 year.

Gas can be recovered from this source through several different developmental schemes. Multiple-use systems, in which geothermal energy, hydropressure energy, and natural gas are derived simultaneously from wells, appear to be most attractive economically. Technology is sufficiently advanced on all aspects of such developments to make them possible now, but no field projects have yet been undertaken. They are, however, in the planning stage, and field demonstration should occur within a year or two under present schedules.

FIGURE 1.5.—P/Z Versus Cumulative Production, North Ossun Field, Lafayette Parish, Louisiana, NS2B Reservoir.



SOURCE. Hammerlindl (1971).

Production records for many geopressured gas reservoirs show two distinct slopes in the plot of shut-in pressure vs. cumulative production (P/Z plot), used to predict reserves (Hammerlindl 1971: 7).

This conclusion leads to an interesting and important concept with regard to the development of the dissolved-in-water gas resource of the geopressured zone. It could increase enormously the recoverability of natural gas from this source. It is as follows:

> Withdrawal of formation water at large rates by multiple-well systems tapping large geopressured reservoirs will lower fluid pressure over broad areas. As reservoir pressure declines, dissolved gas throughout the reservoir will be released from solution; this gas, when its volume exceeds 4 or 5 percent of the pore volume of the reservoir, will collect and move to structural highs in the reservoir, forming gas caps. When these gas caps have grown to sufficient size, they can be tapped by gas wells and produced in the same way as some 8,000 gas reservoirs now in production. In effect, water production to obtain dissolved gas simply speeds up the natural process of pressure decline that has resulted in the known gas reservoirs.
>
> Such artificially-formed gas caps can be found by seismic survey, first by locating the structural highs, and then by observing gas cap formation as re-surveys detect it, by growth of a "bright spot" or "bright zone" in the record.

No serious technological problems need to be overcome to create recoverable reserves from this resource base.

ECONOMIC AND INSTITUTIONAL CONSIDERATIONS

A. The economics of a typical project to secure gas from this source are unproved, but conceptual studies by Wilson et al. (1974) and House et al. (1975) indicate that economical development projects are possible under 1975 market conditions. The gas is so pure that it can be converted to commercial grade methanol or marketed directly; it is the same gas that is produced (non-associated) from some 8,000 geopressured gas reservoirs in the Gulf area.

B. Capital and basic goods and service requirements necessary to make this an important source of gas are essentially "on the shelf"; some modifications of technique in drilling and completing wells in the geopressure zone, already pioneered, will be necessary; and specialized above-ground equipment designed to handle the fluids in new ways, already well along in conceptual and engineering aspects, will be needed. Expending comparable effort in exploration and production of gas from conventional sources could not produce comparable results, in terms of gas production, under the most favorable circumstances.

C. Legal, institutional, and environmental problems associated with exploitation of this resource have already received considerable attention in connection with geopressured geothermal resources research since the production effects are identical. The principal legal problem relates to ownership of the gas dissolved in formation waters: Does the mineral lease include it, or is it a part of the ground water (which must be produced for its recovery) and thus governed by ground-water law? Institutional problems are largely those of governmental regulation (federal, state, or local) and the determination of which agency or agencies have prior authority in this matter. Environmental problems relate to disposal of saline water produced to obtain the gas, and land subsidence that may result from the large-scale withdrawal of formation water. These problems are not unique to this resource development, and have already received adequate study for effective management policy decisions.

D. Multiple use of fluids produced inn the gas production strategy have received sufficient study for feasibility evaluation (Wilson et al. 1974, House et al. 1975), even though gas recovery alone may not be economic under 1975 market conditions.

E. The energy balance between the total energy required in a project to explore, develop, and produce gas from this source, compared to the energy of gas ultimately recovered from the project, is highly favorable indeed. This is because the exploration effort has already been largely accomplished by the oil and gas industry; development technology has been perfected, and equipment required has been fabricated by the oil and gas industry and the water well industry; and because the production technology and equipment already exist or are well advanced. The energy resulting is in the most desirable form; it can be converted to methanol at the well head, used to produce electric power at the well head, or shipped by pipeline to users through an existing and highly effective distribution system.

ASSESSMENT OF POTENTIAL OF THE SOURCE

The key decision required for development of this source is the choice of location of the first project installation. Government can fund and make available government lands for such development, under a favorable lease and cost-sharing arrangement. Industry (the oil and gas industry, a major utility, or a major power user such as Dow Chemical, USA) could contribute all of the management and operational requirement. The project could be entirely done under contract.

Key differences in judgment covering the quantity of resources or reserves relate to: (1) percent saturation of formation waters in methane; (2) recoverability of formation waters for extraction of dissolved methane; and (3) abundance of aquifers in the geopressured zone, suitable for development by production wells. Key differences regarding the state of recovery technology relate mainly to methods of well construction and well field design, and to reservoir permeability. Continuous rock cores for intensive laboratory study, and a series of production tests using carefully designed well fields, are needed to narrow the range of judgment.

The upper limit of contribution, in annual volume, from this source of gas cannot be estimated with confidence at this time, but it should be at least 1.5 Tcf/yr, or about 5 percent of the total U.S. requirement of 28 Tcf forecast for 1975, made by the Denver Research Institute (University of Denver 1973)

cited in Table 7-1, p. 184, v. 1, Federal Power Commission Report, National Gas Survey, 1975. This estimate is based upon 1,000 wells each producing 4 million gpd of water containing 1 cf/gal. or 4 Bcf/day. It is possible that this source might ultimately produce ten times this amount, mainly from the Outer Continental Shelf—perhaps half the total U.S. annual natural gas requirement.

This source could contribute very significantly to the U.S. gas supply in the immediate future (2 to 5 years), perhaps 2 percent of the U.S. requirement within 4 years.

The contribution of gas from this source could be half the U.S. annual requirement in 10 years, and perhaps 80 percent of the annual requirement in 25 years.

The methane dissolved in formation waters of the geopressured zone is by far the largest, most readily accesible, and least expensive alternative source of natural gas in the United States.

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Senator GRAVEL. We will stand in recess until tomorrow at 9:30.

(Thereupon, at 3:05 p.m., the hearing in the above-entitled matter recessed to reconvene at 9:30 a.m. Tuesday, June 21, 1977.)

INCENTIVES FOR DEVELOPING NEW ENERGY SOURCES

TUESDAY, JUNE 21, 1977

U.S. SENATE,
SUBCOMMITTEE ON ENERGY AND FOUNDATIONS OF THE
COMMITTEE ON FINANCE,
Washington, D.C.

The subcommittee met, pursuant to recess, at 9:35 a.m. in room 2221, Dirksen Senate Office Building, Hon. Mike Gravel, chairman, presiding.

Present: Senators Long, Gravel, and Bentsen.

Senator GRAVEL. The hearings will come to order.

Today is the continuation of the energy hearings that we initiated yesterday and our first witness is the distinguished Governor from the State of Louisiana, the home State of our chairman of the full committee, Gov. Edwin Edwards. We are happy to have you here.

Senator Long?

Senator LONG. Mr. Chairman, I am very proud to have our Governor with us today. I have read his statement regarding the energy problem. There is something that is in very scarce supply in Washington, and that is commonsense. The Governor has a view about energy, both its production and its conservation, which I believe can be very helpful to this committee. We are very proud of him in Louisiana.

We have not only an exceedingly able administrator, we also have one of the best-looking, best-dressed Governors with the best sense of humor.

You have a lot going for you, and we are fortunate to have you as a witness.

Senator GRAVEL. Having served briefly with his wife, he also has one of the best-looking wives.

With all of these plaudits, it will be hard to follow.

STATEMENT OF HON. EDWIN EDWARDS, GOVERNOR OF THE STATE OF LOUISIANA

Governor EDWARDS. Thank you very much for your generous comments, and, Senator Gravel, may I say I compliment your State for its contributions to our energy problems and say if the States between Alaska and Louisiana were as willing and able and anxious to contribute to the problem, we would not have to have these kinds of hearings.

Louisiana furnishes 44 percent of the interstate supply of natural gas, more than the aggregate contribution of Texas, Oklahoma, and

New Mexico, and 90 percent of this Nation's offshore development of oil and natural gas comes from offshore Louisiana; and 75 percent of the natural gas shipped in interstate commerce.

I suggest that this makes us qualified to speak on the subject and also gives us a front row seat in trying to develop some national policy.

I have a formal statement which I have presented to the clerk of the committee which I will ask be filed and I will just add to it extemporaneously.

May I supplement this statement by saying that the bottom line, as far as I am concerned, is national Government is overlooking a very important American principle, and that is the free enterprise system.

I would like to suggest again, as I have done many times, that the way the Government can best approach this problem is getting out of the business of regulation and involving itself in the production, supply, and pricing of oil and gas and allow the free market to work its way. That is not the opinion alone of the conventional Governor of an oil and gas producing State. It represents the opinion of most every national economist, most of the trade journals, most of the national publications and newspapers such as the Washington Post and the editorial policy of the New York Times and everyone who has studied this problem except for a few economists who are in the employ of the administration.

I suggest to the Senator from Alaska that many projections and studies have been made about how much oil and gas is in place, not just discovered, in the world and in this country. All of these projections have proven to be woefully short, or off the mark. No one really knows how much oil and gas is in America, or the world. Pricing mechanisms and new techniques will affect dramatically any such projections.

In 1923, a renowned group of scientists, engineers, and geologists predicted that the reserves of oil in this country would equate to 9 billion barrels. That, Mr. Chairman, is exactly the proven reserves now at Prudhoe Bay. It shows how woefully inaccurate these predictions are.

I suggest to this Congress that the only way to really determine how much oil and gas is available for American consumers from our own production is to allow the free market and the American oil and gas companies to have the men, technology, and equipment to produce oil and gas where it can be found to be able to do so.

Comparisons have been made about the projected $10.6 billion budget for the Department of Energy which will represent its first year of operation. By history, we know that if that is the first year's budget, it is going to be more the second, third, fourth, fifth, and ensuing years.

It has been pointed out that the Federal Government could give a $3 subsidy for every barrel of oil produced in this country at a cheaper price than funding the budget for the Department of Energy. I am satisfied that it would have a far more salutory effect in resolving this problem.

In conclusion, I suggest that the administration's program offers no incentives whatsoever to those who know something about the production and transportation of oil and gas. It offers no planned program for the development of areas, particularly the Atlantic seaboard, Lake

Erie, and other parts of the country under the Federal domain. It offers no indication at all of a concerted effort to get production in these areas.

Since the Secretary of Interior has been Secretary, he has acquiesced in or a part of canceling three different proposed leases or lease sales in areas that are highly susceptible for production of oil and gas. In one of the great hypocritical statements of the decade, in 1 week he canceled two leases that were held by companies offshore Louisiana because he said they were not producing them fast enough and at the same time canceled a proposed lease sale in another part of the country stating in one instance he wanted to maximize the production of oil and gas as much as possible. He gave you no reason whatsoever for not even holding the sales in the other areas.

It is typical of the tunnel vision of this administration in wanting the traditional oil and gas States to continue producing at whatever environmental risks and consequences we would have to incur and selling our resources at regulated prices to the Nation while the rest of the Nation fails to respond for its opportunity to produce oil and gas.

I would like to see the Congress of the United States adopt a firm policy that we are going to return to the free enterprise system in the production and transportation and pricing of all natural resources, but recognizing that the attitude of the national media and the hysteria that pervades the country as to what would and would not happen if that occurred, and recognizing that these Americans seem to have forgotten what brought us to the greatness that we now have in this Nation.

I know that this Congress is probably going to adopt some rules or programs relative to this. I therefore suggest that at least the Congress take the position, if a company or individual is courageous enough to spend its or their money in the development of new reserves that that person or that firm sell those reserves or develop them at the market prices. That is the least we can do to encourage development of additional reserves and stimulate oil and gas in this Nation and move us in the direction of independence from depending on foreign sources for huge quantities of our Nation's energy resources.

Thank you.

Senator GRAVEL. What will be the effect on the tax revenues with respect to the President's energy program, particularly the wellhead tax and the regulation of intrastate oil and gas?

Governor EDWARDS. It would not have any effect. We are based on a volume tax. We get 7 cents a thousand cubic feet, whether it brings 18 cents or 50 cents or $2.

Senator GRAVEL. I wish the State of Alaska had that kind of setup. Ours is dependent upon the price.

Governor EDWARDS. The State of Alaska should do that. The States who have coal—Montana, for instance, has a 30-percent severance tax on the value of coal. It has gone up 10 times in the last 4 years when it recognized that coal was going to become very significant in the energy production in our country.

Senator GRAVEL. You said that your tax is based, on volume, regardless of price.

Governor EDWARDS. That is correct. I might say also, as the chairman knows, we in Louisiana are willing to pay the fair market value for gas. It is now commanding a price of $1.50 to $2 a thousand cubic feet as compared to regulated prices which are now averaging less than 50 cents a thousand cubic feet.

In other words, we are willing to pay the fair value.

Senator GRAVEL. Could you state that again? Intrastate is what price?

Governor EDWARDS. It goes now, depending on the location and the extent of the reserve, from $1.50 to $2 a thousand cubic feet. I might say we could sell volumes more if we had it available at that price.

Senator GRAVEL. And the interstate price control is what, coming out of Louisiana.

Governor EDWARDS. The highest control price coming out of 25 pipelines that transfers out-of-State is 52 cents a thousand cubic feet, except for some emergency gas that was sold in the last emergency that went at $1.42.

Senator GRAVEL. The people of Louisiana are paying $1.50 more for gas than people buying gas from Louisiana?

Governor EDWARDS. That is right. We have a unique distinction of the second reconstruction. One can purchase gas in New York coming through interstate lines from Louisiana after paying a nickel a thousand cubic feet per hundred miles to transport it cheaper than he can buy gas a mile and a half from the source of the production because of the fact that we are paying unregulated, but realistic, prices for the gas and the Federal Power Commission is regulating the interstate tax at unrealistic prices.

Senator GRAVEL. I might underscore something here. This strikes me as the same situation in our State. I do not understand how we in political office sustain ourselves in office while offering, or proposing, deregulation when in fact our people—particularly your people more so than mine—are paying more under deregulation than they would otherwise. But that is still a viable concept among the electorate. We do not have enough faith in the national electorate to understand finance.

Governor EDWARDS. That is true. We are not sending any more gas out of the State. Those in other parts of the Nation that want to use it will have to get realistic and pay realistic prices for it. As I told the Governor of Pennsylvania, if the Congress passed a law forcing Hershey Chocolate Co. to sell candy bars at a nickel a bar, there would be no more candy bars, and there will not be any more 40-cent gas being shipped out of the State of Louisiana.

Senator GRAVEL. Maybe we should make people in Pennsylvania pay 25 cents for a Hershey bar and the people around the country pay a nickel.

Governor EDWARDS. That is a classic example of the reversed logic of the whole situation. We are producing, taking the environmental risk. We have the problems. They sit on huge supplies of oil and natural gas off the Atlantic seaboard. Lake Erie, for instance, to mention one interior area refusing to develop it because of some insane idea that it will disturb the fish and want us to continue developing our own resources and bleeding them and sell the produced resources for one-third of their value.

Senator GRAVEL. Let me underscore those figures again. Interstate gas coming out of Louisiana is 50 cents?

Governor EDWARDS. It is closer to 30 cents. The highest price for regulation from the Federal Power Commission is 52 cents.

Senator GRAVEL. From 30 cents to 52 cents while intrastate gas is selling——

Governor EDWARDS. Is $1.50 to $2.

Senator GRAVEL. Thank you very much.

Governor EDWARDS. Let me show you how unrealistic the situation is. The State of Louisiana, not the citizens, but the State as a government, owns gas reserves which are being produced at 9 cents a thousand cubic feet because of the Federal Power Commission price regulations that are 20 years old, we are unable to do anything about it.

Senator GRAVEL. It is not the oil companies, it is the people in Louisiana who are being disenfranchised from a proper legacy or proper return on this 9-cent gas which could be about $1.50 in the interstate market if it were unregulated. It is not the oil companies that are being deprived of these revenues. It is all the citizens of Louisiana who are certainly being hurt by this Federal policy.

Governor EDWARDS. Certainly my State owes 100,000 barrels of oil production a day that sold for $5.35—this is crude worth $15 in the open market. This Government would subsidize oil companies that purchased oil from the OPEC nation, forcing our State to sell its oil for one-third of its price.

The greatest tragedy of all is that that policy is depriving the American people of the hope, the possibility, of becoming self-sufficient in the production of energy. Ultimately, we will run out.

Senator GRAVEL. Yesterday we had testimony from a professor from your university. He indicated that there is a possibility of 49,000 or 50,000 trillion cubic feet of gas in the waters underlying Louisiana and part of Texas that will not be touched unless there is a proper price to go after it. There is more gas than the Nation could use for a number of years.

Governor EDWARDS. That is right, Senator. Every time we talk like that, people on the east coast and California talk about how parochial we are. They do not talk about how parochial they are in insisting the Federal Government cannot develop reserves on the Atlantic seaboard, nor does California talk about how parochial it is when it announces publicly that it would not provide for the discharge of oil coming out of your State or that it will not permit the Government to build a pipeline across California to the East where the demand and need for the crude is.

Senator GRAVEL. When you talk about the transportation of oil across Alaska, I have heard time and time again what a great surplus we are going to have on the west coast. If a pipeline is permitted from the west coast, it will have the capacity to move 1 million barrels a day from the west coast to Texas, which would mean the west coast would have a deficit surplus of some 400,000 barrels minimum a day.

The perception is that it is all the fault of industry. Of course, the Government is not culpable for these kinds of delays.

Governor EDWARDS. The only people being blamed by some elements of Congress for the shortage, those who have been using the cheap oil

and gas all these years all of a sudden are blaming us and saying they are not responsible for today's condition.

Senator GRAVEL. Senator Long?

Senator LONG. Another point that has not been discussed, which you touched on, I would like to develop in a somewhat different manner. When the Government erects many disincentives for energy production, we should not be surprised when we do not see the production that we would like to have.

Let us look at one simple thing that we have to contend with. If a man——

Governor EDWARDS. If I may interrupt you on that point, 3 weeks ago I got a letter from a drilling company. We had issued 13 permits. They had acquired $10 million. They said, take back your permits, we are not going to drill the wells, we are not going to spend $10 million to drill 13 holes.

That is a classic example of the counterproductive effort of this administration. The disincentives far outweigh the incentives.

Senator LONG. Let us explore for a moment the situation that exists with regard to State leases. There are many of them in Louisiana, about one-third of them in navigable waters of one sort or the other. After a company has drilled down to, say 5,000 feet into a salt dome structure, about the best place to look to find more energy would be to drill on that some structure below the 5,000 foot level. Does that not figure?

Governor EDWARDS. That is the geologic principle that is used in the development of oil fields.

Senator LONG. One of the best places to drill, in the same area and in the same geologic structure, is deeper in the same structure. And is it not true that most of the oil in Louisiana is found in salt dome structures?

Governor EDWARDS. That is true.

Senator LONG. Let us suppose that someone has drilled a well down 5,000 feet. He may find producing areas as low as 20,000 feet, but as long as the Federal Government maintains the fiasco of price controls which prevent the sale of that oil or gas for what he deems to be the fair market price, does he not have a disincentive to drill deeper and find oil or gas when it would be classified a "old oil" or "old gas"?

Governor EDWARDS. Absolutely.

To carry that further, they are proposing, and have proposed, that a well drilled within 2½ miles of where an existing well is, is not new oil. Horizontal distance of the surface of the Earth has nothing to do with whether it is from the same reservoir. One may drill a well half a mile from an existing well over a fault and tap an entirely new reserve. Or, to the contrary, you might go 10 miles down one reserve of oil and tap from the same reserve. It depends on the geologic formation 15,000 feet below the surface of the Earth.

Whoever made that 2½ mile proposal, or 5 mile proposal, has no knowledge whatsoever of existing or new production as compared to old production.

Senator LONG. Is it not true that practically all existing leases, certainly all old ones, provide that as long as a leaseholder is producing

minerals in commercial quantities from that structure, he can maintain his lease?

Governor EDWARDS. That is right.

Senator LONG. A leaseholder is in a position to maintain his lease and to prolong the period of its energy production, but he may forego potential energy production because of the fiasco of price controls that has been plaguing this Government for so long.

I believe that Federal mineral leases read about the same as the State leases. I think they are patterned after Louisiana leases, are they not?

Governor EDWARDS. That is correct.

Senator LONG. Until we offer the economic incentives to go out and produce additional energy, no one will know how much energy could be produced.

Governor EDWARDS. That is exactly the bottom line. No one knows how much oil and gas is in this country until we say to the American oil and gas companies, you go out there and find it and you can sell it for a fair price in a free and competitive market. That is the best way to determine whether we have any supplies left in this country to be discovered.

Senator LONG. Furthermore, the Secretary of Interior and environmentalists who have associated themselves with him are still struggling with the theory that a producer out there might, to some degree, pollute the water around an offshore rig.

My understanding is that about 2 percent of the oil pollution of the sea has occurred from oil rigs, blowouts and spills. Over 10 times that amount, about 23 percent, has occurred from waste, spillage, and accidents within the shipping industry. Ten times as much pollution comes from shipping.

Those two sources together would account for almost 30 percent of the pollution oil in the ocean. The other 70 percent, as I understand it, is accounted for by the ordinary, everyday usage that occurs in the country itself. For example, some fellow empties out a crankcase of oil and empties it into the sewer and the oil flows on down the river and finds its way to sea. In other cases automobiles driving down the highway drip oil out of the crankcase, a drop here and a drop there. All those drops after awhile amount to a black streak down the highway, and the oil later washes out to sea.

Practically nothing is being done about the 98 percent of the sea's oil pollution. Do you know of anything substantial that is being done about the 70 percent of the oil pollution that finds its way to the sea because some drops from an automobile, a tractor, a truck, or a railroad engine?

Governor EDWARDS. Nothing at all.

Senator LONG. People are choking on a gnat, but are swallowing a camel by refusing to do anything about the major problem. I was told the other day that a proposed regulation for drilling out in the Atlantic would require that the water discharged into the Atlantic be cleaner than the water taken out of the Atlantic.

Can you see any sense in that?

Governor EDWARDS. Not at all. I see no sense in much of what is being proposed and talked about.

We had one spill at Santa Barbara that created a problem for the coastline. All of the other spills occurred offshore Louisiana. We have not had any adverse circumstances.

Senator LONG. 120,000 wells have been drilled in Louisiana.

Governor EDWARDS. Ninety-five percent of all the wells drilled in this country.

Senator LONG. In the learning stages of the oil and gas industry there were not as many precautions as are taken today. It is my impression that 10 times as much precaution is taken now as there were in the early days.

Governor EDWARDS. A hundred times better technology.

Senator LONG. Even without all of that, there is no indication of any permanent damage to the ecology.

Governor EDWARDS. None whatsoever. Our take from oysters, shrimp, and fisheries have increased on a steady line for the past four decades.

When you want to fish in the Gulf of Mexico, the place to go is near a rig because the rig constitutes a manmade reef that attracts sport fish.

We do not have any adverse consequences from it in the Gulf of Mexico. The national news media has the average person in New England, of course, believing that an offshore rig is a spewing, dirty, ugly apparatus that has to be circumvented by swimmers. That is not true.

The place for development there is 60 miles from the coastline. You cannot see an oil and gas rig from the top of the Empire State Building on a clear day—if they had a clear day to look out in the ocean.

Senator LONG. Meanwhile, the Federal Government has a problem with the Continental Shelf. The revenues from Federal property are not shared with States adjacent to offshore mineral production.

The one reason why Louisiana pioneered in developing the Continental Shelf is that it hoped to make some money out of it, and it did. The Federal Government fives it so that the States get no share of the revenue generated off their shores.

So far, no program has been worked out to compensate the States for the damage to their highways and the burden on their schools and their public services for supporting the offshore oil industry there, is that correct?

Governor EDWARDS. That is true. Not only that, we are not even afforded the opportunity of taking any part of the crude oil and gas coming onshore from offshore development for our own uses.

In other words, it just goes through Louisiana like a steam locomotive, through pipelines. We never get an opportunity to use any of it.

Senator LONG. The possibilities for the States or local governments to make a profit from the production of oil and gas off their shores do not exist. Can one then be surprised that when someone tries to drill out in the Atlantic, they are met with environmental lawsuits by local governing bodies and States designed to tie them up in court?

Recognizing the fact that offshore production will be a burden on the economy of those States and local governing bodies, can one be surprised that the coastal States of the Atlantic all take the view that they should not encourage offshore production?

Governor EDWARDS. Subtly and unexpressed—I do not have any proof of this—I think those people out there are resisting, waiting for the date when the Federal Government will agree to share with the Coastal States. They think as long as they are not getting any share, they would rather leave it out under the ocean, because they assume sooner or later that the National Government will adopt a policy of sharing.

When we run out of ours and there is no more to produce off the Gulf of Mexico, then it will be a national policy to share it with Coastal States as a matter of fairness and equity.

Senator LONG. Thank you very much.

Senator GRAVEL. Thank you very much.

Governor EDWARDS. Thank you very much. See you soon.

[The prepared statement of Governor Edwards follows:]

STATEMENT OF EDWIN W. EDWARDS, GOVERNOR, STATE OF LOUISIANA

Mr. Chairman and members of the Committee, I would first like to express my appreciation for the invitation to speak to your committee relative to the question of incentives for new energy production, currently under consideration before this Subcommittee.

Without regard to its relative size and population, Louisiana's contribution to the nation's energy needs is unparalleled. We produce approximately one fourth of all the oil and natural gas produced in the United States. From this production, we furnish approximately 44 percent of the interstate supply of natural gas, more than the aggregate contribution of the states of Texas, Oklahoma and New Mexico all at a fraction of the cost paid by Louisiana's consumers for their own indigenous resource. This results in Louisiana exporting approximately 75 percent of the natural gas produced in the state. Over 90 percent of this nation's offshore oil and natural gas production and experience occurs off Louisiana's coastal reaches, with virtually all of that production being landed on Louisiana's shore. I doubt seriously that one could find anywhere in the world a higher concentration of activities dealing with the production, gathering, and transportation of oil, refined products and natural gas. This same level of concentration and contribution holds true for refining and petrochemical production.

Given the Louisiana experience, one might reasonably assume that the State and its people have achieved great wealth thereby. Nothing could be further from the truth. Louisiana suffers one of the lowest per capita incomes in the nation and like many other states is struggling to maintain traditional public services to its people. Therefore, I make absolutely no apology for Louisiana's contribution to the nation's energy requirements, for none is in order. By the same token, it is not my intention to boast or promote the state of Louisiana. The point is, however, that the people of my state and I, are growing increasingly weary of the attitudes of some segments of our society that petulantly insist upon more of a kind of activity from my state and people than they are willing to demand of themselves, and all upon terms and conditions they unilaterally deem appropriate. To do so is neither reasonable nor fair. When I or my people complain, the response of our detractors is to the effect that we are acting "selfishly" or "provincially" and thus the polarization escalates.

We just passed through a terribly difficult winter as a nation. The unavailability of natural gas, to some regions of the country led to massive unemployment, a concomitant loss in national production, a slowing of economic recovery and upward pressure upon the currently unacceptable rate of inflation. Throughout the winter natural gas producers, and intrastate pipelines and officials in the principal producing states did everything in their power to locate and make available to the distressed every parcel of surplus natural gas they could find, which we like to feel helped to mitigate the consequences of the shortage. Evidence of the success of these activities can be noted in the fact that FPC chairman, Richard Dunham, who designated the Emergency Natural Gas Act, in order to fulfill the purposes and goals of that legislation, did not have to invoke the operative provisions of that act, mandating conduct or activity on the part

of any producer, pipeline, local distribution company or state official. The legislation suspended the legal impediments to such activities and made it possible for the participants to partially fill the void or deficit, thereby preventing any curtailment of the high priority users the legislation was designed to assist.

Although the crisis experienced had been predicted by many for years and was inevitable, cries of "withholding" and accusations of nefarious acts on the part of producers, and in some instances producing states officials, were made. Ironically, by those who contend most vociferously that the bankrupt policies of the past 23 years, relative to the regulation of natural gas producers, should not only be continued but extended.

In the midst of this same crisis, the newly appointed Secretary of the Interior, delayed and announced cancellation of previously scheduled Outer Continental Shelf lease sales off the west coast. In addition, also during the peak of the same crisis, a United States District court found unlawful, previously consummated lease sales off the Atlantic coast in the area commonly referred to as the "Baltimore Canyon", which suit was instigated and pursued by several states severely impacted by the natural gas shortage. In mid-May of this year, Interior Secretary Andrus "postponed" previously scheduled lease sales in areas off-shore Alaska, California and the southern Atlantic coast. I personally find such actions incredible. I am informed that approximately 50% of the known domestic reserves of coal, oil and natural gas underlie Federal lands, both onshore and offshore, however, production from these same Federal lands constitute less than 10% of total domestic production of these same resources, leading one to question just how one is to define the charge of "withholding".

Now that I have established what I perceive to be Louisiana's license or entitlement to comment upon proposed solutions to the so-called "energy crisis" I will attempt to direct my comments to the question of energy producer incentives.

It is difficult to talk about future sources of energy without commenting upon the national energy plan as promoted by the Administration.

I applaude the President's courage in taking up the difficult challenge of moving the nation toward the adoption of a comprehensive energy policy which calls upon the people to sacrifice, conserve and accept the reality of higher prices for future supplies. Beyond this positive aspect of the Administration's proposal, it is my judgment that it falls short of presenting a meaningful solution to the problem.

I happen to be one of those who believes that any successful political and economic system can only survive so long as it realizes sustained economic growth. In my judgment, the overall effect of the Administration's energy plan, if adopted and enacted into law, will be to produce pervasive economic decline from which this nation may never recover.

The members of the industrialized community, particularly the United States, have become profligate consumers of the world's finite energy resources of oil and natural gas. The fact that the United States ranks first in the per capita consumption of energy is due to the simple fact that it has chosen as a matter of national policy to price it cheaply both by acts of omission and commission. As a nation, we must now pay a dear price for this generation or more of unwise national policy. Over this point there should be little disagreement. What we must avoid, however, is fashioning a remedy or solution that itself is terminal. To avoid creating more problems than we seek to solve, the future equation between energy conservation and energy production must be balanced.

Although serious questions have been raised as to the conservation goals sought by the Administration, there can be little disagreement that the overall thrust of the plan is tilted heavily toward the conservation side of the equation. The Administration proposes heavy taxes on so-called gas guzzling automobiles and rebates on gasoline efficient automobiles. The plan proposes onerous taxes upon industrial uses of oil and natural gas, the articulated purpose of which is to induce conversion of the taxed industrial uses to coal fired facilities.

In addition, the Administration seeks authority to mandate conversion. Tragically, however, I am convinced that the architects of this plan have given little or no consideration to the ability of the coal industry to expand production of coal sufficient to meet the induced increase in demand or how the coal mined will be transported and made available to the nation's highly dispersed industrial complex, or more importantly what the coal will cost. Clearly, the Administration has not structured into the coal conversion goals the availability and cost considerations that are yet unknown, resulting from pending surface mining legis-

lation. I am advised that the National Coal Association, whose members at least superficially appear to be in a position to gain the cost from such policies are in fact opposed to forced conversion for the candid reason that they foresee a massive supply-demand imbalance that will induce upward pressure upon the price of available coal and ultimately result in the clamor for price controls over that currently unregulated industry. How the coal industry is expected to do its long range planning and form the necessary capital to undertake a massive increase in mining in the face of such uncertainty is beyond comprehension. I am further advised that no Administration official, during the course of the formulation of the plan or prior to its promulgation on April 20th of this year, consulted with the National Coal Association or any of its member companies. It is thus no surprise that some agencies of the Government question the stated goals of the Administration's plan.

As I see it, over a period of time this nation, along with the rest of the industrialized nations of the world, must undertake a monumental research effort to rapidly develop less conventional technologies and move quickly to the commercialization thereof. All of this, of course, cannot occur overnight. The capital requirements will be immense. The costs in life style, inflation, jobs and economic growth will be painful. This makes it essential, therefore, that during the costly transition period we maximize the exploration for and production of our remaining reserves of domestic oil and natural gas. Unfortunately, the President's energy advisors have succeeded in basing the portion of the overall plan dealing with future supplies of oil and natural gas on the misguided assumption that the domestic supply of these conventional resources is all but depleted. This of course has long been advocated by those conservationists and environmentalists who have no difficulty in accepting the concept of a no growth economy.

Much lip service is given by the Administration to alleged incentives to producers to explore for and bring on additional supplies of oil and natural gas. In reality, the potential new supply is understated and the incentives are equally overstated. The Administration's natural gas proposal is the most glaring example. First, it proposes to extend Federal price controls over the sale of newly found gas sold in intrastate commerce.

The price ceiling proposed is substantially below the current market clearing price in the principle intrastate markets, where supply and demand are in balance. The actual btu related price structured into the Administration's natural gas proposal is below the prospective FPC cost based rate, the rate design of which was recently approved by the Federal courts. The natural gas provisions of the legislation are further subject to an interpretation that would empower the new Secretary of Energy to roll back prices being paid under operative intrastate contracts, in some instances to a level as low as 29.5 cents per Mcf. The same natural gas provisions of the legislation extend to the President the standby power, under vague and indefinite standards, to regulate the sale and resale rates of intrastate pipelines. The aggregate effect of the foregoing proposals is to inflict the intrastate market with the same disease that has led to the shortages experienced by interstate consumers "protected" by the Federal bureaucracy. This is tantamount to contending that we will resolve the problem by allocating the shortfall. How one can contend that this will elicit new and additional supplies is beyond my capacity to reason.

As if this were not enough, the legislation proposes to empower the President, under an extension of the Emergency Natural Gas Act, to allocate away from the intrastate market supplies of natural gas for the benefit of markets that have demonstrated in the past a total unwillingness to pay the price necessary to secure those supplies.

It should be remembered that the gas available in the intrastate market was produced in response to higher prices paid in that market, with capital formed in the hands of producers through those same higher prices. Consumers in the intrastate markets have demonstrated a willingness to pay these prices so as to secure their jobs and their economy. The fact that the legislation proposes somehow to compensate the loser does little to comfort and ease the anxiety of the people of my state or to ameliorate the divisiveness the energy crisis has stimulated over the past several years.

The President was most courageous and correct when he told the American people on the evening of April 20th, that it was unsound national policy for consumers to pay less for the energy they currently consume than the cost of its replacement. This is a very basic and fundamental principle of economics, particularly when dealing with the production and marketing of a finite resource.

However, I am somewhat confused by the proposal that the replacement cost to the consumer should be achieved through a series of complex taxes, while some of the prices permitted to producers for various increments of new supply not yet discovered are expected to be delivered at less than his costs. Under this policy, the vast majority of the funds derived in higher energy prices paid by the consumer will go to the government for transfer payments instead of going to stimulate more production and the development of both old and new energy sources. Even here, the Administration over the past several weeks has indicated considerable vacilation and indecision as to how much and how these transfer payments will be made.

In my judgment, this proposal is tragically short-sighted. It provides for the most part only for the rationing of a shortage and not for any long range victory for the consumer through more plentiful supplies. You the Congress are being asked to accept defeat when it is obvious that the vast majority of the American people have little if any understanding of the nature of the crisis, much less its depth. Second, you are being asked, through the proposed enactment of the Administration's National Energy Plan and the creation of a Department of Energy, to create and establish the most massive and pervasive bureaucracy that this nation has ever known, empowered to reach into and seriously affect virtually every aspect of human life. This entire package has been conceived and submitted to the Congress in a matter of a few months. Consultation with a few of my former colleagues in the Congress leads me to believe that in spite of the fact that Congress has struggled with these issues for several years that little or no consultation with Congress has occurred. I am frightened when I hear that Federal agencies such as the FPC which have participated in the regulation and implementation of our national energy policy for virtually a generation were likewise not consulted. Testimony of Administration witnesses before the various committees of both the House and Senate clearly reflect that little or no study of impacts were performed prior to the submission of this legislation to the Congress. The credibility of some of those that have been made are subject to question. More importantly, many of the provisions contained within the legislation cause one to seriously question competence of some of those who participated in its drafting.

In summary, I especially implore the Congress, and particularly the members of this committee, to consider the impact upon the nation's economy through the implementation of this program, particularly the tax proposals, and to recognize the gross deficiencies of the plan relative to the supply side of the equation. Plain and simple is the fact that the energy shortage that we now confront, and will confront in the future, may be viewed primarily as a shortage of capital investment. Without a massive increase in the rate of investment, not only in oil and gas production, but also in the development of and conversion to other forms of energy, the shortage can't be reduced. Yet, the Administration's plan puts few additional funds in the hands of the energy producers to stimulate investment. Under this scheme, only the government will have sufficient funds and that means a switch from the private to the public sector. Governments, including this one, have a very bad record when it comes to making investment decisions. In this latter regard, I would suggest that you give serious consideration to a program calling for a sharing of the crude oil equalization taxes with producers, if they are adopted into, even if only on a phased-in basis or on a basis calling for reinvestment in the quest for new supplies as a credit against the tax.

At a minimum, you should require the proponents of such drastic measures to demonstrate to your satisfaction the economic and social costs resulting from their implementation as compared to the alternatives.

I thank you once again for the opportunity to express my views.

Senator GRAVEL. Our next witness is Joseph Downer, executive vice president, Atlantic Richfield Co.

STATEMENT OF JOSEPH P. DOWNER, EXECUTIVE VICE PRESIDENT, ATLANTIC RICHFIELD CO.

Mr. DOWNER. Good morning, Mr. Chairman and Senator Long. My name is Joseph P. Downer; I am an executive vice president and a member of the board of directors of Atlantic Richfield Co. I appre-

ciate immensely this opportunity to appear before your committee to present the views of my company with regard to the impact of Government policy, particularly pricing policy, on the domestic supply of oil and gas.

I would like to begin my testimony today by providing you a few recent illustrations from our industry and Atlantic Richfield which demonstrate that a reasonable regulatory climate can have a favorable impact on increasing domestic oil and gas reserves.

One, stripper well oil reserves in the United States: At the end of 1975, stripper well reserves totaled 4.8 billion barrels of oil or about 20 percent of U.S. reserves at that time, excluding Alaska. Production cost for this oil is very high.

According to the National Stripper Well Association, producing well abandonments in Texas, Oklahoma, and Kansas dropped 45 percent in 1976, compared to the previous year, reflecting the increased economic life of these wells as a result of higher prices. Much of this important reserve would, in fact, be uneconomic to produce at prices lower than the current decontrolled level.

Two, west Texas and California reserve additions: Between 1972 and 1975, as a result of drilling and intensified secondary recovery projects, some 2.2 billion barrels of oil were added to reserves in west Texas and California, both mature oil provinces—an amount approximating 10 percent of current reserves in the lower 48 States. These important additions were made as crude oil price increases were permitted under Government regulations.

Three, deep plays in Southeast United States and Rocky Mountains: Discoveries totaling several hundred million barrels of oil and gas equivalent have been made in the last several years in deep exploratory plays in the Southeast United States and the overthrust belt of the Rocky Mountains. Although these were considered high-risk areas with relatively low potential, the higher prices permitted, even under controls, encourage the industry to risk capital on these ventures.

Four, Prudhoe Bay: Prudhoe Bay, Alaska, crude oil and condensate reserves of some 9.7 billion barrels are equal to more than 40 percent of presently proved U.S. lower 48 reserves. Prudhoe Bay producible gas reserves of 25.4 trillion cubic feet are over 13 percent of current lower 48 reserves. Yet, as recent testimony by my company before the Federal Energy Administration has indicated, proposed crude oil price treatment will yield only average returns for North Slope oil operations. If 1973 crude price levels were to be applied, there would be a negative wellhead value for this crucial reserve and it could not have been economically brought into production.

These four widely different illustrations make the same point: Higher prices, taking into account higher costs, have resulted in increased domestic supply of oil and gas, over levels which otherwise would have existed. The examples cited represent major additions to domestic reserves which would not have been economical, given increasing production costs, except for the price increases which have been allowed under regulations since 1972.

In fact, the number of exploratory wells completed as producers in 1976 in the lower 48 onshore area was more than double the number in 1971. It is very important to recognize that, although the reserves associated with many of these wells may not be large, all of these

reserves were developed at a lower cost than the immediate alternative—imported oil, or the longer term substitute—synthetic liquid fuels.

The above examples show that, in spite of overall restrictive price controls, some progress has been made by the petroleum industry in augmenting domestic supplies. In contrast, certain people in the Government seem to feel mistakenly that this Nation's remaining conventional oil and gas resources are so limited that it is futile to seek them. And further, they contend present prices offer adequate future incentives to explore for and develop the remaining amount.

I would like to make clear to you today, my belief that such persons have too limited a view.

I cannot tell you precisely the extent to which restrictive policies have suppressed exploration and development of domestic resources, but I will show you some additional examples of how we can do more to meet our energy requirements from oil and gas sources within this country and, that we can do this at costs competitive with available alternatives.

