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ENERGY IN THE EIGHTIES: CAN WE AVOID SCARCITY AND INFLATION?

HEARINGS

BEFORE THE

SUBCOMMITTEE ON ENERGY

OF THE

JOINT ECONOMIC COMMITTEE

CONGRESS OF THE UNITED STATES

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MARCH 8, 9, AND 21, 1978

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WEDNESDAY, MARCH 8, 1978

CONGRESS OF THE UNITED STATES,
SUBCOMMITTEE ON ENERGY OF THE
JOINT ECONOMIC COMMITTEE,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10:32 a.m., in room 5110, Dirksen Senate Office Building, Hon. Edward M. Kennedy (chairman of the subcommittee) presiding.

Present: Senators Kennedy and McClure.

Also present: Jerry Brady, subcommittee professional staff member; George R. Tyler, professional staff member; Mark Borchelt, administrative assistant; and Charles H. Bradford, Stephen J. Entin, and Mark R. Policinski, minority professional staff members.

OPENING STATEMENT OF SENATOR KENNEDY, CHAIRMAN

Senator KENNEDY. I have a very brief opening statement I would like to go through, and we will get on with our witnesses.

We want to welcome our panel this morning to our third set of hearings held by this subcommittee since 1976 on OPEC, the oil companies, and international energy supplies.

Over the past 2 years, we have pursued the most difficult of questions—how to bargain with the cartel, how to create arms-length transactions in oil, how multinational oil companies serve or do not serve the national interest.

Today we continue that pursuit. First, it is apparent that oil and gas are likely to be the dominant fuels for the next 15 to 20 years and the bridge into alternative future supplies.

Second, important imports continue to rise. When we started this series 2 years ago, imports constituted 25 percent of oil consumption.

Today, imports make up 47 percent of total oil consumption and cost $40 billion with some projects in the 1980's going as high as $100 billion. While OPEC has held its prices recently because of the surplus created by the North Sea and Alaska, major studies saw the possibility of prices rising rapidly in the mid to late 1980's, $25 to $30 a barrel, perhaps more.

This would present the most serious consequences for the United States. In our hearings during these next 2 days, witnesses will discuss with us the supply of oil and gas in the world which is the subject of these dire predictions.

For today's hearing, we have deliberately invited those who are optimistic in their references to fuel supplies. These witnesses have not been heard and deserve our attention.

Because of scarcity, it is in the best interest of both producing countries and producing companies when we face the predictions of disaster of the horizon.

As I believe will be demonstrated, optimistism is no excuse to avoid the path we must travel, the path of conservation and development of alternative fuels. New production, whether oil or gas or coal or nuclear, takes upward of a decade to bring in, leaving conservation as the best energy source for the next 8 years.

As a signal to back away from establishing an energy-efficient economy in the United States, while striving for efficiency and bringing new energy sources on line, the greatest problem is rapidly rising prices.

Oil prices have been a major cause for inflation, weakened the dollar, slowed recovery from worldwide recession, and cut in half the juice when things were looking more hopeful. How can we insure a favorable excess of supply over demands as we have momentarily?

Can we depend upon the oil companies to explore and produce at all deliberate speed?

Can we increase the number of transactions in oil that are not strictly controlled by OPEC?

Can we help develop countries where the chance for stability may hinge on fuel?

Before us are the questions which challenge us.

Tomorrow we will have administration witnesses and the man who directed the energy policy for the previous administration, John Sawhill. We have asked them to follow today's hearings carefully, and I intend to present to them the arguments made by today's witnesses.

Our first witness is Arnold E. Safer, vice president, economic research and planning, Irving Trust Co., New York City.

STATEMENT OF ARNOLD E. SAFER, VICE PRESIDENT, ECONOMIC RESEARCH AND PLANNING, IRVING TRUST CO., NEW YORK, N.Y.

Mr. SAFER. My name is Arnold E. Safer. I am a vice president and economist with the economic research and planning department of the Irving Trust Co. in New York City. My remarks today are my own and should not be viewed as necessarily those of the institution for which I am employed.

I appreciate the opportunity to express my views on the energy problems now facing our country.

The principal objectives of Government energy policy, within the limits of the immediate technical and political constraints, appear to me as follows:

(*a*) Achieve the greatest possible self-reliance from unreliable and monopoly priced foreign oil sources.

(*b*) Prevent energy shortages from causing increasing economic dislocations.

There are really two separate sets of issues associated with the energy crisis. The first is an international problem, affecting U.S. foreign political and economic policies. These problems relate to OPEC control of world oil supplies which represents a fundamental change in the world power structure. The second is a domestic economic problem which is related to a changing set of social values

among establishment decision makers in the United States. Present energy policies have so confused these two sets of issues that neither of the objectives are being met, and we are in fact further away from them than we were in 1973.

While my remarks here today will stress the international dimensions of the problem, I do not believe that the actions on the international side alone will provide a panacea for our domestic energy problems. These domestic problems will be solved by a combination of both effective conservation policies and by the timely development of alternate fuel sources, such as coal and nuclear power.

Both of these fuel sources today are mired in environmentalist controversies and are not being developed rapidly enough to insure meeting the goals of the national energy plan.

But there is a more general energy problem related to the concept of energy conservation. Energy and economic growth are tied together; the so-called "decoupling" of energy and economic growth has some clear limits. A more efficient use of energy means sacrificing some growth in real personal income while the capital investments for new energy conservation technology are implemented.

Rising energy prices will continue to shift consumer spending to energy and other necessities whose production costs have risen due to energy costs. This means less growth in spending on other less necessary items.

As a result, if general economic policy pushes too hard for a rapid rate of real economic growth, severe inflationary pressure will resume, and another economic recession may follow. Steady and slower growth is necessary until the economy can make the adjustments to these higher energy costs.

Between now and 1985, the economy will grow at a slower rate than during the past decade. The more rapidly it grows now, the greater the likelihood of a recession later.

Turning to the international issues, I will first summarize my remarks and then proceed to a visual presentation of the details.

Natural economic forces today may be working toward a very gradual reassertion of the market power of the oil consuming nations. A slowing in the growth of world oil demand and the expected rapid increase in non-OPEC oil sources suggest that OPEC production peaked in 1977 and should gradually decline to 1980.

OPEC will be most vulnerable to consumer pressures during this period, since a number of the more heavily populated OPEC member nations will have an incentive to expand oil production at a time when world demand for total OPEC oil will be gradually declining.

They can only expand output at the expense of the more sparsely populated OPEC countries. If Saudi Arabia reduces output to offset increased production by the more populous OPEC nations, it could be reduced to production levels by 1980 which even it might find intolerably low.

As another alternative, if Saudi Arabian production in 1980 were held near current levels, other OPEC members would be forced to cut oil production below levels which would permit the planned implementation of economic development programs already in progress.

U.S. international oil policy should recognize the likelihood of this natural friction within OPEC. The period ahead offers the op-

portunity to limit the cartel's power over the world oil market and to reach a more healthy accommodation with the legitimate aspirations of its member governments.

Behind this summary is a detailed forecast of future supply and demand trends for world oil, which I will highlight in the following charts.

If I may be permitted, I would like to stand up and go through a few charts here. These are our projections which we published recently and I would like to point out some of the highlights of some of the numbers.

If we look back in terms of growth rate of the world oil demand, this is the non-Communist world, excluding Russia, China and the Eastern European countries, demand growth between 1973 and 1977 was at a rate somewhere around 1 percent a year and that should be contrasted to a long-term historical growth of perhaps 1 percent a year from the mid-1950's through 1973.

In 1977, the world consumed about 49.5 million barrels a day of oil and we are making a projection based on our economic forecasts of growth in the United States, Western Europe and Japan of somewhere around a 3.5-percent rate in 1980. We then see some economic clouds on the horizon in terms of a potential for a recession or some problems worldwide. So, we have put in somewhat of a decline in 1981, but then a recovery in 1982 through 1985.

I don't think you can avoid the cyclical impacts, but I would like to suggest if one draws a straight line like this to 1982 it is about a 3-percent average annual growth. Going out to 1985, we would look for a slowing even further to about 2.5 percent.

Against that demand growth, which will take us by 1982 to about 55 million barrels a day, we have made projections on the non-OPEC sources. One is assuming these other sources come on stream and therefore the OPEC production is backed out.

That is not an inexorable type process. It depends on political decisions along the way, and the decisions of many private participants in the oil markets.

However, given that assumption, what we would see would be first for the United States and Canada a rather limited growth but still some increase in the Lower 48, that is in the continental U.S. production.

At the present time drilling has increased by about 20 percent a year for the past 4 years, and this is whether you measure it in terms of number of wells or rigs or anything like that.

At the present time the increased drilling has only just about replaced the decline in existing production. I think the economist's use of the elasticity measures is appropriate here because high prices for new oil will generate some marginal increases in U.S. production. We add to that the Alaskan production, which we forecast as reaching around 2 million barrels a day by 1982, which is the present capacity of the pipeline.

To that we would add large growth in Western European and here we are looking for growth to about 5 million barrels a day by 1982. The bulk of it is coming from the British North Sea.

I guess my colleague, Mr. Odell, will address some of those points in more detail. We have forecast for Britain about 3 million barrels a day production in the early 1980's, 1981 or 1982. Whether in

fact that comes about will depend on decisions by the British Government along the way in terms of their own desires to develop that and in terms of the balance of payments needs of Great Britain.

As a banker, I can tell you that they have made, as a justification for the very large loans that they floated on the entire international financial market a year or year and a half ago, the projection of 3 million barrels a day. This was considered fairly firm at that time.

We then moved to an area of the world where there is considerable controversy over the supply projections; that is, exports from the Soviet Union and China to the rest of the world.

Our projections suggest in contrast to Government studies, administration studies, that the Soviet Union will, in fact, not become a major importer of oil in the early 1980's but will continue to increase its exports.

Senator KENNEDY. I would like to ask a question.

You don't have any projections on other potential areas? As I understand, that is sort of a hardheaded realistic approach based upon known resources at the present time, but it doesn't show very much in terms of expansion of say in Latin America or Vietnam or in the other places that have been thought to offer some opportunity for potential?

You will comment on that?

Mr. SAFER. I would like to answer you directly right now.

The reason is in the oil business, and I have some experience in it, the saying is you don't know until you put the drill bit down, so you are talking about wildcatting.

These projections are based on an assessment of the economic and the political judgments that will be made on the development of relatively well known pools of oil around the world.

I don't think that you can make extrapolations out beyond a 4- or 5-year time frame with any degree of believability. This is my own experience, and I think all you can do is try to create an atmosphere which will continue the search for new oil. So, I deliberately did not put those in.

In terms of adding up the numbers, then, we would be looking at an increase between 1977 and 1982 of about 8.5 million barrels a day. There has been debate about some of these numbers, and I have been said to be somewhat optimistic. I guess I am, but even some of my more pessimistic friends tell me perhaps these numbers may be high by at most 2 million barrels a day. So there isn't that much controversy on these numbers.

In terms of the same chart you saw before, putting it on a log scale, looking at demand growth to 1982, 3 percent per annum. With non-OPEC supplies growing at 8 or 9 percent per annum, this would mean, under the assumption that OPEC is the swing producer, that OPEC supplies will have to come down. And we believe they will be coming down to around 26 million barrels a day range in the 1980–82 period.

In 1977, OPEC produced a little over 30 million barrels a day, and as you can see by the charts that I am suggesting this will be coming down to a range of 26 million barrels a day in that 1980–82 period. I want to average it out so the effect of our cyclical projections does not unduly influence the numbers.

Minimum OPEC production is a reference to the idea that in adding up their needs for western currencies to import the goods and services they want, country by country, we determined that about 26 million barrels a day. That is, what they would have to sell to be able to meet the development programs they now have in process.

In 1974, OPEC produced, two-thirds, or 67 percent of world oil consumption. This has come down at present to about 60 percent, and by 1982 they will be coming down to somewhere under 50 percent.

One then looks at the distribution of that oil production within OPEC, coming down from a 30 million barrels a day range in 1977 to the 26 million barrels a day range in 1982. You can see 26.3 which is our point estimate, but one should look at it as a range of 26–26.5. In 1977, the 30 million barrels a day was distributed between other Arab and other OPEC member nations; about 16 million barrels a day, which left 14 for Iran and Saudi Arabia.

The 14 million was split about 8.5 million Saudi and about 5.5 million Iranian. If, in fact, the total production from OPEC comes down to this 26-million-barrel-a-day range in 1982, then how will they distribute the 26 million barrels, the 4 million barrels a day less?

Since the other Arabian and other OPEC members are for the most part the more populous nations, Iraq being one of the large producers, their totals would go to about 17 million barrels a day by 1980–82.

So, if you are talking 26 minus 17, you are left with 9 or say 9.5. We don't know how that 9.5 will be split and all this shows is two polar extremes. Namely at the one extreme Saudi Arabia would take the brunt of the shut-in of the decline in production, and produce some 3 million leaving some 6 million for Iran.

On the other hand, the Saudis may choose not to do that for a number of reasons having to do with their own perceptions of how they want to guide their oil production, and they may produce 6 or slightly more which would leave Iran with only 3 million barrels a day.

I suggest to you, Senator, neither of those alternative are tenable from the point of view of either of these participants of OPEC. I think that is one key pressure point with respect to our ability to negotiate with the OPEC nations.

I would like to make a couple of further points. If one looks at facts and not projections of the ratio of proven reserves of oil to the annual production rates—this chart shows the proven reserves of oil, that is those oil reserves where the wells are drilled, where the capital is committed, where the money has been invested, in order to get production and take the ratio to annual production—it is the years of forward supply, sometimes called the RIP Index or Reserve Life Index. This is the years of forward supply of proven reserves, and this is a chart from 1947 to the present time.

This index rose dramatically through the late 1940's and 1950's, so by the late 1950's it was up to 43 years of forward supply, coming from perhaps under 30 back in the 1930's. Since 1962–63, it has held a fairly constant ratio. In other words, we have had 31, 32 years forward supply for the past 15 years.

No businessman in terms of his commitment of capital is going to commit for 60 years or 70 years in terms of proven reserves. So, my point here simply is the fact of the matter suggests that really these proven reserves of forward supply have not really changed very much over the course of the past decade or 15 years.

If one would like to make a projection into 1978 and 1979, given the new Mexican proven reserves which are not displayed in this chart, my feeling is that the number will, in fact, rise.

You will notice for the United States you have a similar pattern although much lower. Some of this is because the U.S. industry is much more competitive, so they don't commit capital quite as long in terms of competition in the American oil business. So, you have perhaps a 12 to 13 year forward supply. But relative to consumption, the index has been declining and this is the problem with respect to the United States alone.

For the world as a whole, I think economics, geology, and history, prove my case. Finally, I would like to add that the United States in terms of its supply demand balance will have large oil imports for some years ahead. Our projections are that consumption in the United States will rise from a current rate of 18.4 to 21.4 million barrels a day by 1982, including an estimate for the Stragetic Petroleum Reserve. The domestic supply would be optimistic at 13 million which would still leave 8.5 to 9 million barrels a day of imports.

What this means is the United States, based on our assumption of coal, nuclear power, natural gas developments, will still be a large importer of oil. We had better learn how to buy it!

My conclusions: First, an abundance of world oil supplies through 1982; second, oil prices in the marketplace will gradually adjust to this, and OPEC may not be able to index for inflation, so that in real terms, prices may fall a bit. This is the prediction we have at the bank for our own investments and clients.

Third, OPEC cohesion will be strained; and fourth, the United States will remain heavily dependent on foreign oil. That is all I have in terms of these charts, but I would like to continue with a final statement, if I might.

I would like to turn now to the institutional mechanisms by which oil is imported into the United States and by which oil is priced on the international market.

If the United States is likely to be importing substantial amounts of oil over the next decade, as I have projected, how can we stem the growing balance of payments drain on our domestic economy? Obviously, the first answer is to increase our exports of all goods and services, but a detailed examination of that issue is beyond the scope of this discussion.

Second, we should conserve energy, and I believe that stronger measures are called for than the Congress is apparently willing to approve. A worldwide abundance of oil, as I have projected, does not in any way lessen the need for a more energy efficient economy.

In addition to helping to slow the balance of payments drain, an effective conservation program would help to dilute OPEC's monopoly price-setting capabilities. And this leads me to the third and directly relevant factor; namely, to seek a lower price for inter-

national oil, or at the least to put into place new mechanisms which limit the capability of OPEC to further increase world oil prices.

For example, in the international diplomatic arena, it would be helpful to establish the fact that some kind of market exchange system would be a better mechanism for determining the price of oil than an international treaty based upon political perceptions of a "fair" price.

The replacement cost of synthetic energy sources is not a realistic basis for oil pricing; nor is the indexing of oil prices to world inflation a useful departure point for international oil negotiations. Both pricing approaches make little economic sense in the long run and would simply add to the misallocation of the world's resources, both physical and financial.

A market exchange system for oil, possibly regulated by representatives of both consuming and producing nations, would be a more useful approach. And it is over the next few years, when the consuming nations way well be able to exercise significant market influence over the OPEC states, that this approach might be successfully applied.

To be specific, I would recommend a detailed examination and debate over the following complementary approaches for dealing with the monopoly power of OPEC. First the system of foreign tax credits may help to link the interests of some international companies with those of some OPEC members. As a general proposition, the companies should be encouraged to bargain for crude oil at arm's length, thereby promoting competition among the OPEC states for world markets. The present system of foreign tax credits for certain crude oil purchases may not be helpful in achieving that objective.

Second, the U.S. Government, together with other international financial agencies, should aid in the financing of oil exploration outside the United States, primarily in the non-OPEC developing countries. The benefits of this policy should be apparent in terms of potentially adding to the world's supplies of oil and gas, in terms of relieving the balance-of-payments position of some of these very poor countries, in terms of diluting some of OPEC's price-setting powers, and finally in terms of encouraging more competition in international oil markets.

I believe that this additional financing should be complementary to the private sector, engaging perhaps in those ventures where the economic or political risks may be too great for private industry.

Third, I support the ideas of Professor Adelman of MIT concerning the adoption of a bidding system for U.S. oil imports. Essentially, Adelman suggests that the U.S. Government estimate our oil import needs and then use an auction technique to apportion that amount among would-be suppliers of imported oil. The competitive bidding for the right to sell this clearly defined quantity of oil would put each supplier under pressure to sell at a lower price in order to gain access to a larger share of the U.S. market. It seems to me that in the present surplus state of the oil market, this approach has an appreciable prospect for achieving some success.

Finally, the devolopment of an organized exchange market for oil products would help to make the pricing process more com-

petitive. There are some futures contracts for certain oil products now being developed by the commodities exchanges in New York.

I believe that an open, visible pricing system for oil products would eliminate some of the need for excessive domestic regulation and thereby help both the Department of Energy and the oil companies. To the extent that a surplus appears in the market, the trading of the future's contract will help to insure that oil prices react.

If product prices decline because of slow volume, this will be felt by the refiners who will ultimately cut their production, which in turn will feed back to the crude suppliers. This process could then translate into lower crude oil prices, as crude suppliers compete for market share.

Senator KENNEDY. Is that realistic, dealing with OPEC?

Mr. SAFER. I believe it is.

Ultimately, one might see this type of exchange market in crude oil. Product prices are determined by crude prices in the long run. But in the short run, month by month, quarter by quarter, product prices will influence changes in crude prices.

Refiners have to react. They first have to cut refinery runs, and then they cut their crude oil purchases which puts pressure on crude oil prices.

To some extent the process goes on today, but I believe that opening it up and making it a visible and open pricing system for the petroleum products will help to insure that process continues.

I would like to finish my prepared statement.

None of these recommendations alone will likely be sufficient to dilute OPEC's hold on world oil prices. Taken together, however, they would certainly alter the expectations of oil market participants, both private companies and governments.

Nevertheless, for the U.S. Government to adopt these approaches, some of the concern over offending certain OPEC members would have to be reduced. Oil remain as much a commercial question as a political one. OPEC is a seller; the United States is a buyer. Our market interests, therefore, diverge.

We can still be the best of political allies with the member governments of OPEC, but we can still bargain with them over the price of oil. I believe that the broad approach to international oil pricing problems should be to "take the politics out of it" as much as possible.

Thank you.

Senator KENNEDY. It is an interesting and provocative statement. We will come back to you for questions. Thank you, Mr. Safer.

[The prepared statement of Mr. Safer, together with the attached charts, follows:]

PREPARED STATEMENT OF ARNOLD E. SAFER

My name is Arnold Safer. I am an economist with the Irving Trust Company in New York City. My remarks today are my own and should not be viewed as necessarily those of the institution for which I am employed.

I appreciate the opportunity to express my views on the energy problems now facing our country.

The principal objectives of government energy policy, within the limits of the immediate technical and political constraints, appear to me as follows:

(a) Achieve the greatest possible self-reliance from unreliable and monopoly priced foreign oil sources.

(b) Prevent energy shortages from causing increasing economic dislocations.

There are really two separate sets of issues associated with the Energy Crisis. The first is an international problem, affecting U.S. foreign political and economic policies. These problems relate to OPEC control of world oil supplies which represents a fundamental change in the world power structure. The second is a domestic economic problem which is related to a changing set of social values among Establishment decision makers in the United States. Present energy policies have so confused these two sets of issues that neither of the objectives are being met, and we are in fact further away from them than we were in 1973. In particular, increasing constraints on domestic energy production have caused an even greater necessity to import oil from OPEC.

While my remarks here today will stress the international dimensions of the problem, I do not believe that actions on the international side alone will provide a panacea for our domestic energy problems. These domestic problems will be solved by a combination of both effective conservation policies and by the timely development of alternate fuel sources, such as coal and nuclear power. Both of these fuel sources today are mired in environmentalist controversies and are not being developed rapidly enough to insure meeting the goals of the National Energy Plan. But there is a more general energy problem related to the concept of energy conservation. Energy and economic growth are tied together; the so-called "decoupling" of energy and economic growth has some clear limits. A more efficient use of energy means sacrificing some growth in real personal income while the capital investments for new energy conservation technology are implemented. Rising energy prices will continue to shift consumer spending to energy and other necessities whose production costs have risen due to energy costs. This means less growth in spending on other less necessary items. As a result, if general economic policy pushes too hard for a more rapid rate of real economic growth, severe inflationary pressures will resume, and another economic recession may follow. Steady and slower growth is necessary until the economy can make the adjustments to these higher energy costs. Pushing too hard for a reduction in unemployment through higher government deficits will make the energy conservation job that much tougher. Between now and 1985, the economy will grow at a slower rate than during the past decade. The more rapidly it grows now, the greater the likelihood of a recession later. As a result, we may have to tolerate a higher level of unemployment for a few more years until the growth of the labor force begins to slow in the early 1980's.

Turning to the international issues, I will first summarize my remarks and then proceed to a visual presentation of the details.

Natural economic forces today may be working toward a very gradual reassertion of the market power of the oil consuming nations. A slowing in the growth of world oil demand and the expected rapid increase in non-OPEC oil sources suggest that OPEC production peaked in 1977 and should gradually decline to 1980. OPEC will be most vulnerable to consumer pressures durng this period, since a number of the more heavily populated OPEC member nations will have an incentive to expand oil production at a time when world demand for total OPEC oil will be gradually declining. They can only expand output at the expense of the more sparsely populated OPEC countries. If Saudi Arabia reduces output to offset increased production by the more populous OPEC nations, it could be reduced to production levels by 1980 which even it might find intolerably low. As another alternative, if Saudi Arabian production in 1980 were held near current levels, other OPEC members would be forced to cut oil production below levels which would permit the planned implementation of economic development programs already in progress.

U.S. international oil policy should recognize the likelihood of this natural friction within OPEC. The period ahead offers the opportunity to limit the cartel's power over the world oil market and to reach a more healthy accommodation with the legitimate aspirations of its member governments.

Behind this summary is a detailed forecast of future supply and demand trends for world oil, which I will highlight in the accompanying charts to this statement.