A Government estimate of undiscovered recoverable domestic petroleum resources as reported by the U.S. Geological Survey as of 1975, is 82 billion barrels of crude oil, about 16 billion barrels of natural gas liquids, and 484 trillion cubic feet of natural gas.

While a range of such figures has been published, these seem to be feasible estimates in our view. Further, these figures are more than double the comparable quantities of reported current proven reserves. This says that there are significant undiscovered petroleum resources available to us in the United States.

While alternative energy sources such as nuclear and solar power, and particularly coal, offer great potential for the future, none of these can soon meet the energy needs supplied now by petroleum. However, our domestic oil and gas reserves are being consumed faster than they are being replaced. Under present Government policy, we would seem to have no alternative but to accept ever accelerating reliance on imports of foreign oil. This will continue unless we are willing to do what is necessary to increase exploration for and development of domestic—that is, United States—oil and gas.

What prospect is there of future additions to domestic supply? Here are some specific areas which hold promise:

Enhanced recovery. This is oil for which we do not have to explore. It is present in known reservoirs. Techniques are being studied to improve recovery, but all such processes are expensive to implement. A recent study by the National Petroleum Council indicates that substantial increases in recovery are likely when price latitude is available. As an example, the study indicates that if wellhead oil prices were increased from a base of $10 per barrel to $15 per barrel—in 1976 dollars—the increased ultimate reserves available from enhanced recovery techniques would almost double—from about 7 billion barrels to approximately 13 billion barrels.

Given today's prices, we recover on the average only about one-third of the oil we find. Thus, there is reason to believe price increases will make available additional portions of oil already known to exist.

Improved technologies. In addition to enhanced recovery, we believe higher prices will bring forth other new technological advances. Ex-

amples are improved deep water exploration and production technology which could open major new Outer Continental Shelf areas for development.

New exploration tools include the recently developed seismic "bright spot" process for identification of gas reservoirs, and sophisticated seismic techniques for exploring complex geological areas such as the overthrust belt in the Rocky Mountains. Improved fracturing and well stimulation methodology hold the promise of increasing gas production from tight formations.

Many other examples could be given but these serve to illustrate the way in which technological progress, spurred by appropriate incentives, can open high cost or heretofore unreachable areas for development.

Outer Continental Shelf. It is my company's view that the greatest potential for future oil and gas discoveries can be expected to come from the new and extended OCS provinces—offshore Alaska, the Atlantic coast, southern California, and untested areas of the Gulf of Mexico.

State of Alaska. By all accounts, the frontier basins of Alaska contain areas of great potential. But, a major portion of the State is Federal lands and there has not been a Federal lease issued onshore in Alaska during the past 10 years.

It should be noted that as to both the State of Alaska and OCS lands, Government leasing policy must insure that prospective acreage will be made available in a timely fashion if industry is to pursue a vigorous program. And, costs in most of these areas are expected to be very high.

Kuparuk and Lisburne formations on the North Slope. As to this particular resource in which my company also has a direct stake, an FEA consultant has estimated that these reservoirs contain as much as 2 billion barrels of recoverable oil--a quantity equal to about 10 percent of present reserves in the lower 48 States. Given proper incentives under Government policies, these accumulations could prove to be of significant importance.

Prudhoe Bay natural gas. The most significant potential addition to domestic natural gas supplies is the estimated 25.4 trillion cubic feet of producible reserves at Prudhoe Bay for which there is presently no means of transportation from north Alaska to market.

Under a Government policy which would allow at least as much in wellhead prices for these remote, high cost resources as would be permitted elsewhere in the United States, we are of the opinion that this reserve will be made available to the American consumer.

However, by way of contrast, recent recommendations from the Federal Power Commission could yield the unbelievable result of a wellhead price for this gas of approximately "0", or perhaps a negative value, which dramatically underlines the follies possible under overzealous regulation. A major shift away from such thinking will be required to expedite the delivery to market of these substantial frontier gas reserves.

So, when we say there is a lot of conventional oil and gas out there, we are not talking generalities, but specific opportunities. And, while these opportunities will not solve all our long-term energy problems,

they can significantly moderate our difficulties and help us manage the transition to alternate higher cost energy sources.

How can Government help bring these possibilities into being? There is a clear answer—permit a program of aggressive domestic energy development to match the strong conservation measures proposed by the President in the National Energy Act. We would hope the Government would recognize the following in its policy implementation:

Increases in capital spending for oil and gas development, brought forward by appropriate incentives, will increase supply levels over those which would otherwise prevail.

These additions to supply will yield benefits of security of supply, domestic employment, and improved balance of payment factors.

The current alternative to domestic oil is potentially insecure imported foreign oil which is presently selling for about $14 a barrel delivered. The longer term alternate is even higher cost foreign oil and/or higher cost synthetic liquids.

The "in kind" alternative to domestic natural gas is imported liquefied natural gas which is expected to be delivered to the United States at a landed cost of $3 to $4 per thousand cubic feet—equivalent to $18 to $24 per barrel of crude oil—substantially above the domestic controlled price of natural gas or crude oil.

The quantity of capital devoted to oil and gas exploration and development is largely a function of expected return on investment over a relatively long time frame. Even if there is capital available, its commitment is strongly influenced by not only today's, but tomorrow's price, available opportunities, the degree of uncertainty, and other particular investment risks, including political factors.

Time is money. Undue delays in public policy decisions regarding facility siting, leasing and reconciliation of economic and environmental conflicts severely damage investment interest.

We are dealing here with depletable resources. Replacement efforts are discouraged when current resources are sold at prices below replacement costs—the present situation.

Some common sense on pricing. A more aggressive industry exploration program depends upon prospective acreage being made available, diminishing the risk of environmental delay, and creating stability in national energy policy. But, there also is clearly a need for adequate pricing incentives. This is true in terms of present prices, but also of reliable expectation of future prices that would make new exploration projects economic.

The fact that at today's prices, the petroleum industry earns an average profit for all of industry, based on historical cost accounting, does not mean that current price levels are adequate to bring forth as much supply as would prices based on domestic replacement costs.

It is a fundamental point that there is not a single price at which energy becomes profitable. Instead, for each price increase, a certain added volume of oil and gas becomes commercial.

For a higher price, a greater volume would be found and produced. As difficult as it may be to precisely estimate the price-volume relationship, it should be recognized that it does exist.

The Government and prices. We think market pricing is the best means of providing maximum domestic oil and gas development.

We feel the country would be well served by ending present Government control programs.

However, this may well not be tenable, given the apparent current political climate, so that decontrol steps taken over a gradual period may be more feasible. Phased decontrol may be approached a number of ways mechanically.

A gradual ending of direct controls, time-limited excise taxes on profit segments—with proper credits for reinvestments—or other such devices tend to yield substantially the same result.

The key point is that a phased program should clearly contemplate decontrol as an objective and lead certainly to that result.

Need for a long-term view on pricing. Upon analysis, the President's crude oil pricing proposal addresses only the near term.

We join others who have pointed out that in his program the President recognized the replacement cost concept in name only.

While the cost to consumer will move in the direction of the replacement concept, the return to producers is not related to it.

Moreover, there is another major problem with the proposal that is not so obvious: While new oil would be allowed eventually to reach current import prices, further increases are limited by the GNP deflator.

Thus, the system would in no way be keyed to the domestic replacement cost of a depleting resource or substitute synthetic liquids. We think that within a few years, this inherent deficiency would become evident, requiring additional congressional deliberation.

What's needed is the foresight to adopt a pricing policy immediately which will stand the test of the longer term and thereby yield the benefits of predictability and provide the needed results now.

The same holds true for the pricing of natural gas, a commodity even more depressed by Government regulatory action.

Some comments on capital requirement. While more aggressive programs of domestic oil and gas development will demand the application of increased capital, we are of the opinion that in a context of Government recognition of the kinds of realities we have described, including sensible pricing policy, it is reasonable to believe necessary allocations of capital will be forthcoming.

The industry and the capital markets in our view, are ready and willing if government will permit a clear-cut economic environment that will allow us to proceed with the job.

Some specific recommendations. I have tried to outline for you some important concepts as well as some thoughts on better policy approaches. It might be helpful if I bring together a few of these in conclusion.

One, there are additional significant supplies of domestic oil and gas obtainable in an appropriate economic environment, including realistic price incentives, that will bring forth these supplies.

Two, it is crucial for the Government to attempt to ease the climate of uncertainty surrounding energy policies in the United States.

Three, mechanisms that will facilitate the timely resolution of environmental/energy/social conflicts are critical. Undue delays in deciding such questions as facility siting and leasing policy must be ended.

Four, contrary to the approach in the President's energy program, natural gas should not be priced below replacement cost. There would be favorable effects on both supply and demand if the replacement cost concept for gas is adopted.

Five, as we have explained, the President's recommended oil-pricing policy will quickly fall short of any concept of replacement costs, as well as likely increases in the cost of alternative overseas oil. The effect will be to add to uncertainty and truncate the validity of any decisions that are taken now.

We believe that this committee can play an important role in helping bring about genuinely useful energy policy determinations.

For our part, we would be pleased to provide any further information that will be helpful to you.

Senator GRAVEL. Thank you very much, Mr. Downer, for a very, very fine statement.

I wonder, if you can expand on your statements concerning the need for the long-term pricing and the difference of the administration's proposal, as respect to consumer pricing and with respect to what happens to the company aspect of pricing. And you go on to show how it is undercut by the GNP production deflator; could you expand on that too?

Mr. DOWNER. As you know, Senator, the President's proposal would permit so-called new, new oil, newly discovered oil after the announcement of the proposal, to rise to the current world market price of approximately $14 per barrel over a 3-year period. After that, it would only rise in concert with the GNP deflator factor.

As we move into more expensive, more difficult, more hostile environments—and you know the North Slope of Alaska far better than I do—the GNP deflator increase will not provide the necessary price incentives to cover the cost increases that are going to take place in areas of that kind.

Another illustration, which is a rather simple one, but I think it is fundamental to the problem of our industry at this stage of the game, if I were an oil producer and I had a reserve of 100 barrels of oil and I was selling it today and half of it were new oil and half old oil, I would be receiving an average price of $8.50 a barrel. If my lifting costs, the cost to bring the oil to the surface, together with my taxes, amounted to perhaps $3.50 a barrel—these are purely representational figures—I would be netting $5 a barrel of cash flow on my 100-barrel reserve.

That would yield me a total of $500 over the life of that property.

Now, sir, the replacement cost for those reserves today is materially in excess of $5 a barrel. To the extent that the replacement cost is in excess of $5 a barrel—and let us say that it approaches $10 a barrel, currently the case in Alaska—if I spend my $500 to replace my inventory it will yield only 50 barrels of reserves. Thus, my inventory, my reserve, my business, would have declined by 50 percent.

This is the basic problem of the U.S. petroleum industry at the present time, and if that problem is not rectified by the recognition of replacement costs as a pricing requirement, we will be faced with a rapidly depleting U.S. petroleum industry, a rapidly depleting U.S. oil and gas reserve.

Senator GRAVEL. That is apparent. What is also apparent to me, and I would appreciate a correction if you disagree, is that in the present efforts of the administration there is a misunderstanding or lack of appreciation of what replacement cost is. If they are tying the escalation over a 3-year period to today's world prices, that price would be today's world price.

Mr. DOWNER. Yes, sir.

Senator GRAVEL. There is an implicit assumption that the world price will not change for 3 years which, of course, is ridiculous. You just have to read the deliberations of OPEC.

So the Government pricing 3 years hence will be 3 years out of data with respect to world pricing.

Mr. DOWNER. That is exactly right, sir.

Also, it does not take into account the higher levels of pricing which are required for the more exotic fuels, shale, liquification, and gassification and coal, that get up into the $18 and $20 level in the case of shale and go on up to $20-plus in the case of liquification and gasification of coal.

Senator GRAVEL. I asked Mr. O'Leary yesterday, what incentive would a company like yourself have to continue to look for oil under the American flag when, on the face of it, it would appear if you found oil elsewhere you could export it back to the United States and get whatever the traffic would bear. I appreciate the problems of nationalization in other parts of the world. Are there no other parts of the world where you can securely look for oil without fear?

Mr. DOWNER. I would acknowledge that the wonderful political stability of the United States is an enormous factor in the decision-making with respect to exploration. But, there are other places in the world. We, and others in the industry, are active in those areas.

Our effort, however—I think we are as sensitive as any people in the United States as to the vulnerability with respect to the Nation of depending on foreign resources. Our efforts—because we recognize the need—are to place as much of our capital as we possibly can in trying to bring forth domestic energy resources.

Sometimes you would wonder why. If we had foreseen perhaps some of the problems in Prudhoe Bay development, one would wonder whether a logical investor would have gone forward under those circumstances, if we had been able to foresee what the difficulties were going to be.

Ours is an eternally optimistic industry, an industry used to taking enormous risks throughout the entire world, an industry that, despite those enormous risks, has received only an average return on the capital of its shareholders that has been employed and I would presume that we will continue to take those risks.

But I have to say to you that although we are used to taking economic risks, the uncertainty of domestic energy policies makes our risktaking decisions much more difficult.

Senator GRAVEL. What is the motivation underlying decisions to move out of the energy area and into the sales area?

Mr. DOWNER. I cannot speak for Mobil Oil, but for the Atlantic Richfield Co. the future of U.S. energy policy was one factor in our decision. We are a corporation that, we hope, will have a long and successful life. We felt that we had to broaden our asset base in the

light of the uncertainties of domestic energy policy—and also, I must admit, recognizing the finite nature of oil and gas as a future source of energy, which is so significant a part of our total business.

I should point out that our business now has a total asset basis of $9 billion. Anaconda represents an investment of $700 million. That is a large total number, but it represents a relatively low portion of our total asset base.

We, as a company, are currently plowing back, largely into efforts to bring forth domestic energy, about $2 billion a year in capital expenditures.

This contrasts to the $700 million paid for Anaconda and we only have done that once where we are putting the $2 billion in each and every year. It also contrasts to an earnings level of something under a $600 million level. In other words, our capital programs exceed our earnings levels by something on the order of three times.

This has resulted in enormous borrowing on our part. We have had $3 billion of financing over the past 3 years. That cannot go on forever. We have to be able to pay that indebtedness off and continue to maintain a sound financial rating for our company.

Pricing, and adequate pricing, is the only thing that will provide that for us.

Senator GRAVEL. Yesterday, Mr. O'Leary spoke of the pricing that is going to be granted on the North Slope oil, which was originally supposed to be $11.28. Apparently now there is a draft public proposal that it will be below the market price.

Would you comment on that with respect to the incentive that it would give you to further explore in those fields? Will that do the job?

Mr. DOWNER. It is very marginal, sir. Very marginal. If any further negative factor is applied, such as entitlements; if inflation causes the cost of the development to rise at costs that exceed those which we are anticipating, this would require reexamination of the economic wisdom of proceeding with them.

It is our present hope, if the proposals of the FEA go forward, that this oil will compete with foreign oil and should net back something on the order of $7 a barrel at the wellhead, considering the transportation costs. If those conditions prevail and no entitlements burden is placed on that oil, we have pledged ourselves to move forward and initiate an exploratory program possibly leading to development of other North Slope areas which could represent a 2-billion barrel additional reserve for the United States.

Senator GRAVEL. In March when the FEA first came out, it was out of the question. The Government decision was almost self-destructive. It was only with this big squawking of industry and some of us that this was reexamined.

Now the decision has not been made to change that with what has been floated as a proposal. So if this floated proposal does not become accepted policy, we will be denied these two fields of 2 billion barrels of oil. Plus the fact that you have invested in the infrastructure to bring it to market. If it were intelligently priced——

Mr. DOWNER. Exactly right. Plus, the alternative to that oil is the purchase of foreign oil and have those funds flow out of the country. At $14 a barrel on 2 billion barrels that is $28 billion, sir, over time.

Senator GRAVEL What you are telling me now, in another portion here, is that a floated proposal for natural gas pricing out of the Federal Power Commission, would price natural gas at zero at the wellhead.

Mr. DOWNER. That is exactly right, sir.

Senator GRAVEL. What is going to be the impact of that? As I understand it, in order to produce oil you have to produce the gas, otherwise you are going to raise the cost of producing the oil since you are going to have to reinject. That figure is not presently figured into the cost of the oil coming out of the North Slope.

What effect will the policy on gas have on oil pricing?

Mr. DOWNER. It will reduce the rate of return on our total Prudhoe Bay operation to an unacceptably low rate of return.

The rate of return from oil operations per se is a very modest return that the FEA reports indicate to be something on the order of 12 percent after taxes which, taking into account that this kind of gigantic success has to cover all of our many, many failures, as you well know, we recently completed two very dry wells, unfortunately, in the Gulf of Alaska, each one of which, on a gross basis, cost about $20 million.

Those are the kinds of failures that we have to cover by a reasonable return on our successes.

If the crude production from Prudhoe Bay yields something on the order of a 12-percent return and we end up having to reinject that gas forever at an increased cost, as you are pointing out, that will lower that return to an even more marginal return.

The obvious solution to this, sir, is to provide that gas with at least the kind of price treatment that has been recommended in the President's energy program for the lower 48 new gas, namely the $1.75 wellhead price, which would be provided for that gas, were it found in offshore Louisiana, if it were found off the coast from the District of Columbia in the Atlantic.

Senator GRAVEL. Is the $1.75 equal to the world price of oil?

Mr. DOWNER. No.

Senator GRAVEL. What would it be?

Mr. DOWNER. It would be equivalent to a little less than $12 and the cost of foreign oil at the present time is $14.

The landed cost of the substitute was, liquefied natural gas, is going up about $4 a thousand cubic feet, equivalent to about $24 a barrel of crude.

Senator GRAVEL. If I recall the President's statement, he was going to push to have natural gas sold for its equivalent Btu in oil in order to keep that pledge we would have to be selling North Slope natural gas at around $2.25 a thousand cubic feet.

Mr. DOWNER. There is a transportation charge of a couple of dollars, probably given that enormously costly project which will be required.

Senator GRAVEL. I would like to yield to my colleague from Texas.

Senator BENTSEN. Thank you very much, Mr. Chairman.

I have been reading over your testimony, Mr. Downer. When you talk about a 12-percent return, are you talking about a 12-percent return on equity?

Mr. DOWNER. No, sir. On all capital.

Senator BENTSEN. All capital?

Mr. DOWNER. On the Prudhoe Bay facility, yes, sir. It is all equity money.

The average return on all capital employed in my company which is a company that has a capital base of about $9 billion, as I said, was 10.7 percent in the first quarter of 1977.

Senator BENTSEN. What do you have to pay for long term money?

Mr. DOWNER. Including equity and debt—and obviously, we cannot use totally debt—the cost of our capital is not much under that figure.

The average oil company, we are doing a bit better, because, although we have the prospect of the earning power of the North Slope coming along, as you know, many oils are selling at eight times earnings, which would indicate a 12-percent cost after tax for equity.

Although they can borrow at 8½ percent, which is an aftertax cost of only 4 to 4¼ percent. When you mix those two on a weighted average basis you are talking about a capital cost of something on the order of 10 percent.

We are covering that by a very slight margin while taking the kinds of risks that we are taking with the shareholders' capital in the Gulf of Alaska, whereas, I said, we paid $20 million for a structure, we just drilled a $20 million dry hole in it. Shell, who operates another structure, as Senator Gravel well knows, did the same thing.

This does not mean that we do not think that the Gulf of Alaska still continues to be one of the great potential areas for possible large, incremental reserves in the United States. If it fails, the problem we are talking about today, sir, is magnified manyfold for the United States.

Senator BENTSEN. Mr. Downer, I am interested in some of the viewpoints of some of the members when they complain about a company going outside of the energy field for the investment of its capital.

There is nothing that keeps you in the energy field. Your obligation is to your stockholders.

Mr. DOWNER. Exactly right, sir.

Senator BENTSEN. To get the best return, commensurate with some safety, that you can get for it.

So if you have found a better return in some other industry, be it copper or be it a retail chain, your obligation is to your shareholders.

Mr. DOWNER. Yes, sir.

Senator BENTSEN. One of those things that brings about that decision is a question of the great uncertainty in energy policy about what is going to happen in the way of tax proposals, price proposals, or regulation.

I also get concerned with the fact that they talk about horizontal divestiture. If we come up with a study that shows that the concentration of industry is such that it stifles competition, I will be for horizontal, vertical, diagonal or any other kind of divestiture.

Mr. DOWNER. I, and the management of Atlantic Richfield, would join you.

Senator BENTSEN. I have not seen one of those studies that show that. I happen to feel that we have a wealth of talent, technical know-how, in some of these companies that we cannot do without, particularly at this point in our history in light of the present situation.

I have a difficult time understanding this idea of horizontal divestitures, particularly if you are talking about a finite product, such as

oil and gas. If you cannot divest, then you are in a process of self-liquidation.

Mr. DOWNER. Exactly right sir.

Senator BENTSEN. That is a waste of a resource of the country.

Mr. DOWNER. Absolutely.

Senator BENTSEN. You made some comments about stripper wells and what it means in the way of additional oil resources for our country that would otherwise be lost.

Do we not have the same kind of marginal economic well in gas?

Mr. DOWNER. Exactly.

Senator BENTSEN. Should we not have such classification for gas?

Are there not gas wells that are being shut down because they are marginal wells, that, if they had a stripper classification, might be kept open?

Mr. DOWNER. No question about it, sir.

These are enormous increments of reserves in relation to our present situation.

Senator BENTSEN. I think that you ought to give some study to that problem as to how we can keep stripper gas wells in production.

Mr. DOWNER. We will, sir.

Senator BENTSEN. Something that we can defend and sustain, something that is totally justified. I would like to see you give us that information and add that to the record.

Mr. DOWNER. We certainly will.

[The following was subsequently supplied for the record:]

ATLANTIC RICHFIELD CO.,
Los Angeles, Calif., July 15, 1977.

Hon. LLOYD BENTSEN, Jr.,
U.S. Senate,
Washington, D.C.

DEAR SENATOR BENTSEN: At the conclusion of my testimony on June 21, 1977, before the Subcommittee on Energy and Foundations of the Senate Finance Committee, you requested written comments on my Company's view concerning the creation of a category of marginal natural gas production which would be exempt from price controls.

While Atlantic Richfield Company strongly favors free market pricing for all natural gas and believes that such a pricing policy would be in the national interest, we recognize that political considerations may prevent decontrol of all natural gas. It now appears that the most that could be expected would be decontrol of new gas. There are several proposals for this including, of course, the Bentsen-Pearson bill. Recognizing the likelihood that all natural gas will not be decontrolled, my company supports your legislation which would decontrol new onshore gas now and phase out control of new gas offshore over a five-year period.

Your suggested provision for exempting marginal gas production from price controls would be a meaningful addition to provisions for decontrol of new gas. We would suggest that such an exemption be applied to all gas proration units with gross revenue of less than $50 per well per day (approximately equivalent to the stripper oil well ten barrel per day trigger point at an oil price of $5.05 per barrel).

At present, economic relief for marginal properties to prevent premature abandonment and loss of rate in reserves must be sought on a case-by-case basis through the Federal Power Commission. We have found this approach to be ineffective. After requiring a detailed cost presentation, the Commission in these cases will allow special relief only upon a showing that the ceiling rate will not allow recovery of "out-of-pocket" or operating costs, with no allowance for return of capital or return on capital.

The lack of effectiveness of this "special relief" is emphasized by the fact that in addition to finally receiving a rate which only allows recovery of operating

costs after the decision, the producer would commonly have to deliver its gas at a net loss during the time while the case is pending before the FPC. Clearly, establishment of a provision to exclude marginal gas properties from price regulations would certainly be a step in the right direction and would be much more effective than the current FPC special relief provisions or that proposed in the National Energy Act (H.R. 6831).

In an effort to quantify the effects of the marginal gas provisions, we have surveyed a number of industry and commercial data services in an effort to ascertain production, cost and reserve data on an industry basis for properties selling gas to the interstate market. While we were unable to develop data that seemed meaningful, analytically, in terms of your questions, we believe on an industry basis the producing life of a significant number of wells (or properties) would likely be extended by higher prices. This would be particularly true where the installation of a compressor, remedial well work or some other investment is required to continue operations but could not be economically justified at present prices.

However, I should hasten to point out that the provision would not mean that all low rate gas production would increase in price to the free market level, even that delivered to the interstate market, as natural gas is ordinarily sold under long term contract. Such existing contracts would prevent automatic increases of currently flowing gas. However, the provision should allow the producer and the purchaser to negotiate higher prices where they are necessary in order to continue production.

Another very important application of the proposed provision would be to provide the necessary incentive to drill low volume, marginal economic wells. Wells in this category might include those drilled to shallow, low pressure reservoirs with small reserves. The provision might also encourage drilling tight formations which would be of large areal extent but with reservoir characteristics which would allow one well to drain only a small area.

The Federal Power Commission's optional procedure for undedicated gas is ineffective as a means of gaining price relief in order to develop gas from these sources for delivery into the interstate market. As in the case of the special relief provision, the FPC's optional procedure requires a detailed cost study of the specific project proposed. Since the quantity of reserves which the producer hopes to find cannot be definitively quantified prior to the drilling of the wells, the burden of proof borne by the producers in the optional procedure cases is virtually impossible to satisfy. An additional deterrent to the use of this procedure is the fact that if the producer finds fewer reserves than expected, the higher price approved will not be adequate to compensate him for the additional cost incurred and to date the FPC has not seen fit to grant the producer any additional relief in such cases. On the other hand, if the producer finds more reserves than anticipated, the FPC is likely to reduce the price which the producer will be permitted to charge.

I would like to again express my appreciation for the opportunity to participate in the June 21 Subcommittee hearings and present my Company's views with regard to national policies which would stimulate exploration and development of the nation's energy resources. I also want to thank you for this opportunity to provide additional comment which I hope will be helpful in developing more effective policies with regard to natural gas pricing. If you have questions with regard to this material or I can be of further assistance, please let me know.

Sincerely,

J. P. DOWNER,
Executive Vice President.

Mr. DOWNER. I might add, as Senator Gravel said, if natural gas were just merely given, what the President has talked about, a Btu equivalent price as contrasted and compared to oil prices, this would have an enormously stimulating effect on bringing out additional, hard-to-recover gas reserves.

Senator BENTSEN. One of the comments that has been made by the administration is that if you do that, two things would be true—one, that producers have developed all they can develop and have full incentive and do not need further incentive. We get that one comment from some administration witnesses.

On the other side, we get the comment, if you do raise the price to the Btu equivalent and get it up to $2.25, you are going to have such an incredible demand on drilling equipment that the prices are going to skyrocket.

It seems to me that those are conflicting arguments.

What do you think is going to happen if we had a Btu equivalency and the price was $2.25? What is going to happen to the availability of equipment and cost of equipment?

Mr. DOWNER. Sir, the system works. An added incentive will bring out additional equipment.

We have a very vigorous equipment industry in this country. You and I know when the incentive died back in the 1960's and 1970's that rigs were being stacked like cords of lumber. Now they have come back to work and there are companies ready and willing to turn out those rigs in order to let us do the job to bring on this additional gas and oil.

Senator BENTSEN. Well, you explain to me this argument why, on one side, if the price is high enough, if we raised the price, you would have no more drilling. On the other side, if you raise the price, you would have so much demand for drilling equipment it is going to escalate the price.

Can you tell me how that works?

Mr. DOWNER. It is very, very difficult for me to explain, sir. My view of adequate pricing for natural gas would be that it would do the following things, all of which are desirable for the country:

First, you will allocate a precious resource to the highest use, which is what we should be doing with natural gas.

Second, it will affect conservation. There is no better conservation mechanism than paying full value for the commodity rather than you being subsidized for wasteful use of that commodity.

Third, price will stimulate supply and supply and demand come into balance, and that does level off the price increases.

Senator BENTSEN. Thank you very much.

Thank you, Mr. Chairman.

Senator GRAVEL. I would just like to pursue one point.

You spoke of the possibility of excess profits or actually a tax on the price of oil. I have advocated for some time an excess profits tax based upon returns. You point out that your return on investment capital is 10.7 percent.

Would you agree with me that the average manufacturing return in the country is somewhere around 12.8 to 13 percent?

Mr. DOWNER. Yes.

Senator GRAVEL. You are slightly below?

Mr. DOWNER. Yes, sir.

Senator GRAVEL. What would be your reaction to an excess profits tax that says, if you made about 15 percent return on your invested capital, and there are a lot of unregulated American businesses that do that, you would be taxed if you did not plow back. What would be your reaction to that kind of excess profits tax? That will give the American public a guarantee that they are not being ripped off through the windfall profits that you supposedly receive, which I would call inventory profit, not windfall. You have to pay the piper the next time you want to go down in a hole.

Mr. DOWNER. Sir, I think it is a very interesting concept; provided that we can have a reasonable return, we are prepared to commit ourselves to prudent reinvestment of our capital in the oil and gas business. Our capital programs are on the order of $2 billion, as I said. The vast majority of that is going back into energy development in the United States.

Senator GRAVEL. We have to find some device to break the syndrome of misconception that exists between the Government, the media, and the people. We have not succeeded in doing that in the last 3 or 4 years, and the problem has been aggravated even further.

Unless we can put something on the table and say, here is the protection device, why do we need the rest of this? If we have that kind of device we can still have a social determination to let the market work its will.

Mr. DOWNER. Absolutely.

Senator GRAVEL. The only other question I would have is, if the Government—I want to underscore this again because I touched on this question earlier—would bring about in your mind a marginal determination, would you go ahead with that to new fields?

Mr. DOWNER. Yes, sir.

Senator GRAVEL. That is a marginal decision right now?

Mr. DOWNER. We have made the commitment that we would do it.

Senator GRAVEL. We had testimony from Mr. O'Leary yesterday that everything was just great, the industry has more incentives, we do not have to worry about the problem, everything is just moving ahead.

Mr. DOWNER. This negative realization for Prudhoe Bay gas, Senator Gravel, is almost ludicrous when you think about it.

What system requires that people take enormous risk and then receive a negative compensation for it?

Senator GRAVEL. If gas is properly priced and raised to the price of oil, your commitment is that it is really going to cost you some money?

Mr. DOWNER. Yes, sir.

Senator GRAVEL. Senator Bentsen?

Senator BENTSEN. Mr. Downer, there has been concern about the estimates of reserves of oil and gas in this country; estimates have been made by associations. Do you see a problem in a U.S. authorized agency of some kind verifying those reserves?

Mr. DOWNER. No, sir, I do not. I do think, however, we all must understand that this is almost an art rather than a science.

These are directional figures, they are approximate figures, and they will differ, given the economic climate in which the figures are calculated and the economic projections that are made with respect to the figures. But again, as the distinguished gentleman from Louisiana pointed out, we have always erred on the low side in terms of reserve estimates.

Senator BENTSEN. I believe that the President of the United States, or the Congress, has to have what they think is the most sophisticated and most objective estimate of reserves that they can get. If that requires some Federal assistance in that regard, then I think we should have it.

Speaking about erring on the low side, I have seen some erring on the top side. I have seen some of these companies in there at the beginning trying very much to sell their bonds.

Mr. DOWNER. They were encouraged by the regulatory procedures to do that.

Senator BENTSEN. Whatever there was, there was some pretty optimistic data.

Mr. DOWNER. No question about it.

Senator BENTSEN. Thank you very much.

Senator GRAVEL. Thank you, Senator.

Thank you, again.

Mr. DOWNER. Thank you very much. It was a great pleasure.

Senator GRAVEL. Congratulations on starting the oil.

Mr. DOWNER. The fellows up there have done that job. They deserve the Nation's gratitude. They are getting a lot of brickbats, though.

Senator GRAVEL. I would like to interrupt the schedule to accommodate a time problem that we have. I wonder if Mr. Jones might come forward and testify at this point in time.

Senator BENTSEN. Let me interrupt to say that I have known Mr. Jones for a number of years. Mr. Jones is a very able man in the oil and gas business, and a successful one. He is a leader in his community and his industry and we are very pleased to have him with us.

STATEMENT OF A. V. JONES, JR., PRESIDENT, INDEPENDENT PETROLEUM ASSOCIATION OF AMERICA

Mr. JONES. I am appearing today as president of the Independent Petroleum Association of America. Twenty other independent State and regional producer associations join in support of our testimony. Togeher these associations represent virtually all independent oil and gas producers in the United States.

The purpose of our testimony is to suggest changes that must be made in the administration's approach to energy development in this country if domestic producers are to have an opportunity to meet the future needs of consumers of petroleum fuels.

The administration is pressing for total Federal authority to fix prices and manage supplies of oil and natural gas on a basis which, in our view, would assure the continuing decline of production and ultimately force shortages on all the consumers in the country.

I would like all the prepared testimony presented for the record, please, sir, and I am going to paraphrase it somewhat.

I would like for you to look at the chart which is about 3 pages down in my prepared testimony. This shows the history of the oil and gas industry in this country from 1957 to 1971. In 1956 we drilled some 55,000 wells in this country while searching for oil and gas. Thereafter we went through a long decline to a period of time when we were drilling less than 30,000 wells. This was basically because the Federal Government fixed the price of natural gas at the wellhead. Also, the Government took a position of holding a stick over the industry's head and would not let the price of crude oil rise, with the threat of opening the floodgates of imported oil.

Senator GRAVEL. What are the dates?

Mr. JONES. 1957 through 1971.

At the bottom of the chart you can see the dates in these little parentheses that show the amount of money spent in increments in those years.

What we would like to show with this chart is the fact that during this period of price control by the Government, we literally phased out the independents in the industry. The spending by the independent segment of the industry went down through these years as the number of wells that were drilled went down. At the same time, spending by the major companies was increasing.

During those 20 years of decline, when we went from 20,000 companies in the country down to the some 10,000 which exist now, because of what we think are signals from the Government that we do not want a sound domestic oil and gas industry. Those signals were: (1) In 1969 percentage depletion was cut from 27½ to 22 percent. (2) In October 1975 most of the remaining depletion was cut, with the exception of a small exemption for small independents. (3) In February 1976, we had a rollback in the price of oil. This was after, gentlemen, I might point out, that we were aware that we had tremendous oil shortages in this country and after we thought we had a petroleum policy in place in this country that was going to get us out from under price control. (4) In February 1976, we rolled back the price of oil $1.50 a barrel. (5) In September 1976 we retroactively placed a punitive tax on IDC's that would penalize a person for spending money in the oil and gas business. (6) In July of 1976 we froze the crude oil price. (7) In December 1976 we rolled it back 26 cents a barrel. (8) In February 1977 the fees for Federal leases, the rental fees, were doubled. (9) Recently, in March of 1977 we had another rollback in the crude oil price of 45 cents.

We really cannot see where, with this type of action on the part of government, we have any signal that we want the domestic industry to go out and find resources.

I would like to talk a little bit about the resource base in the country, a fact that Mr. O'Leary and the other people who are making policy for the current administration have even chosen to overlook, which is the vast amount of sediment that is available in this country for exploration.

There is a map in my formal testimony which shows that actually in this country only 2 percent of the existing sediments have been explored and developed. Still unexplored are a lot of areas offshore on the east coast, and tremendous areas in the gulf coast. How many more Prudhoe Bays potentially lie in the Alaskan basin? This is something that we do not know, and we have to have a policy that will make it economically attractive to go out and explore in these vast areas.

I call your attention to a chart entitled "U.S. Petroleum Resource Base." There are potentially between 300 billion and 500 billion barrels of oil left in this country to be found.

This would be way in excess of a 50-year supply at the current producing rates. We also have good evidence to believe that there are a thousand trillion cubic feet of natural gas, a 50-year supply at our current 20 trillion per year use.

ERDA, the arm of the Government that would seek to understand how to develop the resource base of the country, has put out a study on four of the tight sand basins in the Western United States. In these basins alone they have come up with an estimate of 730 trillion cubic feet of natural gas. These are in tight sands out there and are resources that can be brought on at a price much cheaper than we are going to pay to import synthetic natural gas into this country.

We maintain that the technology for bringing on these resources are further along than liquifaction and gasification of coal or geothermal resources on the west coast which the administration is hanging its hat on. Why they choose to ignore this vast resource, we do not understand.

We do say, whatever the resource base of this country, a satisfactory price will bring on the exploration effort to find it. The following charts show that drilling expenditures in this country were going down drastically under the controlled prices of the 1960's. Immediately on the increases in prices that we did receive in the middle 1970's, the drilling expenditures of the industry took a drastic upwards surge.

We maintain that would be the case if you were to decontrol natural gas now, and, were we to get a satisfactory price for all the new oil, this money would be spent in drilling.

Senator GRAVEL. According to that chart, with happened to the world price?

Mr. JONES. The oil price did increase under controls. The industry responded with additional drilling. A lot of this expenditure—a very important point—was expended looking for natural gas in Texas, Louisiana, Oklahoma, and the Southwest where the intrastate market was not controlled and was operating under free market conditions.

In Texas particularly there were shortages of natural gas in the early 1970's. Those shortages were immediately filled to the point where they have actually developed a surplus of gas.

Senator GRAVEL. You do not have that broken out, do you, by chance?

Mr. JONES. We can certainly get it for you.

Senator GRAVEL. I would like to see a chart or some figures.

Mr. JONES. Of the gas drilling in Texas?

Senator GRAVEL. Can you show us the stimulation that took place in the free market as opposed to the controlled market. I do not know if you can break it out.

Mr. JONES. Yes, sir. I am sorry it is not in my testimony. It has been documented fairly well. We can certainly provide it for you.

Senator GRAVEL. It would be a good argument for you.

Mr. JONES. We think so.

We call your attention to the chart that we call "Energy Employment and Economic Growth 1955–1976." We make the argument that 75 percent of the energy employed in the country at this time comes from oil and natural gas. This mix is not going to change very drastically for what we call a bridge period—that is, the period between now and 1985 and 1990—when we will be bringing on some of the better uses of coal, such as liquefaction and gasification. During that period of time, we are going to rely on crude oil and natural gas in this country and our economy runs so much on these energy resources that if we do not have satisfactory supplies, we are going to have nothing but a chaotic economic situation.

Gross national product, the number of people employed in the country, and our energy use are mirror images of one another. The U.S. Labor Department estimates that there are 104 million people in this country alive today who are going to have to be employed by 1985. Unless we develop the resources to turn the wheels of industry in this country to employ these people, we will have a depression by that time that is hard to imagine.

If we have to rely on outside sources for this oil, if we continue to increase our dependence on foreign sources, we say that that, too, will bring about a situation that this country cannot tolerate. The gross national product cannot stand a level of balance of payments deficit in the amount that would result from buying 50 percent of our oil needs at $40 a barrel in OPEC countries in 1985.

What kind of money are we talking about that the industry is going to have to generate in order to bring on the resources to keep us from having the problems that I have just alluded to?

During the 10-year period 1956 to 1965, the industry spent $44 billion for exploration and development. During the period 1966 to 1975, it spent $65 billion. As the last gentleman just talked about, capital formation in the oil industry is a very difficult thing—particularly from an independent's point of view. We cannot go into negative borrowing for exploration projects. Banks do not lend to people to drill wildcat wells. They have to generate capital from their own resources. To get where we think we ought to be by 1985, we are going to have to spend $265 billion from the years 1976 to 1985.

That money is going to have to come from oil and gas prices. We have got to somehow get to a replacement cost on pricing oil and natural gas.

I would like to speak for just a minute on the issue—and it has been discussed here this morning—where are the drilling rigs going to come from?

We maintain that we must have 4,000 rigs running domestically in the country by 1985. Where will they come from?

We can look at what has happened in the past. That industry operates on what I call the vacuum theory; that is, if there is need, there is the way we can build rigs—somewhere between 500 and 700 a year. All the people have to have is the assurance that there is going to be a need for the rigs and that we are not going to roll back oil prices again, that we are not going to continue to control natural gas prices.

I call your attention to the attached testimony of the Petroleum Equipment Suppliers Association and the International Association of Drilling Contractors that they can build these rigs. We can build rigs to the tune of 500 a year if a signal is given to the industry. We can have 4,000 rigs running in this country by the year 1985 without too much problem. We have the resource base in the country, we have the people in the country to man the rigs. Unemployment is one of our real problems.

In conclusion, I recommend that you very seriously consider the current administration's program and we hope that the Congress will understand that it is a have-not program for the energy industry in this country.

Conservation? We applaud it. But conservation alone is not enough. We have got to have long-term incentive and long-term stability in this country for the producers to go out and make the commitments that we have to have.

In conclusion, we recommend that you decontrol the price of upper tier crude oil and bring it to world market prices as quickly as possible. Decontrol new natural gas and have some type of phased decontrol for old crude oil.

We must have a taxation policy that is, in fact, an incentive to producers rather than a disincentive and we must have a signal that this country wants to go about becoming energy self-sufficient.

Thank you, gentlemen.

Senator GRAVEL. Thank you very much. I think you have answered my questions. I really appreciate the graphs and charts that you have provided for us. I think they will be very helpful to us.

Senator Bentsen?