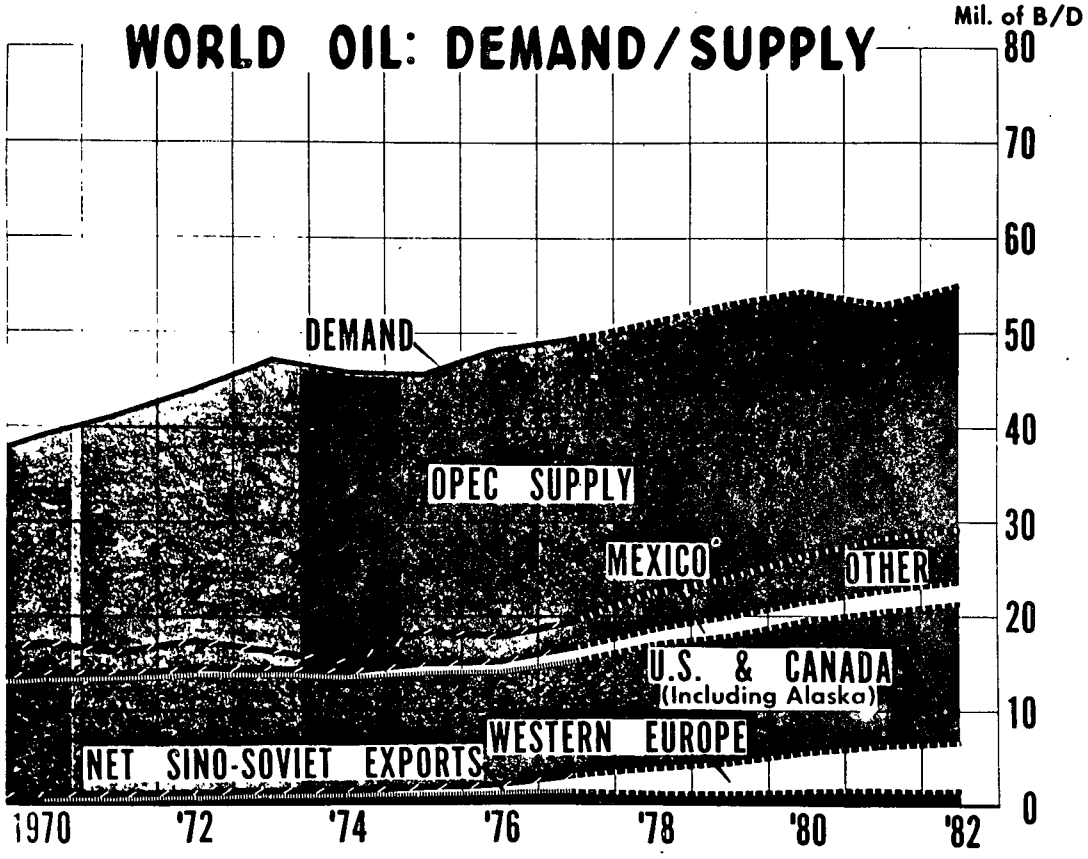
I would like to turn now to the institutional mechanisms by which oil is imported into the U.S. and by which oil is priced on the international market. If the U.S. is likely to be importing substantial amounts of oil over the next decade, as I have projected, how can we stem the growing balance of payments drain on our domestic economy? Obviously, the first answer is to increase our exports of all goods and services, but a detailed examination of that issue is beyond the scope of this discussion. Second, we should conserve energy, and I believe that stronger measures are called for than the Congress is apparently willing to approve. A worldwide abundance of oil, as I have projected, does not

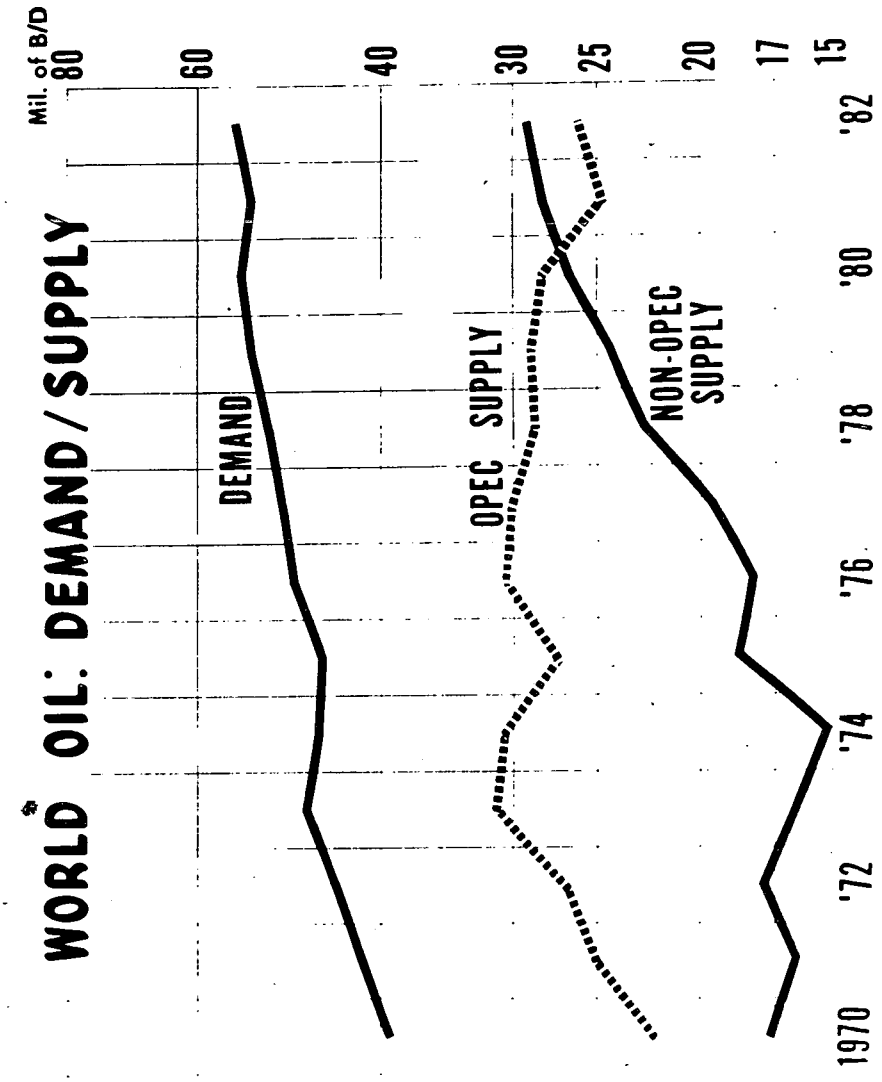
in any way lessen the need for a more energy efficient economy. In addition to helping to slow the balance of payments drain, an effective conservation program would help to dilute OPEC's monopoly price-setting capabilities. And this leads me to the third and directly relevant factor, namely to seek a lower price for international oil, or at the least to put into place new mechanisms which limit the capability of OPEC to further increase world oil prices. For example, in the international diplomatic arena, it would be helpful to establish the fact that some kind of market exchange system would be a better mechanism for determining the price of oil than an international treaty based upon political perceptions of a "fair" price. The replacement cost of synthetic energy sources is not a realistic basis for oil pricing; nor is the indexing of oil prices to world inflation a useful departure point for international oil negotiations. Both pricing approaches makes little economic sense in the long run and would simply add to the misallocation of the world's resources, both physical and financial. A market exchange system for oil, possibly regulated by representatives of both consuming and producing nations, would be a more useful approach. And it is over the next few years, when the consuming nations may well be able to exercise significant market influence over the OPEC states, that this approach might be successfully applied.

To be specific, I would recommend a detailed examination and debate over the following complementary approaches for dealing with the monopoly power of OPEC. First. the system of foreign tax credits may help to link the interests of some international companies with those of some OPEC members. As a general proposition, the companies should be encouraged to bargain for crude oil at arm's length, thereby promoting competition among the OPEC states for world markets. The present system of foreign tax credits for certain crude oil purchases may not be helpful in achieving that objective. Second, the U.S. government, together with other international financial agencies, should aid in the financing of oil exploration outside the United States, primarily in the non-OPEC developing countries. The benefits of this policy should be apparent in terms of potentially adding to the world's supplies of oil and gas, in terms of relieving the balance of payments position of some of these countries, in terms of diluting some of OPEC's price-setting powers, and finally in terms of encouraging more competition in international oil markets. I believe that this additional financing should be complementary to the private sector, engaging perhaps in those ventures where the economic or political risks may be too great for private industry. Third, I support the ideas of Prof. Adelman of MIT concerning the adoption of a bidding system for U.S. oil imports. Essentially, Adelman suggests that the U.S. government estimate our oil import needs and then use an auction technique to apportion that amount among would-be suppliers of imported oil. The competitive bidding for the right to sell this clearly defined quantity of oil would put each supplier under pressure to sell at a lower price in order to gain access to a larger share of the U.S. market. It seems to me that in the present surplus state of the oil market, this approach has an appreciable prospect for achieving some success. Finally, the development of an organized exchange market for oil products would help to make the pricing process more competitive. There are some futures contracts for certain oil products now being developed by the commodities exchanges in New York. I believe that an open, visible pricing system for oil products would eliminate some of the need for excessive domestic regulation and thereby help both the Department of Energy and the oil companies. To the extent that a surplus appears in the market, the trading of the future's contract will help to insure that oil prices react. And if product prices decline because of slow volume, this will be felt by the refiners who will ultimately cut their production, which in turn will feedback to the crude suppliers. This process could then translate into lower crude oil prices, as crude suppliers compete for market share.

None of these recommendations alone will likely be sufficient to dilute OPEC's hold on world oil prices. Taken together, however, they would certainly alter the expectations of oil market participants, both private companies and governments. Nevertheless, for the U.S. government to adopt these approaches, some of the concern over offending certain OPEC members would have to be reduced. Oil remains as much a commercial question as a political one. OPEC is a seller; the United States is a buyer. Our market interests, therefore, diverge. We can still be the best of political allies with the member governments of OPEC, but we can still bargain with them over the price of oil. I believe that the broad approach to international oil pricing problems should be to "take the politics out of it" as much as possible.

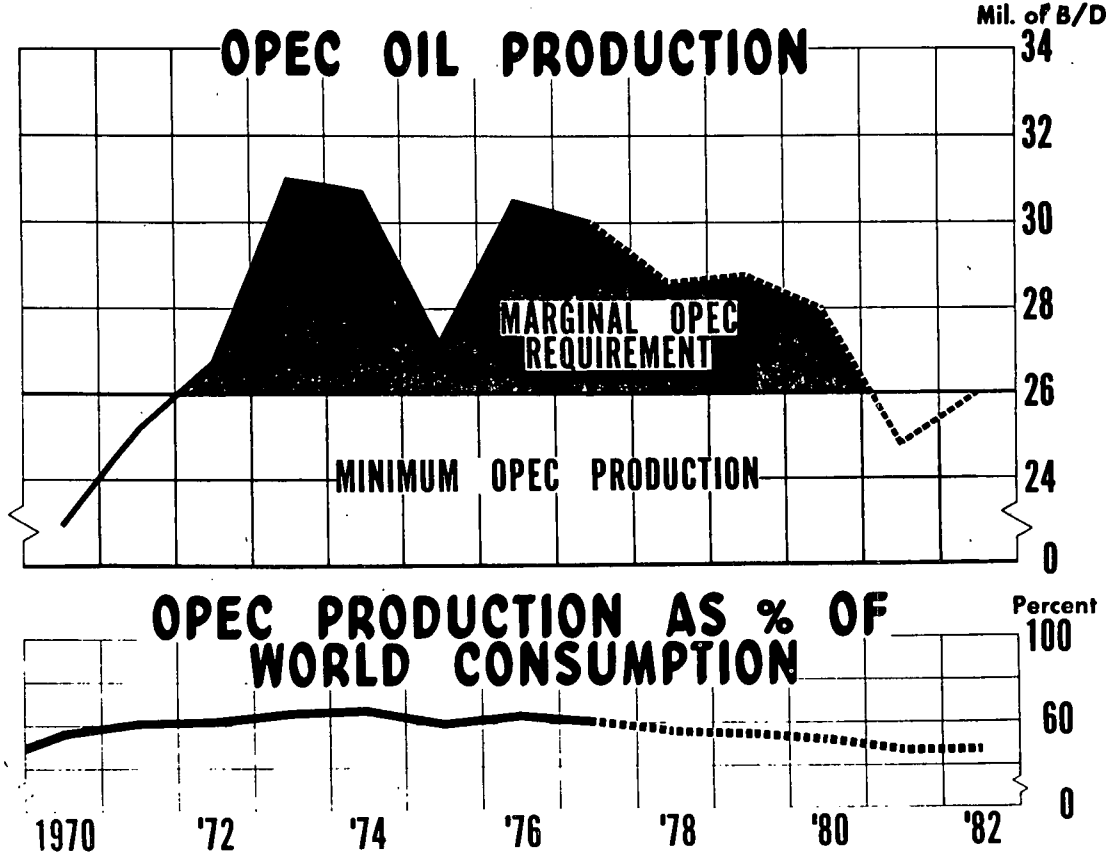
Thank you.


WORLD OIL: DEMAND/SUPPLY
Mil. of B/D
80
70
60
50
40
30
20
10
0
DEMAND
OPEC SUPPLY
MEXICO
OTHER
U.S. & CANADA
(Including Alaska)
WESTERN EUROPE
NET SINO-SOVIET EXPORTS
1970
'72
'74
'76
'78
'80
'82

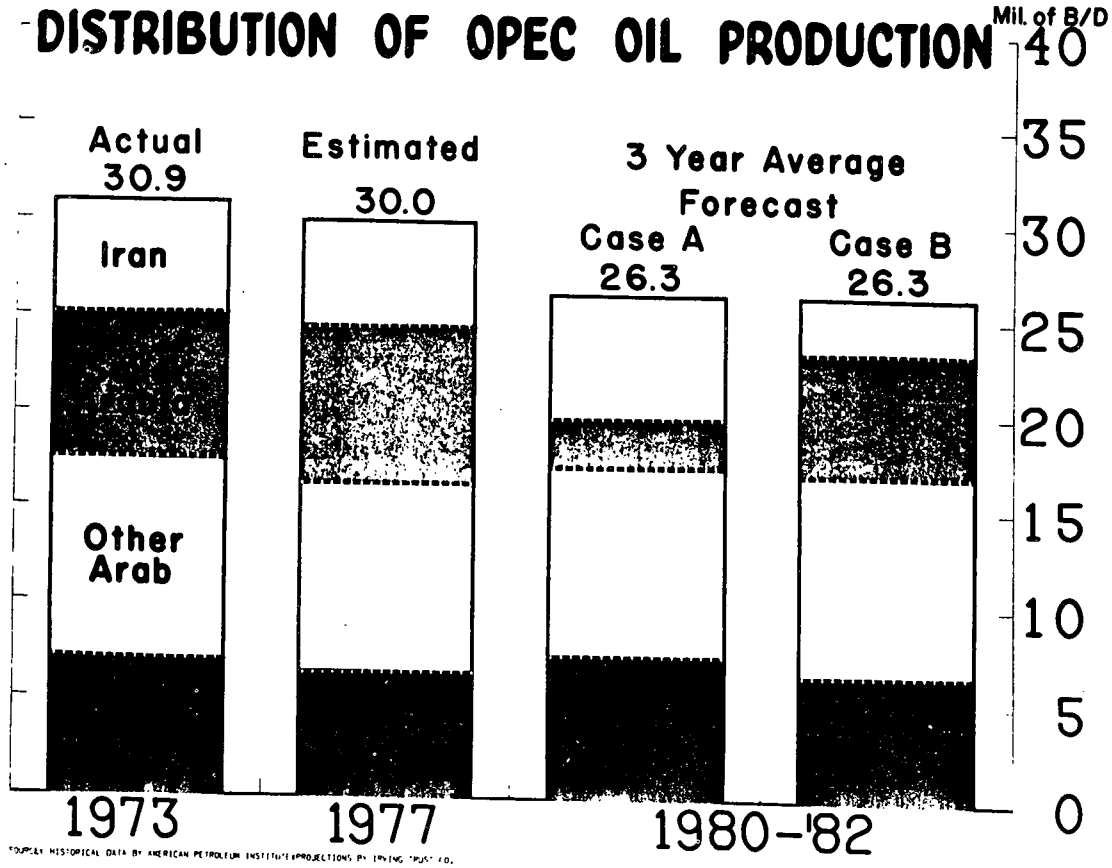

WORLD OIL: DEMAND/SUPPLY
Mil. of B/D
80
60
40
30
25
20
17
15
DEMAND
OPEC SUPPLY
NON-OPEC SUPPLY
1970
'72
'74
'76
'78
'80
'82

NEW OIL SOURCES
1977-1982

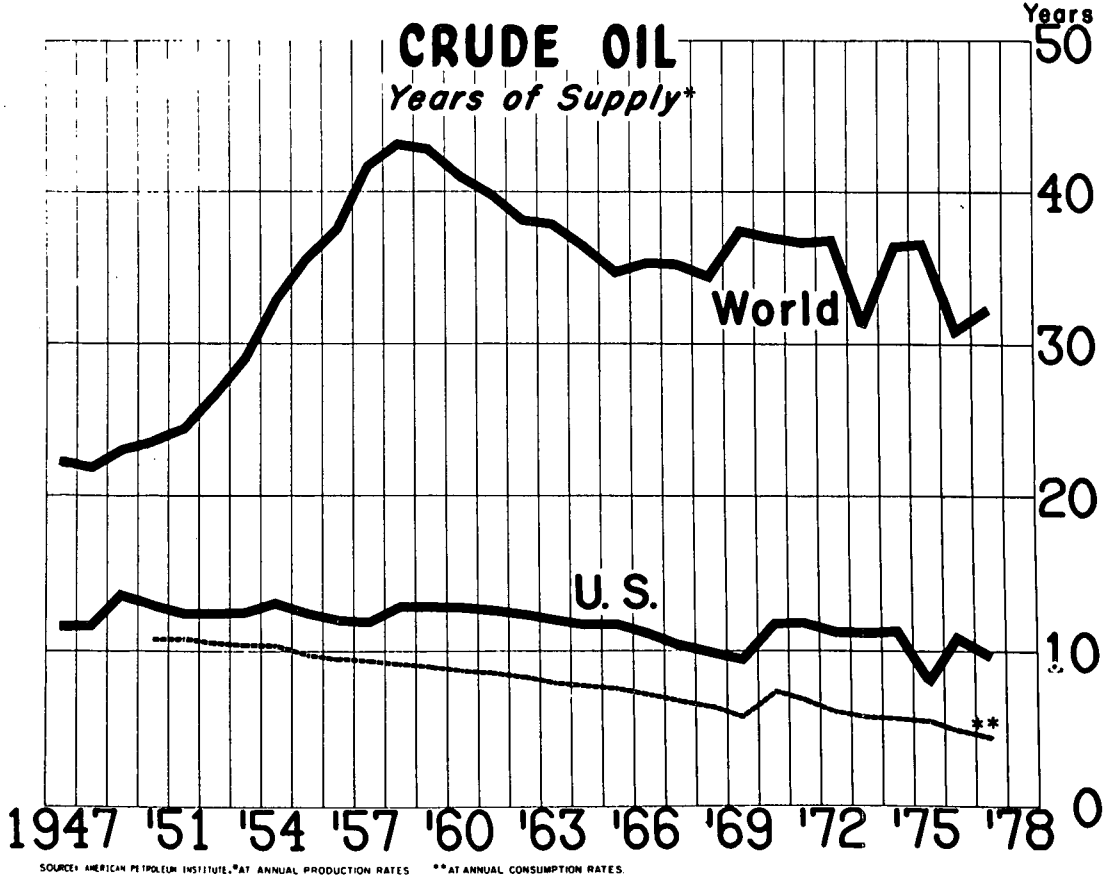
	MMB/D
U. S.	
LOWER '48	.6
ALASKA	1.8
CANADA	.1
W. EUROPE	3.2
MEXICO	1.1
SINO-SOVIET	.4
REST OF WORLD	1.3
	8.5


OPEC OIL PRODUCTION
Mil. of B/D
34
32
30
28
26
24
0
MARGINAL OPEC REQUIREMENT
MINIMUM OPEC PRODUCTION
OPEC PRODUCTION AS % OF WORLD CONSUMPTION
Percent
100
60
0
1970
'72
'74
'76
'78
'80
'82

DISTRIBUTION OF OPEC OIL PRODUCTION



SOURCES: HISTORICAL DATA BY AMERICAN PETROLEUM INSTITUTE; PROJECTIONS BY IRVING TRUST CO.


CRUDE OIL
Years of Supply*
Years
50
40
30
20
10
0
World
U. S.
**
1947 '51 '54 '57 '60 '63 '66 '69 '72 '75 '78
SOURCE: AMERICAN PETROLEUM INSTITUTE. *AT ANNUAL PRODUCTION RATES **AT ANNUAL CONSUMPTION RATES.

U. S. OIL SUPPLY/DEMAND

MMB/D

	1977	1982
CONSUMPTION	18.4	21.4
STR. STOCKS	.3	.3
	18.7	21.7
DOMESTIC SUPPLY	10.6	13.0
IMPORTS	8.8	8.7
INVENTORY CHANGE	+ .7	—

CONCLUSIONS

1 - ABUNDANCE OF WORLD OIL SUPPLIES THROUGH 1982

2 - OIL PRICES (ADJUSTED FOR INFLATION) WILL FALL

3 - OPEC COHESION WILL BE STRAINED

4 - U. S. WILL REMAIN HEAVILY DEPENDENT ON FOREIGN OIL

Senator KENNEDY. Now, I would like to hear from the other witnesses. I hope we can come back to the question of the tax advantage, though as I understand, we treat differently the OPEC countries and those drilling on the North Sea.

We tip it, as I understand in terms of tax policy, more in favor to tying us in more completely with OPEC rather than giving us flexibility.

I would be interested in your comments on that and also what you think can be done with the World Bank and AID types of technology. I think it would be well if we heard the panel. We have a good panel and it is all related to the same subject, but it goes off in some different areas.

We will hear from Peter R. Odell who formerly was an economist with the London School of Economics, but most recently is teaching at Erasmus University in Rotterdam, The Netherlands. We look forward to your testimony. You have some very interesting comments to make which I am generally familiar with, but we look forward to you elaborating on them.

Thank you for coming to share your thoughts with us. Would you proceed.

STATEMENT OF PETER R. ODELL, PROFESSOR OF ECONOMICS, ERASMUS UNIVERSITY, ROTTERDAM, THE NETHERLANDS

Mr. ODELL. I shall keep my comments to the question of the energy outlook for Western Europe, although my own professional academic interests extend to the field of international oil, and I would very much like to have the opportunity at some stage to comment on Mr. Safer's remarks the first thing this morning.

In Western Europe, I think what we have to appreciate first of all is that its dependence upon imported oil is a recent phenomenon. Until the middle 1950's, Western Europe was basically an energy-producing region dependent upon its own supplies of coal and at which time oil provided just a very small part of the total demand for energy in that world region.

As a consequence of, first, rapid economic growth and consequent rapid energy growth, and, second, the inability of the European coal industry to compete with declining real cost oil, Western Europe gradually became dependent to a much greater degree than the United States on the imports of foreign oil. Thus, by 1973, as the result of 20 years of a cheap energy policy in every European country, Western Europe was around 65-percent dependent on imported oil for its supply of energy.

Moreover, most of this oil was supplied to Western Europe by the multinational oil corporations, most of them from the United States, and these were considered, in general, in Western Europe at that time, to be reliable instruments for insuring a future continued flow of the increasing amounts of oil which up to 1973 were expected to be required.

Indeed, the forecasts in Western Europe up to 1973 of the future evolution of Western European energy demands simply extrapolated the 5-percent to 5.5-percent growth rate in energy use to which we had by then become accustomed. Within that framework it was also thought that the increasing use of oil would continue and that

imported oil, would thus become even relatively more important in the total energy supply of Western Europe than it had become in 1973.

At that time, that is up to 1973, the outlook for indigenous oil production was very conservative, as indeed was the outlook for indigenous natural gas production. Indeed, I think it is possible to state, almost as a truth, that the outlook for natural gas in Western Europe has been consistently and continuously underevaluated ever since the middle 1960's when for the first time in Western European history a large new gas discovery was made, the Groningen Field in the Netherlands, which was underevaluated in terms of size and underevaluated in terms of its likely productivity.

As a consequence, the growth of the use of natural gas was also grossly underestimated in national, European, and international figures for future energy use.

Thus, as a consequence, the accepted energy forecast at that time was that Western European dependence on imported oil would continue to rise and from an import level of around 12 million barrels a day in 1973 there was an expectation that by 1985 Western Europe would be importing 20 million barrels a day from OPEC countries, and possibly up to 40 million barrels a day by the year 2000.

Since 1973, the oil demand outlook has changed quite fundamentally, although the fundamental nature of the change is not yet widely understood or widely appreciated. There are several reasons for this change in the outlook for oil in Western Europe.

First, as a consequence of the oil crisis and its impact on the international economic outlook, the economic outlook in Western Europe in itself is very much bleaker and a much lower rate of economic growth is now expected. Thus, a much lower rate of energy growth must also be expected.