Senator BENTSEN. Thank you very much, Mr. Chairman.

Mr. Jones, your testimony will be a contribution and of help to us. One of the things that you just touched on, you talked about the imposition of the preference tax on cost of drilling but you did not talk about the fact that we turn that around.

Mr. JONES. Right. This is the type of thing, Senator, that I am talking about. Even though relief for one year really helped us—we were in a real bind—we still need long term relief.

Senator BENTSEN. Of course you do. Let us talk about cash flow.

I looked at a lot of income tax returns to see what was happening to the cash flow of the independents. What happened was the intangible drilling cost is the only expense that was put on the tax. All the rest of those things put under the preference tax are categorized as income. This was an expense.

Now, if you do not have the cash flow and you have a negative cash flow—and I have looked at a lot that had that—that developed in 1976, what are you going to do?

Mr. JONES. What I did in my case was go out and borrow money. I had to stop drilling, literally shut down my exploration program, in order to create some positive cash flow with which to pay the losses that I had to sustain.

Senator BENTSEN. What you had to do was cut back?

Mr. JONES. Cut back your exploration program. We could not understand why it was this type of tax. At a time that we needed to encourage people to do exploration, how could this type of tax be passed.

Senator BENTSEN. Mr. Jones, another thing that has developed is that we have had an increase in the amount of drilling that is taking place. I get the question asked of me, and I get a statement made by the administrative witnesses, you have all of the incentives.

One of the things I notice is that a lot of it is completion wells, development wells, to expand known reserves, but a reduction in true exploratory. Can you borrow the money to go out and drill a true wildcat?

Mr. JONES. No, this is the real problem. This is what we think the administration has failed to address. When he says there is enough incentive in this program, we think he has failed to understand, really, what the oil and gas business is all about and independents, as optimistic as they are, have to pay their bills. When it gets down to the end of the well, they have to have a cash flow from some source to do this drilling with.

Senator BENTSEN. Particularly to do wildcat?

Mr. JONES. Correct. We maintain that we have to have somehow a phased, decontrol of old oil; even though the carrot will work to a certain extent if there is a high enough price for new oil, the people would like to go out and drill new wells, but they still have to have the money to do this drilling with.

Senator BENTSEN. Mr. Jones, the oil and gas industry is a major industry in the State I represent. I have been to a lot of association meet-

ings during those years. I found that there are very few new people coming into the business, very few young people. Most of the people I saw were older.

I have noted finally some young people coming in, and that is encouraging. I do not think they will stay unless those incentives are there and we have some consistent Federal energy policy.

Mr. JONES. If I could say one thing, Senator, we need to have a policy that the producers believe is stable and it is going to be consistent over a period of time and we quit having these continued attacks and rollbacks.

Senator BENTSEN. Mr. Chairman, I have no further questions.

Senator GRAVEL. As I understand it today, we have some tax treatment for depletion.

Mr. JONES. For small independents.

Senator GRAVEL. What percentage would that be of your independents that would still receive depletion?

Mr. JONES. The number was relatively large. You have to understand, a tremendous amount of the independents, numberwise, are very small.

Probably over half of the independents are getting depletion.

Senator GRAVEL. What about on dollar value?

Mr. JONES. No, sir. I do not know what the dollar value would be, but it would certainly be a small percent of the total cash flow of the oil industry that would be subject to percentage depletion.

All nonintegrated companies get it to a certain level.

Senator GRAVEL. Let me pose the question this way. I would like to know how you view the incentives, and also what the impact would be of the President's program now in legislation? We have depletion to a degree. We have an investment tax credit, we have geological and geophysical costs. Those can be written off.

Mr. JONES. No, sir. That is one thing we are proposing, in fact. The geological and geophysical costs should be written off as an intangible. That would be an incentive we would recommend.

Senator GRAVEL. Then you have your intangible drilling costs and the tax shelter drilling ventures.

Mr. JONES. Of course, the tax shelter drilling ventures are actually just a method by which an individual invests and takes these things you have already mentioned into his tax picture.

Senator GRAVEL. That is how you get your capital.

Mr. JONES As high as 25 percent of the independents' drilling money comes from these outside sources.

Senator GRAVEL. Where does the other 75 percent come from?

Mr. JONES. Internally generated capital flow.

Senator GRAVEL. This is what we have tried to do in the Congress, to have an incentive to get things going. How is this offset by the administration's proposal to tax at the wellhead?

Mr. JONES. The administration proposal does not give the producer anything, really. The tax that they are going to place on the wellhead value of oil and gas and, in fact, take away after the sale and then redistribute to the economy in some way in which we are not sure, leaves no incentive at all for the producer.

We think that in order for the producer to get the $265 billion that is going to be needed in the next 10 years, some of this capital flow

is going to have to go into the industry rather than into the U.S. Treasury.

Senator GRAVEL. We would be raising the cost of energy?

Mr. JONES. You would be telling the consumer he is paying replacement costs, raising his cost of energy up to world prices, as of 1977 or whatever term the administration uses there, yet the money really will not be going back into replacing energy.

Senator GRAVEL. We would be slowly plucking the feathers of a golden goose?

Mr. JONES. Yes, sir, the producer would be gradually selling himself out of business over a period of time.

Senator BENTSEN. Mr. Chairman?

Senator GRAVEL. Senator Bentsen?

Senator BENTSEN. I think the provision calling for a world price on new oil by the administration is excellent. The question is the definition.

Mr. JONES. That is right, and getting there, Senator.

Senator BENTSEN. The definition is an extremely limited one, and I think a rather naive one, but the Ways and Means Committee adopted virtually the definition of the Pierce-Bentsen bill on new gas, which is a much more reasonable definition and one that is much more workable, and one that a number of us will be trying to inculcate over on this side.

But that is a step forward and that will be helpful, I believe.

I brought up the question of stripper wells and trying to use that on gas to save some of the marginal wells that otherwise would be closed down, which I think are important to the reserves of this country. I would like to ask the same thing of you that I asked of the preceding witnesses.

Would your association give us information as to an appropriate classification for something that would be correlated with the stripper oil well?

Mr. JONES. It is a good point, and it certainly has worked in the case of a stripper oil well to preserve a real important resource base for the country. We would be very happy to furnish that.

Senator BENTSEN. Thank you.

Senator GRAVEL. I do not know if the Ways and Means is correct. It is my understanding that the President's price would come into being over 3 years, so the administration's world price would be 3 years too late if you measure that from 1975. You would have a 50-percent target.

Mr. JONES. This disturbed us very much. We do not move fast enough to what we call the market clearing price on new oil. We would hope you gentlemen would look at this.

Again, I would like to say of Congressman Jones' definition of new oil, we would hope the Senate Finance Committee would also look at it favorably.

Senator BENTSEN. Being one of the coauthors, that will be done.

Senator GRAVEL. We thank you very much.

Mr. JONES. Thank you very much.

Senator GRAVEL. We appreciated your testimony.

[The prepared statement of Mr. Jones follows Oral testimony continues on p. 204.]

STATEMENT OF A. V. JONES, JR., PRESIDENT, FOR INDEPENDENT PETROLEUM ASSOCIATION OF AMERICA

On behalf of: California Independent Producers Association; Kansas Independent Oil and Gas Association; Kentucky Oil and Gas Association; Liaison Committee of Cooperating Oil and Gas Associations; Louisiana Association of Independent Producers and Royalty Owners; Michigan Oil and Gas Association; North Texas Oil and Gas Association; Oklahoma Independent Petroleum Association; Pennsylvania Grade Crude Oil Association; Pennsylvania Oil, Gas and Minerals Association; Permian Basin Petroleum Association; Rocky Mountain Oil and Gas Association; National Stripper Well Association; Illinois Oil and Gas Association; Texas Independent Producers and Royalty Owners Association; West Central Texas Oil and Gas Association; Independent Petroleum Association of America; Ohio Oil and Gas Association; Independent Petroleum Association of Mountain States; Panhandle Producers and Royalty Owners Association; and the land and royalty owners of Louisiana.

My name is A. V. Jones, Jr. I am a partner in Jones Company, Ltd., an independent oil and natural gas exploration firm at Albany, Tex. I appear here as president of the Independent Petroleum Association of America, a national organization of independent petroleum producers representing some 4,700 members in every producing area in the United States, and on behalf of the independent State and regional associations listed on the cover page.

The purpose of our presentation is to suggest critical changes which must be made in the Administration's approach to energy development if domestic producers are to have an opportunity to meet future needs of consumers for petroleum fuels. The administration is pressing for total Federal authority to fix the prices and "manage" the supplies of oil and gas on a basis which, in our view, would assure declining production and chronic shortages.

Because the United States already has a very large and growing deficit in its domestic supplies of both crude oil and natural gas, it is our firm conviction that adoption of the administration proposals would so aggravate our future supply position as to cause intolerable impacts on our balance of payments and unacceptable security problems arising out of our loss of control over critical supplies of energy.

The proposals suggested, Mr. Chairman, would amount to a regulatory overkill that would so limit domestic exploration-development investment that dependence on insecure foreign energy would be extended to levels which may never be corrected. When this occurs, many will say, "The industry has failed the consumer. The Government must now take over." Should that happen, our country will—in my opinion—be on a headlong course into an energy doomsday that is unnecessary and therefore avoidable.

Let's look for a moment at where we stand today. In January this year for the first time petroleum consumption exceeded 20 million barrels per day. Imports of petroleum exceeded domestic production—that is, we are approaching 50 percent dependency whereas as recently as 9 years ago we had the ability to produce more oil and natural gas than we consumed. Our January balance of trade reflected the worst deficit in the history of the United States with imported oil accounting for a major share. In 1976 the total cost of imported oil and natural gas was $37 billion. By comparison, the total wellhead value of all domestic oil and gas—which provided 2½ times the energy equivalancy—was about $36 billion.

There appears to be no disagreement about the need for incentives to develop alternatives to conventional oil and natural gas supplies. What does seem to be overlooked by both Congress and the administration is the need to bridge the gap from now until that day when we can rely extensively on alternatives. Crude oil and natural gas presently supply some 75 percent of our energy. For the next several years, we will become increasingly more dependent on insecure foreign oil unless we have a vigorous, healthy and expanding domestic petroleum industry. Instead of being encouraged by sound, consistent policies, oil and gas producers have been confronted with the following:

(1) October 9, 1969—percentage depletion cut from 27½ percent to 22 percent;

(2) March 29, 1975—enactment by Congress of Tax Reduction Act of 1975, substantially repealing percentage depletion for about 85 percent of domestic oil and gas. This long-standing tax policy has been left intact for some 100 other extractive industries;

(3) February 1, 1976—rollback of approximately $1.50 per barrel for new crude oil;

(4) September 16, 1976—enactment by Congress of Tax Reform Act of 1976, retroactively imposing punitive tax on expenditures, not on income of independent oil and gas producers;

(5) July 1, 1976—imposition of a price freeze on all domestic crude oil;

(6) December 31, 1976—a rollback of 20 cents per barrel for new domestic crude oil and continuation of existing price freeze on crude oil;

(7) February 1, 1977—a retroactive doubling of rental fees on most oil and gas leases on Federal onshore lands;

(8) March 1, 1977—a rollback in U.S. crude oil prices of 45 cents per barrel on new oil.

The combined impact of these actions on domestic oil and gas producers is to remove roughly $5 billion annually which otherwise would be available for additional exploration and drilling. This listing should dispel any doubt as to why our domestic oil and gas production is declining and why we grow ever more dependent on insecure foreign oil. The 10,000 independent producers and explorers who drill most of the wells should be making a maximum effort in developing new supplies. But they are not because of the counterproductive effect of adverse Government policy. During 1975 and 1976, active rotary rigs were at a standstill, averaging about 1,650 rigs. Twenty years ago there were over 2,600 rigs active. We should be utilizing 4,000 rigs if we are to bring on new production adequate to reverse our intolerable dependence on foreign supplies. This will require positive actions by Congress and the administration.

Under long years of price regimentation and punitive tax actions, total drilling in the United States declined by 51 percent on an uninterrupted downtrend from 1957 to 1972 (see chart "Total U.S. Well Completions"). On the bottom of this chart, expenditures for exploration and development are shown for this same period—divided between major companies and independent producers. As can be seen, retrenchment by independent producers was the sole factor in the curtailment of domestic exploration and development. Expenditures by the large companies, the so-called "Chase Bank Group," actually increased during this period.

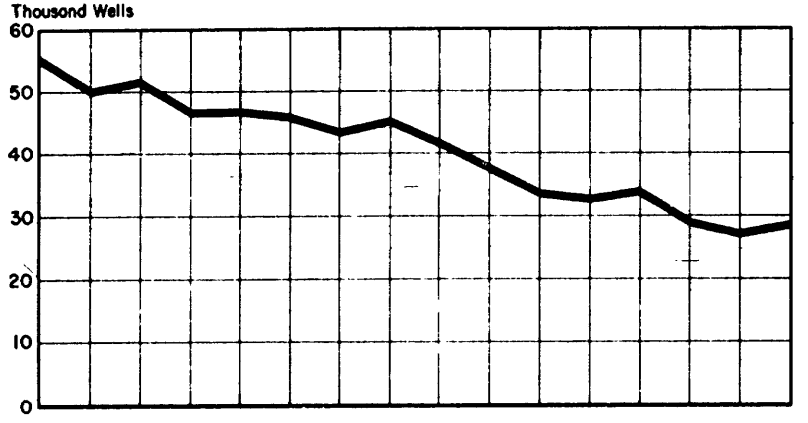
Under pressure of a progressive cost-price squeeze imposed by rigid wellhead price controls, about half of the independent explorer-producers active in the mid-1950's had merged out, sold out or simply gone broke by 1971. Some 10,000 former independents left the industry during this period. The industry was decimated for one primary reason: unrealistic and anticompetitive price-fixing by the Federal Government.

While domestic oil and natural gas exploration, development and production is the most highly competitive major industry in America, there has been a trend toward concentration since the mid-1950's. This trend was caused directly by Federal Government intervention to fix wellhead prices, which established an economic climate in which marginal producers could not survive. Under Government-administered pricing, the large units with profit centers worldwide survived better.

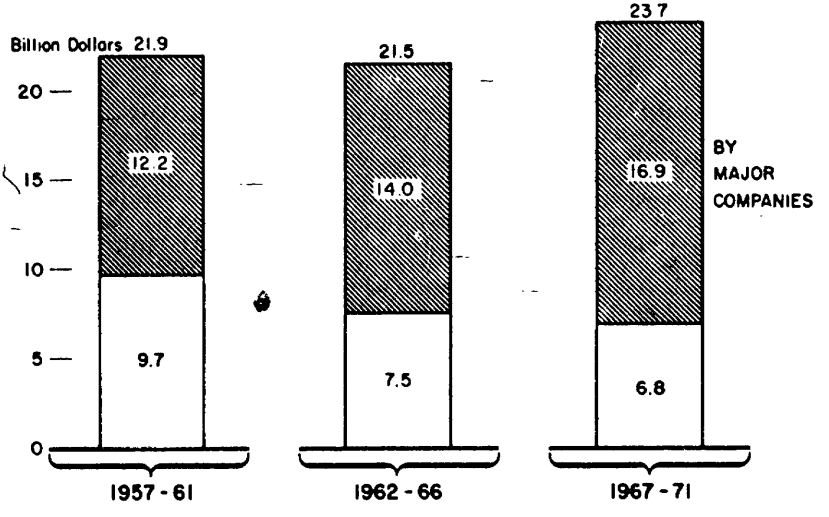
When Government determination and dominance of economic conditions are carried to the extreme, only the big can survive. The Carter administration energy program is a blueprint for such dominance.

To sum up the long experience of contraction in the domestic industry, I call your attention to the chart "The U.S. Petroleum Industry, 1972 vs. 1956." On the lower portion of the chart the decline in the principal activities in the domestic industry in this 15-year period are shown. Geophysical activity, which has been a reliable barometer indicating future directions of rig and drilling activity, dropped 60 percent. Active rotary rigs declined 58 percent, and both exploration and total well completions dropped well over 50 percent.

TOTAL U.S. WELL COMPLETIONS

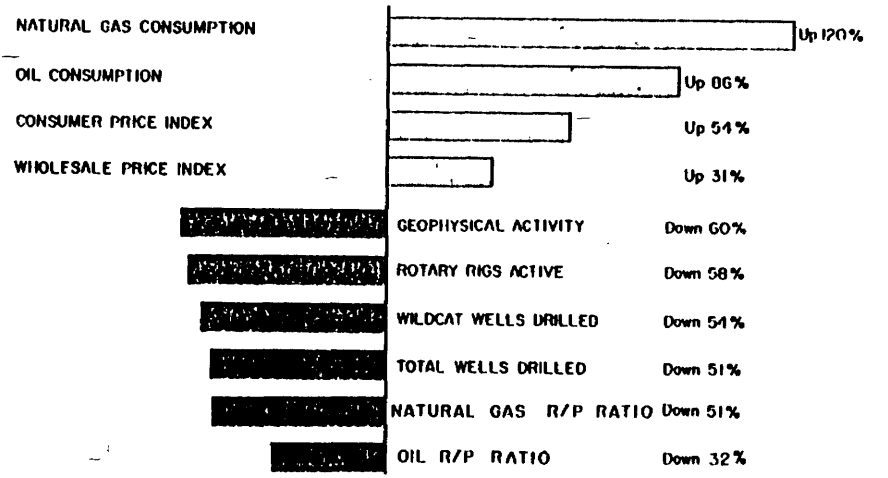


U. S. EXPLORATION AND DEVELOPMENT EXPENDITURES



THE UNITED STATES PETROLEUM INDUSTRY

1972 vs 1956



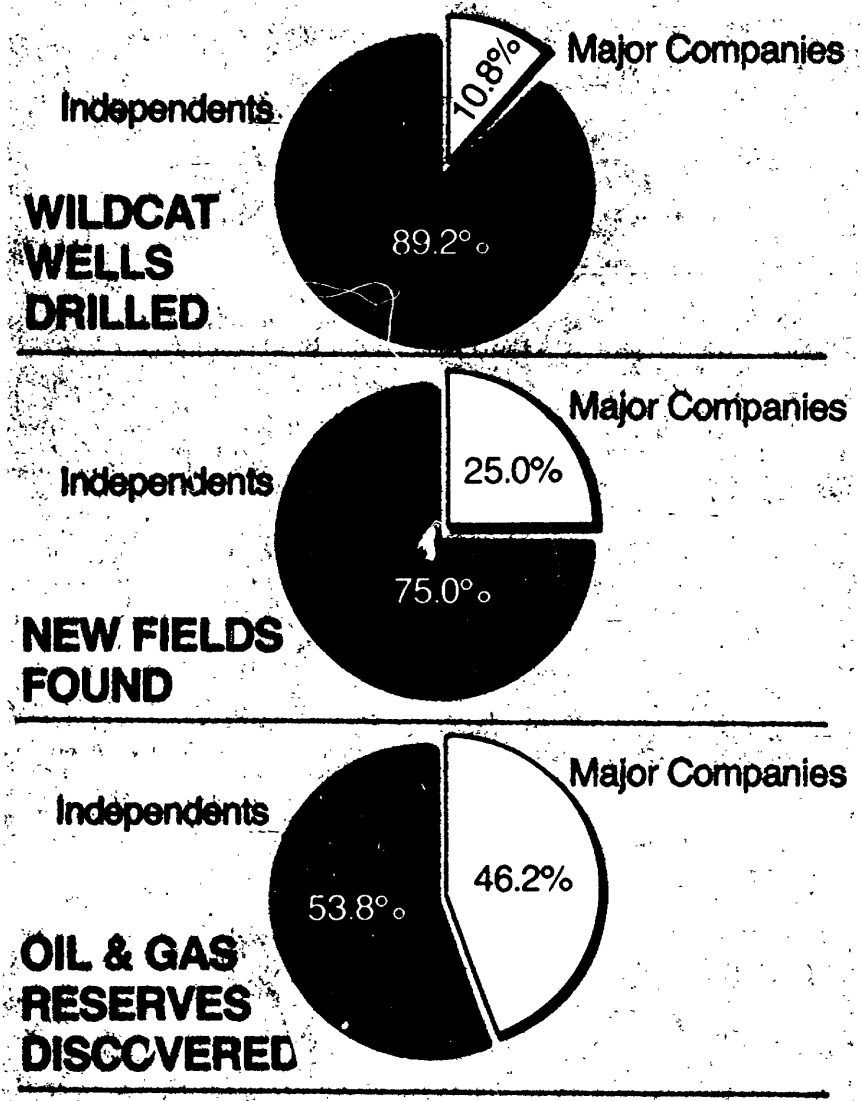
While these basic activities directed at finding and developing oil and gas supplies were declining over these many years, the demand for oil increased 86 percent and consumption of natural gas rose 120 percent. The result was declining reserves, resulting in inevitable and progressive domestic shortages and rising dependence on foreign energy supplies.

This whole experience demonstrated the vitally important role of the thousands of independent producers. Even though the total number of independent explorer-producers dropped by half from the mid-1950's up to the time of the 1973 embargo, in the latest 5 years of this period, 1969–73, independents as a group continued to dominate in domestic petroleum exploration and development.

The chart "Role of Independents" is based on data from the American Association of Petroleum Geologists. It shows that in the 1969–73 period, independents drilled 89 percent of domestic wildcat wells, found 75 percent of the significant new oil and gas fields and accounted for 54 percent of the oil and gas reserves found. This is a significant contribution toward the total effort to provide increased domestic petroleum supplies. The problem has been that the industry as a whole, and independents in particular, have performed at a declining and inadequate level for most of the past two decades.

Beginning in 1974, after a 17-year cost-price squeeze that progressively thinned the ranks of independent explorer-producers, the domestic industry set in motion a resurgence of effort which promises to add significantly to domestic oil and gas supplies. The industry's responsiveness in this short period has demonstrated conclusively what producers have been saying for years—that expenditures to find and develop petroleum fuels would increase in direct proportion to improved price incentives, as they always have.

ROLE OF INDEPENDENTS



Source: American Association of Petroleum Geologists

While the increased drilling response since the 1973 embargo has been significant, it is barely a start toward doing what can and should be done to increase domestic gas and oil production in the next two decades until alternative energy resources can be brought on stream.

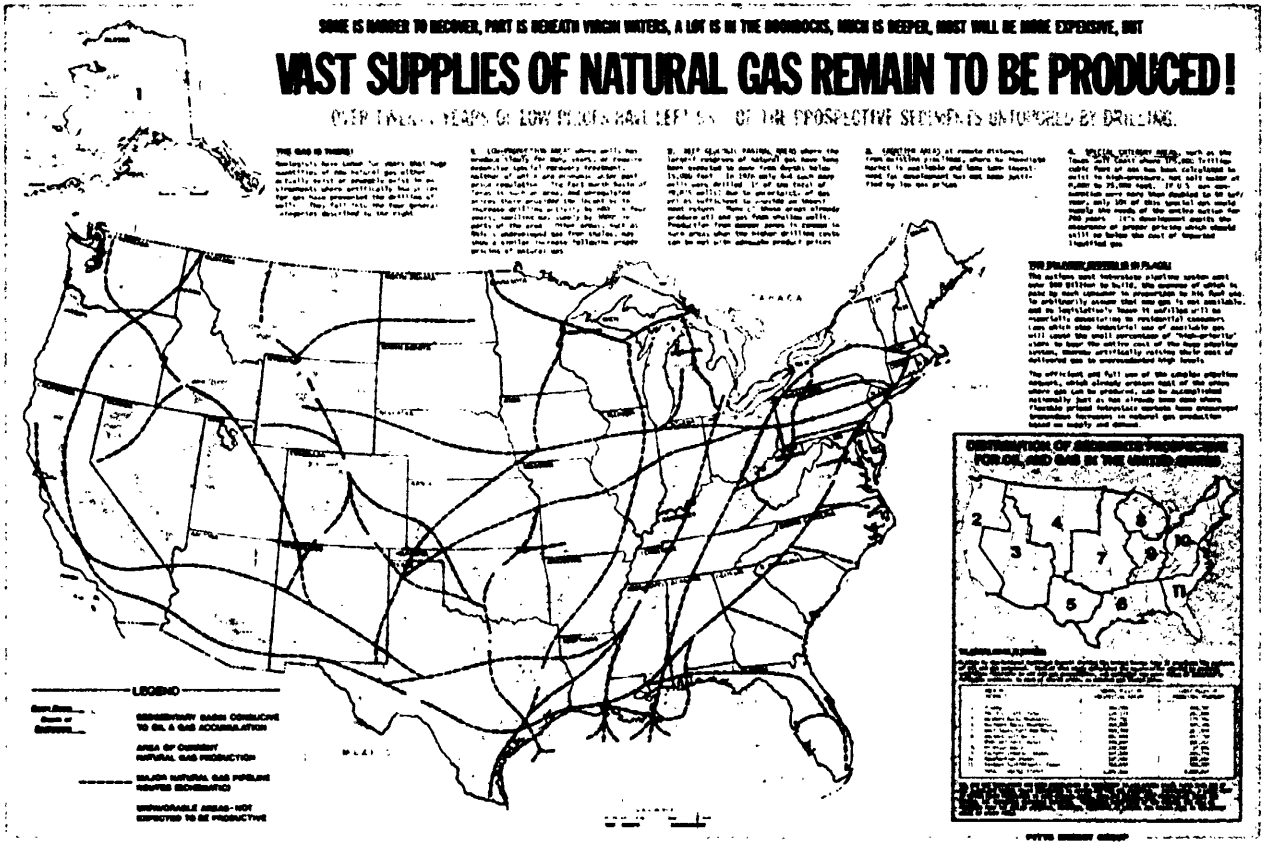
The primary stimulus for increased natural gas exploration and development has been increased incentives of market pricing for intrastate natural gas. It is significant that where difficult intrastate shortages of gas existed in 1974–75, in Texas and some areas of Oklahoma and Louisiana, the market has now cleared and contract prices are generally down by approximately 50 cents per thousand cubic feet from the peak prices of a year or so ago.

Instead of building on this positive experience, the Administration has adopted a defeatist, no win approach which reflects a lack of faith in the proven ingenuity of our industry in finding and providing increased gas supplies, and an unjustified faith in a regulatory system that has been a failure on every count. It is disturbing that this approach is apparently grounded on a number of premises that are without support in our prior experience.

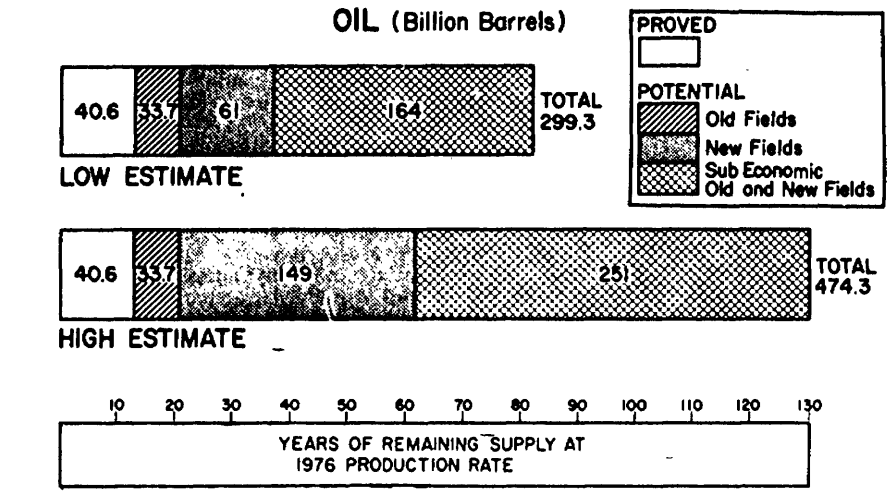
I would like now to discuss specifically some of the administration's premises which, taken together, reflect an unjustified lack of faith in our proven capacity to solve problems.

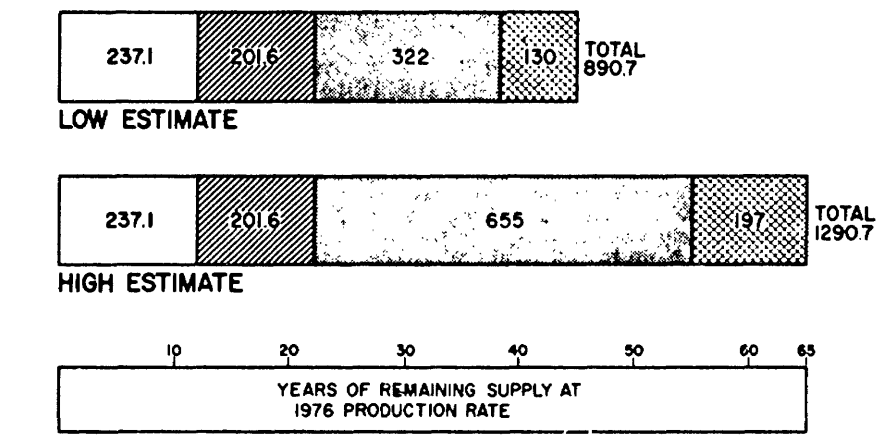
The primary and overriding premise of the Carter program is the conclusion that our petroleum resource base is not sufficient to permit significant additions to supplies. In the case of natural gas, this conclusion was expressed by Mr. John F. O'Leary, the administrator of FEA, who said that natural gas "has had it." Such a conclusion is not justified by anything in the great body of both private and Government data that reflect expert evaluations of the remaining geologic potential for both gas and crude oil.

Professional geologists nationwide agree that vast quantities of natural gas remain to be produced in this country. In 1967, the National Petroleum Council, at the request of the Department of Interior, began a study of future petroleum provinces of the United States. The results of the coordinated study, in which dozens of the nation's most prominent geologists participated, was published in two volumes in 1971. Over 3,000,000 square miles of basinal area in the United States were identified as having sediments prospective for oil and gas. This compares with only 50,000 square miles on which oil and gas production exists, or has existed to date—less than 2 percent of the prospective area, and most of that is relatively shallow (see map attached). With the nation being called on to attack our energy shortages with the "moral equivalent of war," it seems highly inconsistent that we should also be told to turn our backs on 98 percent of the prospective oil and gas sediments, and simply lie down under a flag of surrender. Americans have not responded to the great challenges of the past in this manner.


SOME IS HARDER TO RECOVER, PART IS BENEATH VIRGIN WATERS, A LOT IS IN THE BOONDOCKS, MUCH IS DEEPER, MOST WILL BE MORE EXPENSIVE, BUT
VAST SUPPLIES OF NATURAL GAS REMAIN TO BE PRODUCED!
LEGEND
DISTRIBUTION OF SEDIMENTARY PROSPECTIVE FOR OIL AND GAS IN THE UNITED STATES

U. S. PETROLEUM RESOURCE BASE





SOURCE: U S Geological Survey (1975) These USGS estimates do not include potentially large supplies in tight sands, shales, or geopressured reservoirs or from water depths greater than 660 feet

The U.S. Geological Survey study of 1975 is within the range of estimates of most resource base studies and is considered realistic by many. The U.S.G.S. estimates for potential conventional natural gas and oil resources are shown in the chart "U.S. Petroleum Resource Base." The proved and potential gas supplies in this evaluation amount to a 55-year supply at the 1976 production rate. Another 10 years' potential exists in "currently subeconomic" resources that U.S.G.S. believes will become available with improved technology and/or economics.

These estimates do not include potential natural gas volumes from tight shales and sands in both the Western and Eastern United States, geopressurized reservoirs on the Texas-Louisiana Gulf Coast, or in sediments below water depths of 600 feet. Attached to my statement is a summary from a draft ERDA study which estimates a total gas potential of 730 trillion cubic feet in just four tight sand basins in the Rocky Mountain area. Obviously, development of techniques which would bring these tremendous potentials into production would extend our access to natural gas not by just decades, but by more than a century.

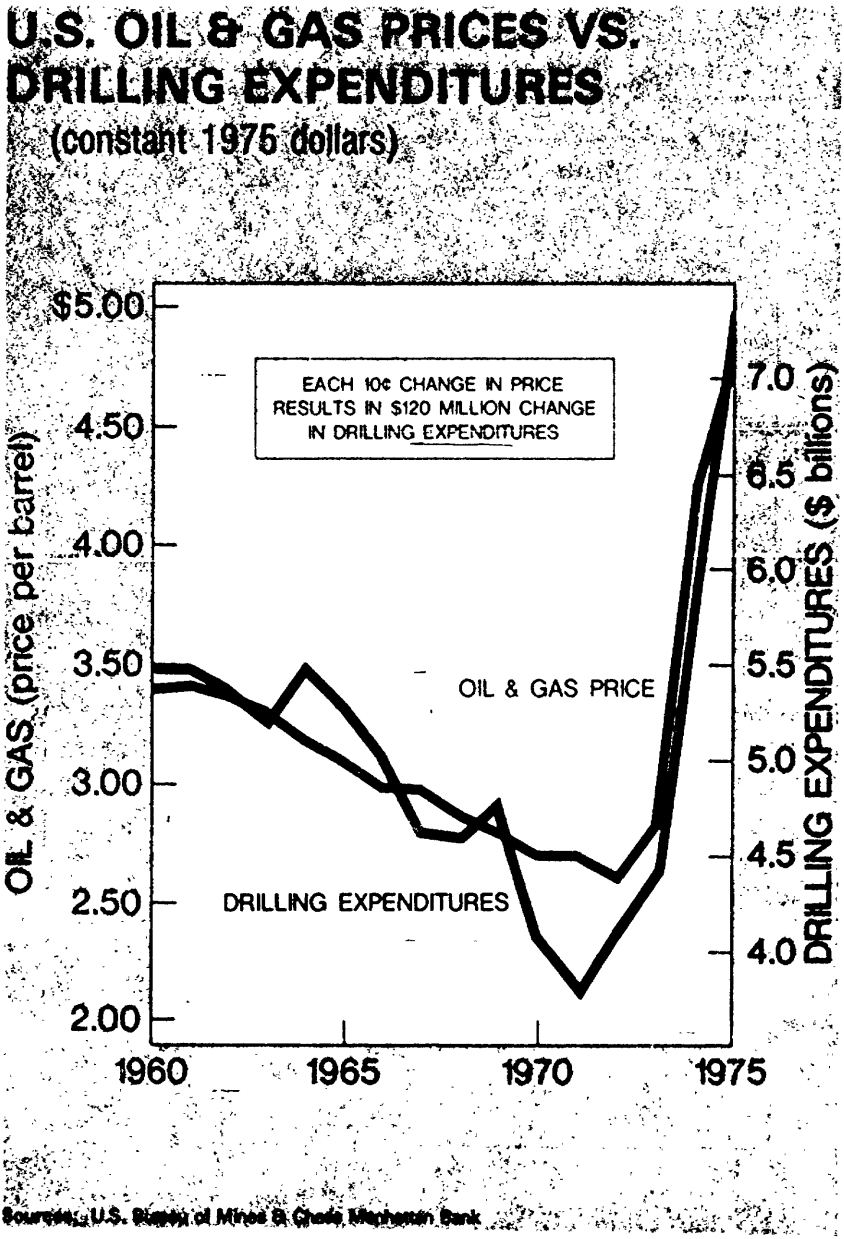
Just as obviously, an economic climate under price regulation that would inhibit development of conventional oil and gas, which the Carter plan assuredly would, also would postpone development of these high-technology resources for the indefinite future. It would be selling the country's consumers tragically short to write off the possibility of improving future supply when we have identified potential supplies in such great abundance.

Another faulty premise upon which the Administration is basing its scheme for permanent price controls is its argument that, "Higher costs (prices to producers) do not yield more oil and gas." All past experience refutes that contention. More oil and gas always has been provided by drilling more wells. Levels of drilling always have been determined by prices at the well for oil and gas, as illustrated by the chart "U.S. Oil and Gas Prices vs. Drilling Expenditures." For each change (up or down) of 10 cents per barrel in the composite oil and gas price, there has been a corresponding change of $120 million in drilling expenditures.

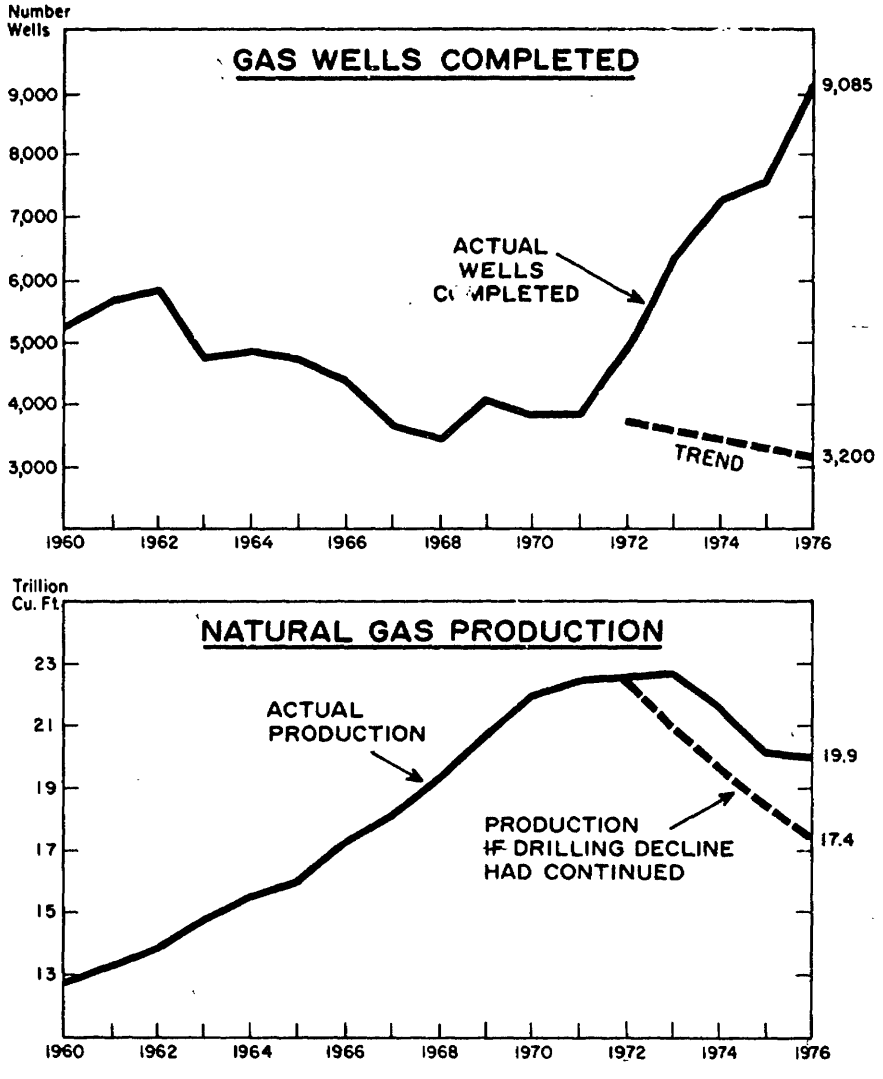
Since 1973, the rise of approximately $2.36 per barrel in this composite price has stimulated increases in expenditures of $3 billion per year. Claims have been and are being made to the effect that this acceleration in drilling is not adding to supply. These statements reflect an expectation that an industry which declined for 17 consecutive years and was in an atrophied condition just four years ago should be able to achieve a turnaround in declining production in just three years. Such expectations are totally unrealistic. On the other hand, they ignore the progress which has been made. For example, the chart "U.S. Gas Wells Completed & Gas Production, 1960–76," illustrates that production in 1976 was 2.5 trillion cubic feet more than it would have been had drilling continued to follow the 1960–71 trend. Except for this real gain in natural gas production as a result of increased drilling in the past four years, oil import dependence in 1976 would have been more than 1,250,000 barrels daily higher and our dollar outflow for foreign oil $6.1 billion greater.

Similarly, our data shows that the decline in domestic crude oil production has been substantially arrested, and production is some 800,000 barrels daily higher than would have been without the 1973–77 acceleration in drilling.

Last year Congress decontrolled wellhead prices of stripper well crude oil. As an indication of producer response to incentives, I note the following results. Abandonments of producing stripper wells have declined sharply . . . 44 percent in the three states which contain about one-half of all the stripper wells in the country—Texas, Louisiana, and Kansas. Total producing wells in the United States increased from 497,000 to 503,000 during 1976. This resulted from increased drilling as well as the decline in abandonment of stripper wells due to the removal of price controls and resultant increase in the economic life of many wells.


U.S. OIL & GAS PRICES VS. DRILLING EXPENDITURES
(constant 1975 dollars)
EACH 10¢ CHANGE IN PRICE RESULTS IN $120 MILLION CHANGE IN DRILLING EXPENDITURES
OIL & GAS PRICE
DRILLING EXPENDITURES
OIL & GAS (price per barrel)
$5.00
4.50
4.00
3.50
3.00
2.50
2.00
DRILLING EXPENDITURES ($ billions)
7.0
6.5
6.0
5.5
5.0
4.5
4.0
1960
1965
1970
1975
Sources: U.S. Bureau of Mines & Chase Manhattan Bank

U.S. GAS WELLS COMPLETED & NATURAL GAS PRODUCTION, 1960-1976

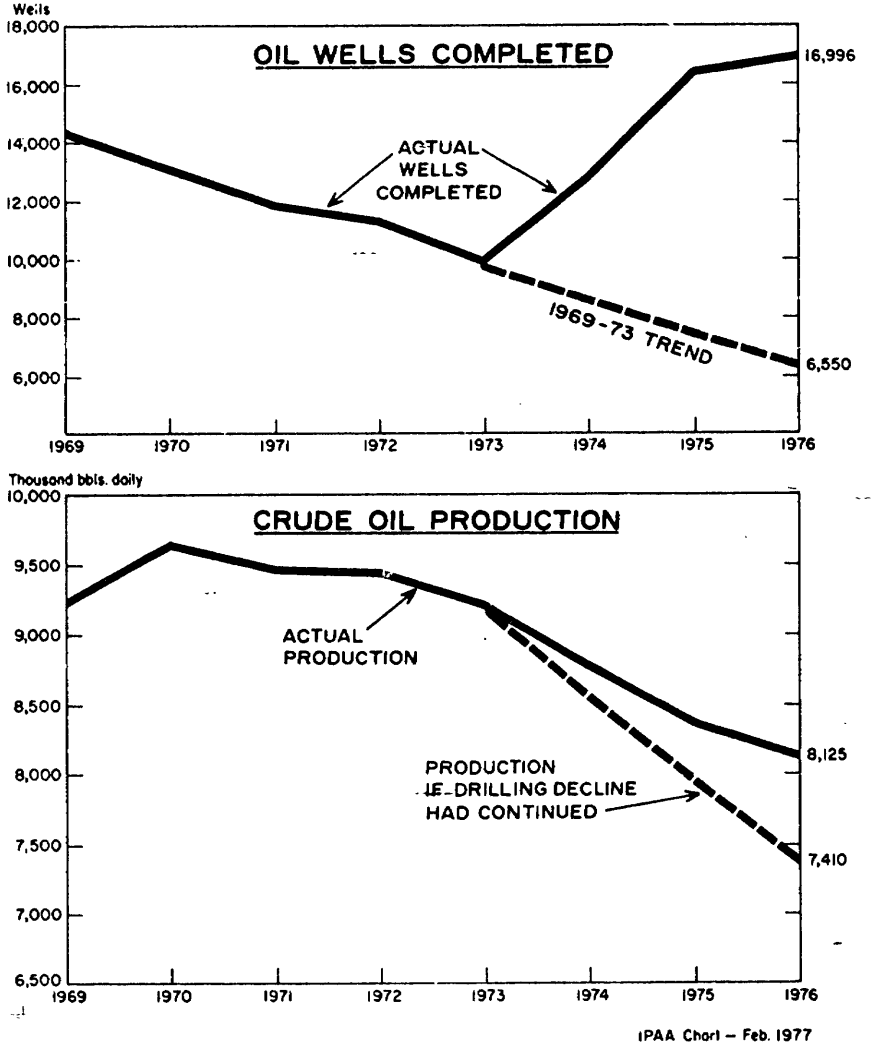


Based on estimated decline in production of only 8 percent per year with no drilling.

IPAA Chart – June 1977

Equally important is that stripper well production now accounts for approximately 16 percent of domestic oil production—up from 13 percent a year earlier—and stripper reserves are now estimated at 7.5 billion barrels—up from 5.8 billion in 1973. The results of this response to the positive incentives of increased prices are shown on the chart "U.S. Oil Wells Completed and Crude Oil Production, 1969–76."

U.S. OIL WELLS COMPLETED & CRUDE OIL PRODUCTION, 1969-1976

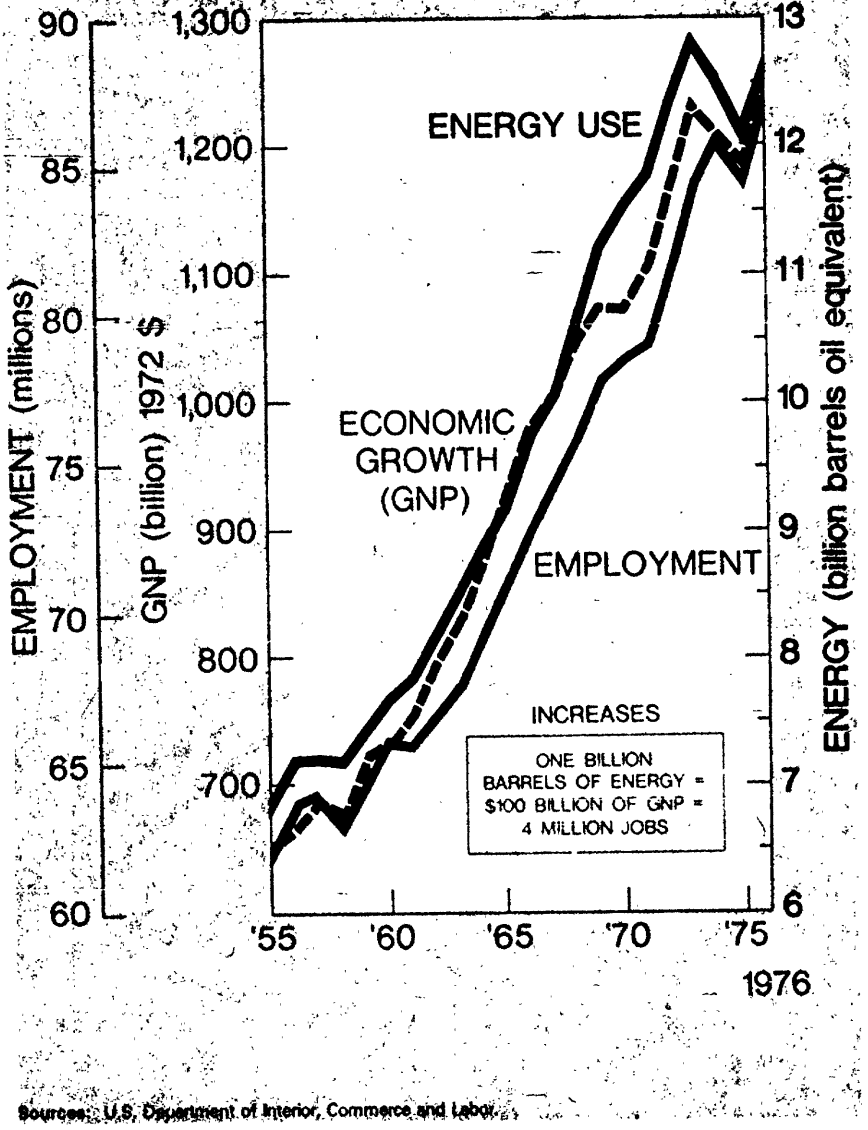


IPAA Chart – Feb. 1977

We have made only a small start in mobilizing the exploration-drilling arm of the domestic industry to the level of activity at which it can and should be operating. To make the oil and gas supply contribution necessary to see the nation through the transition period of the next two decades, we must effectively double the present rate of drilling. This brings me to still another unsupportable premise of the Carter energy policy staff which in one memorandum states that reduced energy growth is "fully compatible with economic growth, development of new industries, and the creation of new jobs." Contrary to the facts, they state flatly, "there is no fixed relationship between energy and GNP."

ENERGY EMPLOYMENT & ECONOMIC GROWTH

1955 - 1976

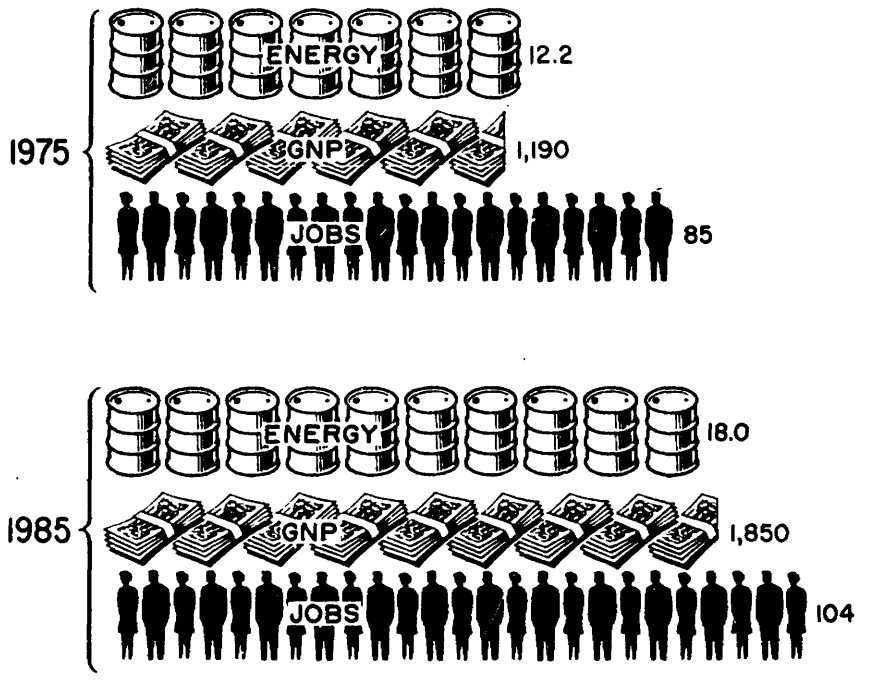


Sources: U.S. Department of Interior, Commerce and Labor

ENERGY EMPLOYMENT & ECONOMIC GROWTH

1975-1985

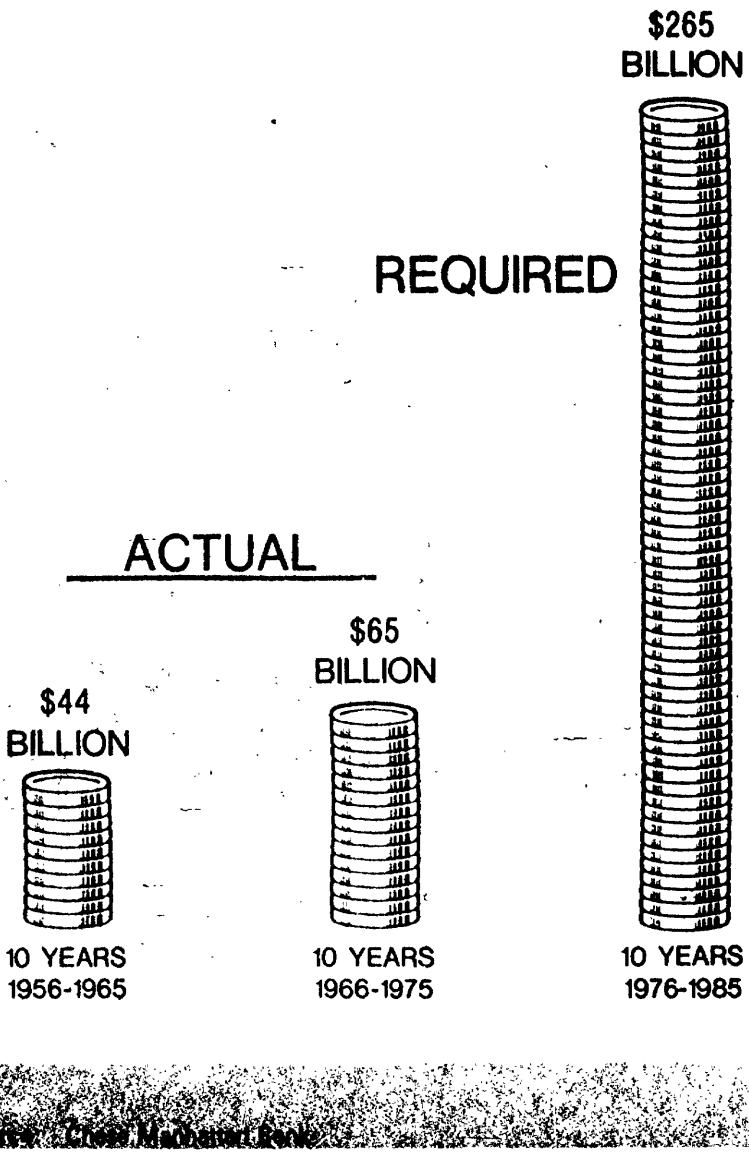
Energy in billion barrels of oil equivalent
Employment in millions of jobs
Economic growth in billion $ of GNP



Sources: U.S. Department of Interior, Commerce and Labor.

IPAA Chart - Feb. 1977

EXPENDITURES U.S. EXPLORATION & DEVELOPMENT



Source: Chase Manhattan Bank

The chart, "Energy, Employment and Economic Growth" covers 20 years of experience during which energy consumption, GNP and employment have been mirror images of each other. In fact, energy consumption equivalent to one billion barrels of oil consistently has been accompanied by $100 billion in GNP and the addition of 4 million new jobs.

What of the future? The next chart shows the Department of Labor's projections indicating that our economy must accommodate 104 million working Americans by 1985. This work force would generate a 1985 GNP of $1,850 billion in 1972 dollars. Based on past experience, this expansion in economic growth will require an increase in energy use of about 50 percent.

In 1975, we consumed approximately 12 billion barrels of oil equivalent. The Chase Manhattan Bank estimates that the petroleum industry must spend some 265 billion (current) dollars (see attached chart entitled "Expenditures vs. Exploration and Development") in the decade 1975 to 1985 on domestic exploration and development in order to accomplish levels of energy adequate to support our workforce in 1985. With 1976 and 1977 almost behind us, the industry will have to expend at the rate of almost $25 billion per year on the average from 1978 until 1985 in order to achieve the lower level of energy supply of 15 billion barrels of oil equivalent targeted by the President's energy plan. The President's Crude Oil Pricing Policy, Natural Gas Pricing Policy and Petroleum Taxation Policy are inadequate to generate these substantial sums of necessary capital.

Unlike most other industries, the petroleum exploration industry is a high risk industry which requires investor capital in hand. Money cannot be borrowed to carry out exploratory drilling programs. The President's National Energy Plan (NEP) falls short in that it fails to acknowledge that the price of a commodity must not only provide the incentive to invest capital to bring on new supplies and also must provide the cash flow from existing production to generate the investment capital. Even if the President's definition of "new" crude oil were reasonable and provided market level incentives for significant numbers of potential investments, producers would suffer cash flow restrictions under the President's program that would disallow maximum effort to increase domestic supply.

The National Energy Plan would price crude oil on a replacement cost basis, but the Crude Oil Equalization Tax (COET) would tax all the increased cash flow from the producer. The COET amounts to a massive income redistribution plan. None of the tax would accrue to the producer for the purpose of increasing crude oil supplies. In the face of naturally declining existing production and an inadequate inflation adjustment factor to fully reflect increasing oilfield costs, the producer would be unable to generate sufficient capital to replenish the reserves he produces.

Natural Gas Pricing Policy as proposed in the NEP suffers the same basic economic failings. It would extend federal control of the price of natural gas sold in the interstate market, a concept which has failed miserably, to the intrastate market. The proposal would in fact, roll back process of some intrastate gas. Consumers of America will have less natural gas available under the President's Natural Gas Pricing Proposal than would be available under the present situation.

Although the President recognized the adverse nature of including intangible drilling expenses as a tax preference item subject to minimum tax, the National Energy Plan failed to recognize other critical limitations on capital formation for independent producers. The provision which limits allowable depletion to 65 percent of taxable income and the recent IRS Revenue Ruling 77-176 particularly inhibit independent oil and gas producers from generating internal funds and raising capital from outside investors.

We have prepared a detailed analysis of the pricing and regulatory proposals for both crude oil and natural gas. These analyses together with our comments on the suggested amendment of the minimum tax on intangible drilling costs are somewhat lengthy due to the complexity of the Carter proposals. However, because we believe a clear understanding of the shortcomings of the NEP are so vital they are appended to my statement.

In summary, in order to accomplish the stated objectives of the President's program or the Chase Manhattan Bank's estimates, a favorable economic environment for investment in the domestic petroleum industry must be provided.

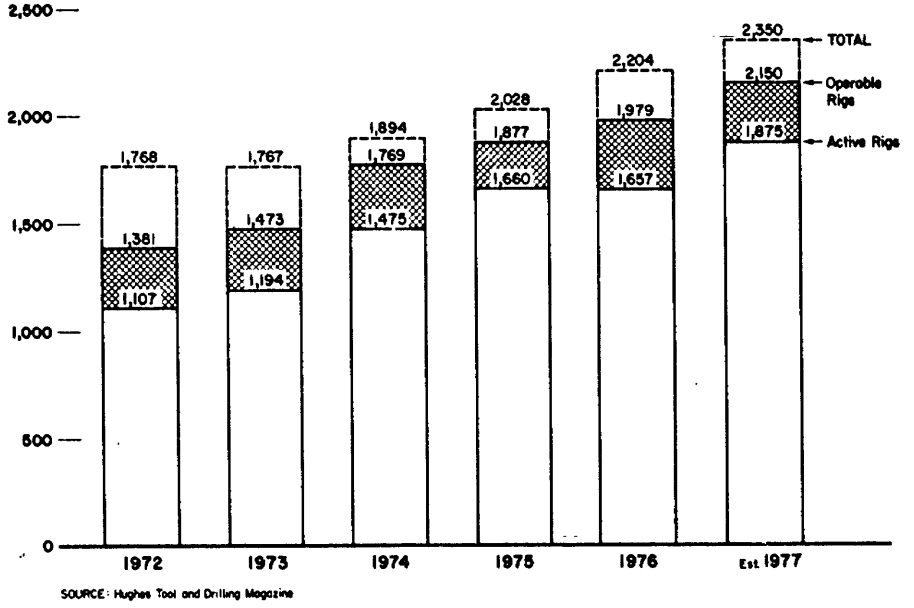
Finally, the faulty premises of the NEP include a highly pessimistic appraisal of the ability of the support industries supplying rigs, pipe and other materials to

provide the hardware to significantly expand exploration and development. Again, the experience of our industry should allay any concern that we would be inhibited by rig shortages or other shortages—except where government policy may signal such uncertainty about the economic climate that fabrication of needed equipment is frustrated.

The chart "U.S. Rotary Rigs Available" illustrates that almost 800 units have been added to our operable rig inventory since the pre-embargo year of 1972. I might say this is 200 rigs more than expert analyses within the industry itself had indicated. Again, there is no basis for selling short our ingenuity and ability to get on with the task of developing our critically needed energy resources.

U.S. ROTARY RIGS AVAILABLE

1972 - 1977 Est.



SOURCE: Hughes Tool and Drilling Magazine

Attached are copies of two statements presented last month to a subcommittee of the House of Representatives considering the same proposal. The first is by James F. Justiss, Jr., President of the International Association of Drilling Contractors. The other is by Gerald A. Helland, Jr., President of the Petroleum Equipment Suppliers Association. Together they clearly establish that the rigs, equipment, pipe and supplies necessary for an all-out expansion of exploration-drilling activity will be there whenever Congress and the Administration give the industry a "go" signal.

SUMMARY

IPAA firmly believes that the solution to our intolerable dependence on foreign crude oil is to unleash private enterprise by relying on market forces to efficiently allocate existing energy supplies, stimulate innovations to conserve our natural resources, and maximize efforts to increase domestic supplies to balance demand with supply. The United States has the potential petroleum resources; and with the proper economic environment, the support industries have the capability of responding to increased demand for their drilling rigs, pipe and equipment.

We must recognize that conservation alone cannot solve our energy problems. To rely on conservation is to risk a highly regimented economy with staggering

unemployment and unprecedented invasion of individual freedom of choice which is a cornerstone of the American system.

In the long term alternative sources of energy will be able to assume a greater share of our energy burden. However, in the shorter term of the next decade or so, crude oil and natural gas will continue to provide the bulk of our energy requirement. The only real question remaining is whether crude oil and natural gas will be developed from our domestic resource base or whether we will allow ourselves to become increasingly dependent on foreign nations for our energy lifeblood. The attendant balance of payment problems and the precarious national security situation make it clear that U.S. consumers should rely on U.S. producers, not foreign countries, for their energy supplies.

RECOMMENDATIONS

Recognizing that replacement cost of energy in the United States is the cost of imported energy and that it is economically efficient and prudent to encourage domestic crude oil and natural gas production at market prices up to that cost to maximize domestic production, stimulate conservation and conversion to alternative fuels, and reduce energy imports, we urge adoption of:

A. Crude oil pricing policy

1. Decontrol the price of upper tier crude oil and all economically marginal crude oil. This will maximize incentives to increase production and prevent the premature abandonment or shutting in of domestic production which would otherwise have to be replaced by foreign imports.

2. Phase out price controls on lower tier crude oil by the end of May, 1979. This would provide the capital necessary for exploration and development to increase the supply of energy for consumers. This would also eliminate the need for a cumbersome entitlements program and other regulatory burdens. Consumers would be given a clear signal that future prices of energy will reflect replacement costs.

B. Natural gas pricing policy

Encourage increased natural gas production by deregulating the price of new natural gas and phasing out controls on old gas. IPAA specifically supports H.R. 2088, introduced by Congressman Krueger, et al, and S. 256, introduced by Senators Pearson and Bentsen.

C. Petroleum taxation policy

The Congress must provide a sound, reliable oil and gas taxation policy which encourages capital formation and spending in the domestic oil and gas producing industry. The Congress must also correct past taxation policies which are now inhibiting investments in drilling crude oil and natural gas exploratory and development wells. Specifically, Congress should:

1. Eliminate for independent producers intangible drilling expenses as a tax preference item subject to the minimum tax. Such a tax is not a tax on income, but instead is a tax on expenditures.

2. Repeal the 65 percent of taxable income limitations on allowed depletion for independent producers of crude oil and natural gas. This provision discourages independent producers from maximizing their drilling investments.

3. Prevent further deterioration in the percentage depletion rate and allowable volume. This would alleviate further deterioration of the capital base of independent producers.

4. Provide for expensing of geological and geophysical expenses rather than requiring their capitalization.

5. Enact an Energy Development Investment Tax Credit which would allow a direct credit against federal income tax for expenditures intended to result in greater domestic energy supplies.

D. Accelerate leasing program

Accelerate the leasing of federal lands on the Outer Continental Shelf for oil and gas exploration and production and reverse federal public lands policies which result in the withdrawal of significant areas from mineral exploration and development.

E. Conservation

Stimulate conservation of energy and our national resources not through artificial taxes, end use controls, or rationing, but by pricing energy according

to the competition. This is the most efficient and least disruptive way to achieve desired results.

F. Regulatory reform

Eliminate counterproductive regulations and streamline procedures for the siting of energy facilities and transportation systems.

We have the natural resources, knowledge and capacity to solve our energy problem. What we lack are adequate incentives which the market place will provide if unreasonable government interference is removed.

IPAA Comments on the Carter Crude Oil Pricing Proposal

President Carter's proposal for the pricing of crude oil will provide neither the economic incentives nor the massive amounts of capital necessary for producers to maximize their efforts to increase crude oil supplies.

At the time of the President's April 20 Energy Message, it appeared the Administration contemplated legislative amendments to the Emergency Petroleum Allocation Act (EPAA), the statute governing crude oil pricing and containing the composite pricing requirements. The most significant element in this approach would have been elimination of the composite pricing system.

It now appears that the Administration has changed tracks and will attempt to implement its pricing policy within the purview of the composite price.

The inadequacy of the composite price concept has been woefully apparent. Crude oil price schedule No. 1 laid out a crude oil pricing schedule between February 1976 and May of 1979 which allowed increases of approximately 7¢ per barrel per month in upper tier ceiling prices and 3¢ per barrel per month in the lower tier ceiling prices. History has proven that schedule to be sheer folly.

Initially, schedule No. 2 froze both upper tier and lower tier ceiling prices at June 1976 levels for the months of July and August. Schedule No. 3 extended that freeze for an additional three months through November 1976. By the end of November, FEA was beginning to see the impact of the Energy Conservation and Production Act which redefined stripper well production and the FEA's clarification of the definition of a property in August. In anticipation of more fully addressing the problem of excesses over the statutory composite price, FEA issued schedule No. 4 which extended the crude oil price freeze through December. Schedule No. 5 continued the price freeze on lower tier oil and rolled back the price of upper tier oil 20¢ per barrel to be effective January through March 1977. However, schedule No. 6 was issued effective March through July of 1977 which rolled back the upper tier crude oil price another 45¢ per barrel and continued the price ceiling freeze on lower tier oil. Prior to July 31, 1977, the FEA should issue schedule No. 7 of monthly crude oil price adjustments.

There have been three rollbacks in the upper tier price since 1975. "New" crude oil sold for $12.99 in January of 1976. In February 1976 the composite price structure of the Energy Policy and Conservation Act (EPCA) rolled back the "new" (upper tier) price to $11.48—a rollback of $1.51 per barrel. Crude oil prices were frozen in June 1976 at $11.60 per barrel through December 1976. On January 1, 1977, upper tier prices were rolled back approximately 20¢ per barrel and more recently on March 1, 1977, the upper tier price was rolled back another 45¢ per barrel.

The upper tier price is now approximately 50¢ per barrel less than the initial price for upper tier oil when the program started in February of 1976. Explorers and developers, primarily independent producers who drill four out of five wells in the U.S., made investments in the 1973–1975 period in anticipation of free market prices and recently in anticipation of escalation of the initial base price to approximately $12.50 per barrel by now. Instead, producers are facing rolled back prices in the $11.00 per barrel range.

Because the composite price system would be retained under the President's proposal, the uncertainty currently surrounding crude oil prices will continue. This will have a substantially detrimental effect on the level of investment in crude oil exploration and development.

Besides the continued uncertainty, the proposed price levels and classifications of crude for pricing purposes are entirely inadequate to bring forth a maximum supply response.

Contrary to the contentions of the Administration, the proposed third tier price provides very little additional incentive.

First, it continues to be a controlled price subject to all the uncertainties of the composite price in particular, and regulations in general. History of the petroleum price regulations prove that they cannot be relied upon.

Second, the Administration proposes to adjust the third tier at a rate no greater than the GNP deflator, which is a poor representation of the oil field inflation. Because oil field inflation has always exceeded the GNP deflator, the real value of this third tier price to the producer will continually decline. If this occurs, the relative price incentives for "new" oil will deteriorate, and less and less crude will be found and produced.

Third, the definition proposed for the "new" oil which would receive this third tier price is so restrictive that very little production will be stimulated.

Although no formal proposal for crude oil has been seen, based upon the President's message and the definition for "new" natural gas contained in the President's energy bill, "new" oil will probably be defined as crude oil—

(1) Produced from an OCS lease entered into on or after April 20, 1977, for an area not previously leased or, if previously leased, for which the lease had been terminated or abandoned; or

(2) From a well not on the OCS on which drilling was begun on or after April 20, 1977, or if a permit to drill is required, for which a permit was issued on or after April 20, 1977, and which is completed 2.5 miles or more from a well that previously produced or was capable of producing gas or oil or which is completed 1,000 feet or more deeper than the producing zone in a well within the 2.5 mile radius if the producing zone is different than in the nearby well.

There are at this moment no lands on the Federal OCS that would qualify for this definition. This is so because the Secretary of the Interior has held no lease sales since April 20, 1977, and existing leases were intentionally excluded from the definition. Because in the relatively well known offshore areas of the Texas-Louisiana Gulf Coast, 3½ to 5 years are required after a sale to develop production and in the more frontier-type areas, an even longer lead time, no production of "new" gas will be forthcoming from the OCS until some years after the Secretary decides to lease. This applies for each sale. The Secretary's recent action to postpone a number of sales and the possibility of enactment of an OCS bill which would result in more delays give little hope of much "new" production from the OCS for years to come.

There are a number of existing OCS leases where a decontrolled price would stimulate exploration and development for new reserves and platform and pipeline installation for known reserves which are currently uneconomic at controlled prices. Yet, the "new" oil definition would deny this potential to the American consumer.

In onshore areas, there is very little land in high potential areas that would qualify for the definition. Studies of the exploratory well discoveries in Texas in 1974 and in Oklahoma in 1976 indicated that only 6 to 7 percent of these wells would fall outside a 2½ mile circle around existing wells. Further, these analyses exclude all those "development" wells which also added new reserves and additional productive capacity.

The practical problems inherent in determining whether the "completion location" of a new well is 2.5 miles away or 1,000 feet deeper than the completion location of any well which prior to April 20, 1977, produced or was capable of producing oil or gas are immense.

First, many producers do not have the well data on all the wells of nearby operators and their predecessors to determine where the completion location is. In fact, in many cases, it is proprietary information which would not be released. For example, where is the completion location if a well was directionally drilled? If non-directional deviation surveys were taken on a supposedly "straight hole", where are these "straight holes" really? If a well as abandoned or produced a small amount of oil or gas on a test, was it capable of producing crude oil or natural gas? How sensible is it to tie the definition of "new" oil to some well which previously produced gas? Why does a new well completed more than 1,000 feet deeper than a nearby well not qualify for the definition, if it is completed in the same formation even if it is not in communication? Who will determine if it is in communication? Can this be done reliably, quickly, and inexpensively? There are other problems—these are just a few. They will exist regardless of whether the definition is ½ mile or 2½ miles, 1 foot or 1,000 feet.

The "new" oil definition in the Carter bill is based on neither economics nor geology. It is arbitrary. As such, it will exclude much of potential for increasing the supply of crude oil, and little additional new crude oil will be produced.

In Circular 725, the USGS made an estimate of the potential crude oil resource base of the United States. One of the categories of potential supply was named

"inferred reserves," and the USGS credits 33 billion barrels to this category which is nearly equivalent in magnitude to the existing supplies of proved reserves. "Inferred reserves" are those which have not yet been found but are likely to be found in and around known oil and gas fields. Extensions of known fields into new fault blocks, development of sands previously uneconomic because of small size or producing characteristics, deepenings, development of heterogeneous reservoirs on closer well spacings are all included in this category, are important supplies which could be brought on in the relatively near term but would not be included in the Carter definition of "new" oil.

This third tier is also supposed to contain incremental production from certain kinds of new tertiary recovery projects. Supposedly, only those technologies which are considered to be especially exotic and high-cost are to qualify, and many of these technologies are still in the developmental stage. Further, the higher prices are supposed to apply to only the incremental production from the tertiary projects. Thus, a producer, even if a secondary operation were not in place and a field were on primary recovery, would only receive the third tier price for the production in excess of the estimated secondary production. The practical problems in making this determination are tremendous, as are the administrative problems. Nevertheless, it is doubtful many producers would choose to go through the bureaucratic hassle, take the risks of uncertainty associated with regulation and price controls, and implement a tertiary project with this type of pricing procedure.

The tertiary proposal, because it excludes some of the more conventional enhanced recovery projects, also fails to recognize the wide varieties in oil field qualities and production characteristics. The ability of a producer to conform any type of enhanced recovery project to a reservoir depends upon the nature and quality of the reservoir, and there are many qualities of reservoirs. On a cost per unit of additional production basis, a water flood on a poor-quality reservoir might be more expensive than a sophisticated project on a good reservoir. Carrying the example further, the price necessary to make the tertiary project economic on the poor reservoir would probably be so high that no one would ever buy the oil. By arbitrarily limiting the price incentives to a few special kinds of operations, the Administration has eliminated a tremendous potential for increased reserves from the poor-quality reservoirs.

The above considerations and the extremely long lead times required to evaluate a tertiary project, implement it, and obtain a production response indicate that very little tertiary oil, like the "new" oil, will receive the third tier price.

This means that the "high incentives" the Administration claims it will provide for crude producers are illusory, and at most producers can anticipate a continuation of the present system.

Under the present system, the price of current upper and lower tier oil will be adjusted at a rate no greater than the GNP deflator. As has been previously explained, this inflation adjustment does not realistically reflect oil field costs. The real prices of nearly all domestic production, therefore, will fall over time, further deteriorating the ability of producers to find and produce new supplies. As long as the price of crude is held below its replacement cost, the producer will be unable to fully replace the reserves he produces. The result can only be further reductions in domestic supplies, greater shortages and more imports.

President Carter's proposal will not allow domestic crude oil prices to rise to current market clearing levels, much less anticipated market clearing levels by the end of the 40-month price control of the EPAA program. It would be naive to assume that world prices will stand still during the remaining price control period; therefore, the disparity between the market clearing price and controlled domestic crude oil price will likely be greater at the end of the 40 months of controls under the composite pricing concept than it was at the beginning of the 40-month period. If the cost of OPEC crude oil increases only 7–10 percent annually, the disparity between imported crude oil costs and price controlled domestic crude oil will be $6 to $7 per barrel by May 1979. It is increasingly evident, therefore, that substantial changes must be made in the current oil pricing program in order to facilitate termination of crude oil price controls by May 1979, the date when mandatory crude oil price controls are "scheduled" to expire.

For the next decade or more, this nation must depend on crude oil and natural gas to provide the bulk of its energy requirements while alternative sources are developed and perfected. Conservation alone cannot throttle our increasing dependence on imported crude oil. The nation cannot afford to depend increasingly

on insecure foreign oil to meet its energy needs. We have the natural resources, the technical expertise and the experience to become less dependent on foreign sources. The only need is to restore the economic and political climate necessary to accomplish reasonable energy self-sufficiency.

An alternative to the unmanageable and unrealistic composite price concept must be diligently sought. IPAA has long advocated complete decontrol of crude oil prices in the United States and IPAA continues to advocate free market pricing as the best assurance for the consuming public of increased supplies of secure domestic petroleum fuels for our expanding economy and national security. Transactions in a free market place would best serve to solicit additional supplies, promote conservation and efficient allocation of existing supplies. However, in the interest of breaking the political deadlock over crude oil price controls, a plan that will assure complete and immediate decontrol of crude oil prices should be considered. Such a proposal may be short of complete and immediate decontrol of all crude oil, but it should provide maximum incentives for crude categories most likely to yield additional production and must contain the assurance that price controls will be removed from all crude oil in the near future. Emphasis should be placed on reaching market clearing prices at the earliest practicable date taking into consideration the nation's economic welfare and national security.

We believe that the above goals can best be accomplished by substituting the following basic crude oil pricing policy for the current composite price concept:

(1) Decontrol of "new" oil: Upper tier oil has been explored for and developed in expectation of receiving market clearing prices during the greater portion of the lives of most wells. Allowing "new" oil to sell at market clearing prices would assure the consumers of the United States domestic exploration and development will not be throttled by domestic crude oil price ceilings. Higher cost foreign oil would then not have to be imported to account for domestic production not being brought on for lack of price incentives.

(2) Phase out controls on "old" oil: A phase out of controls on "old" oil should be adopted to end crude oil price controls as quickly as possible, but no later than May of 1979 as envisioned by the Energy Policy and Conservation Act. A definite phase-out period would allow consumers time to adjust their life styles, and anticipate the inevitably higher prices for energy. This phase out would eventually allow the entitlements program to be eliminated and it is essential so that the massive amounts of capital necessary to meet future energy needs can be generated.

(3) Decontrol "marginally" economic crude oil: No barrel of domestic crude oil should be left unproduced at a controlled price less than the cost of an imported barrel to replace it. It makes no sense to force the consumer to buy imported crude oil when domestic supplies are available at the same prices. The current stripper well exemption from crude oil partially addresses this problem by allowing the production from low productivity wells (less than 10 barrels per day per well) to sell free from price ceilings; but there are additional categories of high cost, marginally economic crude oil production that should be exempted from price ceilings. For instance, some wells must be plugged and abandoned at crude oil producing rates in excess of 10 barrels per well per day because of the tremendous volumes of water that must be lifted to obtain a few barrels of crude oil. Not only are the lifting costs in such situations magnified severalfold, but also the investment in additional facilities to dispose of the water must be made and the crude oil produced from the wells must bear the burden of those investments and the cost to operate the facilities.

A program like the one above, in the absence of immediate decontrol of crude oil prices, would reduce substantially our rapidly increasing dependence on foreign crude oil, our balance of payments drain, and the subsequent drag on our economy. It would serve notice to consumers that they should change their buying habits to reflect the full value of energy, and it would give the domestic crude oil producer the green light to go out and develop new supplies of crude oil and to squeeze the very most out of existing reservoirs with confidence that government crude oil pricing policies will lead to free market prices.

IPAA Comments of Carter Natural Gas Proposal

The Carter Administration's natural gas bill, if enacted, would not only fail to maximize producers' efforts to find and develop additional natural gas supplies, it would result in fewer supplies than under existing law.

The one bright spot in the nation's natural gas supply picture is the intrastate natural gas market which in the significant oil and gas producing states

is unfettered by price controls. As a result, increased prices in recent years have brought forth new supplies, and supply and demand in these states are in balance. The uncontrolled intrastate market also served during the last several winters as the source of natural gas which alleviated much of the suffering and prevented many plant closings in areas served by interstate pipelines.

The Carter bill proposes to extend federal price regulation to the successful intrastate market. Instead of building on that success, it would perpetuate, complicate, and enlarge upon the federal price control system that has failed miserably for the last 23 years.

Although the Administration claims that federal jurisdiction would not be extended to existing intrastate gas, the proposed legislation contemplates federal jurisdiction once existing intrastate contracts expire. Because many of these contracts are of relatively short duration, federal price controls would be extended within a short time to much of this unregulated natural gas.

Further, the bill proposes to limit the price of this intrastate gas to the "BTU related price" of "new" natural gas which in turn would be related to the average price of domestic crude oil. Based on current oil prices, this price would be about $1.54/MCF. (The Administration claims $1.75 in early 1978.) Nevertheless, because producers are receiving for some intrastate gas prices considerably in excess of this "BTU related price", the Carter bill would roll back prices for some flowing gas which was developed in response to higher unregulated prices. Further, it would hold down the future price for any new intrastate production to artificially low levels.

Recent increases in onshore drilling activity have been largely in response to the higher unregulated prices for intrastate natural gas. Reserve additions in the intrastate market average 7.8 tcf during the five year period 1971–1975. The pricing proposal in the Administration bill could cripple the increased natural gas drilling activity, slash the reserve additions of the intrastate market (which have comprised 76 percent of total reserve additions during the 1971–1975 period), and eliminate the one source of additional gas that has kept the nation running in recent winters.

The failings of the current FPC price setting system for natural gas should be apparent to all. Historical cost-based pricing is illsuited to a dynamic competitive industry in which costs increase rapidly and new gas becomes harder to find. Yet, using current FPC methodology, producer filings before the Federal Power Commission for the national rate applicable to the 1977–1976 biennium yields cost-based prices in the $2.40/MCF range. Thus, the pricing mechanism contemplated by the Carter bill would fix by legislative fiat prices considerably below the cost-based price which would result if FPC methodology is used. If FPC methodology yields prices which do not keep pace with current conditions in the gas producing industry and which have resulted in the tremendous shortages of natural gas, how can an inflexible legislatively set, lower price yield a better supply response? Obviously, it cannot. Congress should expect no better success at repealing the law of supply and demand than the FPC.

The Carter Administration claims in "The National Energy Plan" at page 54 that: "This pricing approach (for natural gas) acknowledges that the true economic value of a depleting resource is its replacement cost." Yet, the price proposed for "new" natural gas is not even to be related to the equivalent price of "new" crude oil; it is to be tied to the "BTU related price" of the average refiners' acquisition cost of domestically produced crude oil. Only by sheer coincidence would the "replacement cost" of gas be the average price to the refiner of domestic crude oil.

Further, nothing would create greater uncertainty for the producer than to tie the price of natural gas to the average price, the upper tier price, or the price for "new" crude oil when these prices are ultimately influenced by the composite price limitations of the Emergency Petroleum Allocation Act (EPAA).

No system for the pricing of crude oil could produce greater uncertainty than has the composite pricing system.

A total of six price ceilings have been issued since February 1976. The price of upper tier oil has been rolled back twice, and a freeze on the price of lower tier oil has been extended four times. A seventh ceiling price schedule is anticipated sometime before the current freeze ends in July; but, as yet, no producer has any idea of what price ceiling will prevail for the remainder of 1977 or thereafter. The current Administration, without hearings, has reversed the prior Administration policy, which was developed according to procedures specified in the

EPAA and which supposedly could be relied upon, as to the escalation rates of upper and lower tier ceiling prices. Upper tier prices are lower now than when the program started. To tie natural gas prices to this system of pricing crude oil, and claiming it provides certainty, stretches the meaning of the word certainty beyond recognition.

The Carter bill would result in less supplies of natural gas for the interstate market for yet another reason. Currently, FPC jurisdiction extends only to sales for resale. Because of this, some supplies of natural gas have been flowing to interstate industrial purchasers who buy natural gas directly from producers at unregulated prices. These gas supplies have been invaluable in recent years in keeping a number of plants in operation. Because the Carter bill would extend Federal jurisdiction to all producer natural gas sales, this important source of gas would likely dry up.

The Carter natural gas bill is very poorly drafted and is internally inconsistent; it is, therefore, quite difficult to discern exactly what results are intended.