Second, the very much higher oil prices to which all European customers have become subject has in itself engendered a very marked conservation reaction by users. Western European consumers, unlike consumers in the United States, have not been sheltered from the rise in oil prices since 1973, and as a result there has already been a quite formidable reaction by users to these very much higher oil prices.

Third, most governments in Western Europe have already taken other steps—steps not associated with the pricing mechanism—to assure reductions in oil use. By process of grants and by the process of exultation, these consumers are being persuaded to use less energy; and less energy in Western Europe, which means less oil consumed.

Fourth, the West European coal industry is now being protected, unlike the earlier period when it was subject to external competition from oil. It is also being stimulated, and the fact that West Germany, Britain, Belgium, and France now expect the coal industry in their countries to at least maintain their size and hopefully to increase in size, as for example, in the United Kingdom, when, with the further development of new coalfields and new pits, the output will increase. Also, given the fact that the output of coal will be protected in the marketplace, the demands for oil particularly in electricity generation, will also be significantly reduced.

Fifth, the availability of natural gas continues to increase, and even at the official level it is now estimated that it is likely to rise faster than hitherto anticipated, and this will also have a consequence of reducing oil demand.

In my view, however, the official view on the outlook for natural gas is still conservative in the extreme. The accelerated policy case of the OECD anticipates that there could be a supply of European gas of the order of 258 billion cubic meters by 1985. But this is in a situation in which the resources which have already been discovered, or resources which can be expected to emerge from areas that have already been developed, indicate, with an unconstrained production basis, the possibility of an output of natural gas by the middle 1980's of the order of 400 to 410 billion cubic meters; that is, a rate of production between 50 and 55 percent higher even than the accelerated case of the official views of the Organization for Economic Cooperation and Development.

However, constraints on production as far as oil are concerned, with which I shall deal later, apply also to natural gas, and thus, I think we also have to recognize that the outlook for the supply of, and the demand for, natural gas in Western Europe, is principally a function of institutions and of attitudes, rather than a function of the amounts of gas that can be supplied from the resources base that is now being discovered. So, what I have to say about oil, in those respects, will apply equally to the future outlook for natural gas on the continent. As a consequence of the previously mentioned five restraining elements on the demand for oil, the use of oil in Western Europe may now be expected to increase only very slowly compared with the pre-1973 situation. It is, I think, worth putting on record that in 1977 and continuing through into 1978, the demand for oil in Western Europe remains below the levels of demand that were achieved in 1973 by approximately 1 million barrels a day. By 1985, given the continuation of a rather adverse economic outlook and given the continuation of the impact of the other factors hitherto mentioned, it seems unlikely the demand for oil will exceed 15 million barrels a day—or roughly where we were in 1973.

Extrapolating beyond 1985, through to the year 2000, then again in the expectation of the continuation of the impact of factors mentioned, again the demand for oil seems unlikely to rise much above 18 million barrels a day. Compared with the earlier pre-1973 estimate of a year 2000 demand for oil in Western Europe on the order of 40 million barrels a day, this is less than 50 percent of the previous expectation as on the future of oil and it is, I think, a clear demonstration of the very fundamental change in the outlook for the oil sector of the West European economy.

Now, in the context of this much reduced rate of demand for oil in Western Europe, the outlook for oil imports could be even more drastically changed. This is because the potential oil productivity of Western Europe is now being very much more effectively evaluated.

One has to bear in mind that until as recently as 1974 oil production in Western Europe had never exceeded 0.4 million barrels a day. This year, 1978, it will exceed 2 million barrels a day and with the reserves that have already been discovered or which can now confidently be expected to be discovered with the continued exploration, there seems to be little doubt that by the middle 1980's Western Europe will be able to produce 6 million barrels a day of oil or

more. There are also reasonable resource base prospects, related to the extension of exploration to the many areas of Western Europe which are potentially petroliferous but which have not become expanded, to indicate that the production curve for oil in Western Europe could continue to rise for at least the rest of the century, perhaps to reach a level by that time of more than 12 million barrels a day.

Some simulation work we did on the North Sea in Rotterdam a few years ago indicated that the North Sea alone had a 90-percent probability of containing something like 80 billion barrels of oil and that on full production, given the absence of economic and political constraints, that even the North Sea alone could sustain production rates of the order of magnitude of those I just described.

It is also worthy of note, I think, that this model, which we designed as a conservative model, is in itself underpredicting against the rate of actual development; even though the model and the results from it were way ahead of the kind of figures for reserves and production that were being talked about in the 1974–75 period in Western Europe.

Senator KENNEDY. You are going to develop the point about the production on the North Sea and the reasons why there is limited production?

Mr. ODELL. My intention now is to turn to the factors that will restrain the production from the resources base rather than to go into detail with the arguments and the facts and the parameters that lie behind the argument on the resource base I have just put forward.

I think in order to detail the kinds of ideas about the rate of production that I have just mentioned that I would probably demand very much more time than the committee has available to it this morning.

What I would say, however, is that some of the previous figures, for example figures given by major oil companies on the likely rate of discovery of oil in the North Sea have already been shown to be grossly understated.

In the early 1970's, Shell, BP, and other international oil companies were talking in terms of the North Sea having possible reserves by 1980 of 12 billion barrels. Proven reserves already exceeded this level by 1977. The companies were also talking then in terms of the ultimate resource base from the North Sea as being of the order of 25 to 30 billion barrels but even these figures have already been exceeded in terms of what has been discovered. Meanwhile, some oil companies, Conoco, for example, have now put out forecasts for the likely recoverability of oil from the North Sea Basin which lie within a range going up to 67 billion barrels.

So, the figures we previously simulated for the size of the North Sea oil province are now being approached by those of some oil companies. The collective results of recent governmental interpretations of the size of the North Sea Oil Province also indicate a range of 50–70 billion barrels of reserves.

In other words, the doubts over the validity of our very much higher reserves figures, doubts which were expressed by the oil companies specifically are now being undermined first, by events, and second, by the changing forecasts that are now being made by companies and by governments. Thus, at this stage, I am content to let my case rest on the basis of the facts as they have developed and the forecasts now being made and suggest that overall there is now very much more

confidence in Western Europe that the size of the resource base in question is very much more extensive than hitherto indicated and certainly large enough to sustain the kinds of rates of development that I have indicated earlier in my presentation to be achievable.

Very much more important, in my view, in the context of this committee's investigations are the restraints on the production of oil and gas that now seem likely to make Europe's productivity in these two energy sources less than that which could occur if the resources were fully developed.

May I, however, first discount two sets of issues that are not relevant.

First, I think there is no question that Europe can not raise the finance required to produce the oil to the levels indicated even given the relatively high development costs involved in areas like the North Sea. The amount of investment required amounts to something like $20 per European per year and in the context of a wealthy Western Europe, a Western Europe in which there is a large ability to raise funds, then this kind of financial requirement by a rapidly expanding oil production sector seems most likely to be a restraint on the rate of development.

Second, neither need manufacturing and infrastructure capacity be a constraint in the Western European countries. Unlike oil development in other parts of the world, this new development of oil is taking place in the center of a major industrial and high technology region. What we already have in Western Europe is a technological and an industrial response to the challenges of oil; an entrepreneural response whereby many businessmen, and many industries have turned their attention to developing the technology and the industrial capacities that are necessary to sustain this industry to whatever levels the resources base allows.

In other words, there is no technological, no educational, and no industrial capacity restraint upon the degree to which this resource base could be developed in the context of the capacity of West European industry and West European technology.

However, there are specific technological problems and temporary financial problems in respect of certain oil companies' ability to do too much at the same time, but the worst that these kinds of restraints could lead to is to a degree of slippage in the rate of development plans rather than to their cancellation or to their inability to be fulfilled in the slightly longer term.

In contrast to this generally favorable situation for the development of West European oil there are, on the other hand, severe political, institutional and attitude problems which now stand in the way of a rapid exploitation of Western Europe's oil and gas resources. These are as follows:

First, there is an attitude problem. All Western European governments appear to have been convinced that oil is in inherently short supply. This emerges from their acceptance of a conventional wisdom which suggests that the world's oil resource base is only 2,000 billion barrels. The basis for this belief is nonexistent.

The recent work of the Institut Francais de Petrole as presented to the World Energy Conference in Istanbul last year indicated a set of opinions that the world resource base ranged from a minimum of 4,300 billion barrels and up to 6,400 billion barrels.

The result of an important conference held at the International Institute for Applied Systems Analysis in Vienna in 1976 indi-

cated a world oil resource base of up to 6,000 billion barrels, a figure which is three times larger than the conventional wisdom with which we are presented, and recent Soviet work in this field expressed in a recent United Nations' publication by the chairman of the appropriate committee of the Soviet Academy of Sciences, indicates a Soviet view that the world resource base is on the order of 11,000 billion barrels; moreover, in that same article the author describes that estimate as a cautious one.

Now, in most respects Western and Soviet science on fundamental issues are fairly close together and then seems at this particular stage in the game to be no reason why we in Western Europe, perhaps in the Western World generally, are being presented with a very limited view of the world oil resource base when all the facts produced by the scientists appear to point in a different direction.

I think a clue to the difference was expressed by a Shell spokesman when he said that his company's view that the world oil resource base is 2,000 billion barrels arises from his company's evaluation of the oil that would be available to companies such as his—that is to the major international oil companies—in the light of his company's evaluation of the changing political and economic circumstances for the rest of the century.

In other words, it is both a temporally and a spatially constrained view of the future given the limited degree to which the international oil companies are able to work at the world resource base in light of their nonacceptability in certain countries and in lack of their unwillingness to work in large parts of the world because of uncertainties about the degree to which they can take out their profits.

In other words, we are presented with a view of the oil resource base which is really a subjective industry view rather than an objective scientific view. This is valuable for the companies, but not a valuable attitude for the Western nations.

However, as a result of this sort of presentation of the world oil situation, Western European governments appear to hold a view that oil and gas are so scarce that if you have found reserves then you don't produce them. If you do so, then you won't have enough left for the 1980's or 1990's or after the year 2000. In any case as oil is so scarce, it has a rising value and so it is better to hold on to it.

This constitutes a major constraint on Western European countries' willingness to produce their reserves. Thus, individual Western European countries with large reserves already declared, such as The Netherlands, Britain, and Norway, are declining at the moment to produce too much for export because of the fear that this will make for oil or gas supply difficulties at home in the medium term future.

The country in which I live and work, The Netherlands, is a case in point where the Government has taken a very deliberately conservationist view on the degree to which the resources of gas in The Netherlands shall be produced. Production is to reach a plateau this year or next and thereafter imports will be phased out over the next 5 to 6 years.

Some Western European countries have another constraint on the degree to which the oil and gas industry should be developed. This arises because of a fear that the too raid development of this sector of their economy will harm their economic system and their societies.

This is particularly true in the case of Norway; a small country with the largest potential for gas and oil production in Europe. Yet it is unwilling to do too much too quickly for fear of upsetting the way of life of the communities around the very sparsely populated parts of the western and northern parts of that country. Thus in the case of Norway, fears of the impact of oil and gas on the economic and social systems act as a major constraint upon their search for and the development of oil and gas activities.

Four, there are difficulties in company-government relationships in Western Europe arising from disputes over the sharing of the economic rent which is generated from the developed fields; that is, concern for the super profits for those companies which are lucky enough to find large fields.

Governments would tax away such profits and so reduce the attractiveness of such developments in countries like Britain, Norway, and The Neitherlands. Neither governments nor companies in my view yet comprehend the steps which need to be taken to avoid such limitations on production and yet such steps are possible. Such a compact between producing countries and the international oil industry could, in my view, be achieved and the enhanced production thereby possible would be a benefit to both parties.

There are other restraints on the oil companies willingness to maximize production in Western Europe. I will briefly go through these.

First, of course, offshore oil and gas, which is what we are talking about, is relatively expensive to develop and the companies are not at the moment protected against the risk of the uncertainty arising from too-low-priced oil from elsewhere. In other words, if a company puts too much money into the North Sea, in the British, or the Norwegian sector, given the kind of collapse in the OPEC market that might emerge over the next few years, in the light of the kind of figures with which we have just been presented by Mr. Safer, those companies would not be protected against those low prices: except, of course, in the presence of some kind of intervention system in Western Europe for controlling the import of oil and for controlling the developing energy economy, a development perhaps similar to the one presented by Mr. Safer for the United States, but now in respect to Western Europe.

Second, the international oil companies have many outlets for their exploration and industrial activities. Sometimes they put their funds into alternative fields of endeavor rather than into oil and gas, or they prefer to put it in oil and gas development elsewhere, and in this respect I think it is worthy of note that in the future about which we are talking, the next 10 years, there could well be competition between Western Europe and the United States for the investment funds of the oil companies. These companies will to some degree, have to choose which of these two areas of the world in which to work.

Third, the companies are not as interested as they might be in developing West Europe's oil- and gas-producing potential as this would undermine agreements, commitments, and plans which they have to market oil from OPEC countries in Western Europe. Given that Western Europe is the only part of the world in which the oil companies have almost absolute freedom to determine how they can

best supply the market from their own optimal profitability earning point of view, they may not wish to maximize indigenous production. They have also committed themselves to investments in pipelines and refineries and in transportation systems related to imported oil and this makes it inherently more profitable for them to continue to supply Europe, particularly Southern Europe, from the output of OPEC countries rather than from the oil and gas that could be produced in Western Europe itself. Some studies which we did in Rotterdam over the past 2 years indicated that the profitability of the international oil companies, in supplying foreign oil, OPEC oil to Western Europe, possibly exceeded the profitability that they could achieve after developing resources in Europe itself.

Four, a philosophical point, Western Europe has continued to pursue its general belief in the idea that the continent is natural resource poor and that its best option lies in trading manufactured goods for imported oil and other imported commodities. It is unlike the United States in this respect. Thus, in Western Europe at the moment there is no general willingness, political or economic willingness, to accept the basic idea of an interventionist energy self-sufficiency policy.

Associated with this philosophical belief in the idea of freedom of trade in respect of energy. There is also a belief that the Middle East and Western Europe are somehow naturally interdependent. The idea which was French based originally but which has since been widely accepted at a broader European level, emphasizes that the Middle East is the natural extension of Western Europe. It appears to generate the feeling that, in the final analysis, Western Europe could depend on the Middle East for its oil because the Middle East somehow depends on Europe.

I do not subscribe to that view, but it is nevertheless one of the attitudes in Western Europe that creates an unwillingness to look to self-sufficiency in oil and gas as an energy policy alternative for the future.

Thus, efforts that are currently being made in Western Europe to reduce dependence on imported oil by developing alternative energy supplies have so far been restricted very largely to concern for nuclear power expansion. This proposed massive expansion of nuclear power raises problems of a financial kind, of an acceptability kind, and it is, in my view, at this stage a will-o'-the-wisp in terms of its likely success.

The other options, particularly the indigenous oil and gas option, have so far received little serious attention, even though, as I have tried to show, it is a very serious alternative option for the development of the West European energy economy over the rest of the century.

Thank you, Senator.

Senator KENNEDY. Very interesting, Mr. Odell, thank you.

[The prepared statement of Mr. Odell follows:]

PREPARED STATEMENT OF PETER R. ODELL

ABSTRACT

1. "Cheap energy" policies based on low-cost imported oil in the period after 1957 created high levels of dependence for most West European countries on the continued flow of foreign produced oil. It was generally accepted that the multi-national (mainly United States) oil corporations were reliable instru-

ments for ensuring the continued flow of the increasing quantities of oil which were expected to be required.

2. Thus pre-1973 forecasts of the future West European energy economy extrapolated a 5–5½% growth rate in energy use within which the use of oil would grow somewhat more quickly. At that time, too, indigenous oil production potential was very conservatively evaluated so that most of the increased use of oil was expected to be met from imports. Thus West European dependence on imported oil was forecast to rise from some 12 million b/d in 1973 to 20 million b/d by 1985 and to upwards of 40 million b/d by the year 2000.

3. Since 1973 the oil demand outlook has changed quite fundamentally for the following reasons:

(a) the economic outlook is much bleaker and a much lower growth rate must now be expected.

(b) much higher oil prices have engendered conservation reactions by users.

(c) governments have taken other steps to ensure reductions in oil use.

(d) the West European coal industry is to be protected and stimulated so reducing the demand for oil in some economic sectors.

(e) the availability of natural gas is now estimated at a higher level than previously and this will also reduce oil demand.

Thus, the use of oil may now be expected to increase only slowly (compared with the pre-1973 situation). By 1985 demand may be no higher than 15 million b/d and even by the year 2000 it may not exceed 18 million b/d.

4. In this context, the outlook for oil imports could be even more drastically changed. This is because the potential productivity of Western Europe's petroliferous regions is now being more effectively evaluated. Until 1976 oil production in Western Europe had never exceeded 0.4 million b/d. In 1978 it will be about 2 million b/d and with the reserves that have already been discovered or which can be expected to be discovered, with a continuing exploration effort, there is no resource base problem in developing annual production to at least 6 million b/d by the second half of the 1980s. There are reasonable resource base prospects—related to the extension of exploration to the many areas of Western Europe which are potentially petroliferous—to indicate that the production curve *could* continue to rise for the rest of the century, perhaps to reach a level by that time of more than 12 million b/d.

(N.B. Points 1 to 4 above are based on two papers, viz: (i) "A Return to an Energy Self-Sufficient Western Europe" and (ii) "Western Europe's Natural Gas Resource System: Governmental and Multi-National Oil Corporations' influence on its Development." These papers also include relevant data, diagrams and illustrations.)

5. The restraint on oil production in Western Europe thus seems unlikely to be the resource base though further research for achieving an objective evaluation of this is still required. Thus far, such research has not been undertaken and, indeed, there seem to be interests which are against its being done.

6. Similarly, neither the financial cost of oil exploration and development in Western Europe nor technological/industrial capacity seem relevant as constraining factors. At worst, they will lead to "slippage" in development plans.

7. There are, nevertheless, severe political, institutional and attitude problems which stand in the way of the rapid exploitation of the continent's oil resources. These are as follows:

(a) All European governments seem to have been convinced that oil is in inherently short supply. This emerges out of the "conventional wisdom" presentation that the world's ultimate oil resource base is only 2000 billion barrels. The "basis" for this belief is shown in the document. "The Future Supply of Oil", in which doubts are cast on the validity of the view and reasons advanced as to why the view is put forward. In light of the belief government policy in W.European oil and gas producing countries is in favour of slow rates of exploitation of the reserves.

(b) An extension of this argument adds an important element of constraint. Individual W.European countries with reserves are unwilling to produce too many of them for export—even to neighbouring countries because of fear that this will make for oil and/gas supply difficulties at home in the medium-term future.

(c) Some W.European countries fear that too much development of the oil and gas industry will harm their economies and/or societies.

(d) There are difficulties in government/company relationships arising from disputes over the division of the economic rent which is generated from developed fields. Governments insist on taxing away such super-normal profits

and so reduce the attractiveness of oil industry investment in extensive and intensive oil and gas developments. Neither governments nor companies yet comprehend the steps which need to be taken to avoid such limitations on production.

(e) Apart from this restraint an oil companies' willingness to maximise production in W.Europe there are other reasons why the companies are acting with caution in this respect:

(i) Offshore oil and gas is relatively expensive to develop. The companies are not protected against the risk of uncertainty of too low priced oil from elsewhere.

(ii) The international oil companies have many outlets for their exploration and production investments. They sometimes prefer to put their funds into alternatives, i.e. oil and gas in other areas or into other sectors of economies.

(iii) The companies may not be interested in developing W.Europe's oil and gas producing potential too quickly as this would undermine their agreements, committments and plans to market oil from O.P.E.C. countries. Too much oil and gas production from within W.Europe itself would also add to the downward pressure on oil prices—and even more so on oil profit margins.

(N.B. These arguments concerning the companies are presented in the paper, "The International Oil Companies in the New World Oil Market.")

(f) Western European economic philosophy generally holds to a belief that the continent is natural resource (including energy resource) poor and that its best option lies in trading manufactured goods for imported oil etc. There is thus no general willingness to accept the basic idea of an interventionist, energy self-sufficiency policy. Associated with this in its effects is the belief that the Middle East and Western Europe are somehow "naturally" interdependent: hence, the Euro/Arab dialogue and a feeling that Arab oil supplies are safe enough to see W.Europe through.

(g) In as far as W.Europe—and most individual W.European countries—are concerned, the efforts that are being made to reduce dependence on imported oil by developing alternative energy supplies have been restricted very largely to concern for nuclear power expansion. Other options have not received serious attention.

Senator KENNEDY. Our final witness is Thomas Gold, a director for the Center for Radiophysics and Space Research, Cornell University. Mr. Gold is one of the country's most respected space scientists.

What are you finding out today that would be helpful in this area?

STATEMENT OF THOMAS GOLD, DIRECTOR, CENTER FOR RADIOPHYSICS AND SPACE RESEARCH, CORNELL UNIVERSITY

Mr. GOLD. Thank you, Senator.

I want to make some comments about the basic understanding we have, on which to base any prediction of the fuel supplies that the Earth might have.

I don't merely wish to debate how well one knows the oilfields that have so far been explored and the possibility of finding other oilfields; I want to discuss the more basic point whether the conventional search for fuels like oil and gas is the only possible type, or whether there are totally different possibilities, and I have reasons for suggesting that there are.

In order to explain this, I have to discuss the limited understanding we have of the construction of the Earth, of how it was put together and what there is there.

When one discusses how the materials of the Earth and the other planets were put together, one is of course concerned with the information from such subjects as the study of the meteorites and

the study of the other planets, the space research of the present day. In those contexts our understanding of the origin of the element carbon on the surface of the Earth is extremely limited.

Carbon is very abundant on the surface of the Earth. We are all composed to a considerable degree of it, and so is all the vegetation. Above all it is abundant in the carbonate deposit. These were derived from atmospheric CO_2 and rock minerals, mainly calcium, and have been laid down mainly as calcium carbonates.

All the necessary CO_2 has been at one time in the atmosphere, but it is by no means clear how it got there. All through geologic time carbonates were being laid down. The total amount laid down is immense.

Most geologists would say, with very little justification, that all this carbon probably came as CO_2 out of volcanoes. Volcanoes do produce some amounts of CO_2, but one has no way of making a meaningful assessment of the amounts so derived over long times.

It is better to discuss in the first place how the carbon was imbedded in the Earth and how it may have migrated to the surface. It is most probable that it was imbedded in the Earth initially as hydrocarbons.

There is enough understanding now of the early solar system and of the chemistry applying then. The meteorites which represent some leftover debris, do contain rich carbon sources chiefly in the form of hydrocarbons. They do not contain any other equally rich sources of carbon. We may well consider that hydrocarbons were the chief source of terrestrial surface carbon.

The interior rocks of the earth contain very little carbon, the surface very much. How did it become concentrated in that way? It is unlikely that this happened all at one time, such as by an addition to the surface of a carbon rich material, It is much more likely, and there is good detailed evidence, that the carbon has been reaching the surface as a gas over most of geologic time at a gradual rate.

What is the total amount? If one merely takes the total deposits and divides by the length of time, one would conclude that of the order of 20 million to 50 million tons per year on an average have come out from the interior of the earth as a gas in all of geologic time.

That is a fairly substantial amount, and one feels one ought to be able to find where it is coming from, from where it is emerging into the atmosphere, and in what form.

We have conducted a study over the last year or so at Cornell on the question of the information one has of the deep gases on the earth, and whether there was any indication that some of it was the most stable of the hydrocarbon gases, methane, which on chemical grounds would be expected to be the dominant component.

What we have found was, that indeed, there is very strong evidence that all gases that come from deep down in the crust of the earth are combustible gases. In some cases we merely know it is combustible without knowing whether it is methane or hydrogen or any other mixture of combustibles; but indeed, the deep faults in the earth do produce combustible gases, in a few cases identified as almost pure methane. In one case in the Soviet Union, where this has been monitored more carefully than elsewhere, at the site of an

earthquake, and as a result of the earthquake, which has its roots at a depth of 35 kilometers, suddenly there emerged gases whose hydrocarbon content was 98.5 percent methane. This is interpreted as giving a clear indication, among many others, that indeed down there is an enormous reservoir of methane.

What we also discovered was that virtually every major earthquake of which we have a good record appears to have been accompanied by violent outbursts of a kind that one has to attribute to the outbursts of combustible gases.

What is probably not generally known is that if a violent earthquake occurs, most likely not just the shaking of the ground but a whole range of other dramatic phenomena will occur as well. Flames shooting into the sky, explosions in the air, all kinds of other gas phenomena including sulphur smells, poisoning of animals, all these are a variety of well-documented events for virtually every major earthquake.

It has become clear to us that nearly every event that releases gas from deep down in the earth releases a combustible gas. Neither CO_2 nor water vapor is the dominant component. The dominant component is a combustible gas and so far as we can tell mostly always methane.

We may look at those spots on the Earth where gases register their exit point, where there is an actual way, per chance, of knowing that gases have come out. A type of feature called mud volcano is one where there happens to be a deposit that builds up into a volcanic looking mountain as a result of being heaved up by subterranean gas.

The origin of that gas has nothing whatever to do with the origin of the mud that is closer to the surface. But it is true that among at least 300 mud volcanoes that have been studied on the earth, all over the Earth, almost every one emits a combustible gas, almost methane.

The other point we discovered was that we can understand that that have come out in large quantities, and that enables us to go and measure what the gases are. In other locations large gas emissions might sporadically occur but no one would be there to measure and analyze them.

The fact that such gases are usually combustible gives me a very strong feeling that the origin of the surface carbon is indeed to a major extent methane and other hydrocarbons that have come from the deep interior.

The other point we discovered was that we can understand that methane could live stably in the deep crust of the Earth at a depth of 100 kilometers or more. When it comes up to the surface through cracks it would continue to remain methane so long as the crack was one whose temperature and pressure relationship was of a normal kind, meaning that down below where it is hot the pressure is high, and up on top where the pressure is low the temperature is cool.

But if the pathway from below went through a hot volcanic region, we would understand that even if the gas started as methane it would end up as CO_2. Therefore, the fact that the volcanoes usually emit CO_2 must not be taken as an indication against methane being the primary source of the carbon on the surface.

That point of view now changes one's outlook completely, because it says that essentially a combustible fuel is present in very large quantity at some depth. What quantity?

We don't know how much is left in this reservoir but we can merely say how much this reservoir has supplied in the past. If I give you this in a convenient form, what it has supplied over geologic time would be a quantity which, in the form of methane, would suffice for our present-day rate of fuel usage for 20 million years. So the reservoir so far as we are concerned is virtually infinite.

I cannot tell you it will last another 20 million years, but it is clear that the reservoir is concerned with quantities that are outside our normal range of discussion, indeed immense.

The next question is, have we any way of gaining access to this huge reservoir. I think there is a very good chance we have and in fact I believe that on occasions, unwittingly, we have had access to it already.

What happens in normal exploration for fuels is that one seeks to find a containment, in a geologic formation of a suitable nature, where oil or gas is contained at the depth that one can reach by drilling.

Of course, if gases come up from down below, they would be captured in such formations in any case and that is a convenient place in which to find them. That is what we have been doing.

The geologists have been seeking to find the right structures, the domes, the saltbeds, and so on. On the other hand, a great many places exist where gas is found with no knowledge of any suitable geologic structure there at all.

There are gas wells that have been drilled far beyond the region where it was thought that there was a suitable structure, and they struck rich gas supplies. At great depth it is common for the gas to be rather pure methane, which I believe to be indicative of not having gone through any treatment in the accumulation process at shallower depths, and to be, indeed, this primeval substance.

So the possibility seems to me to exist that we shall find not only containment structures at shallow depths, but that we shall find also structures where a porosity in the rock penetrates far below to fairly close to the surface, to a depth that we can reach by drilling 5, 6, 7 kilometers. Perhaps places exist where the porosity has migrated up to such a height that gases would naturally escape from there to the surface in the next few thousand or 10,000 years, but which we can learn to tap. Very likely this is unwittingly already being done on occasions.

So, what should one do then? One should in the first place investigate very carefully the chemistry of different regions for the symptoms of leakage of methane in order to find the best places in which to drill. Booming phenomena in an area sometimes associated with earthquakes, are in my view the result—when they are not due to supersonic airplanes or other man-made effects—of methane escaping into the air in large amounts, just as it happens in mud volcanoes.

In regions where such booming noises occur one should find the exit points of the gas, and then analyze the gas for quantity and composition. Possibly in our part of the world, now, we have such exit points. Clearly, in the last century, we did. Charleston, S.C., and Novia Scotia had a large series of booming noises in the last cen-

tury and this indicates that there are places where large amounts of gas have come up.

We should investigate all that very carefully. Beyond that, to learn to drill deeper is certainly my advice, and above all refrain from being guided by inadequate knowledge. If I may use the dictim, a good American dictum: "It isn't what a man doesn't know that makes him a fool, it is what he does know that ain't so."

Don't drill only where a case has been made to suggest that there is something there. Explore much more widely, and recognize that the knowledge is thoroughly inadequate on which to base a decision of where to drill. Drill in the first place where you would most desire to find gas. So long as you don't know where it really is, you might as well start there.

Drill in hard rock and not only in sedimentary deposits, for if much of this gas is primeval it may be there also. Wells drilled into a system of porosity that communicates to deep down could produce virtually unlimited amounts. They would produce at a finite rate but will not cease.

I think that this is entirely possible. It is even possible that we already have such wells, like a recent one in Pennsylvania that drilled into a silurian deposit that has no evidence of any vegetation in it. It may be that this is a well that will not cease production, but will just go on and on.

The last point I want to make is, sometimes it is said that even if we find enormous new supplies of fuel we will be severely limited in how much we can burn because of the CO_2 augmenting in the atmosphere.

It is true at the present time we are producing a lot of CO_2 and pouring it into the atmosphere. How important is this consideration? Will the climate change as a result? Will it warm up.

In the first place, let me say that our understanding of the rate at which the CO_2 is fixed by nature is not sufficient. It is fixed by nature apparently more quickly than people have estimated, presumably in the end as limestone, and therefore it is taken out of circulation.

Probably a slight increase in the CO_2 in the atmosphere will in the long run accelerate the rate at which it is sedimented and it will maintain itself, despite the increased production, at only a slightly elevated CO_2 level in the atmosphere, rather than a continuing augmentation.

A slight elevation is not harmful and very likely beneficial for most climatic purposes. Probably we have been doing the opposite by putting aerosols into the air that reflect sunlight and thus tend to produce cooling; a little extra CO_2 will counteract this to a limited degree.

With this outlook that I have developed here, it is quite clear that the rate at which carbon has been poured into the atmosphere (where it would normally all end up as CO_2) is most unlikely to have been strictly steady. At major upheavals, major earthquakes, major eruptions, huge amounts come out at once whether we like it or not, and contaminate the atmosphere for long periods. Nature probably is still doing far more violent things to the CO_2 level in the atmosphere than we are. It is just as possible that nature has in recent times done too little to maintain the average than that it

has done too much. So long as we are sitting on some violent curve of ups and downs that nature is producing, over thousand-of-years periods, it is futile to speculate without knowing what this curve looks like for our time, whether our little bit of addition will go in the right direction or the wrong one. We just don't know that yet. We must investigate that, but at the present time we do not know. It is just as possible in my view that we ought to be burning as much fuel as possible in order to do what nature at the present time might have failed to do than that we ought to burn as little as possible to keep the CO_2 down. This is an area that needs intensive research now.

Thank you, Senator.

[The prepared statement of Mr. Gold follows:]

PREPARED STATEMENT OF THOMAS GOLD

CAN INTERNATIONAL PRODUCTION BELIEVE OIL AND GAS SCARCITY IN THE 1980'S?

Estimates of the global reserves of petroleum and natural gas are based on geological knowledge concerning the distribution of features that have been recognized in the past as being associated with major deposits of these fuels. Such estimates are necessarily uncertain; many regions of the Earth have not yet been explored adequately, and even very large deposits may remain to be discovered by conventional means. But my point is that in addition there is the very real possibility that fuel reserves may exist on the Earth that are quite different in character from those so far exploited. Those may require the development of new and different methods of prospecting before they can be utilized. To explain the reasons for holding this viewpoint, I must first make some remarks about the knowledge we now have of the construction of the Earth.

From a study of the other planets and of meteorites, a picture is emerging of the processes that formed our planets. In such a picture there is a particular interest in the origin of the element carbon that is so plentiful near the Earth's surface, but of low abundance in the deep rocks. How was it incorporated into the Earth in the first place and how did it achieve the present surface concentration?

Many geochemists, including the founder of modern planetary chemistry, Harold Urey, have given reasons why *hydrocarbons* should be thought of as forming a major part of the original carbon supply. Hydrocarbons represent indeed the most abundant supplies of carbon in meteoritic materials. If these are the sources of the terrestrial carbon, one has now good reason to believe that the gas methane, CH_4, would be the dominant hydrocarbon to have migrated from deep levels towards the surface in most of the geologic history of the Earth. Depending upon the pathway that it took from the depth at which it was initially contained, it might be dissociated into hydrogen and carbon, or oxidized to carbon monoxide or carbon dioxide with the appropriate fractions of hydrogen and water.

We do not yet have an adequate knowledge of these processes. Did most of the carbon arrive at the surface as carbon dioxide, as it would from bubbling through molten rock and emerging by the pathway of a volcano, or did much of it emerge as methane from colder exit points? I believe we have strong indications for the latter alternative.

Most of the petroleum geologists in the U.S. have developed a viewpoint that all hydrocarbons found on the Earth derive from carbon used by plants and converted from atmospheric CO_2 by the action of sunlight to the carbon-hydrogen compounds that we now use for fuels; in other words that the energy is all due to the sun and the process of photosynthesis in plants. But there is the consideration that the carbon most probably started out as hydrocarbon in the first place, and that it would therefore constitute a primary energy source (by burning with atmospheric oxygen) if it were still available in that form.

The total amount of carbon that must have reached the Earth's surface in geologic times is very large. If it all emerged as methane it would have been an amount that would supply all our present fuel needs for 20 million years.

There is no indication that the deep source is exhausted: in fact the indications would seem to go in the opposite direction. The rate at which carbon appears to have been added to the atmosphere in recent geologic times is greater than average. There is certainly no reason to suspect that the reservoir is empty, and all that can be said is that, if not empty, it deals with quantities that are immense compared with foreseeable human energy requirements.

The two great questions that have to concern us are: firstly, is it really true that unoxidized hydrocarbons are the primary source of the surface carbon, and secondly, is there any possibility of exploiting even a small fraction of the remaining supply.

After examining a large amount of diverse information as carefully as I can, I believe the answer to the first question to be affirmative. In searching for evidence of deep-seated hydrocarbon sources, we discovered a huge body of evidence for the escape from great depths of combustible gases. There is a clear pattern of events, associated with crustal faults and earthquakes, of the emission of gases into the atmosphere that can burn or explode, and that frequently have no association with known petroleum or natural gas deposits. Major earthquakes in all parts of the globe have been accompanied, preceded, or followed by flashes, violent explosive sounds and many other phenomena that can all be interpreted as due to a massive emission of combustible gases. The smell of sulfur is reported in very many cases, and the widespread effects on wildlife can be understood in terms of disturbing smells or, in many cases asphixiation or poisoning. Large quantities of dead fish at sea, or the sudden movement towards the surface of large numbers of a type of fish that normally lives close to the bottom, are all very well documented events, clearly associated with and sometimes preceeding earthquakes.

What all this evidence implies is that in very many cases when the escape of gases from the deep crust is facilitated by the earthquake processes, it is indeed combustible gases that emerge, and gases that are frequently capable of making violent explosions in the air. This is true also in regions in which otherwise no sources of natural gas have been detected. We must assume that similar processes have occurred over long periods of geologic time, and any estimates of the quantities involved then shows these to be so large that a biological origin seems unlikely. It seems probable to me that we are seeing here that particular gas that has supplied, over geologic times, the bulk of the surface carbon.

In the Soviet Union this interpretation is not nearly as unorthodox as it is here; the most detailed investigations of gas emissions from deep faults have been carried out there, and the conclusion has been reached that the combustible gases, methane and hydrogen, come up from depths much greater than those at which deposits of biogenic materials are suspected.

In the Soviet Union and elsewhere in the world the phenomenon of "Mud volcanoes" tells a similar story. In these formations surface mud is heaped up, sometimes into volcano-like structures many kilometers is size, evidently by a continued or intermittent outflow of high-pressure gases. The presence of the surface mud merely enables the gas venting points to be identified, but it can have no relation to the nature of the deep faults from which the gas streams emerge. The mud volcanoes would be built in these locations by surges of gas, whatever the detailed chemical composition of these gases might be. Most areas of the Earth would not have the surface mud that acts as an indicator, and then no good record of the gas surges would exist there. It is an important observation, then, that mud volcanoes generally emit *combustible* gases, for it indicates that massive gas releases from non-volcanic vents, wherever they occur, are generally of combustible gases. This would indicate that the deeper layers—frequently or always—provide a suitably oxygen-poor environment to maintain hydrocarbons under the very high pressures there. We understand on that basis that such gases as escape through volcanic regions, where they are in contact with hot lava at low pressures close to the surface, would be mostly oxidized and thus show up largely as carbon dioxide, as has been found.

Episodes of loud booming noises in the air have on numerous occasions been reported in some areas on the earth, even in historical times when man-made causes could be ruled out. Some instances of this phenomenon have been associated with earthquakes; they have occurred before, during, or after major earthquakes. We believe that the phenomenon is due to the escape into the atmosphere of large amounts of combustible gases, and their ignition by electrical discharges that they themselves generate. Whenever and wherever this

natural phenomenon occurs again it ought to be investigated, not only because of its possible relationship with earthquakes but also because it may allow us to learn more about the escape of gases from the deep crust.

So far as energy sources are concerned, this type of phenomenon provides an opportunity for analyzing the chemical composition of the gases that come from deep faults in a given region. It is of course necessary first to pinpoint the vents and then to capture gases when an emission takes place. All this is easy to do and has been done in the case of mud volcanoes, but should be done for the other numerous sporadic gas eruptions.

What about the second question: suppose that indeed most of the deep gases are combustible, can we tap them? Probably, to some limited extent, we are already doing so. When such gases happen to be trapped in the upper five kilometers or so, then the conventional gas prospecting and exploitation techniques are applicable, and the results are ordinary gas wells. In chemical composition the gas from those is different from that in the petroleum-associated gas wells, and in some cases it is very pure methane, in my view the almost unaltered efflux from deep down. In some regions, such as in the Appalachians, gas wells are clearly clustered above the deep-lying faults, although the traps themselves are not particularly deep. The overburden over the faults provided the traps. but the presumption is that the source was below.

The question is then whether we can learn to tap the deep supply without requiring the chance of a shallow trap above a deep fault. I believe the possibility exists. Since we cannot drill conveniently to more than about 5 kilometers we obviously cannot hope to reach directly the depths of 50 or 100 kilometers where these gases may exist in a fine network of pores at enormous pressures. We may expect, however, that occasionally some of this porosity comes up to within reach of our drilling capability. In that case a very large reservoir may become accessible, yet none of the overlying structures would need to be the types of formation normally thought of as a trap; these would not be traps but merely occlusions at unusually shallow levels. The entire situation would be quite different from that of the conventional one. New methods would need to be devised to find such places and to pin-point small porosity zones that may have deep connections. One can suggest some approaches to this problem. I feel sure that once we understand clearly that we are sitting on a huge global fuel tank, we shall devise means of tapping it.

Researches that prove, as I think they will, that hydrocarbons have been the prime source of all surface carbon, cannot fail to change much of the thinking and the methods in many areas of the earth sciences, and even the conventional fuel prospecting methods may be influenced. Petroleum may generally be a mix of biogenic and primeval materials, and the search would be influenced by this realization.

It is a fact that all terrestrial oil and gas fields show a very close correspondence with the pattern of major tectonic fault zones or indeed with zones of seismic activity. From this fact alone one may be led to some speculations about the relationship. I note with particular interest that the natural oil seeps have been a major—or probably *the* major—source of information for the discovery of most of the world's oilfields. Natural gas seeps, on the other hand, of which there are many, have not proven to be of much use for finding commercial gas fields. Within the present set of ideas the reason for this would be clear. Oil can exist in the ground essentially only at shallow depths where the temperature is not too high, and in structures that can bottle it up there. Any oil seep is an indicattion of at least some such structure there. For gas this is not so. The natural gas seeps may frequently indicate no more than a very small pathway existing to deep below. Such a pathway may be most unlikely to be interesected by present drilling efforts; and of course, it may in any case be too small to be of interest.

What is needed is new research and fresh viewpoints in the geosciences. Remarkably enough the scientific parts of the space program are a very significant item in this, and looking at the other planets may contribute much to the knowledge required to solve our fuel problems here on Earth. On the side of technology, more efficient and deeper drilling would always be an advantage; but new methods of prospecting, chemical, seismic, gravimetric, that reveal deeper structures, will need to be devised to allow us to draw on the primeval fuel that is available in large quantity but at present mostly outside our grasp.

Senator KENNEDY. To continue in our colloquy, gentlemen, Mr. Gold, would you make a brief comment on the work being done in the Soviet Union on this deep fault theory.

Mr. GOLD. Senator, there is a group in the Soviet Union whose outlook appears to me to be awfully close, I would like to say, on my heels in this. Observationally they are certainly ahead in that their observations clearly show a great interest in the types of gases that come from deep faults, observe them, monitor them, make regular observations, and so on.

Some of the papers begin to hint at the picture that I have just given you, but no more than that. There is a substantial group of geologists in the Soviet Union who are not at all convinced that all hydrocarbons on the surface of the Earth are the result of biogenic processes, while in this country, the geologists, and I think most of the oil geologists certainly have an almost passionate view that there is no hydrocarbon on the Earth that was not made as a result of the reduction by photosynthesis in plants.

I think for a view like this to be passionately held is very foolish. It is held by perhaps the majority of geologists in the Soviet Union, but not by any means so completely as here, and some of their observations point so forcefully in the other direction that some of the groups of geologists there have developed a viewpont not too different from what I have been saying.

Senator KENNEDY. Is there scientific information that would be useful that we could get from the Soviet Union on this subject?

Mr. GOLD. I have found it most useful to find first their monitoring of earthquakes for gas emission. Faultlines on which earthquakes can be expected are instrumented with gas detection devices that monitor and analyze the gas.

We have not been in the habit of doing that. We clearly ought to do that.

Senator KENNEDY. What is ERDA doing, if anything, on this general area? Are they doing research?

Mr. GOLD. I would not know of all that they might be doing, but certainly nothing has emerged so far anywhere near the scale of investigation of Dagestan and of the Northern Kola Peninsula in the Soviet Union.

All of this is a financially trival thing. One is discussing outlays that are of the order of perhaps a few hundred thousand dollars per year for this kind of instrumentation.

Senator KENNEDY. A little more expensive for the drilling?

Mr. GOLD. The drilling would be, but the survey of the gases that come out from different parts, that is trivial expense, and it certainly out to be done full blast.

The drilling is another matter, and I think that one ought to take a certain amount of risk capital firmly in hand and say, let's just explore and get away from the notion that we know where to drill.

Senator MCCLURE. Could I ask a question on that?

I assume when you say, "take a certain amount of risk capital," you are talking about governmental tax funds?

Mr. GOLD. I would advise the gas and oil companies to do that with their funds, too.

Senator MCCLURE. Would you put your money into it?

Mr. GOLD. If I was as rich as the oil companies, certainly; yes.

Senator MCCLURE. You are not as rich as they, but you have some money, I assume. Would you take what money you have and put into it?

Mr. GOLD. Yes.

Senator MCCLURE. We will form a corporation from here out.

Senator KENNEDY. The specific requirements are in the amount of research and monitoring that ought to be done and also gaining as much scientific information from perhaps the Soviet Union as I understand from your testimony which is doing more and exploring this in a serious way. Because, as I understand your testimony, there is a virtual unlimited resource if it bears out.

Mr. GOLD. And I would add to that change the outlook and be prepared to drill deep in places where you have no knowledge at all, build a grid of deep wells. Knowledgeable people have stated that oil in this country would have been discovered as well without any geologic knowledge, if one had done no more than drill where there were oil seeps, and otherwise drilled a coarse grid across the whole United States.

One would have discovered, as it turns out, as much oil as has in fact been discovered.

Senator KENNEDY. Mr. Safer, could we come back to some points that you make here in your testimony? I was interested in the treatment of a tax policy. You talk about the foreign tax credit, and as I understand, there is a distinction between the way the taxes are treated in foreign tax credit and OPEC versus the North Sea, and is that true in other parts of the world?

Are the taxes tilting us more toward involvement with OPEC countries rather than further exploration?

Mr. SAFER. My general understanding on that is that it is correct. I am not an expert on the newer British type of tax as on North Sea oil. I know several gentlemen in the audience who know more about it than I do. I don't want to comment on the details of that.

I would like to say this: I think, in general, foreign tax credits are a legitimate element of U.S. tax policy when in fact there is a demonstrable case that a U.S. corporation operating overseas is paying a tax.

I would, in general, support the idea of foreign tax credits. What is happening here is when oil companies buy crude oil from OPEC it is in large part a cost of purchasing the raw material. It is not a tax imposed by the OPEC government, especially since the change from the concession system, when, in fact, the companies owned the oil and were taxed. We have seen a gradual change in that in most OPEC countries.

So, Senator, it is not a uniform thing. But what does go on with some companies and some OPEC governments is, in fact, that the reduction of the U.S. tax liability of the purchasing oil company tends to lock in that company in terms of its profitability of taking that crude versus another crude.

I am not arguing this from the point of view of incidence of taxes or fairness of taxes, but from the point of view of the negotiation of that company with its supplier. Are they bargaining as hard as they might?

Senator KENNEDY. I think we are all very mindful that there is a virtual moratorium, I don't want to say that although it might be an apt word, on the international agencies in supporting projects for the development of oil in many of the developing nations of the world. Most of the tilt has been toward infrastructure of economic

development. And yet, when you see what has happened in the Third World and perhaps even the Fourth World like Bangladesh and other countries, and see how their economic development has been impacted by the prices of oil and energy, you have to wonder whether it might not have been a wiser investment if some encouragement was given to either the international lending institutions toward oil and gas production. It seems to me that we have that to deal with as well as an American assistance policy which is virtually silent on this issue.

I am just wondering, as you get into this second part of your prepared statment, about international finance agencies, if there is anything you would indicate to us on the wisdom of this type of effort.

Mr. SAFER. I think we certainly have both the U.S. Government and the international governmental agencies' supporting many development projects around the world. We have Eximbank financing of oil equipment-type drilling around the world which helps to provide the drilling company with the equipment for doing the drilling.

I think we have also had one or two cases where Eximbank or perhaps another agency, in fact, financed a national oil company of a foreign government, I am particularly thinking of India where I think that kind of concept was applied. We are not misusing taxpayer dollars to further the search for the oil and gas, which my two colleagues have so ably demonstrated that they very well might be there. That should be an element of U.S. policy, foreign and domestic.

Senator KENNEDY. Senator McClure.

Senator MCCLURE. Thank you, Mr. Chairman. I appreciate the opportunity. I have another appointment and I have to leave, but I would like to have the opportunity to submit some written questions for responses in writing.

I thought I might ask two questions before I go. One is, what rate of economic growth do you forecast for the United States, for Western Europe, and for the developing world?

Mr. SAFER. We have a forecast and it is contained in my prepared statement which is part of my overall testimony, here today, Senator. Stated explicitly, we are basing our growth on the GNP projection for the United States, 4 percent, Western Europe, 2½ percent.

In the emerging countries, the growth rate would be probably somewhat larger, in the 6- to 7-percent range, because they are coming from a very low base.

Senator MCCLURE. And you are projecting then that the energy growth rate, the energy consumption, will run substantially less than the growth rate in the economy?

Mr. SAFER. In terms of this paper that we published, that is not true. In terms of the consumption of oil, I wanted to be on the high side—to project a relatively rapid demand growth where we would not achieve as much conservation as we might like both in the United States, as well as in the rest of the world. I purposely wanted to put what I believe was the judgment that demand might be somewhat higher than perhaps we all might like.

Senator MCCLURE. I will explore that further in written questions because it seems to me the projections you gave in the charts are somewhat the reverse of what you just said. I want to explore that further.

Finally, all three of you were indicating, as I summarized the trends of your testimony, that the predictions of world energy shortage, at least petroleum shortage, are exaggerated, that there is an abundant supply at economically recoverable levels for a great many years.

Am I correct in that an assumption for all three of you?

Mr. SAFER. Let me answer, first. I feel certain between now and the early to mid-1980's that is a very accurate statement.

Senator MCCLURE. There is an abundant supply between now and the mid-1980's?

Mr. SAFER. Yes. In the 5- to 7-year context, I feel very confident in that statement. Beyond that, as I indicated in my prepared remarks, it is an unascertainable fact.

Senator MCCLURE. Mr. Odell.

Mr. ODELL. I will go further than that. I don't think the fact is so unascertainable, even on the basis of the figures Mr. Safer gave for the proven reserves of oil one can go further than that.

I would answer the question by saying the supply and availability of oil for most of the rest of the century, at least, is not a question of the resource base, it is a question of political and economic decisionmaking.