It is clear, however, that a radically new form of federal regulation is contemplated. Because many of the prices would be Congressionally mandated, it would be largely inflexible and incapable of responding quickly to new conditions in the gas producing industry. The legislation appears to give the President authority to redefine many of the statutory definitions. When combined with the many complexities in the pricing structure, its newness, the inadequate price levels, the fact that implementing regulations will have to be developed and probably modified from time to time, even greater uncertainty for producers will result. Such uncertainty can only hamper exploration and development efforts.

Even if the BTU related price for "new" gas provided in the bill was eliminated and a deregulated price substituted for it, the definition for "new" gas is so restrictive and complicated as to provide no real stimulus to exploration.

The "new" gas definition must be read in the context of no less than 15 other related definitions. This, in and of itself, is no small feat. It demonstrates, however, the paranoia with which the Carter bill was apparently drafted. The purpose seems directed more at excluding as many potential new gas supplies as possible from the definition so that there would be "no reward to any firms that may have withheld natural gas last winter" (The National Energy Plan, page 54), rather than providing a needed stimulus to attract natural gas to the marketplace.

The following appears to be a reasonable assessment of the intent of the definition:

"New" natural gas would be defined as gas—

(1) Produced from an OCS lease entered into on or after April 20, 1977, for an area not previously leased, or if previously leased, for which the lease has been terminated or abandoned; or

(2) From a well not on the OCS on which drilling was begun on or after April 20, 1977, or if a permit to drill is required, for which a permit was issued on or after April 20, 1977, and which is completed 2.5 miles or more from a well that previously produced or was capable of producing gas or oil or which is completed 1,000 feet or more deeper than the producing zone in a well within the 2.5 mile radius if the producing zone is different than in the nearby well.

What would be the effect of this definition on the supply of new natural gas? What kinds of gas would qualify?

There are at this moment no lands on the Federal OCS that would qualify for the new gas definition. This is so because the Secretary of Interior has held no lease sales since April 20, 1977, and existing leases were intentionally excluded from the definition. Because in the relatively well known offshore areas of the Texas-Louisiana Gulf Coast, 3½ to 5 years are required after a sale to develop production and in the more frontier-type areas, an even longer lead time, no production of "new" gas will be forthcoming from the OCS until some years after the Secretary decides to lease. This applies for each sale. The Secretary's recent action to postpone a number of sales and the possibility of enactment of an OCS bill which would result in more delays give little hope of much "new" natural gas for years to come.

There are a number of existing OCS leases where a deregulated price would stimulate exploration and development for new reserves and platform and pipeline installation for known reserves which are currently uneconomic at controlled prices. Yet, the Carter bill would deny this potential to the American natural gas consumer.

In onshore areas, there is very little land in high potential areas that would qualify for the new gas definition. Studies of the exploratory well discoveries in Texas in 1974 and in Oklahoma in 1976 indicated that only 6 to 7 percent of these wells would fall outside a 2½ mile circle around existing wells. Further, this excludes all those "development" wells which also added new reserves and additional productive capacity and which were drilled in response to free market intrastate prices.

The practical problems inherent in determining whether the "completion location" of a new well is 2.5 miles away or 1,000 feet deeper than the completion location of any well which prior to April 20, 1977, produced or was capable of producing oil or gas are immense.

First, many producers do not have the well data on all the wells of nearby operators and their predecessors to determine where the completion location is. In fact, in many cases, it is proprietary information which would not be released. For example, where is the completion locaton if a well was directionally drilled? If non-directional deviation surveys were taken on a supposedly "straight hole", where are these "straight holes", really? If a well was abandoned or produced a small amount of oil or gas on a test, was it capable of producing crude oil or natural gas? How sensible is it to tie the definition of "new" gas to some well which previously produced oil? Why does a new well completed more than 1,000 feet deeper than a nearby well not qualify for the definition, if it is completed in the same formation even if it is not in communication? Who will determine if it is in communication? Can this be done reliably, quickly, and inexpensively? There are other problems—these are just a few. They will exist regardless of whether the definition is ½ mile or 2½ miles, 1 foot or 1,000 feet.

The "new" gas definition in the Carter bill is based on neither economics nor geology. It is arbitrary. As such, it will exclude much potential for increasing the supply of natural gas, and little additional "new" gas will be produced.

In Circular 725, the USGS made an estimate of the potential natural gas resource base of the United States. One of the categories of potential supply was named "inferred reserves," and the USGS credits 201 tcf to this category which is nearly equivalent in magnitude to the existing supplies of proved reserves. "Inferred reserves" are those which have not yet been found but are likely to be found in and around known oil and gas fields. Extensions of known fields into new fault blocks, development of sands previously uneconomic because of small size or producing characteristics, deepenings, development of heterogeneous reservoirs on closer well spacings are all included in this category, are important supplies which could be brought on in the relatively near term, but would not be included in the Carter definition of "new" gas.

If very little future natural gas would qualify as "new" gas, how does the bill propose to classify it and price it? Here the situation becomes even more complex and confused.

"Old" natural gas would be defined as natural gas other than "new" natural gas. Therefore, it would encompass all flowing gas, both interstate and intrastate and would cover all gas from new wells or newly discovered reservoirs that happen to be located within 2.5 miles of a well existing on April 20, 1977, unless the depth standards of "new" gas are met, or natural gas from existing OCS leases regardless of when new wells are drilled thereon.

"Old" gas sold under "old contracts" would be priced differently than "old" gas under "new contracts." Again, multiple and interrelated definitions must be integrated in an attempt to decipher the meaning.

"Old" natural gas sold under existing contracts would be subject to ceiling prices which would be the lesser of (1) the contract price for such gas; or (2) the effective "just and reasonable" FPC rate applicable to such gas, plus an inflation adjustment.

This provision is apparently intended to sanctify the price of most gas flowing in interstate commerce; however, as drafted there are several other effects: (1) "Old" natural gas, as defined, is all gas other than "new" gas; it must therefore include both interstate and intrastate sales. This provision could then require that gas flowing under existing intrastate contracts be rolled back to an FPC determined price, if the FPC price is lower than the current contract price. (2) In the case of interstate contracts which receive an FPC price higher than permitted in the contract, this provision could require these prices to be rolled back, also. (3) Because Opinion 770 A is under judicial review, with the rate increase subject to refund, and may not be "in effect", the price for post 1975 vintage gas is unclear.

These problems, if not corrected, would result in the immediate extension of federal price regulation to much of the flowing, unregulated intrastate natural gas. Great uncertainty as to magnitude of future cash flow from existing operations is created. If roll backs do occur, previously sound investments could be rendered uneconomic. The impact on future drilling budgets is also severe because much of this revenue would be reinvested in other drilling ventures.

Another major flaw in this provision, in conjunction with other provisions, is to freeze forever existing FPC prices at their artificially low prices while removing from the FPC all authority to adjust past national rates to reflect changing circumstances.

Because revenues from current production serve as the prime source of funds for investments to replace that resource which is produced, the producer would be placed in a position of slow liquidation of reserves and capital. Further, because these frozen prices could only be adjusted by the GNP deflator, which does not reflect the escalation of oilfield costs, the real value of the production to the producer decreases with time, abandonments are hastened, and reserves are lost.

The low, frozen prices also give false signals to the consumer, cause him to burn more natural gas than he would burn otherwise, thus reducing our supplies of this valuable resource even more quickly. Considering that natural gas is the most premium of all fuels having the best burning efficiency and being the least damaging to our environment, it should be priced to both the producer and consumer in a way reflecting its true value and its replacement cost. The Carter proposal does neither.

"Old" gas sold under "new contracts" would be subject to two, or perhaps more, different ceiling prices.

One kind of gas in this category is natural gas from expiring intrastate contracts, which would be priced at the average "BTU related price" to the refiner of domestic crude oil, whatever that may be, or in other words the price of "new" gas. In most cases this is a roll back. The probelms have been discussed previously.

The other "old" gas in this category, which apparently is meant to include gas (1) committed or dedicated to interstate commerce on or after April 20, 1977, (2) from new wells not qualifying under the "new" gas definition either onshore or in the OCS, or (3) from expiring intrastate contracts, would be subject to a ceiling no higher than $1.45, adjusted for inflation.

This provision does not state that the price is to be $1.45/MCF but that it is to be no higher than $1.45/MCF. The President would be given authority to set it wherever he wants and presumably could do so on a case-by-case basis. In setting the price, the President is directed to take into account the prior contract price and the price necessary to maintain production. What the real price ceiling will be for any natural gas in this category is anyone's guess.

Considering that there will be little "new" gas, and that most gas from new wells, if any would be drilled under the Carter pricing scheme, would fall in the "old" category considering that the chosen maximum price is equivalent to the FPC price for a biennium about 2 years past, and considering the dismal record of FPC rates, there appears to be little hope for significant additional gas discoveries in the future.

The Administration has held out the special pricing provisions in the bill as as the panacean solution to any natural gas supply that is higher cost than the specified ceiling prices. The President would be given authority to set these special prices on a national, regional, or case-by-case basis. Deep water, deep sediments, and geopressured brine are given as examples of the types of production to which the special pricing provisions would be applicable.

No one should be misled by this specious argument. Each FPC ceiling price order since the first Permian case has contained a similar "special relief" provision. It has been interpreted so restrictively, however, that it is of little value to the producer. And there is no reason to believe the situation would change.

Further, no producer is going to make an investment which would be either marginal or submarginal at the applicable ceiling price on the vague hope that the President would grant him a "special price."

The FPC has tried to set national rates for natural gas—and failed. Before that, the FPC tried area rates; they failed even more dismally and created a bureaucratic nightmare. Imagine the complexities of setting a multitude of special rates for all the special kinds of gases, from all the areas with water depths or sediment depths with special problems and costs. There could be hun-

dreds or thousands of separate applications for "special reliefs." Such a procedure would fail, just like the area rates, the national rates, and the FPC "special relief" have failed.

Under the Carter proposal for natural gas, the incentives of the intrastate market will be gone. Shortages and rationing of natural gas will become a way of life. And big brother government will be telling each citizen when he can use natural gas, how much he can use, and for what purposes he can use it. That is, until there are not more supplies at all.

The Carter natural gas bill would be disastrous for this nation. It must be replaced with an approach that can work. Deregulation of new natural gas as proposed in H.R. 2088 or S. 256, is such an approach. It builds on the success of the intrastate market for natural gas. Under deregulation, conservation and production of this valuable resource would be stimulated and conversion to coal and alternate fuels would be encouraged in an economically efficient and timely fashion. Deregulation holds promise for the future; price controls and the Carter bill promise chronic shortages, rationing, and an unprecedented degree of regimentation for both consumer and producers.

MINIMUM TAX ON INTANGIBLE DEVELOPMENT COSTS

Carter proposal

President Carter recommended that the minimum tax on successful well intangible development expenditures (IDCs) of independent, noncorporate oil and gas producers enacted by the Tax Reform Act of 1976, be modified so that only IDCs in excess of net related oil and gas income be subject to the 15 percent minimum tax. Congress recently responded by passing such a provision effective only for tax years beginning in calendar year 1977.

IPAA comments

While IPAA appreciates the President's recommendation and the Congress' action, the modification only partially addresses the full problem. At a minimum, the recent modification should be extended indefinitely and made applicable to calendar year 1976, credit against the minimum tax should be given for 100 percent, rather than 50 percent, of normal income tax, and the IDC preference should be offset by total oil and gas income, not just income from producing operations.

More logically, the minimum tax on IDCs should be repealed totally because it is counterproductive to the goal of increased energy supplies, faulty in concept, discriminating and anticompetitive.

Our domestic shortages of oil and gas are in large part the results of a capital shortage. Without greatly accelerated capital, spending for exploration and development, it will not be possible to find, develop, and produce sufficient supplies of oil and gas to fufill our country's energy needs in the future.

The President and the Congress should recognize this capital shortage problem and through the tax system, encourage, rather than discourage, capital formation and spending in the oil and gas producing industry.

The minimum tax on IDCs is inimical to this objective and thwarts the efforts of independent producers to supply oil and natural gas to the nation's consumers. It directly increases the costs of drilling producing wells, reduces cash flow, and forces drilling operations to be curtailed.

Cash flow is the lifeblood of independent producers. Independents in 1975 made 87.5 percent of all new field discoveries and 89.4 percent in 1976. During the period 1969 to 1974, independents drilled 9 out of 10 new field wildcat wells and made 75 percent of new field discoveries which resulted in 52 percent of the new reserve additions.

The IDC deduction is not a tax loophole. It is a means for rapid recovery of capital enacted by Congress to encourage capital spending for oil and gas exploration and development.

The minimum tax on FDC fails to distinguish between permanent reduction in tax and mere timing differences. IDC is merely a timing difference wherein the expenditure is deductible currently instead of over the life of the well. The only

"preference" involved is the present value of the deferral of the tax until some later period. Imposition of a 15 percent tax on the full value of the IDC expenditure completely destroys the "preference" in most instances and places the producers in a worse position than if he had been permitted to capitalize the IDC as depreciable investment subject to ADR depreciation and the 10 percent investment tax credit.

The imposition of the minimum tax on IDC actually distorts normal economic decision regarding completion of marginal well discoveries. In some instances the impact of the 15 percent tax on IDC if a marginal well is completed more than offsets the present value of the net cash flow anticipated from completion and production. In such cases, the minimum tax forces the producer to plug and abandon the well and the potential reserves are lost to the nation.

The minimum tax on IDC discriminates against independent operators because it applies only to individuals and not to corporations. Individual producers are the "risk takers"; they are essentially voluntary investors whose primary source of income is from oil and gas production. Unlike large corporations with thousands of employees and stockholders and diversified operations, they cannot long withstand a major increase in the cost of the means of their livelihood—the drilling of successful oil and gas wells.

The minimum tax, even as recently modified by Congress (discourages capital formation by independent oil and gas producers because it still applies to the IDC expenditures of outside investors. Independents traditionally have relied on external sources of capital for a portion of their drilling funds. By continuing to subject these funds to the minimum tax, outside investors are discouraged from making oil and gas drilling investments and are encouraged to seek out other areas of financial endeavor. Drilling budgets are consequently reduced.

The minimum tax or IDC is therefore anticompetitive because it reduces the ability of independent producers to drill wells with their own funds and to acquire capital from others. The tax is anticompetitive in another way in that it discourages entry into the oil and gas producing business. Since new entrants have no oil and gas income with which to offset a portion of the IDC "preference", the tax favors those producers and corporations already in the producing business.

The minimum tax in IDC is a tax on an expenditure, not on income. It is, therefore, unique in our tax system and severely handicaps the independent producer. Neither is it in the best interests of the Nation because oil and gas supplies are reduced as a consequence. It is illogical for the tax law to foreclose sources of capital for a vital industry and to encourage the abandonment of marginal wells when increased supplies of oil and gas are so desperately in need.

Western Gas Sands Project Plan

Executive Summary—Introduction

Geologic studies by industry and government indicate that a large resource of natural gas exists in the western states. Most of this resource lies within thick, low-permeability reservoirs that are found in a number of western geologic basins. Although the volume of this resource is estimated to be very extensive, the production of gas from these reservoirs generally has not been economic. Therefore, industry has not had the incentive to invest the capital needed to develop this resource. Commercial development is not likely to occur unless the technical and economic feasibility of producing gas from these reservoirs can be demonstrated.

The United States Energy Research and Development Administration (ERDA) is initiating the Western Gas Sands Project to demonstrate the economic and technical feasibility of developing this resource. The four areas selected for the study are shown in Figure 1. The volume of gas in place in these four areas is estimated to be about 730 trillion cubic feet.

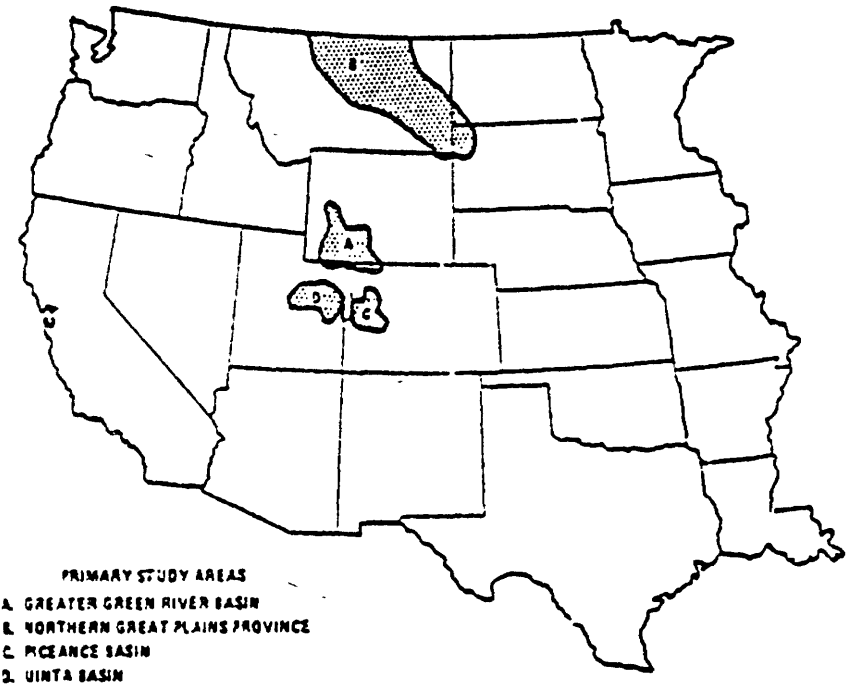


FIGURE 1.—Western gas sands project study areas.

Commercial development of these western resources could help relieve future hardships such as those resulting from gas shortages in 1977, by providing a significant additional gas source. In addition, the federal government could receive substantial revenue through royalty payments on production from federal lands and through taxes. Western states also could derive significant income through ad valorem and other taxes. Using reasonable assumptions, the royalty income could be 45 billion dollars to the federal government over the producing life of the low-permeability reservoir in the principal study areas.

STATEMENT OF THE INTERNATIONAL ASSOCIATION OF DRILLING CONTRACTORS BEFORE THE SUBCOMMITTEE ON ENERGY AND POWER OF THE INTERSTATE AND FOREIGN COMMERCE COMMITTEE, U.S. HOUSE OF REPRESENTATIVES

My name is James F. Justiss, Jr. I am President of the Justiss-Mears Oil Company, Inc. of Jena, Louisiana. In addition to this position, I serve as the elected President of the International Association of Drilling Contractors. Accompanying me today is Mr. Tom S. McIntosh, President of the Zapata Off-Shore Company. IADC, located in Houston, Texas, is the trade association representing the independent contract drilling companies which perform the actual drilling involved in all exploration, development and production phases of the on-shore and off-shore oil and gas business. Our clients are the major petroleum companies, the hundreds of independent producers, and the national oil and gas companies of foreign countries.

Without the services of the contract drilling company, there would be no oil and gas drilling today. Contract drillers are used by producers because of the high level of expertise required to drill for oil and gas; because of the high costs of equipment and trained personnel; because of the immense overhead needed to maintain drilling rigs—especially when they are idle or located far from the needed location; and because of the insurance liability exposure which the

hazardous job of "making hole" encompasses. Independent drilling contractors can do the job more economically than the producers themselves.

We are delighted to have this opportunity today to appear before the Subcommittee on Energy and Power to present testimony on matters concerning all of us—both within and without the industry.

It may appear ironic to some persons, but IADC members endorse conservation of our petroleum resources. We are so close to the subject, that few appreciate as we do, the finite nature of these scarce resources, the degree of difficulty and expense required to locate and extract them, and the unconscionable waste to which they are too often put.

Many of our members live in and around the great oil and gas fields of Texas, Louisiana, New Mexico, Wyoming and along the beaches of the Gulf of Mexico, the Pacific Ocean and the Gulf of Alaska. I can assure this Subcommittee that we are the last people who would want to see the destruction of these areas by irresponsible exploitation.

Today we will focus our comments on the subject of natural gas and the role of the Federal government's policies upon the contract drilling industry's capability to perform its task.

Drilling activity on land is at a sixteen-year high level. As of March 21, 1977, there were 1888 rigs actually making hole in the domestic United States. IADC, with the cooperation of the Hughes Tool Company, issues weekly rig count reports for the United States and Canada. This figure represents a very high rate of rig utilization.

We are pleased to note that the number of wells drilled per rig, or rig efficiency, is at an all-time high. In 1976, each rig in operation drilled 22.1 wells for a total per rig of 102,478 feet. There were, in all, 39,875 wells drilled in the United States. The total footage drilled amounted to 185,297,622 feet for an average depth per well of 4,647 feet.

When we report rig counts, we are including rigs actually in use making hole. This ignores rigs which are logging (testing), running casing (placing pipe in a well), rigging up or down, moving, completing, drill-stem testing or anything else. We are not referring to cable tool rigs or workover or well-service rigs. The cable tool rigs are shallow depth units generally mounted directly on trucks which may be employed to drill wells, but also frequently are used to clean out a working well, modify its casing, retrieve lost equipment or other on-going well repair and restoration work.

In 1976 we believe the entire U.S. land rig census was between 2,200 and 2,400 rotary units. Of these, about 24 rigs are owned by operators (oil companies) and the remainder by drilling contractors.

At this point it would be useful to point out that a rig is just that. It is a composite of mechanical parts assembled for a specific job out of components that might be assembled differently by different contractors. In simplest terms, the rig employs a derrick (the familiar tower so frequently shown as a symbol of oil exploration) and a drawworks to raise and lower lengths of drill pipe. Large motors transmit power through a "kelly" to translate the driving forces into a rotary motion. The entire string of drill pipe rotates to form a very long drive shaft. The bit at the bottom of the drill string breaks up the formation underground. Drilling fluids called "mud" are pumped down the drill pipe and circulate to cool and lubricate the bit and to wash away the cuttings of rock. These cuttings are brought to the surface, removed, and are carefully analyzed to provide valuable geological information. The lengths of 30 feet pipe are joined together by threading. When the bit must be replaced, the entire length of drill pipe must be raised in 90-foot sections and disassembled. This process of threading together the pipe and taking it apart consumes much of the time of the crew.

In order to prevent the well from caving in or from bursting through weak geological formations, casing is placed in portion of the well and cemented to to the rock formations.

Depending upon the depth of the well, the type of underground pressures and the geological information available about the structure, appropriate safety precautions are taken against unexpected blow-outs.

Drilling technology has improved greatly over the years, but the basic principles have remained unchanged. Even after hundreds of millions of dollars of research on exotic methods, there is little expectation that major innovative breakthroughs will occur in the near future. Improved efficiency over the years has increased penetration rates by many times and has probably kept the price of oil from going to as much as $40 per barrel.

The contract drilling business is certainly one of the most competitive in the world. Each contractor bidding on a job bets on his ability to complete the assignment efficiently and without delays. IADC stresses a strong safety and training program. Contractors have come to know that accidents are costly and create delays. Responsible contractors therefore avoid accidents stemming from use of poorly trained crews, cutting safety corners, shortcutting established industry procedures, and use of improper equipment.

Contracts are let either on a day rate or on a footage basis. Sometimes the contrctor will provide a "turnkey" contract in which he handles all the subcontracting such as for mud services, roadbuilding and site preparation, cementing, catering and the purchase of drill bits. In most instances, however, these attendant services are individually contracted by the operator—that is, the owner of the lease.

During the last fifteen years the industry has seen the population of contractors go from 700 to half that number in 1972 and return to about 500 today. The industry activity tends to follow by some eighteen months the level of seismic activity for which lease operators contract with the geophysical contractors. The nature of the drilling business has been cyclical due to weather conditions, tax considerations, constraints on oil and gas prices, availability of new acreage, and limitations on production (such as provided by the Texas Railroad Commission, etc.).

The current statistics showing the large numbers of rigs working on land must be put into perspective. Much of this work is development drilling in old known producing areas where current economic conditions warrant the development of these properties.

Drilling costs increase geometrically as depths increase. In some areas a 20,000-foot well might cost 10 times as much as a 10,000-foot well. Payments to the drilling contractor represent about 36 percent of the total cost which the lease holder pays for the completed well. In 1975 the average cost of drilling (through the stage of installing the Christmas tree—valve system) was $262,008 for a U.S. gas well, $138,640 for a U.S. oil well. A U.S. dry hole cost averaged about $177.500. A hole to 20,000 feet on-shore can easily cost $5 million or more.

Some representative statistics by State show for 1975:

(From the Joint Association Survey of the U.S. Oil and Gas Producing Industry, February, 1977, Edition (American Petroleum Institute, Independent Petroleum Association of America, Mid-Continent Oil & Gas Association).)

State	Number of wells drilled	Total cost, all wells	Number of dry holes
Alaska	58	$157,086,526	16
California	2,166	231,558,916	295
Colorado	1,136	150,273,480	546
Illinois	924	37,178,404	472
Indiana	354	9,383,462	206
Louisiana	3,085	1,507,601,211	1,243
Michigan	520	95,965,744	317
Texas	12,374	2,137,744,970	3,901
Wyoming	1,246	365,348,958	549
Total United States	36,960	6,571,213,923	13,030

One of the most important questions facing the drilling contractor is investment in new equipment. Clearly the indications point to ever increasing depths for discovery of gas which requires deeper rated equipment. At present we estimate a new 7,500-foot-capacity rig—one of the smallest which a rotary drilling contractor would likely purchase—would cost about $1.5 million at today's market. This type of unit would not be suitable for gas exploration in most areas because of its limited depth rating. A more suitable rig for natural gas exploration would be in the $1.8 million to $3.5 million range for a land rig.

Delivery time for a complete new rig is approximately 4 to 6 months today. Drill pipe delivery with proper joints attached is approximately 18 to 24 months. While delivery time does not now represent a constraint on drilling, if an all-out mobilization of drilling is truly fostered by government policy, then all of the component elements—trucks, tubular goods, bits, rig equipment, etc.—will have to gear up considerably to meet the demand.

Offshore, the prices rise dramatically, with $40 to $50 million in rig equipment not uncommon. For more extreme conditions such as deep water capability and hostile environment the cost can go to $65 million. Delivery in this field takes from 9 to 18 months in today's depressed market.

While the number of the available rigs working on land is quite high, the situation offshore is greatly different. According to the "Offshore Rig Data Services—The Offshore Rig Newsletter" (Houston, Texas), at the beginning of February there were, world-wide, 437 mobile units (including tenders) and of these 63 were idle without contract most of these would be available on very short notice for drilling on the U.S. Continental Shelf. There are also 48 units on order today, of which 29 have no contract.

CAN THE DRILLING INDUSTRY MEET THE CHALLENGES OF INCREASED EXPLORATION AND DEVELOPMENT?

The answer to this question is "yes, . . . if". There is no doubt that the contract drilling industry can and will meet the challenge of a substantial increase in the levels of on-shore and off-shore drilling. The first priority should be the immediate expansion of our own Outer Continental Shelf natural gas resources. The equipment is available in abundance and the ever growing energy demands of our Nation's industrial economy demand early exploration and confirmation of petroleum resources within our Country's military and economic security is at stake, as well as causing a devastating effect upon the deficit in our balance of payments, unemployment and inflation. The direct relationship betwen BTU's of energy and jobs is absolutely clear.

The contract drilling industry strongly urges the Congress and the Administration to solidify their joint commitment to an all-out exploration and development program by private enterprise to bring on-board the maximum supplies of natural gas.

What is needed to attract the capital required to support an expansion of the present land rig census is a predictability of policy. This is not merely price predictability of the product. Regulation by the government imposes artificial restraints and creates a process of constant refining or adjusting by the government of what should be a free market condition. We believe that natural gas price increases, to the extent that they take place, will act as a natural inhibitor of wasteful and irresponsible use of natural gas. While some consumers do not have the luxury of conversion to other fuels and can ill-afford increased prices of home heating bills, the large industrial users will be inclined to make early switches to other boiler fuel sources. Even among residential users, conservation will become a more meaningful term with beneficial results coming through decreased consumption.

What we do mean by predictability is simply a set of game rules which remain in effect long enough to be learned and applied to the decisions necessary to perform in the highly complex and demanding business world surrounding energy.

The lead time to place an offshore drilling unit on location requires several months. It requires permits from the Environmental Protection Agency, Corps of Engineers, U.S. Coast Guard, U.S. Geological Survey, Bureau of Land Management and other agencies. Arrangements may well include towing units halfway around the world. Land-based facilities for the support of the crews and the supplies, that are consumed must be arranged. Boats, helicopters, catering services, laundry, cement, mud, chemicals—the list of details is extensive.

From the first nomination of tracts for leasing through the time-consuming permit acquisitions to the actual drilling and the eventual delivery of oil or gas to on-shore facilities is in the range of 4 to 6 years. In frontier areas even longer is likely. The majority of time is consumed by mandatory government requirements and cumbersome procedures. It is not the result of industry delays.

We must recognize that any steps taken today will require considerable lead time for results to be meaningful to the consumer. If all elements of the energy industry can plan for high utilization then the drilling industry can meet the demands placed on it.

It comes as a terrific shock, when with the strokes of a pen, an announcement by the Secretary of the Interior can delay a long-planned lease sale in a known region where drilling with no ill effects has been underway for some time. The disruption to logistics alone is devastating. The lost motion is incredible. The

delay in bringing in useful information and eventually the petroleum products is equally as harmful to the consumer.

Just when the "rules" are learned for one jurisdiction or agency, they may be out for public comment again. The Federal Register becomes a feared, but necessary daily reader.

It has taken the industry since 1953 to evolve a system functioning effectively under the Outer Continental Shelf Lands Act and now the Congress appears ready to substantially alter the procedural steps contained in it. Congress has already accomplished virtually everything that could be asked for in planning assistance and collaboration with the affected coastal states in the Coastal Zone Management Act of 1976. Congress also is providing protection against oil spill liability through legislation which is progressing through Congress with industry approval at this very time. It would now create new steps each of which becomes a target opportunity for strike actions by legal challenges such as is now happening with the Lease Sale 40 lawsuit.

At this point, we would like to state our views on pre-lease Federal exploration.

The Federal government may be reluctant to take on the expense of the kind of exploration program (with its incredibly high-risk, high-loss factor) that private enterprise can and does undertake. The belief that the government can drill a single well, or even several wells, in the frontier areas such as our Outer Continental Shelf and actually reach any useful, reasonable conclusions about the petroleum resources there is absurd. Even the experts in the private sector disagree strongly about seismic interpretation and core sampling results. A test well tells you only something about the precise spot in which it is placed. Without extensive delineation drilling and actual production, there is only speculation of a very rough nature. The cliche is quite true: The only time you know the extent of a petroleum find is when the reservoir is drained dry through production.

One can count the trees in a National Forest. Reliable information on petroleum reserves is not so easily obtained.

Quite frankly, the greatest uncertainty affecting drilling contractors is a "ripple effect" stemming from the actions taken by the government which are aimed at the oil and gas producers—particularly the major companies. The repeal of the depletion allowance, attacks on expensing of intangible drilling costs, threat of divestiture both horizontal and vertical, erratic attitudes towards our Outer Continental Shelf development, possibilities of the creation of a Federal oil and gas company, pricing decisions including additional roll-backs and continual re-adjustment for previous actions which follow from Federal intervention and control of pricing—all are the kinds of action detrimental to exploration programs which would provide the basis for investment in newer equipment and expansion of the drilling industry.

The dangerous result, usually not considered, is the very serious effect upon the relatively small service industries such as the contract drilling companies.

Our plea with the Congress and the Administration is simple: Let us get on with the job we know best in a context of maximum support consistent with reasonable environmental constraints.

It is significant to note that of the top five contractors each has between 50 and 118 rigs, while the next 20 largest only have between 16 and 49 rigs per company. It is clear that the drilling contractors are a small, but vital resource. The government's actions which affect drilling contractors are the small decisions and burdens which so drastically impact on small businessmen in all categories. Yet the demise of a small retail store or the loss of a dry cleaner's establishment surely does not have the same significant ramifications for our Nation's search for and recovery of oil and gas. The business health of the individual members of the drilling contractor industry is absolutely essential to our Country's ability to survive.

STATEMENT BY GERALD A. HELLAND, JR., PRESIDENT, PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION BEFORE THE ENERGY AND POWER SUBCOMMITTEE OF THE HOUSE COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE

My name is George Helland. I was executive Vice President of Cameron Iron Works, Inc., in Houston, Texas, until just recently. I appear before you today in my capacity as president of the Petroleum Equipment Suppliers Association.

PESA is made up of 174 U.S. companies which manufacture petroleum equipment, provide services and supplies to the exploration, drilling and producing segments of the energy industry. Members of the association supply approximately 85 per cent of the petroleum equipment used to develop and produce oil and gas reserves within the United States.

The manufacturers of petroleum equipment produce a wide range of high technology products which have specialized application in the drilling and producing segments of the petroleum industry. These products make it possible to drill and produce crude oil and gas from reservoirs in the earth. The products are designed to withstand the extreme temperatures and pressures encountered in these operations.

Another segment of our membership is made up of the supply stores which serve the needs of the drilling contractors and oil operators by carrying in inventory the equipment for day-to-day oilfield operations. These stores are located in and around the oil and gas producing areas.

A third segment of our membership is composed of service companies which provide equipment, materials and personnel for well-site services. These operations range from evaluation and interpretation of geological prospects to services for drilling and completing wells to companies which provide services used during the lifetime of an oilfield.

We have been asked to testify before this sub-committee on the subject of the resource base available to develop this nation's oil and gas reserves. In other words—are there rotary rigs and the components to make up these rigs available today, and are petroleum equipment suppliers capable of keeping up with demand should orders for rigs and other equipment increase.

The answer to both questions is "yes". We have already demonstrated our ability to produce equipment. Let's look at the record. In 1971 the average demand for drilling rigs was 975. From that low point it climbed to 1,107 for 1972; 1,194 for 1973; 1,471 for 1974; 1,660 for 1975; and last year it was 1,657. For the first 12 weeks of 1977, the average is 1,859.

This growth required equipment which was supplied by the petroleum equipment manufacturers. As activity grew in 1973, demand for equipment increased; 437 new units were delivered for use in the domestic industry between 1973–1975. As of the most recent survey, there were 2,204 rigs available for work. There are over 50 super-deep drilling rigs suitable for drilling for gas which are presently idle.

The following are preliminary figures developed at the request of the committee staff. Final figures will be supplied to the committee next week. Price Waterhouse conducted two surveys: One on the capacity of the industry to produce and affix tool joints to drill pipe and a second survey on the capacity of rig manufacturers to produce rotary drilling rigs.

Preliminary figures for the drill pipe survey show that the industry can deliver more than 12 million feet of drill strings with tool joints attached. And next year, due to increased capacity, the industry will have the ability to produce 18 million feet of drill pipe.

Preliminary figures from the survey of rotary rig building capacity indicates that there exists capacity to manufacture 679 rigs this year which can grow to 930 rigs next year if required. Delivery time on the rigs ranges from 3 to 12 months. Most manufacturers are quoting 6 to 8 months deliveries.

In addition, there is available a significant quantity of drill pipe from rental tool establishments which serve our industry. Besides drilling rigs, there are also available for drilling activity power swivels which can be used on small service rigs to make them capable of functioning as a drilling unit.

We have been asked to comment on the possible need to solve demand for rotary rig output by means of emergency powers granted to the President of the United States whereby output of rig manufacturers would be allocated on the basis of a Presidential order. We find it difficult, if not impossible, to envision such a situation.

Members of this committee may recall that there was considerable talk in these chambers about the lack of drilling rigs in 1974 and early 1975. At that time some individuals complained to Congress that they were unable to get drilling rigs for their planned operations. It should be made part of the record that these individuals did not want to purchase a drilling rig, but instead wanted to contract for the use of a unit for a short period of time.

To find their complaints valid would be the same as regulating the manufacturers of taxi cabs because a cab is not available on a rainy day. What's miss-

ing in the case of drilling rigs is an enterprising individual who can see a future market and is willing to spend $1.5 to $2 million to serve that onshore (or up to $40 million to serve the offshore) market. There is currently sufficient capacity available to meet market demand for buyers in both the U.S. and overseas.

Many casual observers of the industry fail to recognize the importance of the international markets to the U.S. market. It was the business generated in the international markets of the 1960's which kept U.S. plants open. It also helped them to develop new technologies which are making it possible for the industry to meet current demand.

Beginning in 1973, executives of petroleum equipment manufacturers put into motion plant expansion plans which had long been deferred because of lack-luster markets here in the U.S. The low wellhead price of oil and gas, the numerous abandonments of marginal wells, and the decline in drilling activity were all the result of a national energy policy which has failed to provide sufficient incentive to support an active exploration program.

When demand for petroleum equipment expanded, the industry responded with the necessary expansion. More than $1 billion was committed to plant expansion. Three recent new projects will expand the production capacity of the tool joint manufacturers. These manufacturers will invest $38 million to build their new facilities. In addition to the construction labor, they will create permanent new jobs for 1200 people.

The Commerce Department reports that employment in our industry has increased from 25,000 in 1973 to 62,500 in 1977. The investment to create these jobs was made because we believe that petroleum equipment will play a vital role in the future of this country.

What you have heard thus far in my testimony is that we, the petroleum equipment suppliers, are now and will remain capable of meeting the demand for new rotary drilling rigs, for service and for production equipment.

I would like to comment on the nature of the capital commitment required to expand or modernize our plants.

At the company I was affiliated with we have literally hundreds of millions of dollars invested in plants and equipment. The machinery utilized to produce oilfield equipment is always a major investment. Much of this equipment was designed and built by Cameron Engineers. It is unique—single-purpose—and it cannot be easily duplicated.

Other petroleum equipment suppliers have the same kind of investments in plant facilities. In order to expand these facilities, we must make a long-term commitment. It costs a very large amount of money and it takes time to develop the kind of equipment we must have in order to make customized, precision products for the energy industry.

During the Arab oil embargo, many of us thought that the immediate demand for our products signaled the opportunity to make the commitments to expansion that we had predicted would inevitably develop. We expanded our facilities and hired and trained new employees, only to find that the energy industry could not sustain, under the present political atmosphere, such rapid growth in the search for energy. The result was a slack in the petroleum equipment business. Many major oil tool manufacturers have had layoffs. But the productive capacity is available to produce any anticipated requirements, as our survey shows.

To summarize: Plant capacity currently exists to produce 679 drilling rigs and 12 million feet of jointed drill pipe this year, with a substantial potential increase available next year. We can currently meet—indeed, we hope for—additional demand to fully utilize plant facilities now in existence.

We, the manufacturers, have invested more than $1 billion in the past five years to expand our plant capacity. Additional expansion is planned by some of our member companies if and when economic forecasts and political realities show that such massive investment in equipment will be met with increased petroleum equipment orders.

This concludes my testimony and I am open for questions from the Committee. I have with me Mr. Jim Chenault, President of the Oilwell Division of U.S. Steel Corporation and second Vice President of PESA, who is also available to answer your questions.

Senator GRAVEL. We move to the next witness, Mr. Walter J. Herget, president, Rio Blanco Oil Shale Project.

STATEMENT OF WALTER T. HERGET, PRESIDENT, RIO BLANCO OIL SHALE PROJECT; ACCOMPANIED BY DAVID BRODY, ATTORNEY, STANDARD OIL CO.

Mr. HERGET. Mr. Chairman, we appreciate the opportunity to appear before you today. I am an employee of Standard Oil Co. and president of Rio Blanco Oil Shale Project. Rio Blanco is an organization formed by Gulf and Standard Oil to develop Federal Oil Shale Prototype Tract C–a in Rio Blanco County, Colo.

With me today is David Brody, an attorney with Standard associated with that project.

I believe we submitted to you prior testimony. If I could just summarize it and ask that the written testimony be entered into the record.

In summary, our project is to develop a plan for oil shale recovery that we believe is economically satisfactory and environmentally satisfactory. We filed this plan with the Department of the Interior, as was called for by our lease on Tract C–a.

If you are interested, I have a copy of the plan.

Senator GRAVEL. We will take the plan. We may not put it in the record.[1]

Mr. HERGET. You do not have to put it in the record.

Just last week, I announced that the Gulf and Standard board of directors had agreed to fund the original program called for in our plan. This involved an expenditure of something like $93 million in the time from now to 1981. Our plan is in two phases, the initial modular phase and the commercial phase starting in 1982.

We do not need any Government incentives to carry out this initial plan. We do need ERDA laboratory help. We have been getting that help. We would like to continue getting that help so we can develop this oil shale reserve.

The reserves on our tract, we believe, are about 2 billion barrels of recoverable oil. This is only on the 5,000-acre tract. Therefore, we hope to be able to add to our oil supplies in this country.

We think that the industry will probably need some incentives as to make this industry grow. Such incentives might be accelerated depreciation and investment tax credit and perhaps project loan guarantees.

We cannot say today exactly what we would need in our commercial phase, but we would like to have you keep these needs in mind. We certainly, however, do not need any disincentives such as price controls, dismemberment, further taxation, between producing, marketing, and refining segments of the business.

We are fully prepared to go ahead with this plan if we can get some air quality regulations clarified and the Department of the Interior approves the plan.

The government body that administers our lease is the area oil shale supervisor in the Interior Department. This office must approve our detailed development plan. The area oil shale supervisor's office has established a program to accommodate the required oil shale environmental advisory panel's deliberations and advice, public hearings, and so forth, and to reach a final decision on the plan by September 1, 1977.

[1] The plan was made a part of the official committee file.

However, the Department of the Interior was going to schedule timely publication in the Federal Register of notice of the public hearings but has not yet done so. This virtually guarantees delay of the planned decision process.

We would like your help and the help of the administration and the Department of the Interior to let us go ahead with this plan which we think is an important step to develop this natural resource.

Senator GRAVEL. Would you go into what happens physically in reference to your statement concerning the report process on page 2? Walk me through it.

You have shale beneath the ground, oil in the shale. What do you do?

Mr. HERGET. We know what is there. We drill core holes. We will drill shafts down about 1,500 feet, I believe, and then laterally we will drift off those shafts with tunnels and we will rubblize the room with chemical explosives.

Senator GRAVEL. How big are the shafts? 8 by 8?

Mr. HERGET. Yes, sir. The first shaft, I believe will be 12 feet. As you go forward, you might get as big as 30 feet. These drifts are big enough to get equipment in to drill blast holes, put chemicals, explosives, blast that room.

This gives you the permeability that you need. Then you come in from the top and introduce air and start a fire burning. As the fire burns down, it drives the oil and gas ahead of it. That is collected at the bottom and pumped to the surface.

Senator GRAVEL. You seal the shaft off, pump air down, light the fire in this rubblized room you created and, as it burns, just pull off the gas?

Mr. HERGET. Pull off the gas and liquid oil.

Senator GRAVEL. What cost do you have right now, or is it too early to tell what it will cost?

Mr. HERGET. We will not exactly know what our costs are until we get down in the ground, but making a number of assumptions, we think we can compete and have a reasonable return at foreign oil prices.

Senator GRAVEL. We had testimony back in 1974 before this committee perceived a priority that existed. Oil, gas were of primary importance then tar sands and now from my knowledge, going to Venezuela, those sands would have a higher priority than shale which would come in next, costwise. Is that your perception, or have there been new discoveries?

Mr. HERGET. I believe this new, modified in situ method, the cost of producing it is lower. A year or so ago we were looking at surface retort, bringing it up to the surface, heating it, and then disposing of the spent shale. That was on the order of $20 oil. It was considerably above the foreign oil price.

We think this is a cheaper method of getting oil.

Senator GRAVEL. Would this not be the same procedure that one could use for the gasification of coal?

Mr. HERGET. I suppose the same principles would apply. I am not familiar with coal at all.

Senator GRAVEL. This process is called?

Mr. HERGET. Modified in situ, meaning "in place."

Senator GRAVEL. "In situ" means in place?

Mr. HERGET. Yes, sir.

Senator GRAVEL. Thank you very much. I have no further questions. May I wish you well in your endeavor?

[The prepared statement of Mr. Herget follows:]

STATEMENT OF WALTER HERGET

Mr. Chairman, members of the Committee, my name is Walter Herget. I am an employee of Standard Oil Company (Indiana) and President of the Rio Blanco Oil Shale Project.

The Rio Blanco Oil Shale Project is an organization formed by Gulf Oil Corporation and Standard Oil Company (Indiana) to develop Federal Oil Shale Prototype Tract C-a in Rio Blanco County, Colorado.

With me today are Blaine Miller, a Gulf employee and Executive Vice President of the Rio Blanco Oil Shale Project, and David Brody, an attorney with Standard.

Approximately 1 year ago, the Rio Blanco Oil Shale Project submitted a detailed plan calling for development of Tract C-a by the open pit mining and surface retorting method. Compared to other potential development techniques, this program was expected to generate the highest possible percentage of the shale oil resource. Operations under the lease were suspended for 1 year beginning September 1, 1976, because of problems concerned with offtract land as well as air quality considerations.

From the outset, the Rio Blanco Oil Shale Project has been investigating all potentially attractive methods of developing the Tract C-a resource. As a result of this effort, we have now developed what we believe to be an environmentally and economically more attractive program. On May 25, 1977, we submitted this Detailed Development Plan to the Area Oil Shale Supervisor of the U.S. Department of the Interior for approval.

The revised Detailed Development Plan calls for modified in situ development of Tract C-a, which we believe is environmentally more acceptable from several viewpoints:

(1) With the exception of rights-of-way for roads, power, communications, and pipelines, etc., all of the operations will be confined within the Tract C-a boundaries. That is, the present plans call for no requirement for off-tract lands for plant siting or processed shale disposal. We are studying ways to dispose of processed shale underground, such as preparing a slurry so the processed shale can be put back into the burned-out retorts. If the procedure is feasible, we may be able to eliminate substantially all surface disposal and the subsequent need for surface rehabilitation.

(2) Much of the operation will be underground and totally unobservable from the surrounding surface area.

(3) It may be possible to generate more than two-thirds of our electricity requirements as an integral part of the operation.

(4) Water requirements may be reduced by more than 75%.

At their respective May and June meetings, the Board of Directors of Standard and Gulf approved the initial funding of the development called for in this modified in situ Detailed Development Plan. This initial funding, which will cover the period through the year 1981, will include the burning of five retorts of increasing size and will cost some $93 million. Gulf and Standard have already expended $157 million on this project.

We are prepared to go forward with this initial program if and when three roadblocks are removed: (1) Two years of air quality baseline data have shown that federal primary and secondary ambient air quality standards are being exceeded by natural occurrences on Tract C-a, even though there is no industrial development in the area. (2) The area of Tract C-a is currently covered by Colorado's most stringent sulfur dioxide category. Either a category change or some alteration in the standards will be necessary. Some legally satisfactory solution of these two air quality problems must be found. (3) The Area Oil Shale Supervisor must approve our Detailed Development Plan. The Area Oil Shale Supervisor's office has established a program to accommodate the required Oil Shale Environmental Advisory Panel's deliberations and advice, public hearings, etc., and to reach a final decision on this Plan by September 1, 1977.

However, the Department of Interior was going to schedule timely publication in the Federal Register of notice of the public hearings but has not yet done so. This virtually guarantees delay of the planned decision process.

Should there be further delay in the Detailed Development Plan decision process, or requirements for additional environmental impact statements, assess-

ments, etc., we may have no alternative but to seek further suspension of the lease terms on these grounds.

We are not seeking government financial support for the planned 1977–1981 program. However, several of the Energy Research and Development laboratories have been invaluable in helping us solve problems that will be common to all oil shale developers. We believe their continued and expanded support is not only justified but essential to a successful prototype program.

One of the main purposes of this initial modular development program we are now planning is to improve our estimates and projections of producing rates, recoveries, costs, etc. Currently these studies indicate a number of uncertainties which cannot be quantified until we get into the ground, and contain numerous assumptions which have yet to be validated. We have hopes, however, that modified in situ shale oil will be able to compete in a free market with foreign oil. If this proves to be the case, the Tract C-a resource could attain a producing rate of 200,000 barrels per day, and ultimate recovery will be in the order of two billion barrels.

While both Gulf and Standard are planning to proceed with the initial development phase without Federal incentivies, some form of government encouragement for oil shale development may be necessary. The oil shale industry has the potential for contributing significantly to U.S. energy needs and reducing the dependence on overseas sources. However, based on current estimates, the minimum commercial size operation could require an investment of more than $1 billion before any revenue is generated. This is a sizeable burden for even the largest U.S. companies.

The burden takes on increasing significance when we recognize the substantial risk that will be involved in large scale operations. No matter how many pilot plants, demonstration projects or research studies are undertaken, it is certain that there will be a substantial difference between initial expectations and actual experience when full scale operations are undertaken. This will make many companies reluctant to make large investments in oil shale unless the potential return is commensurate with the risk.

We believe there are several areas where the federal government might be able to offer reasonable help for companies undertaking oil shale programs. Such help might include accelerated depreciation, investment tax credits, and project loan guarantees.

These suggestions are made in the context that to fully recognize the potential of oil shale development will require the effort of many companies, both large and small. Without Federal incentives, we do not believe that development of the oil shale resources will progress in a timely manner.

In summary, we generally feel we can begin to develop Trach C-a in an efficient and environmentally responsible manner. We hope to provide additional energy for this country even though it will take several years to develop. But, any unreasonable delays can have a serious effect on our ability to provide this oil in a timely manner.

Senator GRAVEL. Our next witness is Mr. Lloyd Elkins, consultant, Tertiary Oil Productions.

STATEMENT OF LLOYD ELKINS, CONSULTANT, TERTIARY OIL PRODUCTIONS

Mr. ELKINS. Thank you, Mr. Senator. I think you have a copy of my prepared statement. I will not go through that in detail. I will talk mostly from table 2. First of all, tertiary oil recovery, we commonly call it enhanced oil recovery, by most definitions is going after oil that is still in the reservoirs after it has been water flooded, after water has been used to the fullest extent to displace the oil. This makes it very complicated. The technology has been evolving gradually. In the industry—most major companies and many independents are performing field tests, and laboratory research is going on to try to perfect this technology.

There is a real stake here. For example, now, in the Lower 48 States, the proven oil reserves are 27 billion barrels. This eliminates Prudhoe Bay, because that is not a factor in here.

In my judgment—my judgment is based upon having been involved (very closely in some, pretty closely in others) in tertiary oil recovery studies—we have an ultimate target now of about 50 billion barrels. That 50 billion barrels is not going to come on suddenly. My whole statement really points, finally, to how fast can this come on and what the incentives are pricewise and otherwise that might bring it on.

Right now, the country produces, by this definition, 300 to 350,000 barrels a day of tertiary oil. California, for several years has been producing this kind of oil—mostly thermal.

The big stake is in two of the methods, carbon dioxide in a large part of the country and chemical flooding in other parts.

We have the technology pretty well defined. The problem we have not mastered yet is how to make that fluid that we are going to inject find most of the oil in the reservoir. We can do it in the laboratory, very straightforward. We have pilot tests going that are going to help find this out.

The industry will not take the total risk yet until they see an improved technology, one that they understand, one that they know will work in different types of reservoirs. In the period between now and 1980 or 1981, there are going to be a lot of these pilot tests coming along to firm up this technology. The big question is really, how can the energy policy of the country be so designed to provide the incentives that will bring this growth on faster?

At the present time—and I want to talk primarily about table 2 which is in your handout—these three cases present projections of our potential daily rates of production. For perspective you have to visualize now in the United States, the south 48 is producing 8 million barrels a day. This has been going down every year in the 1970's.

Keep this in mind. Case A is the most conservative case. The point of it is, even in the case A or B I do not think we will have over three-quarters of a million barrels a day enhanced oil recovery by 1985. I must say that is in spite of most incentives that might be added right now.

So much has to happen in the next 4 or 5 years. The time is already short. You cannot turn it on much faster than that. If we can get more projects going quickly and the price of oil is right, there is a chance that it could increase up to a million barrels a day as shown in the "C" case.

That calls for taking more risks starting many field tests in order to establish the confidence level and the learning curve that says we can risk developing chemical plants and major carbon dioxide natural supply systems, build big pipelines if we must, to the major areas, as in west Texas where this is primarily going to work first.

Nobody is going to invest in the development of the carbon dioxide or the pipelines system for the operators in west Texas, for instance, until they know that they are going to make a reasonable profit.

So, in summary of what I am really pointing out here is we have two types of incentives—one has to do with the price of crude oil. Case A assumes that by 1980 we would be at the world price of crude oil, $15 in 1977 dollars. That is probably not too far wrong. It is $13.75 now. It probably will go up a little bit more. Inflation has to be added on to that.

Case B kicks this up to about $18, an extra $3, and this is based on a combination of a lot of studies that have gone into this. This is a

middle of the range projection I think. That brings on more oil by about the turn of the century than it would bring on, if it stayed at $15.

Case C, in my own judgment is what this country is pointing to downstream. This assumes a stabilizing world price of crude oil, with the United States having the equivalent price.

This might range between $20 to $25 in 1977 dollars. It could be as low as $20. Sometimes $22 is quoted as needed for liquification of coal. Mr. Herget, just pointed out you can get oil from shale a little cheaper than this now. When the domestic price of crude oil gets to the same level as our total mix from synthetics—gas equivalence comes in here, too—I think that is going to be in the range of $20-plus at that point, with the additional incentive that I will touch on briefly here, we will be able to get up to Case C. In that case, our ultimate target is 50 billion barrels. Even under C, which is up to 3½ billion barrels a day, after the turn of the century, by 2015 we will have only produced 32 billion barrels. Whether the target is 25, 30, or 50 billion barrels is not too important for the next 20 years. In the long-range picture, it really is important.

The other needed incentive right now is a hangup. Someway we need a special price or other incentive for tertiary oil. Special price is awfully difficult to administer. Most of this oil is coming through an operation already partially on secondary. You cannot count the barrels of tertiary oil. It has to be a technical estimate. It will not normally be a measurable quantity.

One way to do it—and maybe this is not the best way—might be some sort of tax incentive—I am no tax expert—applied to the front loaded cost. This is subject to audit. Maybe there is some special drilling that has to go into it, but CO_2 or other chemicals purchased from somebody is going to be a cost you can measure. A significant tax credit for this type of cost for a 40-year period will speed this performance up a lot. Pilots tests will start quicker. The prototype commercial tests will get going—in my testimony, I suggest some sort of tax credit for 10 years based on something that is easily measured would provide the incentive that would bring on this technology, get the learning curve established a lot faster and give us a chance to approach something like case C.

This is oil discovered. It is there. There is a lot of risk involved. If we can diminish risk in that way, I think we can get up to case C.

Thank you.

Senator GRAVEL. Thank you very much.

Let me ask you, what is being done worldwide Are we the only ones looking into tertiary?

Mr. ELKINS. Canada is worried about tertiary. Venezuela, they are looking at it. The heavy oil down there, they are going after with thermal.

When you get to the Middle East, they have so much primary production followed by secondary that tertiary is away downstream. They do not need that yet.

We have a lot of oil that has already been produced down to the point that tertiary is the only thing left in many oil fields. That is why we are so vitally concerned.

Senator GRAVEL. Thank you very much.

[The prepared statement of Mr. Elkins follows:]

STATEMENT OF LLOYD E. ELKINS, PETROLEUM CONSULTANT, TULSA, OKLA.

Tertiary oil recovery (often called enhanced oil recovery) in most projections refers to that oil that might be recovered which is left in place after displacement by water (or oil incapable of being effectively displaced by water).

Three principal enhanced recovery processes are under intense laboratory and field investigation:

(1) Thermal—Steam drives and Insitu Combustion.

(2) CO_2 (Carbon Dioxide)—Miscible.

(3) Surfactant (often called Micellar or Low Surface Tension etc.).

The three methods listed above each has its greatest potential in types of reservoirs not as attractive for the other two. This does not mean each is limited to one type reservoir.

Thermal has the preferred application in low gravity crude fields of the type heavily concentrated in California. There are heavy oils in other states also.

CO_2 will probably find its greatest application in carbonates and dolomitic formations where oil composition and pressure and temperature factors are in the required range. It will also have application in sandstone reservoirs.

Surfactant will find its most frequent application in sandstone formations.

Steam drives in Thermal are well understood technically and in fact are responsible for some 300,000 barrels per day production in California.

Insitu Combustion is higher risk than steam. It has not proven as attractive economically as steam but it will find potential in specific fields as incentives become better defined. Environmental restrictions and water supply may provide obstacles to accelerated growth in production in California. On the other hand more expensive water supply alternatives and systems to minimize air pollution could provide growth with higher crude prices.

CO_2 Miscible may well find applications throughout the Mid-continent (including the Rocky Mountain States) and certain type reservoirs in the Gulf Coast. Probably West Texas and New Mexico type dolomitic fields will see the greatest demand for CO_2. The technology is not yet proven for application of CO_2 in these heterogeneous formations. However, laboratory research and field tests underway or projected are expected to define the difficulties and find the means to minimize their negative affect on recovery performance.

One bottleneck to accelerated application is development of CO_2 supply systems capable of delivering large volumes to large projects. Most operations using CO_2 will find it desirable to have large segments of a field, if not the whole field, under injection at about the same time.

Once CO_2 supply is available, my judgment is that CO_2 enhanced recovery operations will be a medium to high risk operation until field experience and further research reduce the risk.

Surfactant Flooding is at this time probably the highest risk operation of the three. Engineers need to find a way to maximize the ability of the relatively small volume of expensive chemicals to contact one-half to two-thirds of the oil in place before dilution by water and oil destroy the miscibility of the chemical slug with oil and water being displaced. If this can be achieved surfactant flooding could prove to have a greater general application than the other two methods. Both field and laboratory research have this type of objective at top priority.

At this point in time the technological barrier to rapid acceleration of CO_2 and Surfactant flooding is pre-conditioning the reservoir or designing the flooding material to diminish the negative affects of heterogeniety. This is a technological breakthrough that could broaden the application and simultaneously increase recovery efficiency over that projected in most current studies.

In my judgment this type of breakthrough is forthcoming but will probably only come after some disappointing and expensive field tests are behind us.

This does not mean that all attempts at commercialization will wait. If this were to happen the impact of these two methods (CO_2 and Surfactant flooding) would suffer serious delay.

During the time required for this evolution of technology which has to come from field tests, the risks are high and the cautious application will bring on a high level of costs which should not prevail after we are well up the learning curve.

Insofar as Enhanced Oil Recovery is concerned incentives which will stimulate accelerated field testing and commercial attempts in the more attractive projects will go a long way in speeding up this learning curve.

What might it take to accelerate and maximize Enhanced Oil Recovery? The first relates to ultimate recovery potential. This is often referred to as a target. These targets vary both with level of crude oil price and with a judgment as to possible improvements in technology. Targets range from 10 to 15 billion barrels if price for enhanced oil were roughly current world crude oil price delivered to the United States with no significant breakthroughs in technology. The higher range is 20 to 30 billion barrels, with prices around $5 to $10 higher than current world crude oil price delivered to the United States and differing degrees of optimism for technology improvement.

In my judgment a 50-billion barrel target is in range for both reasonable growth in crude oil price combined with expected significant advances in technology. See Table 1 attached. However, whether it be 25 or 50 billion barrels is much less important today than the rate at which it can come on.

To illustrate this I offer three projected production rates which I believe bracket the spread of most likely trends. See Table 2 attached.

In my judgment Case A is the minimum total incentive situation that could prevail and Case C probably approaches what could likely be realized with crude oil prices approaching and staying competitive with synthetic liquids from tar sands, oil shale and coal.

Probably a tax incentive route related to auditable high front loading costs for perhaps a 10-year period could push production toward the Case B or Case C projections.

TABLE 1.—UNITED STATES (EXCLUDING ALASKA) API OIL RESOURCE AND RECOVERY ESTIMATES, DEC. 31, 1974

	Original oil in place (billion barrels)	Ultimate recovery (billion barrels)	Percent recovery	Estimated percent original oil added by enhanced	Recovery added (billion barrels)
Sandstone reservoirs:					
Pacific coast	79.2	19.50	24.6	15	11.8
Rocky Mountain (N. & S.)	21.85	6.51	29.8	10	2.2
North Central district	11.29	3.49	30.9	10	1.1
Central district and Texas district 10	38.28	12.86	33.6	10	3.8
Southeast New Mexico plus Texas district 8 and 8A	15.05	2.93	19.5	20	3.0
Texas district 7B, 7C, 1, 5, 9	26.18	5.73	21.9	20	5.2
Texas district 6	10.96	7.49	68.3		
Texas district 2, 4	14.20	5.58	39.3	10	1.4
Texas district 3 plus southern Louisiana	46.37	23.50	50.7	5	2.3
Southeastern	11.75	4.33	36.8	10	1.2
Northeastern	10.75	2.11	20.3	20	2.0
Total	285.52	94.03	32.9		34.0
After enhanced		128.03	44.8		
Carbonate reservoirs:					
Pacific coast	0	0			
Rocky Mountain (N. & S.)	10.33	2.55	24.7	20	2
North Central	10.32	2.44	23.6	20	2
Central district plus Texas district 10	22.01	5.97	27.1	15	3.3
Southeast New Mexico plus Texas district 8 and 8A	63.75	19.02	29.8	15	9.6
Texas district 7B, 7C, 1, 5, 9	9.12	2.44	26.8	20	1.8
Texas district 6	1.26	.47	37.3	0	
Texas district 2 and 4	.14	.02	14.3		
Texas district 3 plus southern Louisiana	.05	.01	20.0		
Southeastern	7.03	1.62	23.0	20	1.4
Northeastern	.01	.001	10.0		
Total	124.02	34.54	27.9		20.0
After enhanced		54.54	44.0		
Total United States (excluding Alaska) after enhanced	410	183	44.6		[1] 54.0

[1] Rounded to 50,000,000,000.

TABLE 2.—PROJECTED PRODUCING RATES FROM ENHANCED OIL RECOVERY

	Case A[1]		Case B[2]		Case C[3]	
	Daily rate (thousand barrels)	Cumulative (billion barrels)	Daily rate (thousand barrels)	Cumulative (billion barrels)	Daily rate (thousand barrels)	Cumulative (billion barrels)
1975	250	[4]1	250	[4]1	250	[4]1
1985	759	2.83	750	2.83	1,000	3.28
1995	1,500	5.94	1,500	5.94	2,000	8.76
2005	1,500	11.42	3,000	15.15	3,500	18.80
2015	1,500	16.90	3,000	26.10	3,500	31.84

[1] Case A assumes crude oil price approaches $15 per barrel (measured in 1977 dollars) by 1980 plus growth at inflation rate. No other incentive to accelerate learning curve and no significant improvement in technology.
[2] Case B assumes crude price at about the $18 per barrel (measured in 1977 dollars) level by 1980 plus growth at inflation rate no other incentive to accelerate learning curve but significant improvement in technology in the long run.
[3] Case C assumes crude oil price rises to the $20 to $25 per barrel (measured in 1977 dollars) level in the early 1980's plus growth by inflation with other incentives to acclerate learning curve and significant improvement in technology.
[4] Estimated 1,000,000,000 enhanced before 1975.

Senator GRAVEL. Our next witness is Mr. S. K. Smith, general counsel, American Natural Resources Co.

Mr. SMITH. I prepared my remarks on the presumption that Mr. Bennett would precede me and we would be, in effect, on a panel.

Senator GRAVEL. Why don't we have Mr. Bennett precede you and you join him at the table?

STATEMENT OF OTES BENNETT, JR., CHAIRMAN OF THE BOARD, NATIONAL COAL ASSOCIATION

Mr. BENNETT. Thank you, Mr. Chairman. I have a comprehensive statement for the record which I will summarize.

My name is Otes Bennett, Jr. I am chairman of the board of the National Coal Association, an organization which represents the Nation's leading coal producing companies, whose operations comprise more than half of the commercial production in the United States. I am also president of the North American Coal Corp.

I am accompanied by Mr. Arthur Seder, president of American Natural Gas Service Company. NCA also numbers in its associate membership machinery manufacturers, railroads, natural resource developers, financial institutions and coal consultants. I appreciate this opportunity to express the coal industry's views on the tax-related proposals of President Carter's energy program. Coal is not only an existing source of energy, but as the feedstock for gasification and liquefaction, it is an integral part of the more exotic energy sources of the future.

Mr. Chairman, your invitation to testify has raised the question as to whether President Carter's energy program included sufficient incentives for the production of our existing energy resources. You have also asked that the coal industry comment on gasification within this context. I can state at the outset that there are no provisions contained in the energy package that can be characterized as an incentive to help increase coal production. And, without the production, you cannot have a synthetic fuels industry based on coal.

Senator GRAVEL. Are you saying that in the administration's package, you find no incentives?

Mr. BENNETT. No, sir, there are incentives, but no incentive to increase coal production.

In addition to the absence of incentives, I will touch briefly on some of the more important restraining influences faced by the coal industry. I mention these only to highlight the need for positive incentives to offset these negative forces.

The administration is calling on the coal industry to increase annual production from 665 million tons to more than a billion tons by 1985. This goal is realistic if unnecessary constraints are avoided. Potential constraints that are of concern include:

One, on the demand side: stringent air quality requirements that are tighter than needed and that will be made even more restrictive under proposals before Congress; and

Two, on the supply side: Surface mining legislation that could prohibit mining of our most accessible coal even though reclamation is feasible; complicated new Federal leasing requirements which have severely protracted the procedures for obtaining coal leases; and proposed new requirements under the coal mine health and safety law that will not contribute to improved safety but will further reduce productivity in underground mines.

If these unnecessary impediments to increased coal production and utilization are overcome, one essential ingredient is still lacking—investment capital. And huge amounts of capital will be required by our industry to meet the demands for conventional use, as well as supply gasification and liquefaction processes.

Senator GRAVEL. Do you have any difficulties getting sufficient people to go work in the underground mines? Is it high employment or low employment?

Mr. BENNETT. Mr. Chairman, we have no problem getting people per se. We have problems in getting them, the warm bodies, so to speak, to the experienced miner. We will experience, and are experiencing, a delay. We have no problem recruiting employees. To train them to the efficiency that is required is a problem and will continue to be.

Senator GRAVEL. How long does it take for you to make an efficient miner? What is the leadtime there?

Mr. BENNETT. To make a proficient miner—you do not mean a technical engineer?

Senator GRAVEL. A good miner.

Mr. BENNETT. A miner that can operate a mining machine, I would say from 1 to 2 years before he can really become what we call a proficient miner.

Senator GRAVEL. That is not too bad of a leadtime.

Mr. BENNETT. No, sir. We think that problem can be overcome.

Current estimates of capital requirements vary. However, it is generally accepted in the coal industry and the financial community that capital requirements in the industry over the next 10 years will range generally between $20 billion and $25 billion in current dollars, with some estimates going as high as $50 billion.

Senator GRAVEL. You are saying over the next 10 years you are going to need $20 to $25 billion?

Mr. BENNETT. Yes, sir.

Senator Gravel, today with the oil flowing from the first full day in Alaska's history, the Alaskan pipeline, the amount of investment in the pipeline, the institutional system is $20 billion for that one investment. I only wanted to put this in the record so that there would be a sense of proportion in comparison to your figure.

Regardless what the actual figure is, the capital requirements are staggering for an industry with a current total capitalization of about $6 billion. It is for this reason that the coal industry is concerned about the lack of incentives for investment capital in the President's energy program, specifically as set forth in title II of H.R. 6831, now before the House.

Nothing in the legislation would directly aid the coal industry in achieving the levels of production envisioned by the administration.

A more favorable tax climate would both increase the likelihood of generating a greater amount of capital investment funds, and enhance the attractiveness of the industry as a sound, profitable investment.

Legislation to aid the coal industry in meeting its goal is not unfamiliar to the Senate Finance Committee. Bills to provide greater incentives have been introduced and discussed in past hearings. In addition, other proposals exist—all intended to provide greater financial stability to the coal industry.

Title II of H.R. 6831, containing the tax proposals of the President's energy program, would provide incentives, in the form of an additional tax credit, for certain "alternative energy property." With respect to coal, such properties include coal-fired boilers, or other combustors, and facilities to convert coal to specified synthetic gas—500 Btu or less per cubic foot.

In addition, facilities where coal is used as a feedback for the manufacture of chemicals or "other products"—other than coke—would qualify.

Presumably "other products" could include synthetic oil or solid fuel, but the language is unclear. Both liquefaction and facilities for conversion to low-pollutant solid fuels should qualify. To avoid any controversy, this should be made clear in the language of the bill or in the report of the committee.

With respect to the gasification of coal, it is our opinion that the language of the bill restricting the additional tax credit as it would apply to facilities converting coal to synthetic gas of 500 Btu or less per cubic foot is too restrictive.

While existing commercial gasification processes, such as Lurgi and Koppers Totzek, normally produce gas well below the 500 Btu limit; these processes can be integrated with a methanation process and thus more than double the Btu content.

Low Btu synthetic gas from a qualifying plant could, however, be piped to a second across-the-fence facility for upgrading. From an engineering point of view, it is more economical and efficient to integrate the process in the same facility.

The 500 Btu limitation is apparently intended to encourage industrial use. However, industry uses gas for other purposes than firing boilers. For instance, if the gas is used to convert to ammonia, a high Btu gas is most desirable.

If the added credit is intended to discourage conversion of coal to gas for other than industrial gas, the language should so state. However, there should not be restriction as among industrial uses.

It must be reemphasized that these incentive provisions do not apply directly to the coal industry, but rather to the utilization of coal. Nothing in the bill encourage investment in new mines and equipment, except the hope for an expanded market.

Legislation to assist the coal industry in financing expansion has been introduced in the House of Representatives and has been referred to the Ways and Means Committee. To my knowledge, similar legislation has not been introduced in the Senate. One bill, H.R. 4497 should be considered by the Congress and included as part of any tax-related energy legislation.

H.R. 4497 would amend the Internal Revenue Code to provide for a 12-month writeoff for new coal mining equipment. This bill recognizes the high costs of opening mines, the financial risks involved, and the costs of complying with health and safety requirements.

Depending on physical conditions, the cost of putting a new mine into production may cost upwards of $40 or $50 per annual ton of production in today's dollars. Translated, this equates to $40 or $50 million of investment before commercial production begins in a medium-sized 1 million ton a year mine.

There are two other proposals on the House side, H.R. 4178 and H.R. 4556, which address the tax aspects of converting coal to low-pollutant synthetic fuels. And these proposals are directly related to the purpose of this hearing.

The first would provide for the amortization of coal conversion facilities based on a 12-month period. It would further establish a price support program for synthetic fuels produced from coal in recognition of the fact that these synthetic fuels would, even at today's price levels, be more costly than oil or natural gas.

H.R. 4556 would further encourage the manufacture of low-pollutant, synthetic fuels made from coal by extending the cutoff point for depletion purposes by providing that conversion treatment process shall be considered as mining.

Under present law, if coal is processed to produce oil, gas, or solid low-pollutant fuel, such processing is considered beyond the valuation point for percentage depletion purposes. That is, for computing percentage depletion, the coal must be valued before it is converted to low-pollutant fuel. Existing law, however, does permit the processing of oil shale to the point where it is equivalent in value to crude petroleum.

H.R. 4556 would permit, for percentage depletion valuation purposes, processing of coal into low-pollutant fuel—liquid, gas or solid. Thus, the same depletion valuation would apply to synthetic fuels from oil shale and synthetic fuels from coal. If coal is processed to remove pollutants, the valuation for depletion purposes would occur after such processing.

Coal and oil shale represent a large part of our total energy reserves. These fuels must be used to satisfy future energy demands if we are to reduce our dependence on natural gas and oil. Conversion of coal and oil shale to low-pollutant fuels should be encouraged because only when such conversions becomes a commercial reality will the United States be assured of a stable supply of energy.

Oil and gas from coal and oil shale will not completely supplant natural gas and petroleum, but merely supplement them in the very difficult task of meeting future energy needs.

This is true because the cost of producing oil and gas from coal and oil shale is still higher than the current price of natural gas and oil. At some point, perhaps in the near future, the shortage of natural gas and oil and the increasing cost of finding new supplies will drive the price upward to a level where oil and gas from coal and oil shale will be competitive.

New tax incentives related to conversion will hasten that day. I would mention parenthetically that oil shale enjoys a 15-percent depletion allowance, while coal has only 10 percent. Any increase in coal's rate would of course be added incentive to investors and coal producers.

H.R. 4556 would also cover processing of coal to produce a low-pollutant solid fuel. These processes should be encouraged because many utility and industrial plants have need for an environmentally acceptable solid fuel.

We urge the Energy and Foundations Subcommittee and the Senate Finance Committee to give consideration to proposals similar to those before the House in conjunction with the President's energy program. H.R. 4497, in particular, provides a measure of the stimulus needed by the coal industry. Alternatively, the coal industry should be permitted the additional tax credit for the purchase of mining equipment, as is proposed for other alternative energy equipment.

The billions of dollars for capital expenditures mentioned above do not include an expense in the form of a huge contingent liability which is little appreciated or understood outside the coal industry.

No greater area of uncertainty exists in the coal industry than that related to contingent black lung benefit payments. It appears that the cost of this program will be in the billions of dollars over the next 10 years alone. Precise future costs are impossible to compute at this point in time, and more costly amendments in the law are now being considered by Congress.

These potential costs are an outgrowth of the Federal black lung legislation which was enacted into law in 1969 and last amended in 1972. Under that law, coal producers must now pay black lung benefits to coal miners that contract the disease.

These obligations could continue for 50 to 75 years after a mine is closed or the claimant deceased, because the benefits apply to a miner's dependents. Estimates vary, but actuaries calculate it will require about 50 cents of the $1 per ton of coal mined, depending on the life expectancy of the mine and the age complement of the work force to fund each claim.

Insurance to cover this liability is extremely costly and difficult to obtain because the liability is almost impossible to evaluate. Cancellation by the insurer is a certainty if the risk proves too great.

Therefore, we strongly urge enactment of S. 1656, introduced by Senator Hansen, that permits the operator to establish a tax-exempt irrevocable trust into which he makes payments. The payments into the trust would be deductible at the time the payments are made to the trust. This would provide an incentive for the creation of the trust fund and could result in a twofold increase in current contributions to the trust because of the tax benefits derived from the contribution. Any

income earned by the trust would be exempt from taxes, thereby maximizing the accumulation of funds, and payments to the miner would be excluded from the miner's tax liability.

The corpus of the trust could never revert to the creator of the trust. It could not be used as a tax shelter device by the mine owner with the funds to be recaptured at a later date.

There are advantages to both the miner and the operator. The miner working in the mine today, should he qualify for benefits in the future, would know that the black lung disability compensation is being funded on a current basis. Irrespective of the future, there would be money in the fund. The employer, funding on a current basis, could be more certain of meeting his future black lung obligations. In the event the company failed or was dissolved, the trust would remain as a separate entity.

The coal industry recognizes the obligation to compensate the miner actually disabled by black lung. What we seek is a legal vehicle to carry the funds so that today's coal production pays for the obligations arising as a result of current production.

There is another very real problem that could arise in the future if these obligations are not currently funded. State public service commissions could have difficulty approving utility rate increases based on increased coal costs resulting from obligations incurred perhaps 20 years in the past.

Never in the history of the country has an industry been singled out in the manner of the coal industry with respect to black lung legislation, and faced with a financial obligation of this relative magnitude. We ask the Senate Finance Committee to provide a vehicle to implement this requirement of the law.

S. 1656 could be appended to any number of tax bills that pass before the Senate Finance Committee. Of course, the bill is sufficiently important to stand by itself. However, we recognize that legislation of this nature generally must originate in the House unless it is an amendment to a House-passed bill.

While we strongly endorse new legislation, such as that discussed above, to stimulate the production and utilization of coal, we have similar strong views regarding the impact of tax laws now in force with respect to our industry. We believe that one of the most counterproductive provisions in the Internal Revenue Code is that which gives rise to the so-called "minimum tax."

The minimum tax was originally conceived to insure that a select group of very wealthy individuals, who were able to avoid or substantially reduce normal tax liability by seeking out tax shelters, would be subjected to some measure of income taxation. As intended, and originally passed by the House in the Revenue Act of 1969, that end would have been accomplished. However, in the process of legislation, the provisions of the limitation on tax preferences changed considerably.

Ultimately, it came to apply to corporations as well as individuals, and encompassed a series of "preferences" which were not part of the original Treasury package. Furthermore it indiscriminately applies to all taxpayers whether or not the preference arises out of an activity purposefully singled out to shelter income from the taxpayer's principle business activity.

The 15-percent "minimum tax" is suspect valid tax policy when applied only to individuals. As applied to corporations it is completely fallacious. It is a restriction on virtually all the attempts by the Federal Government to encourage business expansion through the tax system and should be repealed as it applies to corporations.

The greatest single encouragement to the coal mining industry—an increase in percentage depletion—has not yet been discussed. The committee is fully aware of the arguments for increasing the allowance for coal. Basically it is a question of capital formation. The points discussed above relative to other incentives apply equally if not more so to increasing coal's depeltion allowance to at least 15 percent, placing coal on an equal status with oil shale, but still well below the 22 percent permitted uranium.

The provision in the code limiting the percentage depletion deduction to 50 percent of the taxable income from the property would prevent most coal producers from using a full 15-percent allowance, thus limiting the revenue impact. However, the prospect of utilizing the full benefits in years of greater profitability will help entice capital to this high risk industry.

In conclusion, we urge that any tax-related energy legislation include positive incentives such as those mentioned above for increased investment in coal.

Senator GRAVEL. Thank you. I think your statement is self-explanatory except for my interruptions. I want to thank you.

Mr. Smith?

STATEMENT OF S. K. SMITH, GENERAL COUNSEL, AMERICAN NATURAL RESOURCES CO.

Mr. SMITH. Thank you, Mr. Chairman. My name is Stanton K. Smith. I am the general counsel of American Natural Resources Co. of Detroit, one of the Nation's major interstate natural gas transmission and distribution systems. I am appearing today on behalf of Arthur R. Seder, the chairman of American Natural, who regrets that he is unable to appear.

American Natural Resources and the Peoples Gas Co. of Chicago are in the final stages of completing plans for the construction of a Lurgi type, high-Btu coal gasification plant to be located in Mercer County, N. Dak. We have received a conditional water permit from the North Dakota State Water Commission and have more than adequate coal reserves committed to the project.

These reserves are controlled by Mr. Bennett's company. That is why we are appearing together. They will be mined by his company.

Engineering and construction planning work is being completed on a schedule which would permit field construction to begin in the summer of 1978 and completion of the plant in early 1982. Proceedings before the Federal Power Commission, the Bureau of Reclamation of the Department of Interior, the North Dakota Public Service Commission and the North Dakota Department of Health should be completed in time to permit construction on this time schedule. All of these proceedings involve detailed environmental reviews and approvals.

Of considerable importance is the fact that the Governor of the State of North Dakota and other State and local officials have announced their support for our project. We are working with these officials to assure compliance with their State and local laws and concerns, particularly the impact of the project on their communities, environmental impacts, strip mining codes, and reclamation standards.

In effect, all aspects of our joint project are ready to proceed on this time schedule except one, namely, financing.

Originally, the project was planned by American Natural as a full-scale commercial gasification plant designed to produce an average of 250,000 Mcf per day or 91 billion cubic feet per year of high Btu gas capable of being transported and distributed in existing natural gas pipelines and distribution systems.

This would have represented a significant portion—about 10 percent—of American Natural's current gas supplies. However, a number of considerations led American Natural to decide to construct the plant in phases and the first phase plant is now designed to be one-half the size of the original plant. The complexities involved in the construction of this country's first high-Btu gasification plant, the untested environmental and socioeconomic effects of the plant during both the construction and operating periods in this country and most importantly, the practical impossibility of arranging financing for a plant which would have cost in the neighborhood of $1.3 billion, dictated a decision to build the plant in two phases and to invite the Peoples Gas Co. to join us in equal ownership of the plant. We believe that the initial plant as now designed is the smallest sized plant capable of demonstrating the viability of a commercial sized plant.

As is obvious from the history I have just related, our purpose in constructing the plant today is different from its original purpose as a gas supply project. We now recognize that if coal gasification is to become a part of the gas industry's long-term energy strategy, we must first demonstrate its environmental acceptability to all Federal, State, and local authorities representing our country's affected citizens.

Second, we must demonstrate to the financing community its operating capacity and reliability and its overall economic and financial viability as a new energy source.

The leaders of the financial community are responsible for investing the savings, pension funds, insurance reserves and other investment funds of our Nation's citizens. Despite the fact that we have successfully gasified North Dakota lignite coal in a full-scale test and some of the Nation's most experienced engineering firms have testified as to its operating reliability in accordance with its designs, doubts persist in the minds of investment institutions. The risk is simply too great for these investors to purchase the debt securities needed to finance the plant even the reduced first phase plant.

Because the size of the capital investment is so large relative to the plant's capacity to produce gas as well as to the assets and capitalization of the project sponsors, the risks associated with the introduction of what is considered as a new industry and the unknown response of regulatory bodies to the future of this industry, these investments are simply unattractive when compared with the multitude of other investment opportunities and when considered in light of the legal principles of prudent investment.

Likewise, the two equity owners, American Natural and Peoples Gas, cannot prudently undertake the full financial burden for both the debt and equity portions of our financial plan. The initial plant will cost in excess of $600 million. This is about 40 percent of the total common equity of the two sponsoring companies, yet it will represent less than 3 percent of their current gas supply.

Moreover, both sponsors are heavily committed to other gas supply programs, all of which are capital intensive and equally as vital if their customers are to be served. The sponsors are willing to provide an equity investment equal to 25 percent of the cost of the gasification plant, or a total of about $150 million. They are also willing to provide or support both the debt and equity financing necessary to construct the related coal mine and gas transmission line. This represents an additional financial risk of about $210 million.

They cannot however, as prudent managers of their businesses, obligate their parent companies and devote their entire credit capacity for the full $600 million cost of the gasification plant itself.