We have the opportunity to produce the oil and gas when we need it at a price we can afford if we choose to take the political and economic policymaking position.

Mr. GOLD. I would add to that I think in 10 years' time we may look on all these discussions from the point of view of how blind could one have been not to have recognized the enormity of the potential supplies.

Senator MCCLURE. You all three make me feel very bad because I just insulated my house and got a smaller car and now you are telling me I am wrong.

Mr. SAFER. Sir, I think that is a wrong perception. Oil costs. You will save money. That makes sense.

Senator MCCLURE. You are saying "economically recoverable," then you are talking about increased costs above present markets.

Mr. SAFER. I am saying you insulated your house, that is a rational economic move.

Senator MCCLURE. You are also saying costs may go up.

Mr. SAFER. They well may.

Mr. ODELL. One of the decisions that needs to be taken is a more active conservation. An involved component involves the conservation both as a consequence of price and as a consequence of Government action.

Mr. GOLD. In my view, the availability of oil will be limited all right and will run out eventually, perhaps a little bit further in the future than people have said, but the reservoirs of oil the Earth possesses is certainly a very limited quantity.

It is natural gas that I think does not have a bottom lid. That is important because the usage may sometimes require a liquid fuel, and we will have to learn industrially to convert natural gas into liquid fuels.

Senator KENNEDY. If I could ask, one of the matters we have been interested in, in the committee, in terms of the international petroleum and gas supply, is the information that would give us some

knowledge about what is the available. The second factor which is going to have a very important impact on the U.S. price, and, obviously, this carries us on to a point which was included in your testimoney, is, how is society, how is a country, how we as policymakers can impact that price at the present time for the foreseeable future.

Obviously, if we are able to see the kinds of marketing factors which Mr. Safer pointed out, where there is increase in production of non-OPEC countries acting outside OPEC's kind of system, there is going to be, and somewhat over the production of the market resources, the possibility of having impact on price. It is going to be enhanced if it is very clearly and thoughtfully worked out.

On the other hand, if we find new resources as a result of either tax policy or other international agencies or other support where additional resources are brought onstream and yet those countries are going to act in harmony with an OPEC policy, it isn't really going to make very much difference.

What can you tell us? Is that what is happening now? Are the non-OPEC developments really acting, if not directly, in harmony with the OPEC countries? What do you think from an economist's point of view would be the steps necessary to bring about some of the competition that may very well mean an important relief to the United States, to Western Europe, and equally important, to Third World countries?

Mr. SAFER. Senator, I would like to answer in terms of the thought that you are alluding to. I guess in looking at world supply-and-demand projections, the tendency is to look at OPEC versus non-OPEC, but in fact one might say a barrel is a barrel. To the extent a government would be exporting, they are going to try to get, I assume, the market price, that means the highest price the market will bear at that particular point in time.

The non-OPEC country which most stands out in my mind as a major source of oil today and likely to increase substantially is Mexico. The pressures on Mexico in terms of its need for foreign exchange, its rising population, its desire to increase its standards of living, I think will suggest that the Mexicans will want to sell the oil.

The question is to develop the appropriate mechanism by which the market will reflect the fact that Mexican oil will be competing with other sources of oil over time. I think we could allude to that kind of process in many countries around the world.

As buyers, we have to negotiate in our own interests and it should have as little as possible to do with the political relations with that country.

Mr. ODELL. I think, Senator, that if the United States were to pursue the policy that Mr. Safer suggested in his testimony, and if Western Europe were to pursue energy self-sufficiency, then, certainly, the steam is going to be taken out of the growth of OPEC demands.

I think the figures for OPEC demands, that Mr. Safer gave, would significantly be reduced even further if Europe took the path as I described as possible in my own testimony.

Senator KENNEDY. Possibly, but as I gather from your testimony, probably unlikely.

Mr. ODELL. Unlikely in the present political and economic circumstances, but, again, I think these are humanly possible to analyze and, obviously, if one makes the analysis, one comes up with conclusions that alternatives can be followed in oil and gas production, and it is conceivable that policies toward a higher rate of production in Europe will be taken.

But this raises two questions, that can be taken only in the context of a degree of European protection for its own production, protection necessary to sustain the investors against the uncertainties, the same will be true of the United States.

We, then, have an important industrial nation on the outside looking in, Japan, which may then be in a position to take advantage of our, and your, decision to get our own oil and gas production up, and they, perhaps, may take advantage of the consequential lower price on the world market to our further discomfort and possibly disadvantage, and thus a policy in this respect, I think, would have to involve the Japanese as well as Western Europe and the United States, and that could be obviously be done through the OECD.

I could see an advantage to the Western industrial world accepting such a penalty for its own energy costs, a cost of energy which affects the supply price, a cost of North Sea as opposed to——

Senator KENNEDY. What is the difference in price now?

Mr. ODELL. In terms of supply price, we are talking about the cost of oil in Saudi Arabia of 25 cents a barrel and in the North Sea of perhaps $5. So there is a big difference. So we would probably have to commit ourselves to oil at about present-day prices in real terms to sustain the kind of growth that I foresee as possible for the future given the Western European and resource base.

If we sustain that level and OPEC breaks as a cartel because it tries to get entry, or individual members of it try to get entry, and reduce prices in order to do it, we, obviously, have to neutralize the Japanese possibility of taking advantage of that, but on the other hand, I think that then gives the Third World countries access to oil at possibly a lower cost than we are charging ourselves for our energy with a consequential beneficial effect in terms of Third World development leading to a multiplier effect back into our economic system in terms of their demand for our goods.

Thus, I would see this as a device whereby we can achieve a stronger upward multiplier effect in the world economy as a whole, looking at the consequences for this in terms of the individual parts of the Western system.

Sentator KENNEDY. What can you tell us, Professor, from your own knowledge of American initiatives in trying to coordinate that kind of a policy, from your views of the various meetings, the Paris meetings of 2 to 3 years ago, the activities of the OECD: Is there any such policy underway? Ae we going to do anything now?

Mr. ODELL. There was, Senator, the decision to provide the second dollar a barrel basement price to provide some security for investment in new areas in the Western World. I think that is now overtaken by events, we ought to think in terms of a price significantly higher than that.

I think the problem of the international organization in the future, particularly the OECD, is that it believes in scarcity, it believes in the pressure of demand on supply by 1982 or thereabouts, and as a consequence, it is not really now pursuing an active research policy in respect of what options could be followed if we think in terms of OPEC being brought under pressure as a result of developments here and in Western Europe, what that implies in terms of the protection that would have to be given to producers in these regions in order to create that possibility in the world economy.

There is only one option being looked at, I think, at the OECD level, and that is the option of scarcity. We have assumed that to be not the most likely event but almost the only possible evolution of the world oil market between now and the early 1980's, and I think there is decreasing justification for taking that as the only option and the fact that we do take it as the only possibility, I think, is leading to dangerous constraints on the political and economic opportunities we might have otherwise forgetting the world economy going rather more quickly.

Senator KENNEDY. Just a final point on this. This attitude of scarcity, which is in the OECD and on which you commented in your presentation, is the mood which is prevalent in Norway. I would imagine from what you have said about production capacity, it is prevalent in terms of North Sea oil as well, in each of the countries as well as in the OECD as an institution that coordinates government policy, I gather, would I be correct?

Mr. ODELL. That is true, Senator. One has the somewhat crazy situation where a belief in scarcity creates a scarcity because the potential producers believe that resources are scarce and depreciate in value inevitably, then they have no propensity or willingness to produce.

For security supply reasons, there is the feeling that we must not produce and supply too much now or in the foreseeable future because if we do there will not be enough for our internal consumption in the post-1985 period, and a producing country might say we want to be slightly ahead of the field.

There is this belief that perpetuates the situation and indeed helps to create the situation we now face and which has then a consequential effect on a much broader range of problems the Western World faces, notably how to get the economy moving and that has an important impact on the degree to which we can look to growth or no growth.

Senator KENNEDY. If I could, Mr. Safer, I would like to come back to this idea of a commodity futures market in, say, OPEC. What percent of the trade would it take to have some influence on the price?

Mr. SAFER. I think that there are a couple of problems here. One will be the inertia of the companies in terms of their normal way of doing business. To what extent they will want to participate?

My belief is, frankly, that in today's world, when you are talking about the products that we are referring to, organized futures trading could reach 20 percent of the market. At the present time, the New York Mercantile Exchange has before the Commodities Futures Commission, futures contracts on No. 2—that is, heating oil—and No. 6; that is, fuel oil for utilities.

One might think of extending that to wholesale gasoline as well. The process, of course, is one where the jobber, distributor, terminal operator, in the case of No. 6, the utilities, all I think, will have an interest for the following reasons.

When prices were much lower, 4 or 5 years ago, the cost of carrying the inventory was not as high as it is today. At the same time, the demand growth today is much less certain than it was a few years ago.

At the present time, the jobber-distributor is faced with a very high—four or five times—his cost in terms of inventory carrying; and secondly, in terms of slow volume, uncertain volume, as we move toward more conservation.

So we think he would benefit most substantially in terms of a classic hedging of a commodity. Similarly, the utilities who today buy large amounts of No. 6 fuel oil, we believe also in terms of an uncertain price in the future, will want to have the advantage of doing that.

In terms of trying to answer your question explicitly, my own belief is after a 2- or 3-year period, we could look to perhaps as much as 20 percent of the volume of No. 2 and No. 6, at least in the Northeast, beginning to go through that market.

Senator KENNEDY. I would like to get your comments on this. We have heard in our other hearings about the presence of the oil companies and they indicated that these prices that have been establishd in OPEC are basically outside of their capacity to be influential. In spite of some of the obvious points about the interest the companies must have about increasing price, what that means for profits and all the other factors, they talk about the administered price as being something that these countries have reached a firm decision in their ability to influence it, even when their economic power and their influence within the countries is extremely limited at best.

I am wondering what comment you would make on that assumption. How valid is it, Mr. Safer?

Mr. SAFER. I think it depends on the state of the market, sir, and the expectations which the participants in the market have. In 1973, as a result of some political events which occurred at the time, the Arab States, the Arab members of OPEC, decided to embargo the United States; but in order to do that, they had to cut production as well.

They cut it up to 20 to 25 percent. They thereby created a shortage. I think other members of OPEC who had very little interest in the Arab-Israeli war moved into the breach and raised prices substantially as a result.

I think the time is coming this year, the next 2 to 4 years, where that is no longer true. We are now heading toward a time when we will have greater supplies and so that the leverage of the buyer should be exercised or can be exercised in the marktplace.

In that context I would simply ask this. OPEC determines prices. they have said explicitly they do not in general determine volume, except, perhaps, when it is hitting a certain ceiling, but so far not on the downside. So somebody must be determining the volume—the quantity—in order to hold the price. So in a surplus market, an abundant market, the buyer has leverage, and the volumes and prices are determined jointly.

Senator KENNEDY. Mr. Odell.

Mr. ODELL. I think in the past it was true—post-1968 until 1973—that the oil companies certainly took the lead in trying to get the industry away from its low decreasing profit situation in the late 1950's and 1960's. At the time, the oil companies were talking about getting up the price. But I think what they had in mind was a rise in the price of international oil to provide a profitability for reinvestment in new resources, for higher profit earnings for themselves, moving up through the 1970's to a price of perhaps $7 a barrel by 1980, which was one figure that a Shell spokesman used at an Institute of Petroleum meeting in the United Kingdom in the early part of 1973.

That kind of price increase would not have been disastrous for the world economy. It would have been gradual. It would have been a sustainable kind of approach, and companies I think may well have been able to make it stick in light of their control over large portions of the market in, say, Western Europe.

Matters were then, as Mr. Safer has suggested, taken out of their hands in 1974, and the price increases since then have been a question of an OPEC determination to get higher returns for the use of their resources. But companies have only participated in that process in the sense that they can still make profits out of the higher prices.

I indicated in my prepared statement that on the basis of Dutch data from 1976, that they appeared to be making something like 85 cents a barrel upstream margin on crude imported into the Netherlands, which was basically a taxpaid profit because the taxes had already been paid elsewhere, and it is against this that they judge what it is best to do elsewhere, how far they ought to go in developing alternatives to this oil on which profits can be made in the light of the weakness that might be caused in the marketplace if, in fact, they went ahead too rapidly with certain other developments in particular markets such as Western Europe.

Now, in Western Europe, we have a situation in which this is uncontrollable, first, because government, with the exception of the French, have no means whereby this industry is regulated. Second, 80 percent or so of the oil market, which is controlled by the international major oil companies, can be determined by no other body than the head offices of the companies concerned.

They still make the decisions on how Europe is to be supplied, and from which sources. I think the public has agreed as to how the international companies have reached agreements with the OPEC countries, as a result of the managerial agreements, so, until we know this information, we do not know the degree to which alternative developments are constrained by the fact those companies are tied in by their profitability on the OPEC oil to the maintenance or increase of supplies from those quarters as to supplies from alterative areas.

Senator KENNEDY. What should be the guidepost on the amendment that they would be required to take that would influence the market? What should we look for? We are going to get into that tomorrow but what can you tell us about the signs we ought to look for on that?

Mr. ODELL. I don't think we are in a position—in terms of Western Europe—where we can define that very precisely because we have not

yet done the basic research, or all the basic research, that is required on the evolution of the oil and gas supply curve: one, because we have had this belief in scarcity, two, we have had a continued underestimation of the ability of the industry to produce in Western Europe, and three, we have not yet got access to the full data whereby we can precisely define the growth of the oil and gas supply curve from indigenous resources.

Once we have done that, and I think this sort of exercise could be done by an activity and positive policy on the part of the OECD or the EOCC in the process of 8 or 9 months. Once we have done that, and once we have also reached some consensus on the likely evolution of the demand curve against our estimate of the likely development of the economy, then we have, if you like, a balancing item in terms of the amounts of toil that, in those circumstances, we would require from external sources of a period of years from, say, 1980 to—onward.

Against that we could then in cooperation with the oil companies—and I would not exclude this, in fact, have argued for this in a book soon to be published—perhaps in cooperation also with OPEC decide on some supply schedule for OPEC oil in the context of this evolution of the demand situation on the evolution of an ingenous native supply position for a period of at least post 1980 and thereafter for the foreseeable future.

Research needs to be done on the supply and demand side of the equation as far as Western Europe is concerned.

Mr. SAFER. I interpreted your question a little differently. I thought you were asking how much the OPEC countries themselves would like to sell as a minimum. In that regard we do have some information because we do know the tentative outline of agreements between the companies and the Government of Saudi Arabia where the statement was made to the effect that the companies agreed to purchase a minimum of 6 million barrels a day. Subsequently it was raised to 7 million. I conclude that Saudi Arabia would like to sell somewhere in that 6 to 7 million-barrel-a-day range into the world market.

Senator KENNEDY. This has been very helpful, very interesting and extremely informative. I want to thank all of you very much for your presence here this morning. We will continue our hearings tomorrow morning.

The subcommittee stands in recess. There may be other members that have questions. If there are, I hope we can get some written response.

Thank you very much.

[Whereupon, at 12:37 p.m., the subcommittee recessed, to reconvene at 9:45 a.m., Thursday, March 9, 1978.]

ENERGY IN THE EIGHTIES: CAN WE AVOID SCARCITY AND INFLATION?

THURSDAY, MARCH 9, 1978

CONGRESS OF THE UNITED STATES,
SUBCOMMITTEE ON ENERGY OF THE
JOINT ECONOMIC COMMITTEE.
Washington, D.C.

The subcommittee met, pursuant to recess, at 9:45 a.m., in room 5110, Dirksen Senate Office Building, Hon. Edward M. Kennedy (chairman of the subcommittee) presiding.

Present: Senators Kennedy, Javits, McClure, and Hatch.

Also present: Richard F. Kaufman, general counsel; Jerry Brady, subcommittee professional staff member; Katie MacArthur, Hank Banta, and Jan Kalicki, professional staff members; Mark Borchelt, administrative assistant; and Charles H. Bradford, Stephen J. Entin, M. Catherine Miller, and Mark R. Policinski, minority professional staff members.

OPENING STATEMENT OF SENATOR KENNEDY, CHAIRMAN

Senator KENNEDY. The subcommittee will come to order.

Yesterday we heard provocative testimony from three witnesses who are optimistic about oil and gas supplies and about the existence of opportunities to prevent ruinous prices in the future:

Mr. Arnold Safer told us that for the next 5 years oil would be sufficient and prices stable.

Mr. Bernard Grossling presented a paper and will testify in detail on March 21 that the world has at least an 80-year and may have a 280-year supply of oil at 1976 consumption rates.

Mr. Peter Odell explained that Europe could be energy self-sufficient, but is failing to develop the North Sea and other resources out of expectation of future scarcity.

Mr. Thomas Gold told us we could be sitting on a huge fuel tank of natural gas.

The world is not running out of oil, we were told, but many nations are hedging against the future, holding back production in the expectation that a barrel in the ground will be worth more than a barrel on the surface.

We learned, once again, of the enormous reliance placed on Saudi Arabia. It is no disrespect to the Saudis, however, to suggest that this dependency is both unwise and unhealthy in the extreme.

Yesterday's witnesses told us about other energy-rich countries which collectively have both the resource base and the technical capability to bring on line oil which would substitute for the exclusive Saudi dependence. Yet the British are producing below cap-

pacity. The Norweigans are locking up their oil for the future and not even exploring north of the 62d parallel. The Dutch are cutting back exports of gas.

Argentina could go into large-scale production. Mexico may have discoveries of staggering proportions. China could be a substantial exporter. None is a member of OPEC.

While we can understand how any one country will hedge on the future, the net effect is that a large number of countries apparently intend to hold oil off the market in the early and mid-1980's just when it will be needed. Together they could influence the price. Betting on a high-priced future for themselves, this encourages Saudi dominance, if not supply shortages and escalating prices.

Then we come to the role of the oil companies and their unique partnership with the cartel, a partnership which guarantees access to the U.S. market. The cartel always has a market and can informally allocate shares even in today's surplus environment.

To me this suggests that we take every possible step to create free market, arm's-length transactions in oil by whatever means possible. The now well-known plan to auction off the right to import oil, the creation of a futures market in petroleum products, the purchase of our strategic reserve by sealed bids, and an effective end of the right of oil companies to deduct from U.S. taxes the royalties they pay to foreign governments, are four of the suggestions we received yesterday. There may be others. Every suggestion brings problems. What strikes me most sharply is the absence of even the slightest consideration of these options within the Government.

Today's witnesses provide us an excellent opportunity to consider each of these questions and other questions they will raise. We had hoped to have with us today Secretary James Schlesinger. However, Mr. Schlesinger asked us to postpone his appearance because of his heavy commitment both in the coal strike and the Natural Gas Conference. At this request we have scheduled a third day of hearings for March 21 at 9:30.

Along with Mr. Schlesinger we will hear from Mr. Bernard Grossling who was originally scheduled to appear yesterday.

Our first witness is Mr. John Sawhill, former Administrator of the Federal Energy Administration and now president of New York University. Mr. Sawhill earned the respect of many of us in the Congress, in both parties, during his tenure as FEA Administrator and remains an important voice in energy policy.

I realize you have come here at considerable inconvenience and have not had time to prepare an opening statement. If you would care to make a few introductory remarks, we would be most appreciative.

Mr. Sawhill.

STATEMENT OF JOHN SAWHILL, PRESIDENT, NEW YORK UNIVERSITY, AND FORMER ADMINISTRATOR, FEDERAL ENERGY ADMINISTRATION

Mr. SAWHILL. Thank you very much. I appreciate the opportunity to appear before your committee today. It seems to me, that the combination coal strike currently upon us and the natural gas shortages we experienced last winter are at least bringing home to the Ameri-

can people the seriousness of the energy problem that the country faces. Part of our concern with the energy problem is that none of us really agrees on what the problem is, so in my brief introductory remarks I would like to try to define the energy problem as I see it.

The problem breaks down into three separate and related, but somewhat distinct, problems. The first is the problem of supply security. As Senator Kennedy pointed out in his opening statement, the United States is becoming more and more dependent upon the rest of the world for its oil supplies. This is true of some of its allies as well. The fact that we are becoming more dependent on imports and that our imports are becoming more concentrated in the politically unstable Middle East, mean that we have a problem of assuring access to oil on a secure basis, and this is one dimension of the energy problem, the problem of security.

The second dimension is the problem of financing and the ability or lack of ability of the weaker economies in the world to manage the mountainous debt burdens that have been imposed by higher energy prices. Of course, the problem is more acute in some of the less developed countries, such as Peru, Zaire, and Pakistan, where we are already seeing, as a result of higher copper prices and other developments in the world economy, difficulty in managing their external debts. But it may become equally severe for some of the southern European countries, the so-called Mediterranean countries of Portugal, Spain, Greece, and Turkey. So this then would be the second dimension of the problem, as I would see it, the problem of managing the world's financial situation in such a way that these mounting burdens can be handled without causing a financial crisis.

The third and perhaps most serious dimension of the energy problem is the need, which we will eventually have to have as a world, to transit from an economy based on liquid hydrocarbons to an economy based on other energy sources. As you have pointed out again in your opening statement, there is no shortage of energy, but there may be a shortage of oil. I believe that there will be eventually plateauing or declining production of oil as we exhaust the world's reserves of liquid hydrocarbons, and this will mean that we will have to rely increasingly upon alternative energy technologies.

Now, the ability to transit in an orderly fashion to this next generation of energy technology is compounded by a number of factors. The first is the long leadtime required to develop new energy supplies and to improve energy productivity. It takes a long time, as we are finding out in some of our offshore drilling activities, to explore and develop offshore oilfields. It takes a long time to build coal conversion facilities. It takes a long time to build nuclear plants. It takes an equally long time to improve the energy efficiency of industry, to change an automotive fleet from a fleet of gas guzzlers to a fleet of energy-efficient automobiles. So, the difficulty of making this transition is compounded in the case of energy by long leadtimes.

It is also compounded by the fact that as we seek to expand energy supplies, we invariably run into the need for tradeoffs with some of our environmental concerns. These issues have to be discussed, the tradeoffs have to be understood, and it takes a long time to have this kind of discussion and to come to the conclusions and agree-

ments that must be reached if we are to expand energy supplies in a way consistent with our environmental concerns.

One overriding problem in dealing with energy is the very fact of uncertainty. We really don't know what the energy future will be. In 1973, most of the forecasts for the world's energy future were relatively optimistic. Between 1973 and 1977, energy forecasts became increasingly more pessimistic, and now we are seeing that, as you have said in your opening statement, the Safer forecast and some of the more recent forecasts by some of the oil companies are becoming more optimistic again. I think that was because in 1973 we didn't understand energy forecasting very well and had not had a great deal of experience with higher energy prices and some of the other policies that had been put into place.

In 1973–77, we have seen major price changes. We have seen a number of other energy programs put into place, and now we can evaluate the effectiveness of those programs, and that has led some people to become more optimistic in their forecasts because they have seen that energy demand is somewhat responsive to higher enrgy prices and that there have been a number of efforts successfully made to expand energy supply.

As far as what we should do about the energy situation that we face in the world today, the first and most important thing, of course, is that we recognize the seriousness of the problem and that Governments in the United States and elsewhere in the world begin to take the actions necessary to do something about it. Of course, this is particularly important because of the long leadtimes that I mentioned earlier, Secondly, it seems to me if we view the problem in an international context, it will be particularly important for the United States to insure that some of the less-developed countries have the means to develop their indigenous energy supplies. By this I mean their oil and gas as well as their coal; in order for them to be able to do this, they need access to technology. They in some cases may need financing. In some cases they may need encouragement to remove the barriers to leasing and some of the other institutional barriers that have prevented the companies from going in and developing these supplies. A coordinated approach on the part of the U.S. Government and other governments toward helping these countries develop their indigenous energy supplies can be an important way of relieving some of the pressure on the world oil supply-demand oil situation.

Beyond this, it seems to me, it is important that we resolve the nuclear debate that is currently raging in the world. We have, and I think with some success, been able to initiate the international nuclear fuel cycle evaluation program, but I think we have to recognize that this program will do nothing more than provide technical information to policymakers, and it will be up to policymakers in this country and abroad to negotiate the kinds of agreements that will permit us to move forward to develop the world's uranium resources in a manner consistent with minimizing the risk of weapons proliferation.

I think at this point, Mr. Chairman, I would conclude my opening statement and would be delighted to answer any questions you might have.

Senator KENNEDY. I think you have put in a very fair framework the dimension of the particular problem. I am mindful that the last time that you appeared here, on January 13, 1977, before the committee, you referred to some of the steps that should be taken. You had talked not only before this subcommittee at that time, but appeared before other committees, and in most of these areas you have outlined here, you have used the questions of supply security, and you mentioned the importance of helping and assisting LDC's to develop these supplies. But you have to have access to technology and financing.

We have seen that there has been, really, a limited effort. We will explore that later in the hearing with people from Treasury, and there will be instances that will be raised where there have been some initiatives, but we really haven't, nor do I detect much from DOE in terms of exploration effort in finding various resources that exist in the world. As a matter of fact, as we will hear later in the morning from Mr. Bosworth, given the effectiveness of OPEC in setting and upholding prices and the willingness of Saudi Arabia to act as the swing target, our relationship with OPEC has contributed to fairly stable oil prices.

There have been two general increases of 10 percent during this period. Market prices are currently frozen. This reflects some degree of restraint. We will come to the end of the period when we can rely on good relations to bring about an adequate means to control demand for oil, meaning the United States.

I don't really detect much of a sense of urgency for the development of alternative petroleum supplies in other areas outside of OPEC, either financially or through initiatives by the Congress or within DOE, to try to deal with complex international financing agencies to move in this area. I think there is an inherent kind of resistance by the oil companies in terms of technology. Maybe I am wrong about it.

What do you think we must do to understand the seriousness of the problem? I would imagine part of that is understanding the need to develop alternative resources, if they do exist, in other parts of the world. You have talked about that.

Mr. SAWHILL. I think it is quite important, Senator.

Senator KENNEDY. Can you tell us about the ability of financial international agencies to deal with it? Is that going to take structural changes? Is it going to take an attitude that we just can't rely on the oil companies to have parallel interests with consumer interests here in the United States? What do you perceive as the bottlenecks toward moving us in these areas?

Could you focus on developing additional sources of petroleum resources in other parts of the world, both gnancially and from a technological point of view, and tell us what you think should be done?

Mr. SAWHILL. First, I might try to size the problem. The World Bank has estimated there are potentially about $30 billion of energy development projects that could be undertaken over the next 5 years in the oil-importing, less-developed countries. The Bank itself has made plans to participate in approximately $10 billion of these, so that leaves, in effect, a $20 billion gap. Somehow the financing and

the technical assistance have to be made available to the LDC's to develop these resources.

Now, I don't feel that we are going to find a great big bonanza of oil supplies in any one country. What I think is going to happen is that we will find in a number of countries in Africa and South America, particularly, that there are opportunities to develop smaller fields, but each will add to the world's oil supply and each will help alleviate some of the strains that our forecasts have shown must be alleviated if we are not to become more and more dependent on OPEC.

Senator KENNEDY. Could you explain the $10 billion, where you get that and what its significance is?

Mr. SAWHILL. The Bank has tentatively made plans, as I understand it, to participate in the project costs of developing oil and gas fields in some of the LDC's. It currently has a project underway with Pakistan, I believe, and one of the oil companies, and is looking into other opportunities in this regard. Whether that estimate of $30 billion is absolutely right or not, I don't think any of us know for sure.

We do know there are a number of projects. There are a number of opportunities for exploration in the LDC's. They have not been nearly as well explored as the United States and the North Sea and Russia and some of the more highly industralized countries. So we have great potential opportunities for exploration.

The geologists apparently feel there is not going to be another Saudi Arabia in the African or Latin American LDC's, but to the extent that they each can add individual supplies it can be helpful.

There are two or three things that it seems to me prevent LDC's from developing these resources.

Senator KENNEDY. Let me ask you, in fashioning this, do you think in the AID program that we ought to be more imaginative in terms of helping and assisting these LDC's to move in this area as well? The Congress certainly has not addressed that issue seriously.

Mr. SAWHILL. I would like to see the U.S. Government, itself, through its AID program undertake an initiative in this regard. There are already some small programs that have been started, but they are not on the scale that is needed if we are going to achieve rapid development of LDC resources. It seems to me this could be a very important initiative of the U.S. Government, important in helping LDC economies manage the financial crisis they face as a result of higher oil prices and important in bringing on additional supplies to the world market, which could alleviate the supply-demand situation that we are facing.

I would think that the U.S. Government as well as the governments of some of the other developed countries, such as Japan, West Germany, and others, might take the initiative in providing technology and financial assistance. It isn't only a question of financial assistance, I think it is also a question of technology.

The oil companies in some cases are willing participants in this process. In others they have been concerned, I believe, because of the fear of expropriation, to perhaps be as aggressive as they might have been.

Senator KENNEDY. That takes a coordinated governmental policy to assure that losses would not be burdened. I think that is a very

important aspect which we ought to be addressing again as a coordinated policy.

Didn't the Saudis talk about an initiative, I think 2 or 3 years ago of attempting to provide financial and technical assistance in this area? As I understand it, what you say is that we ought to have the program in exercising our influence, whether it is in the international financial machinery or in the regional machinery that is established or in its direct aid programs or in other kinds of programs that are going to have a direct impact on appropriations, and there really ought to be a coordinated kind of approach in the fashioning of an energy program.

Mr. SAWHILL. Yes; but I think it has to be a combination, as you are suggesting, of international financial institutions such as the World Bank and unilateral U.S. programs. I don't think we can rely only on the international financial institutions.

Senator KENNEDY. Perhaps you could comment on the major oil companies' projections for the immediate future where they show supplies into the early eighties to be sufficient to meet demands, given a long-time arrangement they have made with the OPEC countries. Should we expect major oil companies to have an interest in such an undertaking? Even granted the fact that it takes any period of time, 3, 4, 5, or even 7 years, to bring these projects onstream, should we expect that the oil companies will be falling over themselves to find new resources when they may very well be under contractual obligations to offload petroleum products from OPEC countries where they have had long-term agreements and understandings?

How aggressive would they be or should they be or should we expect them to be to try to look into these newer areas where they may very well be competing with themselves?

Mr. SAWHILL. I think the concerns they have are, one, that often they don't find leasing available on commercially acceptable terms in some of these LDC's; and, second, they are concerned about the fear of expropriation. After all, they have been their assets expropriated in a number of foreign countries and so naturally they are concerned about making major new investments. So it seems to me this is an area where Government could be of assistance.

Senator KENNEDY. Have your views altered or changed at all on the systems which ought to be developed for making that oil which is available more cost competitive?

You refer to that in some detail in your earlier presentation and we have really pretty much moved away from giving much consideration to that, in a serious way. There have obviously been a number of plans, the futures market, the Adelman plan and a number of other suggestions, that have been made, some repeated yesterday.

Has your own thinking on this been further refined? Is it still possible? Are there other ideas that ought to be given serious consideration?

Mr. SAWHILL. It seems to me what has happened is since 1975 the real price of oil has declined; in other words, the price increase has not kept up with inflation. As we have seen additional supplies coming on from the North Sea, the prospect of additional supplies in the North Slope, the prospect of Mexican production, the possibility of production in some of the Latin American countries such as

Argentina, I believe that perhaps the need for some kind of mechanism to insure that U.S. consumers are obtaining the best possible price is perhaps not as great as some of us once thought it was. In other words, the world price itself seems to be responding more to supply-and-demand conditions than it seemed to in the immediate aftermath of the embargo.

So today we have seen price softening, we see a period of adequate or excess supply for the next several years. I believe that we should be in for a period of relatively stable prices.

Senator KENNEDY. Isn't this just the time, given the situation you have described, at least in terms of the competitive price situation, that we ought to be maximizing our efforts to find mechanisms to impact price? With the projections about the availability of a resource through the early part of the eighties this presents the best opportunity for impact for us, and whatever we are going to do we ought to be about the business of doing it.

Mr. SAWHILL. The best way to impact price is to do everything we can to reduce our imports. To the extent that we become less of a factor in the world market, this will mean that the supply-and-demand situation will be even more favorable to a further softening of prices. So I think the best suggestion I could make for seeing us take actions to expand our domestic supplies or continue to curtail our demands.

Senator KENNEDY. I think we have to accept that as granted, and obviously there are a lot of people up this hill who are wrestling around on that problem at the present time. It seems you have to make a bona fide effort to do that. Howe successful we will be is pretty much an open question; even with the suggestion of a compromise position. But I suppose it is again how we ought to be viewing the world market that is going to obviously impact the pricing here in the United States.

Obviously an important reduction of importing by the United States would free up more petroleum and would have an important impact. But beyond that, if we maximize that effort, we have in the future, and where we are establishing mechanisms to it. Doesn't this present a rather unique opportunity we perhaps might not have foreseen several years ago, to have a greater opportunity for leverage on price than we had in the past. And where we are establishing mechanisms to try to deal with that issue, it would appear to me that now is a particularly appropriate time to try to do it.

If we have an attitude where we are getting along pretty well as it is, the oil-producing States are playing ball with us and therefore there isn't much need to try for leverage. This doesn't suggest an issue of confrontation as was suggested in the past. But what it does do is suggest hardheaded bargaining with regard to national interests of the West and whether we are being sufficiently imaginative in dealing with it.

Mr. SAWHILL. It seems to me there are really two levels at which we deal with OPEC. There is the political level and there is the commercial level. At the commercial level it is probably best for the companies to continue to operate as they have in the past, and it is probably not an area for Government involvement. It is at the political level where the Government, through its initiatives can bring

a great deal more to the bargaining table than a commercial enterprise can.

After all, it is the U.S. Government that provides the security blanket to Saudi Arabia. It is the U.S. Government that provides arms to many countries in the Middle East. It is the U.S. Government that can take the initiative in encouraging a settlement to the Middle East situation. It is this leverage that we have, that we can take, and to some extent have taken advantage of. But I would repeat that, from a strictly energy standpoint, to the extent that we can do everything possible to reduce the size of our imports and to move quickly ahead with an energy policy, and, at the same time, move ahead with the other initiative that we have been discussing of helping the LDC's expand their production and, finally trying to bring some resolution to the nuclear question. It seems to me that these three activities will be of great assistance in expanding the world supplies and reducing the need for OPEC imports and therefore bring pressure on prices.

Senator KENNEDY. Of course, there is always the possibility that if we reduce imports, the Saudis will reduce production and raise prices and we would be just in the same place that we are at the present time.

Mr. SAWHILL. My feeling is that the Saudis will not significantly reduce production below current levels. The Saudis have a major developments program underway.

Senator KENNEDY. They can reach that with a still important reduction and some increase in price?

Mr. SAWHILL. Yes; but I think increasingly they are going to find it more and more difficult to reduce production much below current levels. They are building in a very expensive development program that is gaining a momentum of its own. So I am somewhat hopeful that production reductions below the current levels will become increasingly difficult for the Saudis, just as they are for many other Middle Eastern countries. In other words, I think there is less of an opportunity today than there once was for production reduction.

Senator KENNEDY. How were those production limits really established, based upon your own study of them? Were those really established by their Minister of Petroleum, Mr. Yamani, and others, or is that more reflective of the arrangements of the companies themselves? It is obviously a blend, but looking back over the history in the United States where in the early years of petroleum production, with the Texas rate bureaus and others where there was a control of production availability, it took careful sophistication and ability on both the parts of the companies and the railroad commissions. Is that what is happening in Saudi Arabia today?

How are those figures really established and set?

Mr. SAWHILL. I think what has happened is that it has changed over a period of time. Early in the sixties it was clearly the companies that were in the driver's seat, that were in a position to set production limits. Today I think that is a decision made on the part of the Government, and the companies are pretty much in a position where they have to accept the limits that have been established by the Government, so the companies are certainly involved in carry-

ing out the desires of the government. But I think the actual establishment of the limits is pretty much a decision of the Government.

Senator KENNEDY. That would be worthwhile knowing.

Mr. SAWHILL. Yes; it might be worth talking to company representatives.

Senator KENNEDY. That relates really to another point you raised before and that is the information which would be available in those contracts. We would have some kind of idea of what responsibilities for the companies would be in offloading or transporting. As I understand it, we can make reasonably accurate estimates from their judgments—publications such as trade journals—but certainly, precise information, in that area, would certainly appear to me to be desirable for the fashioning of a national policy.

Mr. SAWHILL. At one time there was an initiative that the Federal Energy Administration developed to obtain information on the terms and conditions of contracts between the international oil companies and the producing governments. Apparently this initiative was carried through——

Senator KENNEDY. Do you think it would be worthwhile and desirable?

Mr. SAWHILL. It would probably not be desirable for the government to be involved in the negotiating process. I don't think that would be desirable, but I think it would be desirable for the Government to have a clear understanding of the terms and conditions under which oil was being made available to the United States.

Senator KENNEDY. That was one of the General Accounting Office's recommendations as well?

Mr. SAWHILL. Yes.

Senator KENNEDY. Finally, what is your view about the world supply? Has it altered or changed over the period of your own study and reading and thinking about this problem, or does it pretty much hold the same?

Mr. SAWHILL. I certainly agree that for the next few years, at least between now and 1985, we are not going to face a serious oil supply problem. I think the real issue is what will happen in the late 1980's and the early 1990's as oil production begins to decline and we lose the benefits of this incremental production from the North Sea and the North Slope.

Trying to forecast oil supply and demand is a very risky business. All the forecasters that I have seen have always ended up being wrong, many of them by a fairly large margin. So I think we have to recognize the uncertainty——

Senator KENNEDY. You say that most of those were underpredicted or overpredicted?

Mr. SAWHILL. Most of them were underpredicted; certainly between 1973 and 1976 or 1977. So I believe that we have to be very careful about pinning all of our policy on a particular forecast, because uncertainty is one of the peculiar characteristics of the energy business. I think we have to learn to live with that uncertainty and to recognize that we have to plan for a fairly pessimistic forecast because the consequences of being wrong are very severe indeed.

Senator KENNEDY. Of course, the other side of that is almost a self-fulfilling prophesy of scarcity, isn't it? The testimony that we

heard yesterday, and we had a very articulate presentation on that, talked about countries really folding because of scarce resources and the corresponding action of sufficient pressures for upward pricing. We get into a scarcity mentality, which has a very important effect on marketing as well as availability, which could have an important impact on the relationship between various countries.

Mr. SAWHILL. Yes. I think there is always that factor present in any forecast.

Senator KENNEDY. We want to thank you very much for your presentation. It has been very helpful and worth while to us.

Our next witness represents the administration. We welcome the Honorable C. Fred Bergsten, Assistant Secretary of the Treasury for International Affairs.

Before joining the Government he was one of the most prolific writers on international affairs. I think it would be fair to say he has been one of the major influences on the governments of developing countries through the international lending agencies, and we take note of that and congratulate you. Your prepared statement will be included in the hearing record.

Mr. Bergsten, please proceed.

STATEMENT OF HON. C. FRED BERGSTEN, ASSISTANT SECRETARY OF THE TREASURY FOR INTERNATIONAL AFFAIRS

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

In the statement I have prepared for the subcommittee, which I will summarize briefly at the outset, I focused on two elements. The first is simply to remind the committee, because I know it is not the main topic for discussion today, of the critical importance of this energy question for our balance-of-payments position and the state of the dollar in the exchange markets which, of course, is a major concern of the United States right now.

The facts are simple and straightforward, but I think worthy of repetition. Our overall trade deficit is running on the order of $30 billion last year and probably this year as well. Our oil imports total $45 billion, up from less than $5 billion as recently as 1972. So it is quite clear the dramatic increase in our level of oil imports not only raises a range of underlying economic and foreign policy problems of the type you have been discussing earlier with Mr. Sawhill, but also have a very important impact on our external financial position and, therefore, on the strength of the dollar and some very major U.S. economic interests.

The increase in oil prices has been the dominant factor in our increase of that total import bill, accounting for $36 billion of the $45 billion rise in U.S. oil import costs over the last 5 years. There is one difference in the U.S. oil-importing picture from that of most other industrialized countries. We have imported more oil not only because of our increased consumption, but also because of our decline in domestic production, and in fact it comes out roughly 50–50. It is not simply that we have been consuming more oil and therefore importing more; it is because our domestic supply situation has been declining rather steadily over the entirety of this decade.

That, too, has had a major impact on the U.S. trade balance. I would simply conclude this short set of comments on the trade situa-

tion by reiterating what the President and many of our Cabinet officers have said time and again that the adoption of a comprehensive energy program by the Congress is the most important single step we can take to stabilize the dollar in the world financial markets today and begin the improvement of our external trade position, which is essential in the national interests.

The weakening of the dollar, which began late last year and has continued over the past couple of months, clearly correlates with growing doubts that the United States was ever going to adopt a decisive energy program. Even though the actual results of our new energy program would take several years to come fully into play, adoption of that program, we believe, would have a very important effect on the financial markets. It could strengthen the dollar and restore confidence in the ability of the United States to deal with its trade balance and external trade deficit situation, so I would take the opportunity——

Senator KENNEDY. Why don't you comment on where that flow chart goes in the next 3 years, either with or without the energy program?

Mr. BERGSTEN. Over this year, the course of 1978, we would not expect any significant change in the value of U.S. oil imports, the main reason being the increase of production from Alaska now coming onstream. But over the next year or two there will again be some increase in the level of our oil imports, perhaps by $3 or $4 billion in 1979, and perhaps a bit more in 1980, depending upon what level of inflation one assumes. But the volume of our imports is likely to pick up again over the next 2 or 3 years, increasing the cost of our oil imports in the shorter run.

If we can bring something like the national energy plan into effect and do it quickly, we should then begin to get some major effects by the early 1980's, and by the mid-1980's reduce oil imports by perhaps 2.5 or 3 million barrels a day. This would at least keep the oil import situation from getting any worse than it is today in terms of our balance-of-payment situation and enable the normal increase we would expect in our trade balance on other items to pick up the slack and get the kind of improvement we need in our overall position.

Now in the meanwhile we have not simply sat back and waited for the Congress to act. We have made a major effort to avoid any——

Senator KENNEDY. Good for you.

Mr. BERGSTEN [continuing]. We made a major effort to avoid any increase of world oil prices this year that would have further driven up our oil import costs. We were successful with that through extensive efforts with the oil-producing countries, including Saudi Arabia, that you discussed before. However, it is clear that for the longer run reducing our own levels of consumption and getting increased production into line are going to be critical factors in what happens to the world oil price and therefore U.S. import levels.

Let me turn from that to the question you have been focusing on yourself earlier this morning, the issue of increased oil production and what that can do on the energy fronts.

In terms of reducing U.S. vulnerability to supply interruption——

Senator KENNEDY. Just before you do, could you comment on what your estimate is in the refinancing of LDC energy costs? What is

going to happen and how do we perceive that over the next few years? Can you give us any insight on that?

Mr. BERGSTEN. The overall balance-of-payment deficits of the developing countries rose, of course, very sharply after the oil price first went up, but in the last couple of years it has declined and runs roughly now at about $25 billion a year. That is the current account deficit of the non-OPEC developing countries. That, in fact, is not so abnormal given the fact that developing countries should usually run current account deficits in order to import capital and promote their own development program.

To the surprise of many people, those deficits of the oil-importing countries have been financed quite effortlessly over the last 2 or 3 years. There have not been major defaults. There has not been international monetary instability.

Senator KENNEDY. Where is it coming from?

Mr. BERGSTEN. The OPEC money itself, the OPEC surpluses which have resulted from their increased oil prices have been channeled to some extent directly, but more so indirectly through the international financial markets to these developing countries. There has been an increase in official assistance, particularly through the World Bank and the other international development banks, but the private money markets have, in fact, financed about three-quarters of the current account deficits which are the counterpart of the OPEC surplus.

They have done so on quite a smooth, effective, and stable basis, again contradicting some of the alarms that were raised in this area some 2 or 3 years ago. These flows and imbalances have to be watched carefully.

Our regulatory authorities have to be vigilant in their surveillance of the international activities of U.S. banks and financial institutions, but on the whole it has worked quite successfully, and we think it will maintain a high degree of stability. There have been fewer defaults and requiring of rescheduling of LDC debts in the last 3 years than in the last 10 to 15 years on an annual basis.

Senator KENNEDY. What is the significance of this amount being in the private sector? What should be the things you are concerned about?

Mr. BERGSTEN. I think the main concern would be that individual recipient countries were borrowing beyond their means, borrowing simply to finance consumption of oil or anything else, and putting themselves in a position where they could no longer repay that debt on a steady basis. A related concern would be of lenders, particularly in the private sector, simply putting out money without any assurance of likely repayments.

We don't think either of those are occurring now. As I say, we are monitoring it very closely. We have improved our data collection. We have improved the international consultative procedures to watch over that, but on the whole we think it is working in an unusually stable and effective manner.

Getting beyond that to the fundametals, I do note that to reduce U.S. vulnerability to supply interruption, I think the United States has already taken the two critical steps, acting domestically to set up a strategic petroleum reserve to give us substantial stockpiles that would protect us in the case of supply disruption, but also remem-

bering that we are deeply concerned also about the conditions of our allies abroad setting up an emergency oil-sharing program through the International Energy Agency's emergency oil-sharing program that would attempt to have the same result on an international basis.

Senator KENNEDY. You don't want to overdramatize the strategic reserve. That is very much in the planning stage. In the area where I come from in New England they still have not settled that and are going through all kinds of gymnastics on that particular issue.

There is a policy to establish a strategic reserve. I am sure they will get on with it. I don't think I would overdramatize the impacts of the strategic reserve.

Our last meetings with Mr. O'Leary and others still show there is a long way to go in terms of establishing such a position.

OK, let's keep moving.

Mr. BERGSTEN. The final point I wanted to come to is what we have tried to do to deal with the question you have been raising this morning, the question of increased supply of energy production around the world. We clearly need it in a number of senses, conventional oil and gas, synthetic gases and hydrocarbons, to develop new technologies and for the longer run solar and fusion——

Senator KENNEDY. Let me interrupt. If this energy package passes now for natural gas—we have the agreements of coal conversion, utility rates—what would the impact of that be on the balance of payments? What is your estimate?

Mr. BERGSTEN. One would have to look at the final details of the legislative package, again, but on the current status that we would hope would pass, I think the consensus view is that when fully in place, it would reduce our oil imports by something like 2.5 to 3 million barrels a day.

The rule of thumb is that every million barrels a day is worth $5 billion a year in terms of constant 1978 dollars. So if we got a 3 million-barrel-a-day reduction, that would reduce our oil import costs by $15 billion from where they would otherwise be. That, of course, would be a major contribution to dealing with our problem of the dollar and our trade balance.

On the question of increased production, as you said, Mr. Chairman, we have, in fact, been trying to move in a number of areas to support increased production of energy, particularly oil and gas, in the developing countries. We think it is an area where the multilateral institutions, the World Bank and the Regional Development Banks, have a major role to play, but where we can use our own Overseas Private Investment Corporation to try to deal with the issue.

The World Bank, as Mr. Sawhill mentioned, made a major study of this issue about a year ago, stemming out of a U.S. initiative in that area and concluded that there was significant potential for increased energy production in perhaps 30 to 40 developing countries with a total impact on world production which they estimated at 5 to 8 million barrels per day.

I stress at the outset this is an estimate that should not be regarded as precise. It is uncertain, as Mr. Sawhill said. all these things are, but it is the best judgment which the Bank could come up with.

In addition, it has to be recognized this 5 or 6 million barrels a day is fairly highly concentrated. Mexico would by itself be a major

element in the picture, Egypt would be a major element, so would Oman. In most of the countries the amounts are small. They would contribute in a major way to those countries' own development by reducing the foreign exchange bottleneck and they would add to the world supply-demand picture.

The World Bank has decided to launch a program which by the time it gets fully on track in fiscal 1980 and 1981 would plan to be spending about half a billion dollars a year in supporting energy development projects in the developing countries.

Now, the half a billion dollars a year from the World Bank, we would hope, is going to be matched by additional funding in the Regional Development Banks and we have been promoting that within the Inter-American Bank. Even so, the funds from these international financial institutions would represent only a part of the energy projects we are talking about because the bulk of the financing would continue to come from the private sector.

As Mr. Sawhill mentioned, we will put the number he mentioned in a different way, the World Bank could see perhaps $6 billion a year being profitably spent to invest in production of energy sources in the developing countries around the world.

Now we think the World Bank can play an important role for two reasons: First, to bring its own finances to the table; and, secondly, to play a catalytic role. This gets to a question you were raising regarding the relationship between the companies and the countries. Both sides of that equation have been very hesitant in recent years in the developing world.

The companies have been afraid they will come in, sink their capital, find some oil and be kicked out. The countries have been afraid they will get euchered by the companies that have a lot more experience and are big international firms and all that. There has been a hesitation on both parts to do the kind of exploration that is essential to get increased output.

We think the international institutions can help both sides of the equations. We can help assure the countries that they will get a fair deal, helping them in writing contracts, and their participation in the deal and at the same time give the companies some assurance that the contracts that are worked out on a fair basis on both sides will be maintained and not unilaterally abrogated in subsequent periods.