As a result, the sponsors have sought financial support from the Federal Government as the necessary ingredient for demonstrating the viability of coal gasification in this country. Thus, in response to your request for testimony on what incentives are needed for the development of existing energy sources, we support the position of Mr. Otes Bennett, Jr., stated on behalf of the National Coal Association but wish to add that for this Nation to use its known coal reserves for high Btu coal gasification purposes governmental financial support for at least one and perhaps two demonstration gasification plants is absolutely necessary.

The most practical method of providing this support would be for the Federal Government to guarantee the debt securities which must be issued to finance such a plant. Our financing plans call for 75 percent of the cost of the plant to be financed through debt issued by the subsidiaries of the two sponsor companies which will own the plant. On this basis, the Government would guarantee approximately $450 million of debt. We understand that the Senate has now approved the granting of generic authority to the Energy Research and Development Authority to issue loan guarantees in order to "demonstrate the technical, environmental, economic, and social cost benefits and impacts of nonnuclear energy technology."

We also understand that the House is expected to act on this in the near future and that $300 million ERDA budget authorization for fiscal 1978 is being proposed in both Houses. If enacted, this legislation would permit ERDA to select a demonstration scale coal gasification project which would meet the purposes of the act quoted above and other criteria established by the act.

This would be followed by the necessary congressional appropriations to "fund" an appropriate portion of the guarantee and final authorization by Congress of the guarantee as approved by ERDA. Thus, the contemplated legislative process will permit Congress to exercise a final review of all environmental, socioeconomic, financial, and other issues involved.

We would hope that the Congress, acting through interested committees such as yours, would not only support the demonstration of high-Btu coal gasification as a future source of energy for our country but also act as leader in seeing that it actually happens. As all are

aware, this Nation has vast coal resources available for this purpose and the Nation's natural gas reserves are being depleted at a rate much faster than new reserves can be discovered.

There is an obvious need for the gas that can be produced from coal. Moreover, coal gasification is an economic and environmentally acceptable method of using these reserves when compared with burning coal for electric generation purposes. The American Gas Association has prepared materials which demonstrate the desirability of using our coal reserves in this fashion and these materials are available to the subcommittee and its staff if you desire them.

In the case of the North Dakota reserves dedicated to our project, coal gasification is indeed the only means of making this energy source available to the principal markets served by our sponsoring companies. These markets are principally in the heavily populated and industrial Middlewestern States of Illinois, Michigan and Wisconsin, as well as in a number of other Midwestern States served by our two gas systems

While this new energy source will be expensive when compared with current sources, it will be competitive with alternative fuels when sold on a "rolled-in" or average-cost basis. In addition, we expect that over the full life of a commercial gasification plant the cost to the consumer will be reasonable when compared with the alternative energy sources.

This is true for a simple reason that many overlook when comparing current natural gas prices with future coal gas prices. About 60 percent of the cost of the coal gas is attributed to the cost of the initial capital investment. These costs will not escalate after the plant's construction has been completed. In fact, because of depreciation and reduced interest costs as debt is retired through sinking funds, capital costs will decline over the life of the project.

Thus, we believe that it is entirely likely that the synthetic gas produced from coal from a plant built in the late 1970's and early 1980's will be the lowest cost gas when the full life of the project is considered.

In addition, this gas will be distributed through existing gas systems now in place. Thus, it will extend the useful life of these existing systems and increase their utilization which is otherwise declining because of reduced natural gas supplies.

The effect of this will be to reduce delivery cost to our customers, especially when compared with the alternative of providing other new, but nongas energy sources.

Since the principal alternative fuel is imported OPEC oil, coal gasification will reduce dependence upon this source of energy in accordance with the goals of the President's national energy plan and should likewise benefit our future balance of international payments.

In conclusion, we believe that a demonstration coal gasification plant, such as the one proposed by our two companies, will prove to investors and the general public that coal gasification is a viable energy source for our country's future. The incentive needed from Congress is the loan guarantee which I have briefly described.

Once the demonstration phase has been completed, the industry should be able to finance full commercial development of coal gasifica-

tion without continuance of a Federal loan guarantee program. I should add at this point that this eventual private financing will be facilitated by the passage of section 415 of the President's National Energy Act.

This section extends the jurisdiction of the Federal Power Commission to coal gasification facilities. Through the process of certifying these facilities to be in public interest, the FPC, in effect, determines the relative interests of consumers, investors, and the public, and allows each to place reliance upon the Commission's action.

Today's traditional pipeline financing is largely based upon the investor protections inherent in this process, and in the constitutional safeguards surrounding them.

Future private coal gasification financing could be founded on similar principles. Accordingly, we support this energy development incentive and urge its enactment by Congress.

Senator GRAVEL. Thank you. I think your statement also explains itself and I have no questions. I appreciate your testimony, gentlemen.

That concludes the hearings.

[Thereupon, at 12:15 p.m., the hearings in the above-entitled matter were recessed, to reconvene at the call of the Chair.]

[By direction of the chairman, the following communications were made a part of the record:]

STATEMENT OF AMERICAN GAS ASSOCIATION

A COMPARISON OF COAL USE FOR GASIFICATION VERSUS ELECTRIFICATION

Introduction

As a result of the increasing reliance by the U.S. on foreign energy sources in the past few years, there is considerable interest in significantly increasing the utilization of the large domestic resources of coal. To date, the primary focus of attention has centered on examining the potential of using more coal for increased electrification. While increased production of electricity is desirable in a number of applications, its additional contribution to overall U.S. energy supply will be limited by cost, efficiency, environmental, and other factors.

A major alternative method of using coal is the production of high Btu or pipeline quality synthetic gas from coal. While the technology for coal gasification has not been commercially demonstrated in the U.S., such applications are now feasible. Moreover, production of gas from coal offers the opportunity to make use of the existing gas pipeline transmission and distribution system in the U.S.

A major U.S. energy policy issue, given the increased desirability and benefits of using coal, is the extent to which emphasis should be given to accelerating the introduction and widespread application of coal gasification technology as opposed to using coal primarily to generate electricity. The resolution of this issue has significant implications for energy regulatory and developmental decisions especially those related to pricing of supplemental coal gas supplies.

This paper provides a comparative analysis of coal gasification and coal-fired electronic generation of energy destined for the residential market on the basis of: Production and End-Use Efficiencies, Environmental Degradation, Plant Capital Requirements, Production and Transportation Costs, and Production and End-Use Energy Costs.

Executive summary of results of analysis

In comparing coal consumption for electric generation and coal consumption for production of pipeline quality (high Btu) gas, the following results were obtained:

On the basis of efficiency of the utilization of the energy content of the coal, gasification of coal is estimated to be considerably more efficient than coal electrification.

Using conventional technologies at the residential end-use, the overall system efficiency is 36 percent for coal gas and 25 percent for electricity.

Using advanced technologies at the end-use (heat pumps), the efficiency advantage of coal gas is substantially higher in almost all regions of the country with the greatest advantage for coal gasification in the most northern parts of the continental U.S. (62 percent for coal gas versus 35 percent for electricity).

From an environmental standpoint, coal gasification plants would result in significantly less air pollution, would generate less solid wastes, and would use far less water than a coal-fired electric power plant producing the same amount of useful energy.

For comparable size plants, air emissions are between 9 and 2 times less for coal gasification, depending on the category.

With respect to water use, a coal gasification plant is estimated to consume 88 percent less water than a comparable coal-fired electric plant.

With respect to the cost of the energy to the end-user, coal gasification has substantial advantage over coal electrification, even when advanced end-use technologies are employed.

For current technologies (i.e. using electric resistance heating and conventional gas furnaces), the average residential cost of energy used would be about $7/MMBtu for coal gasification vs. about $14/MMBtu for electricity from coal.

Using advanced space heating technologies (i.e. heat pumps), the cost of energy from gas produced from coal is between $4 and $5/MMBtu depending on the geographical area compared with $7 and $10/MMBtu for electricity for the same area.

With respect to plant capital investment, for the same amount of delivered energy a coal gasification plant requires about one-third the capital investment of a coal-fired electric plant delivering the same amount of usable energy. When end-use efficiencies are considered, a coal gasification plant requires about one-half the capital investment of a coal electric plant.

A 250 billion Btu per day coal gasification plant would cost about $1.3 billion whereas an equivalent coal electric plant would cost about $2.7 billion.

Production and end-use efficiencies

Lurgi coal gasification technology is expected to have an overall thermal efficiency of production of 71 percent.[1] This conversion efficiency includes conversion by-products (liquid fuel and chemicals) that are marketable. For purposes of this analysis, coal gasification conversion efficiencies credit roughly half of the by-product as energy and half as non-energy, resulting in an overall plant efficiency of 65 percent. Capacity utilization is estimated at 90 percent for the gasification facility.

The coal-fired electric generating efficiency used in this analysis is based on western sub-bituminous coal with flue gas desulfurization (FGD). The thermal efficiency of production used is 32.8 percent and the plant capacity utilization is estimated at 70 percent.[2]

Residential end-use efficiency can vary widely depending on a number of factors, including the kind and age of the appliance, frequency of maintenance, etc. For purposes of this analysis, average rated efficiencies for the natural gas or electric home appliances have been used.

Table 1 shows average residential end-use efficiency for natural gas and electricity with conventional and advanced home appliances. For conventional appliances, the average residential end-use efficiency is based on the 1968 national residential consumption pattern for the four gas or electric appliances (space heating, water heating, cooking, clothes drying). For advanced appliances, conventional space heating has been replaced with thermally activated (gas-fired) heat pumps or electric heat pumps. Inclusion of both electric and gas heat pumps in this analysis is appropriate since electric heat pumps are available today and commercial availability of gas-fired heat pumps is expected in the same time frame (early 1980's) as the first commercial coal gasification facility.

Heat pump efficiencies vary due to climatic conditions. For this analysis, six cities have been chosen as representative of the range of U.S. climatic conditions. Since heat pumps include both heating and cooling cycles, cooling has been accounted for in the end-use seasonal performance factor (measure of efficiency).

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[1] C. F. Braun and Company Interim Report, "Factored Estimates for Western Coal Commercial Concepts," October 1976.

[2] Electric Power Research Institute Final Report, "Coal-Fired Power Plant Capital Cost Estimates," January 1977.

TABLE 1.—RESIDENTIAL END-USE EFFICIENCIES[1]

	Conventional		Advanced 4 appliance performance factor[3]	
	Gas	4 appliance[2] Electricity	Gas	Electricity
Atlanta, Ga	64	94	90	185
Concord, Mass			109	130
Houston, Tex			82	198
Philadelphia, Pa			102	164
Seattle, Wash			110	158
Tulsa, Oka			99	178

[1] Based on 72 percent of energy consumed by space heating, 19 percent water heating, 7 percent cooking, and 2 percent drying. Because of the lack of data, residential energy consumption patterns for the 6 urban areas was not accounted for in this analysis; however, it is expected these differences would result in only small variation to the average residential end-use efficiency.

[2] Conventional gas appliance efficiencies: 66 percent space heating, 65 percent water heating, 40 percent, cooking, and 65 percent clothes drying. Conventional electric appliance efficiencies: 98 percent space heating, 91 percent water heating, 75 percent cooking, and 65 percent clothes drying.

[3] Heat pump seasonal performance factor: Atlanta (gas 1.03, electric 2.20), Concord (1.29, 1.46), Houston (0.92, 2.38), Philadelphia (1.20, 1.92), Seattle (1.31, 1.84), and Tulsa (1.15, 2.12).

Combining conversion, transmission and distribution, andresidential end-use and coal-fired electric generation. Table 2 shows total system efficiencies for both efficiencies provides a measure of the total system efficiency of coal gasification conventional and advanced (i.e. heat pumps) end-use appliances. Except in Houston when using advanced end-use technologies, total system efficiency for coal gasification is considerably higher than coal electricity.

TABLE 2.—PERCENT OF COAL BTU'S DELIVERED AS USEFUL RESIDENTIAL ENERGY

	Total system efficiency (percent)			
	Conventional[1]		Advanced	
	Gas	Electric	Gas	Electric
Atlanta, Ga	36	25	51	40
Concord, Mass			62	35
Houston, Tex			46	53
Philadelphia, Pa			58	44
Seattle, Wash			62	43
Tulsa, Oka			56	48

[1] Sample calculation using conventional appliances (percent)-

	Mining and Transportation	Conversion	Transmission and distribution	End-use	Total system
Coal-gas	89.5	65.0	97.0	64	36
Coal-electric	89.5	32.8	91.2	94	25

Based on the above calculations assuming conventional appliances, nearly 30 percent less coal is required for a coal gasification facility supplying similar quantities of useful end-use residential energy than that required for a coal-electric facility.

Environment

From an environmental perspective—including physical, chemical, biological, and socioeconomic impacts—coal gasification would produce significantly less environmental effects than coal electrification at every major step in the production and transportation chain. Coal gasification versus coal burning, underground pipelines versus unit trains or overhead high voltage power lines, etc. (See Table 3). Indeed, coal gas plants would readily conform to the Clean Air Act, even with the proposed 1977 amendments on non-degradation.

Air Quality.—The President's Council on Environmental Quality recently found that commercial-scale gas plants will cause about one-tenth the air pollution of equivalent coal electric plants, even those that use the best pollution control technology available.[8]

[8] "A Western Regional Development Study: Primary Impacts," prepared for CEQ under contract No. E04AC037, by Radian Corporation, August 1975.

Non-degradation.—Proposed 1977 Clean Air Act amendments concerning prevention of air pollution in areas that are presently clean would impose severe siting restrictions on coal-electric power plants. The restrictions on coal gasification plants, however, will be negligible. A recent FEA/EPA study [4] suggests that all the coal gasification plants that were proposed in 1976 for inclusion in the federal loan guarantee program would comply with, and even exceed, the most stringent version of the non-degradation amendments presently before the Congress.

In fact, as shown in Table 4, numerous expansions of coal gas plants beyond the initial 250 MMcf/d level would theoretically be allowable at the proposed sites under the non-degradation rules, while not even a single coal-fired power plant of equivalent energy output could be built and operated at some of these same sites under the proposed law.

Water Resources.—Proposed coal gasification plants would consume 5 to 10 times less water than equivalent coal-fired or nuclear electricity generating plants (see Table 3), and would require only a small portion of available water supply in each region.

Land Impacts.—According to ERDA's draft programatic EIS,[5] the mining activities associated with a single 250 MMscf/d coal gasification plant could cumulatively affect 6,020 acres of land over a 20-year period in the Four Corners region, for example. In any single year, only a small portion of this acreage would be disturbed or out of production. In regions such as this, it is believed that the range and agricultural productivity of Western surface-mined lands can be largely restored, and often enhanced beyond previous levels. Proposed surface mining legislation currently before the Congress would impose little unanticipated new costs to most of the proposed near-term Lurgi coal gasification projects.

TABLE 3.—SUMMARY COMPARISON OF ENVIRONMENTAL IMPACTS OF 2 ENERGY-EQUIVALENT PROJECTS

	High-Btu coal gasification plant (250 MM ft³/d	Kaiparowits Power Plant (3,000 MWe with scrubbers)
Air emissions (pounds per hour):		
Particulates	180	1,070
SO_2	450	4,300
NO_x	1,780	20,830
CO	90	1,200
HC	30	360
Water requirements (acre-feet per year)	6,300	54,300
Solid wastes (tons per day)	1,400	5,100

Sources: Radian Corp. "A Western Regional Energy Development Study: Primary Environmental Impacts," vol. II, prepared for the Council on Environmental Quality and the Federal Energy Administration under contract No. EQ4AC037, August 1975.
"Final Environmental Impact Statement on the Proposed Kaiparowits Project," U.S. Department of the Interior, March 1976.

Note: All figures rounded. Proposed coal electric power plant at Kaiparowits was to include wet cooling towers and underground mining, both of which tended to increase its projected water use.

[4] U.S. Environmental Protection Agency, "Summary of EPA Analysis of the Impact of the Senate Significant Deterioration Proposal," April 1976.
[5] Synthetic Fuels Commercialization Program, Draft Environmental Statements, December 1975, Energy Research & Development Administration and Department of the Interior.

TABLE 4.—EFFECT OF NONDEGRADATION RULES ON HIGH-BTU COAL GASIFICATION AND COAL-FIRED ELECTRIC GENERATING STATIONS [1]

Potential sites	Nearest protected area (class I)	Number of plants: Coal gas, 250 MM ft³/d	Number of plants: Coal electric, 3,000 MWe
San Juan County, N. Mex...	Canyon DeChelly National Monument (35 miles away); Mesa Verde National Park (50 miles).	8	None
Mercer County, N. Dak.....	Lost Wood National Wilderness (90 miles); Theodore Roosevelt National Memorial Park (81 miles).	9	None or 1
Converse County, Wyo.[2]....	None.....	8	None or 1

[1] Adapted from reference 2, Table 3. Source for coal gas plants: Environmental Research and Technology, Inc., "Impact Assessment of Significant Deterioration Amendments to the Clean Air Act on Siting of Synthetic Fuel Plants," April 1976. All figures rounded. Results based on meteorological assumptions and 250 MM ft³/d Lurgi coal gasification plants using best available control technology (BACT).
[2] Coal energy production at this site is limited by class II SO_2 24-hr increments.

Solid Wastes.—Solid wastes from a coal gasification complex include spent ash remaining after coal gasification, sludges generating during the water treatment process, and spent limestone from the sulfur dioxide scrubbers installed on waste gas streams. The quantities of solid wastes are significantly less than those associated with a coal electric plant with the same energy output.

Capital requirements

On the basis of equivalent quantities of end-use energy from conventional appliances (see Production and End-Use Efficiency Section), a unit-size coal gasification facility, 250 million cubic feet per day (MMcfd), produces the same amount of energy as a 3,000 megawatt (Mwe) coal-fired power generating station. When advanced appliances are used, the size of either facility, in terms of a fixed amount of usable energy consumed in the end use, would vary in each region since residential end-use efficiencies vary.

Based on recent capital cost estimates of $1.3 billion for a 250 MMcf/day western coal gasification facility and $895 per kilowatt of installed capacity for a western coal-fired electric facility with flue gas desulfurization, a coal gasification facility requires roughly half the capital investment of a coal electric facility delivering the same quantities of energy to the end-use ($1.3 billion versus $2.7 billion).[6] Table 5 shows unit investment on the basis of delivered and useful end-use energy. Even with the higher efficiencies available from advanced electric appliances, the investment savings from coal gasification in all cases is nearly 50 percent.

[6] C F Braun and Company Interim Report, "Factored Estimates for Western Coal Commercial Concepts," October 1976.
Electric Power Research Institute Final Report, "Coal-Fired Power Plant Capital Cost Estimates," January 1977.

TABLE 5.—UNIT CAPITAL REQUIREMENTS

[Cost per annual MM Btu]

	Delivered		Useful end-use			
			Conventional		Advanced	
	Gas	Electric	Gas	Electric	Gas	Electric
Atlanta, Ga.	14.69	47.17	22.95	50.18	16.32	25.49
Concord, Mass.					13.48	36.28
Houston, Tex.					17.91	23.82
Philadelphia, Pa.					14.40	28.76
Seattle, Wash.					13.35	29.85
Tulsa, Okla.					14.84	26.50

TABLE 6.—DELIVERED RESIDENTIAL ENERGY PRICE CALCULATION

[1976 dollars]

	Coal gasification	Coal electricity with scrubbers
Capacity [1]	250 MM cfd	3,000 MWe
Annual generation [2]	91,300,000,000 cf	18,396 G Wh
Capital cost	$1,300,000,000	$2,700,000,000
Annual fixed charge [3]	$213,100,000	$442,500,000
Cost per million Btu:		
Capital charge [4]	2.34	7.05
Fuel cost [5]	.72	1.31
Operating and maintenance [6 7]	.96	.59
Credit for byproducts [6]	(.72)	NA
Transmission and distribution [6 7]	1.15	4.82
Total	4.45	13.80

[1] A 250 MM cfd coal gas plant delivers 155.2×10^9 Btu per day through conventional residential appliances. A 3,000 MWe coal plant delivers 153.7×10^9 Btu per day through conventional appliances.

[2] For coal gas average daily send-out is 250 MM cfd and peak day is 275 MM cfd. For coal electric average daily send-out is 50,400,000 kWh.

[3] Calculated at 16.39 percent per year over facility life. Based on 75/25 debt to equity, 10.75 percent interest, 15 percent return on equity, 2 percent taxes (other than income), 50 percent income tax, and 35-yr life.

[4] Annual fixed charge divided by annual generation.

[5] Based on 7.50/ton subbituminous western coal.

[6] C. F. Braun & Co. Interim report, "Factored Estimates for Western Coal Commercial Concepts," October 1976.

Gas transmission costs calculated on the basis of 300-mile transmission. Distribution costs are taken from data in "1975 Gas Facts." Residential distribution cost is calculated by subtracting the average price paid by utility companies from the average residential price charged by utility companies. An escalation factor of 5 percent was then used from mid-1975 to mid-1976.

[7] Electric transmission and distribution cost is the difference between average residential revenues per kilowatt-hour and the average cost of production for investor-owned electric utilities. The average residential revenues per kilowatt-hour are given in the "1975 Edison Electric Institute Statistical Yearbook." The average production cost is a computed figure obtained by adding average variable production costs as given in the above reference and estimated fixed capital charges. These fixed charges are calculated by allocating 45 percent of net total electric utility plant assets to the generation plant and multiplying it by the 1975 embedded capital cost of just over 12 percent. The fixed and variable costs are then combined and allocated over energy sales for investor-owned utilities in 1975. The differential resulting from the subtraction of production cost from average residential revenues per kilowatt-hour is then escalated at a 5 percent annual rate from mid-1975 to mid-1976.

Production and transportation costs

Table 6 shows production and transportation cost estimates for coal gasification and coal electricity. Production costs were calculated on an incremental basis, using standard regulated utility accounting procedures. Transmission costs assume use of existing lines and approximately 300-mile transmission from conversion facility to consuming market. Distribution costs are calculated on the basis of 1976 average residential distribution costs.

The costs of generation are particularly sensitive to two factors—the capital cost of the facility and the price of coal. For this analysis the facilities were assumed to be located in the west, with operation beginning in 1982, and using Montana sub-bituminous low sulfur (Powder River) coal. Although national air quality standards could most likely be met without flue gas desulfurization equipment (scrubbers), more stringent State standards in many areas may necessitate their use. As a consequence, scrubbers and the resulting energy losses have been included in the calculations for the coal-fired electric generating facility.

The coal gasification advantages of greater conversion efficiency and lower capital cost per unit output cited earlier are clearly reflected in the delivered cost of coal gasification which is nearly one-third that of coal electricity ($4.45 versus $13.80/MMBtu).

Residential end-use energy costs

Delivered energy costs do not, however, reflect the entire comparative cost, since residential end-use efficiencies are generally higher for electric appliances. By dividing the delivered energy cost by the average residential end-use efficiency, an average residential cost per useful Btu of energy is calculated (see Table 7).

TABLE 7.—RESIDENTIAL END-USE ENERGY COSTS

City	Cost per million Btu of useful energy consumed			
	Conventional		Advanced	
	Coal gas	Coal electric	Coal gas	Coal electric
Atlanta, Ga.	$6.95	$14.68	$4.94	$7.45
Concord, Mass.			4.54	10.61
Houston, Tex.			5.43	6.96
Philadelphia, Pa.			4.35	8.41
Seattle, Wash.			4.05	8.73
Tulsa, Okla.			4.49	7.75

Table 7 shows for the average residential user with conventional appliances (gas furnace or electric resistance space heating), that the average price per million Btu (MMBtu) of useful energy consumed by the four major home appliances (space heating, water heating, cooking, and clothes drying) is $6.95 for coal gas versus $14.68 for coal electricity. Even when advanced appliances are considered, the average residential consumer would still pay less (ranging from 24 percent to 63 percent less) for gas made from coal than for electricity from coal.

GREATER BAKERSFIELD CHAMBER OF COMMERCE,
Bakersfield, Calif.

RESOLUTION NO. 0002-77-18-05

Whereas President Carter deserves praise for forcefully bringing the energy shortage problem to the attention of the public and for establishing a goal of energy conservation; and

Whereas the energy shortage has developed primarily as the result of governmental price controls set at unrealistic levels; and

Whereas in our opinion, conservation alone will be insufficient to reduce our increasing reliance upon foreign supplies because:

(1) The current price of "old oil" has been set considerably below the replacement cost,

(2) With declining daily production, the cash flow to producers will also decline,

(3) With a declining cash flow, exploration for new reserves will decline in spite of the proposed added incentives for increased prices for new oil to be found after April 20, 1977; and

Whereas an all-out exploration effort will be required to reduce our reliance upon foreign oil; and

Whereas in the absence of an increased cash-flow to the producer, this objective will be an impossibility; and

Whereas even though the price for new oil will eventually rise and will be limited only by the current price of imported oil; and

Whereas even at this price only the very largest prospects can be considered economically feasible in remote land or deep offshore areas; and

Whereas the proposed price for new natural gas obviously will stimulate activity in the more difficult areas; and

Whereas the coal industry has stated in no uncertain terms that it will be unable to meet the goal established for coal production by 1985 with current and proposed restrictions; and

Whereas the added cost for energy to be paid in taxes by the consumer seems totally unjustified because it provides little incentive to relieve the supply problem: Now therefore be it

Resolved, That the Greater Bakersfield Chamber of Commerce shall go on record as being opposed to President Carter's energy program as specifically defined, notwithstanding the commendable objectives, because it will have a depressing effect upon the economy leading to higher unemployment; and be it further

Resolved, That copies of this resolution shall be mailed to President Carter, the Senate Finance Committee, the Senate Energy Committee, the House Ways and Means Committee, Senator Alan Cranston, Senator S. I. Hayakawa, and Congressman William M. Ketchum.

This resolution is duly signed and adopted this thirteenth day of May, nineteen hundred and seventy seven, Bakersfield, California.

ROY D. BAR,
President.
LOUIS J. HODGE,
Secretary.

[SEAL]

STATEMENT OF THE COMMITTEE FOR TAX INCENTIVES TO ENCOURAGE RENEWABLE RESOURCE USE

MEMORANDUM RE INCENTIVES FOR DEVELOPING NEW ENERGY SOURCES

This memorandum has been prepared and submitted by the Committee for Tax Incentives to Encourage Renewable Resource Use (the "Committee") to document the potential energy resources available from by-products and waste produced by the agricultural, timbering and other sectors, and the need for appropriate tax incentives to encourage use of these renewable supplies. The Committee is an ad hoc group composed of various organizations which have been investigating the use of these supplies, and various state agencies which recognize their potential for easing the energy shortage in various geographic areas and sectors of the economy.

Under President Carter's proposed legislation implementing a national energy policy (as prepared by the Federal Energy Administration), industry would receive a 10 percent tax credit (in addition to the 10 percent investment credit) for the purchase and installation (in facilities existing on April 20, 1977, and for use in an industrial process going on at that date) of equipment designed to burn or otherwise utilize coal. Except in the case of "boilers" (a term which is not defined in the legislation) the bill does not offer any incentive for the use of other forms of combustible or feedstocks, such as agricultural by-products and waste, wood and other by-products and waste materials.

At present, there are numerous programs investigating the feasibility of using these materials for applications other than those classically described as "boilers." These include direct process and space heating applications, and as a feedstock for gasification. Use of such materials would produce cheaper fuel supplies, would use renewable material which is presently treated as waste or a low-value by-product, and would extend the life of the world's non-renewable resources, particularly natural gas and petroleum, but also coal. Use of these energy sources might in many cases solve environmental problems (such as the disposition of solid waste) and avoid the strip mining, air pollution and water consumption problems connected with the direct use or gasification of coal. Further, in most cases these waste products would be available at the location where they are to be utilized, so they would not require transportation, with its attendant cost and use of energy. Since they would be produced by the same process they fuel, these supplies would be more reliable, especially for essential industries such as seed corn drying.

At the present itme, gasificaiton of waste and by-products into low BTU gas appears to be the preferred industrial method of utilization, since the process is cleaner, and presents less of an ash disposal problem, while the fuel produced is more versatile. The gas, for example, can be used as fuel both for a direct drying oven and for an engine which can run a pump or electrical generator. The technology is known (among other things it powered some 700,000 motor vehicles in Western Europe during World War II), but has never been commercially devel-

oped in the United States due to the availability of cheaper, more convenient fuels. Now it is under active development, and will probably be available in the market in approximately two to three years. It is estimated that a low-BTU gasifier with feeidng equipment, sized to produce 1,000,000 BTUs per hour (the equivalent of a thousand cubic feet of natural gas) might cost on a mass-produced basis approximately $25,000–$35,000.

As of the date of this memorandum, there at least four specific programs under development where tax incentives ccould materially advance the use of these renewable fuels, as well as at least one general area where use of renewable feedstocks is being investigated. The specific areas are the use of corn-cobs and stalks as a feedstock for gasification into low-BTU gas which would be used to fuel seed-drying ovens; the use of so-called "ginning trash" (cotton, stalks, leaves and other trash picked up in the cotton bale and separated out in the cotton-ginning process) which would be used initially for direct heat to dry cotton, but perhaps ultimately could be gasified to run cotton gin equipment; use of corn and wheat waste as feedstock for gasification into low-BTU gas to drive farm irrigation pumps in many areas of the United States; and use of almond shells as a feedstock for almond proccessing. The more general area is the use of wood (including waste and cut timber) for space heating, process heating and gasification. Each one of these applications will be discussed separately below.

The four specific applications alone could save billions of cubic feet of natural gas (or its equivalent in barrels of oil) each year, based on the following individual projections of releasable energy from these by-products and wastes:

	Billion cubic feet
Cobs (for drying)	[1] 2.8
Cotton trash	[1] 2.8
Irrigation (high cost applications)	[2] 130.0
Almond shells	[3] .8

[1] 0.5 million barrels of oil equivalent.
[2] 23 million barrels of oil equivalent.
[3] 0.14 million barrels of oil equivalent.

To put the total savings from these sources in some perspective, the city of Washington, D.C., in 1975 required 24.8 bcf to supply all of the needs of its residents, while residential usage for all of New England was 133.5 bcf. Thus, known potential applications could fuel five Washingtons or all of the residential customers in New England. More importantly, this list is by no means an exclusive catalogue of the applications where renewable waste or by-products materials might be used to replace the combustion or other utilization of nonrenewable fuel supplies. The conversion credit language recently adopted by the House Ways and Means Committee can be expected to lead to many alternatives involving wastes other than those described below.

Use of cobs for drying seed corn

In total, about 25,000,000 bushels of hybrid seed corn are produced annually in the United States. Hybrid seed, it is believed, accounts for 99 per cent of the United States' production of approximately six billion bushels of corn annually. In terms of bushels, commercial corn is the largest grain crop produced in the United States by a factor of three. In 1975–76, approximately 70 per cent of the United States corn crop was consumed domestically, while 30 per cent was exported, resulting in trade credits of approximately $5 billion. Corn is one of the most basic sources of human nourishment, both indirectly as animal feed and for direct consumption.

Hybrid corn represents one of the real advances in agriculture developed in America, since the corn produced is hardier and has substantially higher yields than corn from conventional seed; however, since it is hybrid, it cannot reproduce itself satisfactorily and accordingly the seed must be produced in substantial quantities by special processors, of which there are approximately 200 in the United States.

Corn producing hybrid seed ripens in the early fall. The ears must be picked and the kernels dried to a moisture level of 11 per cent from 30 per cent before the ear has a chance to freeze, which would kill the germ. Excessive heat in drying can also kill the germ; 110 degrees Fahrenheit is the ideal drying temperature. Drying is accomplished in large buildings having holding bins in which a heated air stream is carefully controlled as it passes through to effect drying. It requires approximately 140,000 British Thermal Units of heat to dry cobs containing a bushel of seed corn to the required moisture level.

At present, this heat is primarily provided by burning natural gas, supplemented when necessary by propane. Fuel oil can also be used, as can (in theory) any other source of heat which permits temperature adjustment and does not result in the spread of particulates or products of combustion.

Various seed producers have been experimenting with the use of corn cobs as a fuel for the drying process. The cobs from a ton of seed corn have a recoverable energy content of approximately 14,000,000 British Thermal Units, or approximately enough to dry the very seed that they grow. Thus, a year's fuel requirement could be largely provided by concurrent by-products. Each ton of cobs used to dry corn would have 14 mcf of natural gas, and a total conversion of the corn seed drying industry to cob-burning could save approximately 2.8 billion cubic feet of natural gas annually. To date, the industry has spent an estimated two million dollars in research and development of various processes to use this fuel; no governmental funds have been received for this effort.

At present, in some areas cobs can be sold for prices ranging between $4 and $10 per ton for use in certain industrial processes, as furfural, carriers of chemicals, polishing agents and feed fillers. However, there is an abundant supply of cobs to meet all of these needs. A much higher form value use for a ton of cobs is the replacement of non-renewable resources, either through direct combustion or gasification. At the present time neither the technical nor the economic feasibility of any of these processes has been firmly established; none of them have been perfected to the point where could be relied on. However, to the extent that they can be perfected and employed, they will permit one of America's most vital and fundamental (although relatively small) industries to continue to function, while minimizing its use of nonrenewable resources, by drying the seed corn ears with heat derived from equal quantities of cobs available from the seed production.

Use of "ginning trash" in cotton processing

Present domestic cotton production is approximately ten to eleven million bales per year. Each bale contains approximately 150 to 200 pounds of so-called "ginning trash" (which includes stems, leaves, and pods of cotton and various other field debris) which is removed in the ginning process. According to the U.S. Cotton Ginning Research Laboratory, Stoneville, Mississippi, this "trash" can release from 7,000 to 8,000 BTUs per pound. Total U.S. production of cotton is approximately two million tons a year with a potential of 28 trillion BTUs, or the annual equivalent of 2.8 bcf of natural gas.

At the present time, the ginning industry uses primarily natural or liquid petroleum gas to dry the raw cotton. This is an essential step before ginning. As a result of last winter's interruptions of natural gas, ginners began experimenting with the use of "trash" in direct firing heat exchangers. However, substantial technical problems have been encountered, primarily with the residue from combustion; further, this application does not require as much heat as the "trash" is capable of generating. As a result, the ginning industry is also considering gasification of this waste product with some of the gas being used for process heat, and the balance of the gas being used to generate the electricity needed for the ginning facility. It is estimated by Stanford Research Institute that in this manner a cotton gin could become virtually self-sufficient as far as energy is concerned.

In the past, this "trash" was returned to the fields and plowed back in by the cotton farmers; however, at present hauling and related costs make this unfeasible. Various other possible uses or disposition are precluded by Federal regulations or are not feasible. Utilizing it as a gasification feedstock would accordingly also solve a solid waste disposal problem.

Cotton is the primary natural fiber produced in the United States and is the raw material for the textile industry employing 1.2 million people and producing shipments valued at $33 billion annually. Raw cotton is also one of America's leading export commodities.

Gasification of harvest waste for irrigation

Irrigation from deep wells is one of the major uses of energy in agriculture, requiring fuel for the pumps which bring the water to the surface and distribute it through sprinklers over the fields. In 1974, irrigation required the use of natural gas, propane, diesel fuel and electricity having the energy equivalent of 261 bcf of natural gas. On many farms, the corn stalks, wheat straw, or animal waste produced on the farm could be gasified to produce the fuel necessary for this operation. On many of these farms if no irrigation were provided, there would be virtually no crops produced and the land would become almost valueless.

Approximately 9 percent of the U.S. corn crop (or 600 million bushels) is grown on irrigated land, as are substantial amounts of wheat and other crops. Farmers in many parts of the country, including the belt extending from Nebraska through Kansas and into Texas (where approximately 75 percent of the irrigated corn and wheat production occurs), Arizona, California, and the eastern parts of Washington and Oregon, use this method of improving yields. All are concerned with the rising cost and declining availability of conventional fuels, and the use of gasifiers for these applications is under active investigation. Since irrigated corn yields 40 or 50 percent above the national average on a per-acre basis, maintenance and expansion of irrigated crops also reduces the amount of energy used in operating tilling equipment, presently the largest component of agricultural energy use.

One major producer of corn has indicated that his fuel costs for natural gas for a 296-acre farm in northwest Kansas rose from $3391 in 1974 to $6425 in 1976, while his yields remained the same. He estimates fuel is now costing over 13 cents a bushel, or approximately 5 percent of the average 1976 corn price. Another farmer in the same area reports fuel costs for irrigation almost doubling from 1975 to 1976. These costs could be substantially reduced by use of gasifiers; More importantly, a more reliable supply would be established.

The feedstocks used for these processes would have some value devoted to other uses. For example, a certain amount of organic material should be returned to the soil each year to continue its fertility; however, it is estimated this would require approximately 25 percent of the agricultural waste produced each year, leaving more than enough for gasification purposes. There are acceptable substitutes for all of the other uses, and the preferred use would be as a fuel substitute.

Almond and other nutshells for process use

Almond processing, which is carried on primarily in California, uses electricity and natural gas as the fuels for shelling, drying and roasting almonds. The largest almond processor, which accounts for approximately 60 percent of U.S. production, uses 562,000 therms of energy a year, and estimates that the almond shells which it produces as a by-product have the potential to release 5,250,000 therms of energy (the equivalent of 525,000 mcf of natural gas). For the whole industry, this would indicate a capacity of approximately 0.8 bcf. Preliminary studies have indicated that the most feasible use of these almond shells will be gasification, with the gas then used for process heat and to generate electricity. This conclusion is based primarily upon concerns about air pollution from direct combustion of the shells. Similar processes are presently being investigated by walnut growers, and may also be usable by certain peanut processors. At present, these shells have a very low value for use as mulches, industrial fillers, and surfacing materials.

Lumber and lumbering waste

According to the Institute of Gas Technology, wood and wood wastes account for almost one half of the total bio-mass produced on the earth; the 116,000,000 dry tons of forestry waste that are generated annually in the United States by logging and wood manufacturing operations contain an extimated amount of energy equal to two trillion cubic feet of natural gas (approximately 10 percent of the United States natural gas usage, or 3 percent of its total energy usage). Wood presently is being used as a boiler fuel—the pending ERDA appropriations bill contains authority for the Administrator to guarantee a loan or loans for a 50 MW electrical generating facility in Vermont which would use boilers fueled exclusively by wood.

Similiarly, some wood is being used for space heating and direct process heat in furniture and similar factories, according to the Vermont State Energy Office. IGT has indicated that wood and timbering waste is a feasible feedstock for gasification.

Other materials

It has been estimated that each person in the United States produces an average of ten pounds of household, commercial and industrial refuse each day, and that this refuse has a heating value of approximately 5,000 BTUs per pound. Similarly, there are other agricultural processes, such as sugar cane production, which create substantial amounts of by-product or waste (sugar cane waste is presently used in Hawaii to generate electricity). Many more applications might

emerge if appropriate incentives are given to the industries in question—certainly, these industries should not be faced with coal conversion receiving a tax credit while they do not.

Revenue loss estimate

Allowance of the 10 percent conversion credit for these applications, it is estimated by the Committee, would result in a revenue loss of approximately $5 million for conversion for corn seed drying, $16 million for conversion for cotton ginning and $240 million for conversion of the significant irrigation projects. In each case, this would be spread over the number of years necessary to convert all facilities.

STATEMENT OF PAUL W. EGGERS, PRESIDENT, GEOTHERMAL KINETICS, INC.

This statement is submitted in support of legislation which would make available for the development of geothermal energy resources exactly the same tax incentives already available for all other extractive industries. Equality of treatment is essential to development of this attractive and potentially significant environmentally acceptable, domestic energy resource. The Senate has twice passed legislation to provide tax incentives for geothermal development, most recently as part of the Tax Reform Act of 1976.

Enactment of this legislation is badly needed by small independent companies. A great deal of important work is being done by these companies like Geothermal Kinetics, Inc. which is engaged exclusively in the development of geothermal energy. Although only six years old, it has brought together a team of experts who have been pioneers in the field of geothermal exploration. We are hampered, however, by our inability to attract adequate capital to exploit known geothermal resources.

We are unable to attract sufficient capital because (1) commercial bankers are unwilling to take risks on an infant industry which they know little about and which has no track record; (2) there is a time lag of about five years between the drilling of a well and the realization of income; and (3) private investors are reluctant to invest for these reasons and because of the current uncertain tax treatment. In our judgment, a business deduction and intangible drilling costs such as would have been provided by the Fannin bill, S. 2608, would provide sufficient incentives to solve the problem of attracting capital in adequate amounts to create a viable geothermal industry.

In addition to the deduction of intangible drilling costs as recommended in the President's National Energy Plan, a deduction against income derived from geothermal production is necessary. The tax deduction for intangible drilling costs proposed by the President will not alone be enough to attract the necessary investment to assure strong geothermal development. The additional deduction against income is also essential.

The President's energy program has been criticized to some extent on the grounds that it does not place sufficient emphasis on production. Providing incentives for exploration and development of geothermal energy resources will be a positive approach to solution of the energy problems.