It is in this catalytic role in addition to the financing role that we think the banks can play a role. In June of last year the World Bank approved the first loan for oil exploitation, $150 million for oil in India and is now preparing three additional ones for oil production in Thailand, to boost oil production, in Pakistan, are to develop and transmit offshore gas in Tunisia.

The Bank is building up its energy division very substantially. It has been holding meetings with major oil companies to involve them in this activity and trying to provide advice to the countries as to how to attract the investment. The Bank will carry out surveys in 40 different developing countries in order to assess potential projects and see what can be done to increase energy production in all of them.

Senator KENNEDY. Does that include exploration? What does "survey" mean?

Mr. BERGSTEN. That is meant to look at geological prospects to see if there is potential for development to take place. The Bank itself is reluctant to get into the exploration itself.

Senator KENNEDY. Is there any institution that is prepared to get into financing exploration?

Mr. BERGSTEN. The United Nations' revolving fund, I believe, has the capability and mission of doing that. It has not done too much so far. The World Bank does want to work on the exploration problem in an indirect way, however. As I said, one of the fears of the company has been they will come in and spend a lot of money on exploration, find some oil and be expropriated.

By World Bank agreement to participate in the subsequent development stage, we think it can encourage the private firms to go into the exploration stage, feeling they will then have a fair shake of getting the results that occur later on. That is one of the major objectives of the Pakistan project I mentioned where the World Bank has agreed to participate in development if oil were found.

A private U.S. company has therefore agreed to go ahead in an exploration project which could have the kind of results that we are seeking. So the World Bank would go at it indirectly. In terms of exploration help, I believe the U.N. fund is the only international institution that is currently in a position to do that.

Mr. BOSWORTH. The U.N. fund is a small fund. Its capitalization is $25 to $30 million. The average cost of an exploration well can be as much as $100 million. So as a matter of objective fact, the U.N. revolving fund does not have the sort of financial resources required to permit it to play any real role whatsoever in petroleum and gas exploration.

Senator KENNEDY. As I gather from your responses, one of the key terms of the development is going to be gaining information on some aspects of exploration. There really isn't a mechanism for that at the present time other than surveys that are being done based upon information which is available.

I am just wondering how effective a program is going to be if there isn't at least some exploration to find out and get some preliminary information.

In terms of making an assessment about what the mineral resources are, the best possible information is needed. But as I understand from your comment, that is not being done and there really isn't the mechanism to do it. It is not a banking item.

Mr. BERGSTEN. Our own OPIC program is moving in that direction to insure projects by smaller companies in new producing countries, countries that have new production potential that would cover the variety of stages of a contract. I think at the international level we do not have a major program at this time.

Mr. BOSWORTH. If I might comment briefly on that, Mr. Chairman, the World Bank and other public institutions, as Mr. Bergsten has indicated, are expanding their activities in the field of resource assessment, geologic surveys, et cetera. It is correct, however, that there is no public institution at the moment which is making available capital for exploration activities.

Basically, as Mr. Bergsten indicated, this is because this is a very high-risk undertaking. There are a large number of dry holes and those dry holes are expensive.

By and large the private sector, not simply the major oil companies but very importantly the smaller independent oil companies, has demonstrated a willingness to engage in risk capital exploration, which is a role that they are well suited for and a situation with which they are very familiar. But they are reluctant to do so unless they have some assurance that if they find oil and gas, they will be able to stay in the project long enough to recover a reasonable rate of return on their risk capital outlays for exploration.

That is where the World Bank's new program, we think, is of fundamental importance. Even though it is not spending money for exploration, it can get into the contractual relationship at a very early stage and offer the private companies some protection against what they perceive to be political risks, and assure them that if they find the oil and gas, the contract will hold together long enough for them to get a reasonable return on their investment.

Senator KENNEDY. How does OPIC play in this investment?

Mr. BERGSTEN. What OPIC is now beginning to do, and it is only over the last year that it has begun to do it, is provide insurance for the activities of the U.S. firms that are going into the oil business. It has done so already on one project which is an exploration project in Jordan. It has done so on an oil concession project in Ghana. In fact, the response of the firms to the OPIC program has been a very sizable one, and OPIC's problem is going to be to ration its resources, which are fairly limited.

The same problem arises here——

Senator KENNEDY. How much is the guarantee for?

Mr. BERGSTEN. I believe in the Jordan case it is about $30 million, and in Ghana it is roughly the same.

It was $30 million in Jordan and $50 to $60 million Ghana. The problem here is that OPIC does have some limitations both in its overall authority and in the share of its total portfolio it wants to put in this sector. Therefore, we are working on another front.

There are OPIC-type institutions in 16 other industrial countries that insure guarantees to their firms investing abroad. We are trying to have our OPIC work with its counterparts in other industrial countries so they can provide support for the joint ventures which are frequently taking place among the different countries' oil companies.

One of the commissioners of the Common Market was here just a few weeks ago, Claude Cheysson. I had a discussion with him and they are moving in this same direction to try to coordinate their efforts in the Common Market. At the next board meeting of OPIC I plan to make an item on the agency on this issue, for us to work more closely with the other countries who have oil companies, to work in the developing world. If we can get a number of countries involved in the oil projects through the private firms and through the Government agencies, the recipient country will have second and third and, hopefully, fourth thoughts about upsetting contractual relationships, which in turn had deterred the process from going forth as it should. It is a bit the same as we are trying to do through the World Bank international process, so as to stabilize the investment climate and get going the flow of investment capital which is essential to get the kind of production increases we need.

Senator KENNEDY. The point is, how clear is the call in Treasury for this kind of activity and how do you balance this against what might be a State Department position that we don't want to upset the applecart in terms of the relationships with the Saudis? You know, they are holding the price now and they are giving us a continuation of the product, and we had better not rock the boat with regard to some of our traditional resources.

Mr. BERGSTEN. Mr. Chairman, there is absolutely no disagreement on that, be it Treasury, State, the Department of Energy, anybody. We all feel a critical need to increase production around the world wherever it can be done. In fact, I should say in our discussions with the Saudis themselves they are by no means opposed to other countries increasing their production. Indeed, they have shared in some R. & D. activities that would promote the development of new technology production elsewhere.

So I don't think that is a problem internationally or domestically.

Senator KENNEDY. What is the basic kind of problem? What are the bottlenecks to getting this moving? You mentioned close to the half billion dollars—$400 to $450 million—by 1981, with some possibilities for matching with the regional development. Why are we so slow in getting this thing moving and what do you expect from the Congress to try and move it more rapidly?

Mr. BERGSTEN. The reason that the World Bank project was a little slow getting going was, frankly, that it did not get pushed until the change in administrations. The previous administration had sought some similar objectives through a different approach, the so-called International Resource Bank, that had been proposed in 1976, but for a variety of reasons that didn't take off.

When we came in, we concluded it was much better to push with the existing institutions. One of the major points in the London Summit Declaration last May, which President Carter and his counterparts addressed, was exactly this need. I think there have been two constraints in moving more quickly. One is that it is a new activity for these institutions.

Historically the World Bank and the other international lending agencies had really stayed out of the business of oil exploitation. They had done power projects, including the use of indigenous sources like thermal, but they had not gotten into oil on the basis that private capital was available. But what has happened in the last 5 to 10 years is that the investment climate for private investment for energy projects has become perceived by the private companies as very negative.

I was saying that is why we are trying to do a number of things to restore the climate that will attract private investment. The World Bank had no staff, no capabilities, no expertise in this area. They are building it up rapidly, but it does take time.

The second thing is money. The World Bank and other banks have been lending an increasing amount each year for development projects for developing countries, getting into agriculture, basic human needs types of projects. They simply need additional resources.

Another declaration at the London Summit was agreement to support a sizable increase in the capital for the World Bank.

Mr. Chairman, I would hope on these energy grounds as well as other grounds the Congress would support our contributions to the Banks. They have to have that.

Thank you, this completes my oral statement.

[The prepared statement of Mr. Bergsten follows:]

PREPARED STATEMENT OF HON. C. FRED BERGSTEN

I appear before you today to discuss two aspects of the world energy situation that are of special concern to the Department of the Treasury: the impact of the energy situation on our balance of payments, and the roles of the multi-lateral lending institutions and our own Overseas Private Investment Corporation (OPIC) in helping to promote energy investment in the oil-importing developing countries.

ENERGY AND THE TRADE BALANCE

The primary area of Treasury concern is the role of energy in the U.S. balance of payments. The increased price of oil has been the single most important factor underlying the adverse shift in the U.S. trade balance. Our overall trade deficit was about $31 billion in 1977, and should range in the same order of magnitude in 1978. Our oil imports cost about $45 billion in 1977—up from less than $5 billion as recently as 1972. Increased import volume would have raised the bill only to $9 billion; higher prices account for the remaining $36 billion. While our sales to OPEC countries also increased, our trade deficit with the OPEC countries amounts to about $20 billion.

In contrast to developments in virtually all other oil-importing countries, the volume of our oil imports has risen because of reduced domestic output as well as higher domestic consumption. Over the last five years, domestic production declined by 1.5 million barrels a day and consumption increased by 2.5 million barrels a day. Roughly 40 percent of the increase in U.S. oil imports since 1972, or about $16 billion, can thus be attributed to reduced production and 60 percent to increased oil consumption. The effect of higher oil prices on the U.S. trade balance has been magnified by the erosion of our position as a major producing country—not just by rising demand, as is the case of the other major oil-importing countries. This erosion, of course, was underway before the oil price increases and is only now being partly offset by rising Alaskan oil production.

In years to come, the energy component of the trade balance will be dominated by the relationship between the growth in the capacity of the oil-producing countries, in particular the surplus countries, to absorb imports and the U.S. need to import oil. Adoption of a comprehensive national energy program which both pares consumption and expands U.S. energy production is an essential U.S. response to this central part of our trade balance problem.

Early action on this front is necessary to strengthen confidence in the dollar in the exchange markets as well. The weakening of the dollar since late 1977 has correlated closely with growing doubts, both around the world and in the United States itself, that we were ever going to take decisive action to reduce oil imports. Though the National Energy Plan would not produce its maximum results for a few years, its adoption—more than any other single step, from an international financial perspective, would provide convincing evidence that the United States could and would respond decisively to its energy problem. Adoption of comprehensive energy legislation is thus critical for both long-run and short-run reasons.

In addition, I should mention that this Administration has made a major effort to avert any increases in world oil prices—in order to avoid further increases in our oil import bill, as well as to avoid reigniting inflationary pressures and renewed recessionary tendencies around the world. To this end, we have carried out an extensive and ongoing dialogue with the key oil-producing countries. Our recent efforts to convince them that any price increase would be disruptive—for both them and ourselves—were successful Continued success in these efforts, however, will depend in turn on our ability to limit our own demand for energy imports.

The final issue relating energy and our international economic position is the financing of the large U.S. imbalances of 1977 and 1978, and the role of OPEC in that financing. The key here is that U.S. capital markets continue to play a major role in the process of global intermediation between depositors

and borrowers, including the United States itself. The U.S. capital market is roughly as large as the combined national markets of the other major developed countries. The breadth and depth of our market makes it the world's leading national financial market.

We expect that our markets will continue to play a vital role in the financial intermediation process, including investment of OPEC funds and the channeling of funds from OPEC surplus countries to borrowers elsewhere. We estimate that, as of end-September 1977, about $40 billion of OPEC's total assets of $170 billion were in the United States. These assets are held primarily in the form of Treasury securities, other marketable bonds, equities and deposits in U.S. banks. In addition, we estimate that $70-80 billion of OPEC assets has been placed in either national capital markets outside the United States or in the Euro-banking market. Most of these placements were dollar-denominated.

EXPANDED ENERGY PRODUCTION

This discussion has emphasized that U.S. vulnerability to foreign decisions on oil prices plays a major role in our balance of payments difficulties. At the same time, the United States has taken certain steps that should reduce our vulnerability to supply interruptions—including the creation of our strategic petroleum reserve and the IEA Emergency Oil-Sharing Program.

We need to take additional action, however, if we are to be successful in influencing price decisions. Conservation measures go only part of the way. In the longer run, we need to develop all possible energy resources, new and conventional, which can be produced at economic prices. Thus, we need additional energy measures that encourage:

Expanded production of conventional oil and gas, both within the United States and in other areas where potential reserves exist which can be exploited economically;

Increased investment in development of synthetic liquid and gaseous hydrocarbons, or close substitutes such as methanol;

Increased investment in development of new technologies for more flexibility utilizing our enormous solid fuel resources; and

Intensified development of energy technologies such as solar power, fusion, wave motion, etc., which have the advantage of non-depletability.

U.S. policy toward oil and gas production in non-OPEC developing countries complements our domestic energy objectives, by seeking to encourage the LDCs to develop their indigenous energy resources. This effort deals directly with one of the most severe bottlenecks to their own development—the crushing costs of oil imports. At the same time, it will improve the worldwide energy demand/supply balance.

Such steps will require substantial investment. It was necessary, therefore, to consider the best way to provide the resources needed for such investment as well as to remove barriers to it wherever possible. This led the Administration to take several initiatives, notably in expanding the role of the international development banks and our own OPIC in energy development.

We believe this is an area where the multilateral institutions should logically play a major role. The United States and other participants at several summit meetings have committed themselves to help assure adequate levels of investment in energy production in the nonoil LDCs. The CIEC Ministerial Conference reached similar conclusions last June, including a recommendation that the IBRD expand its activities so as to increase capital flows into development of LDC energy resources. We have made similar proposals to the Inter-American Development Bank.

Our support for this approach is based on the belief that the World Bank, and perhaps the regional banks, could usefully serve as a catalyst in expanding LDC energy production, both through direct participation in energy projects and as a source of lending. Historically, the primary determinant of development banks' role has been the fact that they do not finance activities for which private capital is readily forthcoming. Except for power projects, therefore, their direct financing of energy was largely limited to a few coal projects. Oil projects were left primarily to the international oil companies. Any role for the development banks was limited to associated infrastructure.

After the oil price increases in 1973, LDC energy problems became a focal point of international concern. Initially, particular attention was paid to the impact of increased import costs on their external payments positions. Once facilities were in place to deal with this immediate problem, attention turned to the longer term impact of energy costs on LDC growth prospects.

Perhaps the first major effort to do something concrete in this area was the U.S. proposal at UNCTAD IV (May 1976) for an International Resources Bank (IRB) to promote investment in LDC mineral and energy resources, primarily through an international insurance mechanism. In September 1976, the United States asked the World Bank to study the IRB proposal. This led to a review of the proposal and the general problem it was intended to overcome.

The World Bank's study (Report No. 1588, "Minerals and Energy in the Developing Countries," May 4, 1977) concluded that "establishment of an IRB would not be feasible or generally acceptable, and . . . other solutions of the investment problem in mineral resource development should be sought." As a result of the Bank study and our own further review, this Administration decided not to pursue the IRB concept—but, at the same time, to pursue the same objectives vigorously through existing institutions.

The World Bank report concluded that there was significant potential for additional energy production in 30-40 LDCs, with a total impact on world production of 5-6 million barrels per day. (The bulk of this production would be in Mexico, Egypt and Oman.) The report made a number of recommendations for an expanded effort to promote additional LDC energy sector investment. These recommendations were the basis for an IBRD Board decision in July 1977, approving for FY 1980 an IBRD/IDA lending program of $400-$450 million in fuel minerals alone—which would relate to projects totalling $2-2.5 billion—and an IFC lending level of $50-75 million in fuel and non-fuel minerals. Annual IBRD lending might average $500 million thereafter. The Board also agreed that the Bank should act as a catalyst to mobilize increased private investment in the mineral sector and should emphasize technical assistance. Bank management was instructed to coordinate with the other development banks and report back to the Board in one year. At that time the whole program will be reviewed to set new guidelines for lending limits in the light of experience gained in the first year.

This major shift of Bank policy enjoys the strong support of the industrialized and developing countries alike. An important reason is the conviction among member countries that the Bank's presence in negotiations on energy projects could help allevate friction between private investors and host governments. In particular, host countries might consider the Bank's presence helpful in protecting their interests against giant corporations and in providing impartial advice and information. At the same time, companies might find it helpful in assuring fair treatment in later years. We believe that unilateral action to change contract terms at a later time, which has become a major deterrent to private investment in energy resources in developing countries, is much less likely if both parties are satisfied that a fair agreement was reached at the outset—and if unilateral steps to abrogate contracts later were to involve the entire international community, through the World Bank, rather than just a single company or even a single country.

On June 30, 1977, the Board approved its first loan for petroleum exploitation—a $150 million loan for the development of oil and gas fields near Bombay in India. Since July, the Bank has proceeded to implement the Board's decisions. Among the steps it has taken are the following:

Three additional loans are being prepared for Board approval: an engineering loan to Thailand for preparation of an oil production project, a project in Pakistan to improve the productivity of an existing field and finance a feasibility study for a new oil field, and a project in Tunisia for development and transmission of offshore gas resources;

The Bank's Energy Division has grown from four to twelve professionals. Two provide advice on energy planning and use, and the others search out projects;

Bank staff has had discussions with major U.S. oil companies, seeking to interest them in participating with the Bank in this effort. It is not yet clear how they will respond, but they have expressed interest;

The Bank is seeking to facilitate exploration by providing advice to LDCs on the laws and incentives needed to attract private capital. It is also prepared, at the exploration stage, to indicate a willingness to participate directly in the development phase if exploration proves successful:

Over the next several years, the Bank intends to survey some 40 developing countries for potential projects. All of these have at least promising geologic prospects; and

Bank staff is developing a coordinated approach with staff of the regional banks, which are also developing energy projects.

We believe that the World Bank has responded in a positive way to our initiatives to expand LDC energy production, and that the regional banks will soon be doing so as well. Indeed, these developments show, once more, the great value of these institutions in moving rapidly to promote both U.S. and global economic objectives—a major reason why we should continue to support them strongly. We recognize that energy is an area where the Bank has not had much experience, and will be closely following its further actions in this area as well as steps by the U.S. private sector to take advantage of the Bank's initiatives. The Board's review of the program's first year, scheduled for this coming July, will provide an opportunity for a thorough assessment.

We will also be stepping up our bilateral technical assistance to support LDC energy development, particularly under new authority provided by Section 119 of the Foreign Assistance Act. The Agency for International Development has already submitted recommendations to the Congress as to how to implement this section and is carrying on studies to identify the energy needs, uses, and resources which exist in the developing countries. In addition, the Department of Energy is developing a program of cooperation with developing countries in non-nuclear energy technologies.

OPIC ENERGY PROJECTS

Finally, we are expanding the activities of OPIC to include LDC energy projects. OPIC has introduced a program to develop coverage for new types of energy investments—joint ventures, service contracts, and the like. This type of financing may open up new opportunities for the exploration and development of energy resources. The Administration wants OPIC to continue, and expand, its use of insurance and guarantees in non-OPEC LDC energy projects.

Before 1977, OPIC's exposure in energy projects other than oil refineries was negligible. Under its new program, however, OPIC has insured a production-sharing project for oil exploration in Jordan and insured an oil concession project in Ghana. In the Ghanaian project, OPIC insurance facilitates non-resource bank financing that would not otherwise be available for the project.

Private firms have already begun to demonstrate the feasibility of management contracts, service contracts and other nonequity arrangements in all and mineral projects. These approaches offer economic benefits to host countries and profitable opportunities to American companies, and respond to the desire of many developing country governments to maintain sovereign control over their natural resources. They reduce the risk of subsequent contract disruption, and thereby encourage private investment to proceed.

OPIC can play an important role in helping U.S. investors and host countries work out such mutually acceptable arrangements. This will help reduce the tensions which have diverted investment from the developing countries. Also, by reducing the likelihood of expropriation, it will help avoid the inevitable problems for U.S. policy which arise when exproporiations occur, including issues posed by the legal requirements of the Hickenlooper and Gonzalez Amendments and Section 502 of the Trade Act.

The dollar amounts of OPIC activlty in this field will be small compared with the capital requirements for most energy and raw materials projects. Leveraging of OPIC's involvement will thus help it have a significant impact. To do so, OPIC is seeking to coordinate its efforts with similar institutions in the sixteen other countries in which they exist—particularly in the European Community, which has already begun to coordinate its efforts for similar reasons. This coordination would minimize the likelihood that host countries would renege on their end of investment bargains, by increasing the number of home countries which would be adversely affected and thus increasing the stakes of host countries in maintaining cooperative arrangements.

CONCLUSION

Thus, to conclude, we have made some progress in putting in place policies that will reduce U.S. vulnerability to foreign price and supply decisions, assist the poorer countries to expand production of their indigenous energy resources, and reduce the impact of higher oil prices on our balance of payments.

Additional actions, however, are necessary. Quick passage of the Administration's energy program is the major such step. For the longer run, we will continue to promote increased production throughout the world. As new energy production comes onstream, both within the United States and elsewhere, both the United States and the world as a whole will become less vulnerable to the energy crisis.

Senator JAVITS. Will the Chair yield at this point?

Senator KENNEDY. Senator Javits.

Senator JAVITS. Gentlemen, you are having trouble with the Congress because you haven't identified for the Congress where the interests are of the American people, the American business, and American employment in the IFI, and when you do, your troubles will diminish. These abstractions no longer go. So when both Treasury and State get down to cases as to what it means to American business and American employment, I think you will find that this will move because you will have the sympathy of the country. Today, as I say I am your greatest advocate, abstractions just don't work. That is what it sounds like. But you simply have to relate it to the practicalities of the American economic scene. Then I think it can work.

Mr. BERGSTEN. We will do our best to meet that adjustment.

Senator JAVITS. I think it is your problem. It is my problem, too, but I am just telling you what the story is.

Senator KENNEDY. What are the sizes of the companies you are dealing with, with OPIC? Are you emphasizing the smaller companies?

Mr. BERGSTEN. Yes, including some which are newcomers to the energy business, in the case of the Ghanaian projects, in fact, it is a small consortium of companies which have been involved in other types of activities which are newcomers and we think this is an important aspect of it to add to the diversity of countries and companies in the oil markets to increase the competitive nature of the market.

Senator KENNEDY. Can you elaborate a little bit on the types or you could submit it? I would be interested to what extent these guarantees are going to the majors, what to the middle-sized, and the companies themselves who don't have inherent conflicts of interest with the major OPEC countries, and what the policy view of the Department is on that issue.

Mr. BERGSTEN. None of the projects so far have been for major companies. The two have been for smaller companies, Filon and Agri-Petco, which are newcomers to the business. There are several applications in now; namely, from again, smaller companies, and we will submit a full list of what that profile looks like.

Senator KENNEDY. Is that because the larger ones are not moving into these areas or the smaller ones have come to you or what is the reason for it?

Mr. BERGSTEN. I think it is a combination of the two things. The smaller companies do tend to go for the smaller projects and we do, under OPIC policy, limit our exposure to about $50 million per project, and about $100 million per country. As the oil business goes, Mr. Bosworth said before, those are not large amounts of money. So we tend to get smaller companies, smaller countries.

Mr. BOSWORTH. I might point out that, among the early projects being undertaken through the new World Bank program, at least

two, which are in the preliminary stages, include participation by the major oil companies, not the small independents.

Senator JAVITS. I would like to ask some questions as long as the Chair has paused long enough to ask questions of his own, because I have another hearing. May I do that? I will confine myself to 10 minutes.

Senator KENNEDY. Of course.

Senator JAVITS. Mr. Bergsten, your testimony is very interesting for what it implies as well as for what it says. One of the things I want to ask you about, referring to your prepared statement, is regarding intermediation; the financial intermediation process of channeling funds from OPEC surplus countries to borrowers elsewhere. Now, isn't it a fact that that money goes into American banks or through American intermediation channels which are liable for the money as original debts and that then the LDC's are liable over to them, is that correct?

Mr. BERGSTEN. It goes through both American and foreign banks but there is the private channel in the middle; yes.

Senator JAVITS. You give us the figures on that which I think is very important. You said we estimate, as of the end of September, that about $40 billion of OPEC's total assets of $170 billion were in the United States. These are held in the form of Treasury and other marketable bonds, equities, and deposits in U.S. banks. The U.S. banks are the financial intermediary you are talking about, isn't that true?

Mr. BERGSTEN. Right.

Senator JAVITS. In other words, it isn't the Treasury that is an intermediary.

Mr. BERGSTEN. That is right. The major lending would come from the private banks.

Senator JAVITS. Do you have any idea, if it is not a secret figure, as to the amount involved in that intermediation?

Mr. BERGSTEN. I am looking up the detailed data. Actually, in terms of OPEC assets in the United States the large bulk has been in Treasury and other securities. The bank deposits of OPEC countries tend to be in the Eurodollar and Eurocurrency markets and that is a large chunk of that non-U.S. share of about $130 billion that I mentioned in my statement.