The geothermal industry is at a stage similar to that of the oil and gas industry thirty to forty years ago. The industry needs the same types of incentives as those which proved to be so successful in spurring the development of oil and gas resources. We are asking only that geothermal, an infant industry, be granted the same incentives and opportunity for growth that were initially provided for oil and gas.

The potential of geothermal energy in this country cannot and will not be developed unless incentives are provided to enable this infant industry to become viable. Exploration and drilling are very expensive operations and require considerable amounts of risk capital. As you know, risk capital will be made available only if there are reasonable prospects of a substantial return on the investment. In the absence of tax incentives of the type already available to coal, with which geothermal competes, the prospects of significant production at competitive prices are remote.

Moreover, it should be remembered that geothermal resources are available not only in the form of super heated steam but also in the form of steam and hot water with lower temperatures. A temperature of 350° is hot enough to be used for the production of electricity, but as the temperature decreases, the costs rise. Enactment of similar incentives to those provided for coal will make it

possible to produce electricity from marginal and intermediate geothermal areas which otherwise will remain undeveloped for decades. Only areas like the Geysers where super heated steam is available close to the surface, will be developed in the absence of tax incentives.

It is now generally recognized that geothermal offers a significant environmentally-sound source of energy in the Western part of the nation and probably the Southwest as well. Geological and geophysical work conducted in the Eastern part of the United States indicates that there is a substantial potential for development of geothermal resources in that section of the country also.

During the past five years improvements in technical and scientific techniques of locating and exploiting geothermal prospects, have made the commercial development of geothermal resources an immediate possibility. I should like to emphasize that additional research and experimentation will not be necessary for geothermal development as it will for some of the more exotic energy proposals. The technology is known and available. All that is needed to make geothermal energy an immediate, readily available, partial answer to our increasing energy crisis is clarification of the tax laws to accord with the decision of the Court of Appeals for the 9th Circuit in *Reich et al.* v. *Commissioner of Internal Revenue*, 454 F2d 1157 (9 Cir. 1972), affirming 52 T.C. 700 (1969). In that case the Court held that geothermal steam is a depletable resource and entitled to intangible drilling costs and depletion. Unfortunately, the Commissioner of Internal Revenue has not accepted the holding of that Court.

Thank you.

STATEMENT OF JOSEPH W. AIDLIN, VICE PRESIDENT AND GENERAL COUNSEL OF MAGMA POWER COMPANY

To the Honorable Chairman and Members, Magma Power Company, of which I am an officer and General Counsel, supports legislation that would provide a business deduction for the extraction of geothermal energy and the expensing of intangible drilling costs with respect thereto.

Our experience as pioneers in exploring for, developing and furthering the utilization of geothermal resources leaves no doubt that legislation such as this is essential if development and utilization of the resource is to be accelerated. Our belief, based upon our experience, is that the extensive geothermal resources which exist in our country could make a major contribution in meeting our energy needs. We are also convinced that such will not be the case unless the tax incentives referred to are granted at this time.

Federal loan guarantee and grant programs are helpful, but they are not a substitute for, nor in effectiveness are they the equal of, the utilization of private capital in geothermal development and use. The characteristics of the resource, however, are such that the necessary capital buildup and the necessary inducement for capital expenditure are not now sufficient, nor will they be sufficient for some time, without additional tax incentives.

Magma Power Company operates only in the field of geothermal resources. We have no present interests in any other energy sources. We have devoted all of our available resources to exploring for and developing the resource and in exploring the means of utilizing these resources, especially in the generation of electric power. For example, we are at the present time utilizing all of our cash available from our operations at the Geysers field in California (where we operate in a joint venture with Union Oil Company of California and Thermal Power Company, owned by Natomas) to the construction of a binary cycle, electric generating plant in the East Mesa area of Imperial County, California in order to demonstrate the technology and economics of the generation of electric power using medium-range temperature waters. We concede that this program is not entirely orthodox and it is daring, but we concluded that it had to be done if we were going to avoid additional years of delays in the utilization of the geothermal resources already known.

Despite our activity as a private free enterprise organization and despite the fact that the decision of the 9th Circuit Court of Appeals granted intangible deductions and depletion to us at the Geysers, the Internal Revenue Service continues to harass us and to question this right, which is obviously the law of the Circuit. It is imperative that the Congress resolve this and other questions once and for all and point all activities of government in the single direction which Administration policy has already indicated in some of its proposals in relation to energy.

It will undoubtedly be of interest for you to know that the development of

geothermal energy will make available lower cost energy and be of far greater benefit to the people in the long run than the questionable loss in tax revenues which might result from providing geothermal the same tax incentives provided coal and other extractive industries. Pacific Gas and Electric Company has reported that in 1976 its system price per net kilowatt hour in plants using fuel oil was over 24 mills per kilowatt hour for fuel oil. The cost was over 17 mills per kilowatt hour for natural gas, and the cost was 11.35 mills per kilowatt hour for geothermal energy. In 1977 the price being paid for geothermal steam at the Geysers is at the rate of 14.18 mills per kilowatt hour. The fuel oil and natural gas prices will, of course, be higher than the 1976 prices. The fuel cost savings at the Geysers are obvious and so is the public interest.

We do not hesitate in stating that enactment of section 2004 of the Tax Reform Act of 1976, as passed by the Senate, will accelerate development and use of a resource which exists in massive quantities and which should be rapidly developed in the public interest.

Thank you.

STATEMENT OF DR. CAREL OTTE, UNION OIL COMPANY OF CALIFORNIA

Mr. Chairman, my name is Carel Otte. I have been actively engaged in geothermal work since 1962 and have personally participated in both research and operating activities in most of the major geothermal areas of the country. I have also been active in scientific and geothermal industry association affairs. I am President of the Geothermal Division of Union Oil Company of California and I am Chairman of the Advisory Committee on Geothermal Energy of the U.S. Energy Research and Development Administration.

I am appearing in support of legislation similar to the Fannin bill, S. 2608, of last year, which would have provided for geothermal development the same type of tax treatment as that provided other wasting assets. Steam and hot water from the earth's crust is readily available in many places, primarily in the Western United States, while the geopressured areas of Louisiana and Texas hold promise for the long-range future. Geothermal energy has the potential of providing environmentally acceptable, domestic energy in important amounts. The geothermal industry is very pleased that the President has proposed in the National Energy Plan to confirm to geothermal drilling a tax deduction for intangible drilling costs.

While we heartily endorse this proposal and urge its adoption we believe that there should also be allotted a deduction from gross income derived from geothermal properties. This would recognize the clear scientific evidence that geothermal energy is an exhaustible or wasting natural resource (Appendix B) and would put it on an equivalent basis with other wasting assets such as, for example, strip-mined coal with which it is in competition for central station power generation.

If geothermal energy is to make the substantial contribution to domestic U.S. energy which it is capable of making within the last quarter of this century, it is imperative that encouraging tax legislation be enacted and that appropriate tax incentives be provided. Without such incentives, the tremendous amounts of capital required for geothermal energy production will simply not be available. At the present time geothermal development is being held back by lack of investment and by high costs which make it non-competitive with other energy sources.

The outlook for geothermal energy production has been studied extensively by various Governmental and non-Governmental groups and the consensus emerging from these studies is that there is the geological opportunity to delineate geothermal resources to support 20,000 megawatts of electrical generating capacity by 1985. Such capacity—equal to 5% of current national electrical capacity—represents the equivalent of 250 million barrels per year of low sulphur crude oil. However, resource development to support this capacity is estimated to require investment ranging in excess of $10 billion.

There are tremendous economic barriers which this industry must overcome: the tremendously high costs of drilling for geothermal deposits in hard rocks, with high temperatures and corrosive fluids; the very large capital investments required over several years before revenues can begin for a geothermal project; the requirement for drilling many replacement wells at each development site to maintain a constant stream of energy; and the present discouraging Federal income tax controversy.

It is inconceivable that, given our present energy crisis, this nation should not make every reasonable effort to develop available domestic energy resources, particularly when the costs of doing so are so small. Enacting the legislation we are supporting would result in a loss of Federal revenue estimated at less than $20 million for the first year in which it is fully effective. This amount would rise significantly over the years only if there is substantial increase development of geothermal resources, which would, of course, be the objective of the legislation; and which would result in taxes collected far in excess of the cost of the tax incentive provided. And these are taxes which will not be collected if the desired development does not occur.

We are satisfied that if legislation similar to that of section 2004 of the Tax Reform Act of 1976, as it was passed last year by the Senate, the so-called Fannin bill, is enacted into law, there will be provided sufficient incentive to attract the necessary capital investment to create a new industry providing significant amounts of sorely needed energy in future years. Without incentives of this type the future development of geothermal energy remains clouded.

I have attached a statement giving a brief background on geothermal energy development (Appendix A). I have also attached draft legislation virtually identical with that which the Senate Finance Committee and the Senate passed last year as part of the Tax Reform Act (Appendix C). It is urged that this legislation be approved for the third time by the Senate and enacted into law.

APPENDIX A

ATTACHMENT TO STATEMENT OF DR. CAREL OTTE FOR THE SUBCOMMITTEE ON ENERGY AND FOUNDATIONS, SENATE COMMITTEE ON FINANCE, JUNE 24, 1977

Brief history of geothermal energy development

The only major U.S. geothermal energy development is The Geysers field located about 90 miles north of San Francisco in California's Sonoma County. The development began in 1960 with a 12.5 megawatt generating plant. In 1973, it became the largest geothermal development in the world, with a capacity of 400 megawatts. The installed generating capacity now exceeds 500 megawatts, sufficient to supply electrical requirements of a city of 500,000; an additional 400 megawatts is now under construction. The Geysers eventually is expected to achieve a capacity of more than 2,000 megawatts, but it will have required more than 25 years to achieve it.

Other areas which have promise for early development in the near future—given the needed incentives—are in North central New Mexico and the Imperial Valley of California, and active exploration is also being carried on in other parts of California and New Mexico and in Nevada, Oregon, Idaho, Utah and Arizona. The geopressured areas of Louisiana and Texas hold promise for the longer range future.

Practical utilization and potential role in national energy picture

Geothermal energy undoubtedly has the potential for a fairly wide range of use in coming decades, and even today in some nations it is utilized for space heating and industrial process heat, such as in the New Zealand paper industry. However, the immediate and near-term practical use in the United States is and will almost certainly continue to be primarily for electrical power generation. A pound of steam from the earth is indistinguishable from a pound of steam from a fossil-fuel-charged boiler and has been proven to be as effective in powering conventional electrical generating equipment.

But there are tremendous economic barriers which this industry must overcome: the tremendously high costs of drilling for geothermal deposits in hard rocks, with high temperatures and corrosive fluids; the very large capital investments required over several years before revenues can begin for a geothermal project; the requirement for drilling many replacement wells at each development site to maintain a constant stream of energy; and the present discouraging Federal income tax treatment.

The projected investment for developing resources to support 20,000 megawatts of generating capacity includes the costs of drilling at least 1,200 exploratory wells and 8,000 development wells at a minimum cost of $750,000 per well, or a total of $6.9 billion in 1977 dollars in drilling costs alone. Depreciable investment in hook-up facilities will add another $3 billion, bringing the total investment requirement to about $10 billion. Moreover, a like investment will be required for

replacement production wells and facilities through the approximately 30-year operating life of each development as the resource depletes.

Tax considerations

It is extremely unlikely that the goal of 20,000 megawatts of geothermally-generated electric power will be achieved unless encouraging tax legislation is enacted and tax incentives thereby clearly established.

At the present time the Federal income tax treatment of geothermal well costs and production is in doubt. The Circuit Court of Appeals in the *Reich* and companion cases (*Reich et al.* v. *Commissioner*, 454 F. 2d 1157 (9 Cir. 1972), affirming 52 T.C. 700 (1969)) held that geothermal energy in The Geysers field is an exhaustible natural resource and is entitled to depletion under existing law. In spite of this decision and the clear scientific evidence that geothermal energy is an exhaustible natural resource, the national office of the Internal Revenue Service is disallowing intangible drilling cost treatment and percentage depletion in respect of all geothermal activity and has announced its intention to press its position in the courts.

As a fledgling industry, geothermal energy must compete with the lowest cost alternative energy available to electric power utilities. In the West, where geothermal resources are most prevalent, the alternative is low-cost, strip-mined coal. Loss of percentage depletion and the right to deduct intangible drilling and development costs for geothermal energy would mean that the major portion of the geothermal resources would be non-competitive with coal and other alternative sources of energy which have the benefit of more favorable tax treatment. As a result, the nation's geothermal resources would remain largely undeveloped.

DEPLETION OF GEOTHERMAL RESOURCES

It has been scientifically established that geothermal resources do deplete, and this conclusion has been accepted not only by scientific writers but by the courts on the basis of evidence presented. In the case of *Reich et al.* v. *Commissioner of Internal Revenue*, 454 F. 2d 1157 (9 Cir. 1972), affirming 52 T.C. 700 (1969), the first question considered by the United States Court of Appeals for the 9th Circuit was stated by the Court as follows: "(1) Are the taxpayers' reserves of geothermal steam an exhaustible natural resource?"

The Court affirmed the decision of the Tax Court that geothermal steam in the Geysers area was depletable. A copy of the decision is attached. In pertinent part the Court stated:

"The principal factual dispute between the parties before the Tax Court concerned the nature and exhaustibility of the steam reserves at The Geysers. After reviewing extensive documentary evidence and hearing expert testimony from geologists and engineers, the Tax Court made these findings of fact:

"Geothermal steam is a gas. The geothermal steam at The Geysers is contained within a closed reservoir in a finite amount with no significant liquid influx to or boiling within its confines. The geothermal steam at The Geysers is an exhaustible natural resource which has depleted and is continuing to deplete.

"Our review of the record convinces us that ample evidence supports this factual conclusion."

The reasons why geothermal energy is depletable may be summarized briefly.

Depletion in Geothermal Reservoirs.—Geothermal energy, unlike solar energy, is a finite resource. It takes geological time periods of several hundred thousand years for a geothermal field to mature or for the magma to heat the surrounding rock and fluids by conduction, but it takes only 50–100 years to extract its useful energy. In another 100,000 years or so, a depleted geothermal field may be ready again for exploitation. None of the major geothermal fields known so far have been abandoned but these reservoirs do show partial depletion and depending upon their age this is significant.

Heat Depletion.—Rock is a poor conductor; it is a good insulator. In a mature geothermal field, like the Geysers, the heat being transferred from the magma is roughly the same as the heat being lost at the surface due to conduction, and is about 64 million BTU per hour.

In the Geysers, the current production is about 9 million pounds per hour of steam. This corresponds to a heat extraction rate of 11,000 million BTU per hour. Thus, the heat extraction is about 170 times the heat recharge. In other words, the heat extracted in one year is equivalent to the heat released by the

magma in 170 years. The number is expected to increase as the installed capacity at the Geysers increases to four times the present amount.

Mass Depletion.—In the foregoing, we limited our discussion to the depletion of heat energy. Water is the medium through which heat is extracted and all indications are that water also depletes. The rate of water depletion will depend on the location of a geothermal reservoir in relation to the surface topography and the subsurface hydrology. The cold outside water may move into the hot water aquifer as soon as hot water is withdrawn, or it may not move at all. If the same amount comes in as goes out, pressure in the reservoir would not decline, but that is not in line with the experience.

Major geothermal reservoirs have shown a decline in pressure with time, indicating water depletion. Ramey [1] studied the shallow zone of the Geysers and plotted pressures against cumulative production clearly showing a decline in pressure. Ramey and Whiting [2] carried out a similar study on the Wairakei, New Zealand field (Figure 3) indicating depletion. Celati, et al [3] discuss pressure decline in Larderello, Italy.

Since it is established that geothermal resources are exhaustible, it is the job of the scientists to insure that a particular geothermal resource will last as long as the project life of the particular generating facility using the energy product. This is of critical importance.

Since steam cannot be transported the generating plant must be built at the geothermal site, and it is totally dependent upon the energy produced at that site. Therefore, the economics of the situation requires that the geothermal field be capable of producing enough energy to supply 100% of the needs of the generating facility throughout its life. For example, if the life of the facility is projected at 35 years, the scientists must insure that the geothermal field will produce sufficient energy to supply the facility for 35 years, i.e., the field must not be exhausted before the 35 years have expired. This determines the rate of extraction of the geothermal energy.

The experience at the Geysers field with respect to the drilling of wells to replace depleted wells may be enlightening.

Year and number of wells drilled to replace depleted wells	*Installed generating capacity in kilowatts*
1972 (1)	192,000
1973 (1)	302,000
1974 (2)	412,000
1975 (7)	467,000
1976 (6)	502,000
1977 (to date) (6)	502,000

It will be noted that replacement wells were needed in earlier years, but that as production continues more wells are needed.

APPENDIX C

A BILL To amend the Internal Revenue Code of 1954 to allow a deduction with respect to the extraction of geothermal energy

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That:

(a) Part VI of subchapter B of chapter 1 of the Internal Revenue Code of 1954 (relating to itemized deductions for individuals and corporations) is amended by adding at the end thereof the following new section:

"SEC. 192. BUSINESS DEDUCTION WITH REGARD TO GEOTHERMAL ENERGY PRODUCTION

"(a) IN GENERAL.—There shall be allowed as a deduction in computing the taxable income of a holder of an economic interest in a geothermal energy property an amount equal to 22 percent of the gross income from the geothermal

[1] Henry J. Ramey, Jr.: "A Reservoir Engineering Study of The Geysers Geothermal Field, March 1, 1968," submitted as evidence, *Reich et al. v. Commissioner of Internal Revenue,* 1969 Tax Court of the United States, 52 T.C. No. 74, 1970.

[2] R. L. Whiting and H. J. Ramsey: "Application of Material Energy Balances to Geothermal Steam Production," *Journal of Petroleum Technology,* Vo. 21, July 1969, p. 893.

[3] R. Celati, P. Squarci, L. Tani, and G. C. Stefani: "Analysis of Water Levels and Reservoir Pressure Measurements in Beothermal Wells," *Proceedings, United Nations Symposium on the Development and Use of Geothermal Resources,* San Francisco, May 20–29, 1975, Vol. 3, p. 1593.

energy property for the taxable year, excluding from such gross income an amount equal to any rents or royalties paid or incurred by the taxpayer in respect of the property.

"(b) LIMITATION.—The deduction allowed under subsection (a) may not exceed 50 percent of the taxpayer's taxable income from the geothermal energy property for the taxable year, computed without regard to the deduction allowed by this section.

"(c) SPECIAL RULES.—

"(1) LEASES.—In the case of a lease, the deduction allowed under subsection (a) shall be equitably apportioned between the lessor and lessee.

"(2) LIFE TENANT AND REMAINDERMAN.—In the case of property held by one person for life with remainder to another person, the deduction allowed under subsection (a) shall be computed as if the life tenant were the absolute owner of the property and shall be allowed to the life tenant.

"(3) PROPERTY HELD IN TRUST.—In the case of property held in trust, the deduction allowed under subsection (a) shall be apportioned between the income beneficiaries and the trustee in accordance with the pertinent provisions of the instrument creating the trust, or, in the absence of such provisions, on the basis of the trust income allocable to each.

"(4) PROPERTY HELD BY ESTATE.—In the case of an estate, the deduction allowed under subsection (a) shall be apportioned between the estate and the heirs, legatees, and devisees on the basis of the income of the estate allocable to each.

"(d) DEFINITIONS.—For purposes of this section—

"(1) GEOTHERMAL ENERGY.—The term 'geothermal energy' means any means any product included in the term 'geothermal steam and associated geothermal resources", as defined in section 2(c) of the Geothermal Steam Act of 1970 (30 U.S.C. 1001(c)), and shall include natural methane gas contained in, or produced in association with, any such product.

"(2) GEOTHERMAL ENERGY PROPERTY.—The term 'geothermal energy property' means property from which the taxpayer extracts geothermal energy.

"(3) GROSS INCOME FROM THE PROPERTY.—The term 'gross income from the property' means the gross income from extracting geothermal energy from the property, excluding any value in respect of transportation from the well site.

"(4) PROPERTY.—The term 'property' has the same definition it has under section 614(a). For purposes of applying such section 614(a) with respect to this section, a well producing geothermal energy shall be considered to be a gas well.

"(e) APPLICATION WITH SUBCHAPTER 1.—No deduction shall be allowed under section 611 with respect to production of geothermal energy.

"(f) REGULATIONS.—The Secretary shall prescribe such regulations as may be necessary to carry out the provisions of this section.".

(b) CLERICAL AMENDMENT.—The table of parts for such part VI is amended by adding at the end thereof the following new item:

"SEC. 192. Business deduction with regard to geothermal energy production.".

(c) TECHNICAL AND CONFORMING AMENDMENTS.—

(1) Section 57a)(8) (relating to items of tax preference) is amended by inserting immediately after "section 611" the following: "or the business deduction for geothermal energy production allowable under section 192".

(2 Section 62(6) (relating to definition of adjusted gross income) is amended by striking out "and the deduction allowed by section 611." and inserting in lieu thereof a comma and "the deduction allowed by section 192, and the deduction allowed by section 611."

(3) Section 263(c) (relating to deduction for intangible drilling and development costs in the case of oil and gas wells) is amended—

(A) by adding at the end thereof the following new sentence: "Such regulations shall also grant the option to deduct as expenses intangible drilling and development costs in the case of wells drilled for geothermal steam and associated geothermal resources, as defined in section 2(c) of the Geothermal Steam Act of 1970 (30 U.S.C. 1001(c)), to the same extent and in the same manner as such expenses are deductible in the case of oil and gas wells.", and

(B) by amending the caption of such section to read as follows:

"O INTANGIBLE DRILLING AND DEVELOPMENT COSTS IN THE CASE OF OIL AND GAS WELLS AND GEOTHERMAL ENERGY WELLS.".

(4) Section 613A(b)(1) (relating to limitations on percentage depletion in case of oil and gas wells) in amended—

(A) by inserting immediately after the comma in subpargraph (A) the following: "and",

(B) by striking out "and" in subparagraph (B), and

(C) by striking out subparagraph (C).

(5) The last sentence of section 617(a)(1) (relating to deduction and recapture of certain mining exploration expenditures) is amended to read as follows: "In no case shall this subsection apply with respect to amounts paid or incurred for the purpose of ascertaining the existence, location, extent, or quality of any deposit of oil or gas (other than geothermal energy) or of any mineral with respect to which a deduction is not allowable under section 613 or section 192.".

(d) EFFECTIVE DATE.—The amendments made by this section shall apply for taxable years beginning after December 31, 1976.

GULF UNIVERSITIES RESEARCH CONSORTIUM,
Houston, Tex., June 10, 1977.

Hon. RUSSELL B. LONG,
Chairman, Senate Committee on Finance,
Washington, D.C.
(Attention of Mr. Michael Rowny).

DEAR SENATOR LONG: The Hearings of the Senate Committee on Finance scheduled for June 20-21, 1977, are of particular importance to the nation and, especially, to the Gulf Coast region. We are concerned that a great deal of optimistic and misleading testimony has been presented to the Congress about energy resources and supplies which are "alternatives for oil and gas." Also, we are concerned that the present plans of the Administration place too much emphasis and confidence in the effectiveness of conservation rather than on maintaining an adequate energy supply to support the national economy and security.

We believe it is evident that much of this enthusiasm for alternative energy sources, and the corresponding lack of support for accelerated domestic oil and gas exploration and production, stems from "environmental concerns" regarding both onshore and offshore oil and gas drilling and production which are based on conjecture or self interest rather than on fact and scientific evidence. Therefore, it is requested that the enclosed Testimony be included in the Record of these Hearings in order that—

The Committee be apprised of the real situation as regards the nation's dependence on oil and gas for at least the next 15 years;

The severe economic consequences of time delays in pursuing an accelerated program of domestic oil and gas development, particularly in Outer Continental Shelf areas; and

The kind of program the U.S. ERDA must undertake quickly if acceptable time delays are to be avoided AND reasonable Federal policy based on real data and facts is to be generated.

I am sure you realize that the consequences to the nation will be more severe in Louisiana and Texas than in other parts of the nation. Therefore, we urge that the information presented herein (which results from this Consortium's continuing research over some seven years in coastal/continental shelf environmental sciences and some four years of continuing R&D for the AEC, Bureau of Mines, National Science Foundation, Energy Research and Development Administration, and Federal Energy Agency relating to oil and gas recovery) be considered in Committee actions relative to the national energy program.

Sincerely yours,

JAMES M. SHARP,
President.

Enclosure.

STATEMENT OF DR. JAMES M. SHARP, PRESIDENT, GULF UNIVERSITIES RESEARCH CONSORTIUM

My purpose in presenting this Testimony is to strongly recommend a Federal program designed to accelerate the development of continental shelf oil and gas resources. This recommendation is based on the very high level of national dependence on oil and gas as primary energy sources until about 1995. There is no viable substitute for crude oil during that time. The only alternative for natural gas is the direct combustion of coal—which will require a great deal of capital and time, and which faces severe environmental constraints. The U.S. Energy Research and Development Administration has declared that oil, gas, and coal are our only means for maintaining maximum domestic energy supply in the next 15 to 20 years—which is the time needed to develop longer range energy alternatives, to reduce them to commercial practice, and to expand their application to supply significant percentages of the national energy demand.

There are only two approaches to increasing domestic oil and gas supplies and reserves. The first is the development of processes for increasing the production rates and ultimate recovery from known domestic reservoirs—that is, by the successful development of Enhanced Oil and Gas Recovery processes. These programs are under way. However, current levels of effort directed to this objective are not sufficient to realize the potential, particularly during the critical 1977–1995 period. The second approach is the discovery and development of new oil and gas.

Of these alternatives, informed sources agree that the development of new oil and gas resources in Outer Continental Shelf areas offers the most potential for (1) the fastest energy supply, (2) the largest energy supply, (3) the most economical energy to develop, and (4) the energy supply which offers the greatest economic and trade benefits. In addition to this exceptional potential, new OCS oil and gas imposes less environmental and social impact than any of the non-oil and gas alternatives.

Only oil and gas can power existing systems. They do not need the very large capital investment and time required to change processing, transportation, distribution, and utilization systems. This is true whether the end use is residential, industrial, municipal, or defense. This is not true of other alternatives, including the direct combustion of coal.

The most effective stimulation of OCS oil and gas development would be to establish (1) a favorable political climate, (2) a stable and realistic economic policy, and (3) a reliable and reasonable OCS lease sale schedule. However, my recommendation is NOT directed to these basically non-technical actions that might be considered. Rather, my recommendation is that the U.S. Energy Research and Development Administration—in close cooperation with the Department of the Interior, the National Oceanic and Atmospheric Administration, and other cognizant agencies—rapidly initiate what has been called, unfortunately, an OCS Technology Research Program. I say this is unfortunate because it implies the wrong concept to most people. Generally, this implies Federal design and construction of offshore platforms, pipelines, seafloor completions and pumping stations, offshore processing plants, and the like. I am specifically NOT recommending such a program. Anyone who has taken a thorough look at the exhibits at the Offshore Technology Conference must conclude that industry does NOT need Federal help in designing and operating such equipment.

What industry DOES NEED is the information it requires to APPLY the design, construction, and operating technology it has developed in the most cost-effective and predictable manner. What it does need is sufficient basic information on the environmental processes and the resulting forces and operating conditions with which it must contend in making this application. What it does need is basic technology concerning structural concepts and dynamics, foundation engineering properties and stability determinations, and the performance of materials under the new environmental and operating conditions that it will face; this is the kind of basic technology upon which any established engineering and operating practice must feed if it is to improve and remain competitive. What industry does need are viable and practical alternatives for maintaining reliable communications and reliable and accurate navigation—at greater distances offshore—in environments which are highly variable and unpredictable—and under physical and regulatory constraints which impose less than optimum conditions for reliability and accuracy. Industry needs, probably most of all, a sound basis

and a mechanism which makes it possible to work jointly and effectively with government to resolve or correct environmental, economic, social, and jurisdictional issues which severely penalize development time scales. Finally, it needs an effective means for technical liaison with government wherein as-yet-undefined requirements for completely new and innovative technology can be identified, and appropriate industrial, Federal, or joint initiatives are taken to avoid technological shortfalls which would penalize development time scales or which would jeopardize safety, reliability, or economics. It seems clear that government shares these needs with industry if it is to plan and manage national energy programs on an informed basis.

Meeting these diverse needs of industry and government by way of a Federal program strongly implies the need to overcome prior deficiencies as identified, for example, by the Office of Technology Assessment in its recent report on "The Coastal Effects of Offshore Energy Development." That is, means must be established which permit the ready and understandable use of the voluminous data that available by those who are responsible for policy, management, and engineering decisions.

It is quite clear that this type of program cannot be conducted by industry alone on a time scale that would maximize domestic oil and gas production in the next 15 to 20 years. Certain of these research tasks cannot be accomplished by industry alone on any time scale. They require Federal participation in developing the information required, and in the informed use of that information for rational decision-making. To a very large degree, the technical information required depends on Federal programs which already exist, such as the BLM Continental Shelf Environmental Baselines program. There are many such programs which could, and should, produce valuable basic data if these data are collected and merged, evaluated, and reduced to directly useful engineering, operating, and management data and information.

This recommendation is far from being a new one. This same basic program has been defined as being both an appropriate and an essential Federal role for more than a decade. Well-informed national level groups, composed of government, industry, and academic members, have repeatedly recommended this program and have emphasized its importance. The Ocean Science and Technology Advisory Committee of the National Security Industrial Association, the Seafloor Engineering Committee of the National Research Council, and the Oil and Gas Panel of the Conference on the Commercial Development of the Oceans are but three such groups that have made essentially this same recommendation. None of these groups has questioned the validity and appropriateness of this Federal role in accelerating OCS development by this means—provided the program is conducted with effective joint Federal/industry planning, is directed by a non-regulatory agency, and effective means for data and information summarization, display, and dissemination is implemented within the program.

Without this program, OCS oil and gas development will certainly be delayed. Also, one can expect that with delay there will be penalties in cost as well as the commensurate shortfall in domestic energy supply. And, a consequence of serious magnitude is that the size and producibility of these important resources will not be known in the interim, thus denying our national energy planners basic management information of major importance.

There is no time to waste in initiating this program. A great deal of work is required to access and evaluate existing basic data, to determine environmental data requirements which would permit sound engineering and operational design, and to evaluate the technical and socioeconomic approaches to resolving issues which work to produce time delays. This analysis, feasibility determination, and scientific, engineering, management, and socioeconomic design of the program—which must precede major experimental effort—and which must be carried out jointly by government and industry—is, in itself, time-consuming. This preliminary technical effort should begin immediately.

I believe it is important to emphasize that the usefulness of the program that is recommended is not at all limited to the development of offshore oil and gas. It applies to all continental shelf activities and, also, to many deep ocean activities. Some of these are directed to improving the nation's energy supply situation. Additionally, many of the elements of the program are applicable to nonmarine activities as well. In fact, the program that is recommended is probably justified independently of OCS oil and gas development with, of course, some changes in priorities and in time scale.

STATEMENT OF JOSEPH R. RENSCH, PRESIDENT, PACIFIC LIGHTING CORPORATION

My name is Joseph R. Rensch. I am President of Pacific Lighting Corporation, the parent company of Southern California Gas Company—the nation's largest natural gas distribution utility. Southern California Gas Company supplies gas to 12 million people in southern California—an area with limited readily available alternatives to its long time dependence on the use of natural gas as its primary energy source for nontransportation fuel. We in southern California are acutely aware that the nation is facing an ever worsening shortage of natural gas. Our supplies from traditional sources have been dropping precipitously since 1970 and since 1972 our interstate supply has declined nearly 30 percent. Without additional sources of supply by the early 1980's, we will be forced to turn off our small commercial and industrial customers who are currently unable to switch to alternate fuels.

The National Energy Plan (NEP) proposes to lessen the impact of supply shortage through an ambitious program of conservation. The plan outlines taxing and pricing provisions to discourage waste in order to reduce the annual growth of total energy demand to below 2 percent. It is hoped such a program will reduce dependence on energy imports while renewable energy sources are being developed. Certainly we recognize that conservation is vital to any national energy policy, but the NEP does not establish a balance between conservation and the production necessary to our nation's economic well-being. Greater emphasis must be given to production of energy from conventional sources using present technology until renewable resources can be developed. And renewable energy will not be available as prime supply until sometime after the turn of the century.

Technology exists now to proceed with the development of an urgently needed alternative fuels program and the production of substitute natural gas (SNG) should be an essential element in that program. It would use coal, our nation's most abundant fossil fuel in an environmentally sound way; it would be competitive with electricity and other future domestic energy supplies; it would be a source of supply for those homeowners and businesses who do not have the capability to use other fuels.

Conservation, while extremely necessary, cannot do the job alone without imposing severe social and economic change. The impact of declining supplies is too great. The Southern California Gas Company has pioneered in actively promoting conservation and energy saving devices to better use our energy resources but our present conservation program will only reduce gas requirements for residences and small businesses approximately 8 percent by 1980 and possibly 13 percent by 1985. With the hardships and unemployment this supply situation portends, we have made the decision to move ahead in developing new domestic and foreign sources of energy. One such important new domestic source is high Btu coal gasification.

An affiliate of Southern California Gas Company and a subsidiary of Texas Eastern Transmission Corporation have formed a joint venture—WESCO—to plan, build and operate a high Btu coal gasification plant in northwest New Mexico. The WESCO project will be located on the Navajo Indian Reservation adjacent to a coal and water supply and near the existing Transwestern natural gas transmission line to southern California. This pipeline is not now being utilized to capacity, thus it can easily accommodate the 250 Mcf per day of high Btu synthetic gas that would be produced by the WESCO plant. The tremendous investment costs of a new energy transportation system will not be required to move the product SNG to the market area.

The WESCO project has been found by the FPC to be in the public interest, the final EIS has been filed with the CEQ, and a 25 year supply of coal and water resources have already been contractually committed to the project. In New Mexico, both the Environmental Improvement Agency and the Surfacemining Commission have issued the permits necessary to build and operate the coal gasification facility and to open and operate the supporting surface mine. A mutually acceptable business site lease from the Navajo Nation is near completion.

The California Public Utilities Commission, the California Energy Resources Conservation and Development Commission, and the California Air Resources Board, the three principal agencies in the State of California concerned with energy matters, have all endorsed the present need for the coal gasification project as valid.

Under the ERDA schedule for the demonstration and proving of second generation technology, commercial size plants are not expected to be a reality until the

early 1990's. In light of our declining natural gas supply situation, the time required for this research and development underscores the importance of proceeding with coal gasification plants using the proven first generation technology. We must move forward now to demonstrate the technical and commercial compatibility of the various processes that make up a high Btu coal gasification plant. We need to improve and optimize the existing processes, and develop markets for the many by-products. Here alone, the by-products may constitute the feedstocks for a whole new chemical and process industry.

A commercial plant built now will, in effect, demonstrate the viability of present and future high Btu technology in relation to the potentials of solar, geothermal, and other new energy sources. Additionally, it will demonstrate the social, economic and environmental attractions of a full size operation.

WESCO's engineering, planning and design are sufficiently advanced to permit actual construction of such a commercial facility to begin in 1978, with a scheduled completion in early 1983, providing present financial obstacles can be overcome. Delays cause not only higher costs, as inflation takes its toll, but also a worsening gas supply situation. In view of the critical need for additional supplies of gas, it would be prudent to move ahead now with a proven technology in commercial or demonstration plant applications, so as to bring to market high Btu synthetic gas from coal as quickly as possible.

Since known reserves of coal are sufficient to fuel this nation for several hundred years, coal gasification could contribute significantly to our energy supply. Failure to construct such a coal gasification plant of the size being proposed, is analogous to withholding 2.3 tcf of natural gas off the market.

The gasification technology that WESCO has chosen to use is that of the Lurgi process, which has long been commercially proven in the production of a medium Btu gas. This process would be combined with a methanation step already proven in a pilot plant in Westfield, Scotland, to raise the SNG Btu level to that of pipeline quality gas. It is most important that the synthetic gas be such that it can be commingled and used interchangeably with the existing supplies of natural gas now moving in gas transmission and distribution networks throughout the country.

The advantages of high Btu coal gasification are many. It will provide a continued gas supply to priority demands, i.e., homes and small businesses already equipped with natural gas burning appliances. The thermal efficiency of the high Btu coal gasification process, using present technology, is in the range of 65 to 70 percent. The overall energy use efficiency—from the mine to and including the ultimate use at the consumer's appliance—is approximately 40 percent, which is one and a quarter times the overall efficiency obtained by converting coal to electricity in a conventional power plant. This advantage represents cost savings to the consumer.

Gasifying coal is also environmentally attractive. Only about 15 percent of the WESCO coal is actually burned in boilers to produce steam for the gasification process. The remaining 85 percent is reacted chemically in enclosed vessels, thereby producing very limited emissions of pollutants. Synthetic high Btu gas burns as cleanly as does natural gas.

Over the years, the natural gas consumer has had an economic advantage over consumers using other energy forms to meet heat energy needs. This advantage is expected to continue as synthetic gas from cool is introduced, particularly in those areas of the country where the only alternative energy for residential, commercial, and small industrial customers is electricity. A coal fired electric generating plant, together with necessary transmission and distribution facilities, requires from two to six times the investment required for a coal gasification plant delivering an equivalent energy output. The residential customer will have to pay at least twice as much for electrical energy produced by coal fired steam electric generation as he would for gas energy produced by coal gasification. This cost differential is due to the lower thermal efficiency of electric generating plants, more expensive transmission and distribution facilities, and the high cost of meeting electric peak demands.

In California—and this is according to a published analysis made by the California Public Utilities Commission staff—the 1976 cost of energy delivered to the point of use from new nuclear or coal-fired electric generating facilities was over $12 per million Btu. By comparison, the cost of gas from the WESCO coal gasification project, using existing pipeline facilities for delivery to the point of use, was figured at less than $3 per million Btu's. That cost has escalated to $3.60 in terms of January 1977 dollars. Costs related to coal-fired electric

generation has experienced similar escalation. Even assuming the worst in terms of further delays and cost escalation, the cost of energy resulting from coal gasification should continue to have a substantial cost advantage, by comparison with the electric alternative, for the southern California gas consumers.

The principal remaining obstruction to proceeding with the WESCO project is the inability of the project sponsors to obtain financing without federal loan guarantee assistance. These highly capital intensive projects add a new dimension for most regulated natural gas companies.

The gas industry's current heavy financing requirements relate not only to coal gasification, but also to expensive liquefied natural gas projects and pipelines that traverse Arctic terrain with conditions never before confronted. It is a giant step from where the industry is now to where it must go—to a vastly higher investment capital plateau. It is apparent that this giant step is going to require federal incentives for coal gasification.

When one looks at the enormous capital requirements of each new capital intensive coal gasification project, in relation to the size of the sponsoring natural gas companies, it is understandable that lenders are unwilling to rely on such companies to provide the credit assurances they demand. Yet, these companies provide the only sponsors for such vitally needed projects. Even though they might desire to do so, the project sponsors simply do not have the resources to finance such projects exclusively on their own credit. They must also maintain their ability to finance and keep their existing facilities operable so as to serve the consuming public.

Until a plant of commercial size and capability is proven in the United States, lenders will continue to require assurance of repayment in the unlikely event of completion failure or premature abandonment. They are concerned about possible governmental interference or regulatory action that could delay construction, interrupt production or impair the flow of revenues required to pay their interest and principal when due. They are also apprehensive about protections against new mining laws that could cut off the coal supply, against new environmental laws that could complicate or impair operation of the plant, and so forth. Here is where government assurances become very necessary. Delays resulting from such developments during construction could result in serious cost overruns.

It is a matter of providing the minimum level of incentive that this vital energy industry requires as it moves from one capital plateau to a much higher one—one which will allow financing through the private sector. There are few matters confronting our nation today that have any greater significance than the subject of energy and supplying the needs of our citizens for premium energy in the most economic manner.

The national Energy Plan notes that although coal comprises 90 percent of the fossil fuel reserves within the United States, the United States meets only 18 percent of its energy needs from coal. The NEP calls for an increase in coal production from 600 million to more than 1 billion tons per year by 1985. There are areas within the United States such as southern California however, that cannot utilize coal through direct combustion and if this increase in coal consumption is to be realized and benefit all customers, particularly those in large metropolitan areas, an aggressive program must be initiated which will allow development of alternative fuels to go forward.

The ERDA Authorization Bills for FY 1978 in the Senate and the House contain a provision that will allow the Energy Research and Development Administration to use loan guarantees as a means to develop nonnuclear energy forms, i.e., synthetic gas. This bill is necessary if projects such as the WESCO high Btu coal gasification plant are to be constructed. The bill has been passed in the Senate as S. 1340 and will soon be on the floor of the House as H.R. 6796. Passage of this legislation could allow ERDA to move forward with a program which would include sufficient plants and production capacity to prove the viability of this new industry to the financial community. This will permit supplies of high Btu substitute natural gas to be brought to the marketplace within the next five years. As the NEP evolves, Congress should provide all of the tools that wise counsel allows so that it may include the best possible balance of production and conservation.

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