Senator JAVITS. I think it is very important to get the U.S. bank figure, because, after all, if you are talking about $40 billion, that is getting pretty close to the total capital of the U.S. banks, and they are borrowing short and lending long, and that is what worries me and worries many other Americans.

Mr. BERGSTEN. Our estimated, our figure for OPEC bank deposits in the United States between 1974 and September of last year was only about $6 billion of this $40 billion total. The rest of it was in marketable securities.

Senator JAVITS. This, as I say, is being borrowed short and loaned long, isn't that right?

Mr. BERGSTEN. Technically, that is right, although given the increasing holdings of the OPEC countries, the strong tendency is for them to maintain their deposits, roll them over, and keep them in the institutional channels where they were. Even if they switched from

one bank to another, the interbank channels funnel those back into a balanced state——

Senator JAVITS. Certainly, and the Eurodollars are also very heavily U.S. banks like Citicorp, Chase, and others which operate worldwide. You have something, I think, in the area of $200 billion or $300 billion in so-called Eurodollar currency operation; is that correct?

Mr. BERGSTEN. Right.

Senator JAVITS. So that is a liability. It may be operated abroad, but it is a liability to the U.S. banks. It is my considered judgment, as the General Accounting Office has said, that we have to put a lot more muscle behind the matter of getting original indebtedness from the OPEC countries to the less-developed countries, and this intermediation business is very dangerous for the United States. I say that to you flatly, and that is why I came here this morning. You know the facts and you are laying them out very honorably, and I deeply believe this policy is a very serious one.

Second, the Treasury securities may be great for OPEC, but it is just like skimming the top at Las Vegas; it is not a capital pool for the world. Or it is capriciously run by them depending upon money management, where they get an extra quarter of 1 percent. Again, it is my deep conviction that the muscle of the United States has to be placed behind that operation to see that they carry their responsibilities. They are making all the money there is.

Now, the question I would like to ask you—which is fundamental to those, and you mentioned it again very honestly and honorably and knowingly, and I don't think there is anybody that knows it better than you—isn't it a fact that at the Bonn Summit in July, these policies are going to have to be harmonized by the industrialized countries, otherwise we will pay a heavy penalty in a depression or recession for this amount of frozen capital which is enormous, and for the competition, the niggling competition, for these very operations of exploration that you mentioned between U.S. and other firms which are proceeding on totally different guidelines, totally different premises?

Mr. BERGSTEN. Senator, at the summit and at a whole series of meetings, formal and informal, we are constantly working on this problem in an effort to assure continued stability of the international financial system, and to contribute to that to increase the direct flow of OPEC money to developing countries. That was one of the objectives, in fact, of the Witteveen facility that we negotiated at the IMF last year and which the House passed authorizing legislation on quite recently. The reason this administration went for the Witteveen facility in the IMF, rather than the OECD safety net proposed by the past administration, was that it would tap OPEC money directly, and we succeeded in getting 50 percent of the financing for the Witteveen facility, about $5 billion, from the OPEC countries, of which Saudi Arabia put up half. That allowed a channeling of OPEC funds to developing countries. We have tried to get the OPEC countries to increase their funding of the development banks, the World Bank, and the other development banks. Last year, when I completed the negotiation for the fifth replenishment of IDA, we were delighted we got $½ billion for the direct funding of the IDA project. We will seek more on the next replenishment of

IDA. But we did make a significant step forward. So we did agree that a direct channeling of those funds should be attempted as much as possible.

It is correct that the liabilities of the private banks are nominally short term, and some of their credits to developing countries are also, but some are longer term. As I say, this is something that we monitor closely. We increased our surveillance, our data systems, the activities of our bank regulatory agencies. But so far we have concluded that the process does occur on a stable basis, that the mechanisms are in place to deal with any problems that arise, and that we can, with confidence, assert that the system is a stable one given the facts as you have outlined them and as I concur with them. Nevertheless, we watch it closely, and we will do everything we can to improve that stability over the coming months and years.

Senator JAVITS. Do you crank into that the foreign Euroloans for which the banks allow? Do you know what they are?

Mr. BERGSTEN. That is an area where we have been particularly hard at work to increase our knowledge of the factual situation; and working largely through the Bank for International Settlements in Basel, we have improved greatly the data collection so we know what the picture is. In addition, the regular coordinating discussions among the central banks in the BIS, our own discussions with our counterpart Finance Ministries discuss this on a consistent basis to make sure we remain on top of it.

Senator JAVITS. May I say I would look to you for recommendations for anything in the law that prevents or keeps you from getting this data. There is no reason why any U.S. bank carrying that liability shouldn't tell you what it has loaned and where it got the money and on what terms. Is there any prohibition in the law?

Mr. BERGSTEN. I do not know of any. In fact, 2 months ago at mid-January, the bank regulatory agencies, including the Comptroller of the Currency at Treasury, published a new data series which lays out in much greater detail than ever before the disposition of the banking funds you are talking about. It, for the first time, netted out the Eurobanking components of those financial flows so we could see who the ultimate borrower was. Traditionally, if a U.S. parent lent money to its Paris branch which then onlent it to Argentina, it showed up in the U.S. data as a U.S. claim on France, whereas in fact the ultimate liability was with Argentina. And this new data series that our regulatory series has worked out and published 2 months ago for the first time enables us to see where the real financial channels lie.

I will review the question you asked. I will see if there are any problems we think we still have and if so we will be back to you on it.

Senator JAVITS. Now, you said some things about OPIC which are important because OPIC is going to conference. Is there anything in the OPIC bill as passed by the House or the Senate—and by the way, I should be a conferee—which inhibits the plan that you have testified to; that is, oil exploration or fossil fuel exploration in the developing countries?

Mr. BERGSTEN. There was one provision not actively discussed in this year's congressional debate which does place a modest limit. OPIC works primarily through insurance and guarantees, as you well know, being one of the fathers of OPIC, but OPIC has a direct

loan program, a small one, but it can in some cases be useful. There is now in the statute a prohibition on the use of that direct lending program for oil or energy projects. I don't make a lot out of that because I am not sure it would be terribly important but that is, at least, a marginal inhibition in the statute which you might want to review the desirability of that.

Senator JAVITS. If it is an open question in conference, I will certainly review it. Could you get me the departmental opinion, especially the Department of Energy, as to any reason why that should or should not be in the law so that we have that.

Finally, may I say, Mr. Bergsten, I realize your position, you are speaking for the administration, but it is my considered judgment that of all the cases that justify linkage, this is a situation that justifies linkage. We are the sole primary security of the world, including the OPEC countries, economically, diplomatically, financially, and militarily. It is high time we used it for the benefit of all of us. We have to use it in these negotiations to accomplish these purposes.

Thank you, Mr. Chairman.

Senator KENNEDY. We are going to hear from Mr. Bosworth unless there are other questions.

Senator JAVITS. I apologize.

Senator KENNEDY. Not at all, Senator, they were excellent questions.

Mr. Bergsten, in your prepared statement, relative to the GAO report, you said:

> However, the recommendations which flow from it cannot be supported by the Treasury in their present form specifically with respect to your suggestion that the United States Government provide official support for oil import supply contracts negotiated by U.S. firms the Treasury is not in favor of injecting the U.S. presence in what we view as a private international transaction.

Of course, the recommendations were to get information and intelligence on the nature of these agreements, and it would appear to be a rather negative comment on that particular issue. I don't know whether you want to make any comment before we go to Mr. Bosworth.

Mr. BERGSTEN. Only to say that was our comment on the draft report, and I think some changes were made in the final version. I think that is the only comment I would have.

Senator KENNEDY. Do you want to see if you have a different position?

Mr. BERGSTEN. I will review it.

Senator KENNEDY. Mr. Bosworth, just as an opening to that, I want to also indicate the attitude of the Department on this and on the GAO report, where this subcommittee had invited responses by the Department for reactions to the recommendations. There are some rather important recommendations along the lines that we have talked about here and incentives for developing new foreign resources, issues which I raised earlier, and Senator Javits and others have raised, the question of the importance of developing the resources in other countries. We might develop that in the course of our exchange. For example, we question whether U.S. policy has addressed the opportunities for developments in non-OPEC coun-

tries to increase the world supplies in which the United States would share. It then says we believe there are opportunities to encourage development in non-OPEC countries and then tie such resources to the United States, and it points out the potential opportunities. It mentions that most of the countries consume little energy relative to the developed industrialized countries, so they will probably seek to export as much oil as possible in order to reduce their needs for U.S. aid. They continue, "We believe the U.S. efforts should be directed more specifically toward encouraging private oil companies to increase their activities in LDC's."

In the State Department's, Mr. Katz' comments in the latter part of the report, they say, "We have some basic problems with the analysis and we therefore believe that the proposal that the executive branch prepare reports on how to implement the recommendations is not well founded."

Now, I think that is one of the most arrogant statements that I have had the good opportunity to read in terms of a request, a serious request, either by this subcommittee and by the GAO. No one is accepting every final dot and "t" and comma in that report, but there are many recommendations which are extremely important, very thoughtful, and along the lines that we have heard important testimony from people who have given this a great deal of attention. I just thought it might set the stage a little bit for your testimony.

Senator JAVITS. Could I join you in that completely, Mr. Chairman, and request that the Department respond to us on this record so we see whether they repeat the same response they made to the GAO?

Senator KENNEDY. I think we should make such a request.

Mr. BOSWORTH. We will be happy to respond to that request, Mr. Chairman.

[The following information was subsequently supplied for the record:]

DEPARTMENT OF STATE'S COMMENTS ON THE GAO DRAFT REPORT: "RELATIONSHIP BETWEEN U.S. MULTINATIONAL OIL COMPANIES AND THE GOVERNMENTS OF THE ORGANIZATION OF PETROLEUM EXPORTING COUNTRIES"

We welcome the opportunity to comment on the Review of the Relationship Between U.S. Multinational Oil Companies and OPEC Governments. As you know, the Department of State and our embassies abroad have cooperated with your auditors over the better part of the past two years in order to facilitate their examination of a complex and serious issue to which this Department and others have devoted a great deal of thought and effort.

The report contains a wealth of historical material which is useful to have on the record. Its analysis in some respects is cogent. However, we believe that, as a whole, the analysis and the representation of current policy are incomplete. This has led the auditors to conclusions and recommendations which in some instances already are reflected in our policy and which, in others, if followed, could do more harm than good because they fail to take adequate account of the realities.

We find the report incomplete in its analysis of the basic economic factors underlying the world oil situation. Although the report acknowledges that a seller's market for oil exists, it does not explicitly state why this is the case or how this fact affects policy and negotiations. It needs to be stated more clearly that the oil producers' bargaining power rests on an economic base. The U.S. and the world are dependent upon increasing amounts of OPEC oil for which there is no substitute available in the medium term. This dependence arises, in the first instance, not simply from the oil producers' control of the price and supply of

oil but from the inability thus far of the oil-importing nations to reduce their oil consumption or develop alternative sources of energy to sustain economic growth.

It is this deep dependence on imported oil which is at the root of our vulnerability to price increases and supply interruptions. We agree with the statement in the report that "we should not accept the status quo of risk laden dependence" and we are more optimistic than the authors about the potential of the United States to reduce its dependence over time. Doing so will positively affect the climate in which government and company negotiations with the oil producers are carried out.

At the same time, if demand for oil continues on its present course, most forecasts warn that in the 1980's market forces will push oil prices sharply upward unless oil production is substantially increased. Among the oil exporting countries only a few, principally Saudi Arabia, have much potential for expanding production capacity greatly between now and the mid-80's. Saudi Arabia has a small population and limited opportunities to spend oil income domestically. In this context, a seller's market for oil means that the world needs to buy Saudi oil more than Saudi Arabia needs to sell it. Discussions and negotiations regarding the terms of supply for oil necessarily take place in this context. Unless this is fully recognized, it is easy to overestimate the "leverage" that could be brought to bear in an attempt to "change the groundrules" of negotiations.

We agree with the authors that it is important to encourage oil development in the non-OPEC developing countries. Greater oil production would assist their overall development and contribute to increasing world oil supplies. The U.S. has therefore encouraged the IBRD to expand financing of energy projects as the report notes, and has supported other initiatives to promote LDC energy development. Because of lead times required to explore and develop as yet undiscovered oil reserves, these countries, as a group, will continue to have an oil deficit through 1985 at least.

The authors analyze the importance of long-term sales agreements to oil producing governments and to oil companies, but the extremely important interest of individual consumers and our modern industrial society in a continuous supply of oil has been overlooked. Except during the disruptive embargo of 1973–74, our country has been able to take for granted that an adequate flow of oil supplies would be forthcoming to meet market demand. But unless the importance of this continuous flow is understood, it is easy to believe that we can threaten not to permit ourselves to purchase foreign oil except on terms which we dictate. The threat would not be credible and it could be harmful to the U.S. economy to have to carry it out. If the world oil market is likely to become tighter, as most forecasts suggest, it would seem particularly unwise to encourage companies to meet U.S. oil demand from the world supplies that may be left over after other oil importing countries have taken their requirements under long-term supply arrangements.

In discussing potential leverage for influencing the oil producers' policies, we do not believe that the report adequately acknowledges that the U.S. Government has made a sustained effort to develop a broad relationship with key producers, not least because of our interests in the supply and price of oil. Such factors as the U.S. ability to supply technology, to provide security assistance, to offer investment outlets ,and to be helpful in resolving regional disputes are central elements in this policy. In asserting our interests to producing countries on oil policy questions, we do so in the context of these broadly-based relationships. In addition, as these countries become more integrated into the world financial and trading systems, they acquire a greater appreciation of their own stake in global economic welfare and security.

The U.S. has more to gain through seeking cooperation with the oil producers than by confronting them. Our oil supply and price objectives require affirmative cooperation from them, especially from Saudi Arabia, in increasing production to meet world needs and mitigate price pressures. The positive elements which we contribute to these relationships encourage a positive response to our assertion of our interests. Threatening to cut off cooperation smacks of economic warfare. Such an approach could not achieve our oil supply and price objectives, although it would jeopardize our relations with the producers. They could be expected to react by turning to competitive suppliers of what they need and by retaliating in the area of oil policy. Thus the U.S. strengths cited in the report are more effective as carrots than as sticks.

At the same time, it is not correct to characterize our policy toward the interests of U.S. companies in the producing countries as "hands off". When U.S.

companies have been faced with confiscatory, discriminatory or otherwise illegal acts by producing country governments, and have sought the diplomatic assistance of the U.S. Government, it normally has been given. For example, the United States vigorously protested Libyan expropriation of oil interests of American companies. In the large majority of cases of abrogation or alteration by producing country governments of contracts with the oil companies, the companies have not sought the assistance of the U.S. Government. Nevertheless, the United States has placed on record its views, "with regard to current or future expropriations of property or contractual interests of U.S. nationals, or arrangements for 'participation' in those interests by foreign governments", that "foreign investors are entitled to the fair market value of their interests. Acceptance by U.S. nationals of less than fair market value does not constitute acceptance of any other standard by the U.S. Government. As a consequence, the U.S. Government reserves its rights to maintain international claims for what it regards as adequate compensation under international law for the interests nationalized or transferred." (Department of State Statement of December 30, 1975, printed in the *Department of State Bulletin* of February 2, 1976, at p. 138.) This statement of U.S. policy has been conveyed to foreign governments by U.S. diplomatic posts.

In summary, we have some basic problems with the market and policy analyses underlying the conclusions and recommendations in the report. We therefore believe that the proposal that the Executive Branch prepare reports on how to implement the recommendations is not well founded.

JULIUS L. KATZ,
Assistant Secretary of State for
Economic and Business Affairs.

Senator KENNEDY. While Senator Javits and Senator Hatch are here, Mr. Bergsten, you spoke about U.S. leadership in the World Bank and the IFI's and the other initiatives, I would just underline what Senator Javits has pointed out, that you are going to need high administration leadership in this particular area, in the Congress. I think the statement you have just made and your own obvious interest and writings about this issue in the past are splendid. I think one of the messages I hope you take back is that it ought to be given the kind of high priority, front-burner attention which I think you have outlined. The Members of Congress and the members of this subcommittee are expecting leadership in this area and we are expecting it to be the kind of high priority leadership that I am sure the Department can give.

Our second administration witness is the Honorable Stephen W. Bosworth, Deputy Assistant Secretary of State for International Resources and Food Policy. Mr. Bosworth has been involved in the U.S. food policy for the last 4 years. He was Director of the Office of Fuels and Energy and participated in the organization of the International Energy Agency.

Although you have been involved in our previous colloquy, you are indeed welcome to make your statement at this time.

Mr. Bosworth, please proceed.

STATEMENT OF HON. STEPHEN W. BOSWORTH, DEPUTY ASSISTANT SECRETARY OF STATE FOR INTERNATIONAL RESOURCES AND FOOD POLICY

Mr. BOSWORTH. Thank you, Mr. Chairman. Given the shortage of time, I would propose not to try to summarize in great detail the prepared statement I have submitted for the record.

Given the subjects of discussion this morning to date, I thought it might possibly be useful to try to place in some perspective the

administration's attitude on this very critical question of energy development in the developing countries, and I would be happy to respond to questions or comments on the other subjects covered in my statement.

Mr. Chairman, if there is any impression that the administration in any way downplays the importance of accelerating to the maximum extent possible energy development in developing countries, I would like to correct that impression. We consider, I think, in all agencies in the administration, that the most rapid possible development of alternative energy sources—alternative to those oil supplies presently coming from OPEC—is in the highest national interest. Mr. Bergsten has outlined this morning the several programs that we have already put in place or are now studying which are designed to accelerate that process of energy development in the non-OPEC developing countries. It should be noted, I think, that this new activity on the part of the World Bank that we have discussed already this morning was very directly a U.S. initiative. This was a proposal we made in the Conference on International Economic Cooperation in Paris and was adopted by that Conference in its final ministerial conclusions.

I think, though, Mr. Chairman, that while I want to emphasize the importance that we place on this issue, I should state clearly that we do not feel that in the medium term, at least, that as Mr. Sawhill said this morning, there is any bonanza out there that we have not yet discovered. There are problems. The development of energy in the developing countries is constrained by two factors; one is the resource base that exists, and there is a good deal of uncertainty over that; and the other is the policies of those countries themselves combined with the financing and technology requirements needed to bring those resources into production. Lead times are extremely long. Even if the world were suddenly to discover another Mexico, for example, in 1978, it would, on the basis of current leadtimes, be well into the mid-eighties before that oil or gas would be available. That is not to say that it is not imperative that we accelerate our search and exploration for those alternatives; but I think we have to bear in mind that by the mid-eighties the only oil that is going to be in production is really oil that has already been found and we face a very critical situation in the medium term.

Senator KENNEDY. The only point, and I want you to get through your statement, is that it is very difficult for you to say with any degree of certainty about what is out there and what is not out there. No one questions that you have to have some knowledge of the oil and gas to bring it on in terms of the early eighties and the late eighties. But to look over any chart about where the drilling is done and where it has been done, and compare these to some of the areas in the world which have been identified as potential areas for production, you see that it just has not been done to date. I don't know even with the program that has been outlined here this morning in terms of supporting efforts through international financial agencies, where there is going to be very much of a difference. It may very well be after all these types of holes are done all over the rest of the world that there still won't be any production; but to make the statement and the comment that we can say with any degree of certainty that there won't be increased production I think is a courageous statement, but I am not sure it is necessarily an authoritative one.

Mr. BOSWORTH. I didn't mean it to be either courageous or authoritative, Mr. Chairman. My only thought was that while it is imperative that we accelerate exploration to the maximum extent possible in those areas that have not received that many exploration wells and where preliminary seismic information is available—and in the most promising of those seismic areas the exploration is tending to go forward—my point is by the late eighties and the early nineties, there may be significant volumes of oil available in the world coming from currently undiscovered reserves. But the lead times involved are such that by the mideighties that oil will not be available even if it is discovered in the very near future. That does not mean that we should not use all of the instruments that are at our disposal to insure that capital, both bilateral and multilateral and more importantly, private sector capital, is going ahead as rapidly as possible into those exploration activities.

Mr. Chairman, I might speak very briefly in summary of my statement, given the constraints of time, discussing first the origins and nature of the current energy problem and the degree of U.S. vulnerability that evolves from that problem and then outlining in a general fashion the frame-work of the U.S. policy response to this problem.

In summary, Mr. Chairman, the problem that we now find ourselves in is a rather direct result of a series of events which took place in the decades following World War II which resulted in the world as a whole and the United States in particular becoming excessively dependent upon oil in general and imported oil in particular as a source of energy. This has created for us two distinct but related types of vulnerabilities as a Nation. One is the vulnerability that we are all very painfully aware of, possible interruptions of our oil import supplies. As Mr. Bergsten has outlined very briefly, we have done what we think is feasible to begin putting in place a system to respond to that vulnerability, both internationally through the international sharing program and what you correctly described as the still preliminary phase of the strategic storage program, but nonetheless a very ambitious program and a very ambitious set of targets.

The second type of vulnerability we face is somewhat more difficult to define and certainly somewhat more difficult to respond to. That is, that the oil-consuming countries in general, and the United States in particular, because of the underlying factors of supply and demand and because of the fact that oil supplies are concentrated in the hands of a relatively small group of countries, are in a market situation in which we believe we have insufficient control over that market. It is a market situation in which the supply of oil currently available in the world and the price at which it is sold is in the hands of the producing countries and over which the consuming countries have relatively little influence in a market sense.

At the moment, Mr. Chairman, as has been indicated, we are enjoying what may be a respite of 2, 3, perhaps a bit longer, years; but it is only a temporary respite. It is the result of new oil supplies coming into the world market from Alaska and the North Sea, and it is also very importantly the result of the fact that the world economy as whole has been growing at a very slow rate over the last 4 years and thus world demand for oil has not been increasing at a

very rapid pace. So at the moment there is a slight excess of productive capacity in the world beyond that needed to meet current demand.

The U.S. policy response to this problem, Mr. Chairman, must start with the establishment of an effective, comprehensive U.S. domestic energy program. That is essential both for objective reasons and for political reasons.

Objectively, the United States, because of its tremendous weight in the world energy market is the key to moving the world faster in this process described this morning as the transition away from excessive reliance on oil and toward increasing dependence on more plentiful sources of energy. Politically it is important because it is impossible for the United States to exercise fully its leadership position in the world if we ourselves are not seen by other oil importing countries, and importantly by oil exporting countries, to be meeting our responsibility for taking the difficult domestic decisions required to move away from excessive and rising dependence on imported oil. We are pursuing in effect, Mr. Chairman, a policy of three separate but very closely related elements. First, we have established in the International Energy Agency a major new international institution for cooperation among other industrialized countries on the subject of energy. I think it is fair to say that in the past 4 years we have turned the energy issue from one which was threatening to become a very divisive force among the industrialized countries to a unifying force among them. We have put in place an emergency sharing program which is on a standby basis and we believe ready for implementation should it be required. We are also making substantial progress toward the coordination of national long-term programs for the reduction of dependence on imported oil. In that context, Mr. Chairman, I might say we are currently engaged in a vigorous review of individual member country energy programs in the IEA in the context of which we are examining such things as whether or not, for example, those countries which have oil and gas resources are developing them at the optimum rate.

Senator KENNEDY. What is your conclusion so far?

Mr. BOSWORTH. Well, I would have to place the United States in that same group of countries, of course, as do the other countries in the organization.

Senator KENNEDY. That is fine.

Mr. BOSWORTH. I think that there is room for considerable criticism over the pace at which the United States is developing its energy resources. With regard to the United Kingdom, I think their own financial requirements have until now dictated a very rapid pace of development of their energy resources. The situation with regard to Norway is, of course, somewhat different.

Senator KENNEDY. What do you draw in terms of the North Sea oil now of its development? We heard testimony yesterday that it was not being maximized, they didn't believe that it was going to be maximized over the period of the next 5 to 7 years. What conclusions do you draw about both today and the steps that are being taken in Great Britain to bring that on stream?

Mr. BOSWORTH. These policies are, of course, of acute domestic political concern to the countries involved. We are all familiar with

the series of difficult problems the United Kingdom Government has faced. Their progress to date has been encouraging. They are now producing significant quantities of oil from the North Sea and our estimates are by 1985 they will be producing between 2.5 and 3.5 million barrels of oil a day, which given the leadtimes involved, is a rather significant achievement.

Exploration activity continues. Whether or not that should be accelerated is a matter on which reasonable men could have different opinions.

Senator KENNEDY. I don't know whether you are familiar with the testimony we had yesterday about the initial projections, about the reserves there being 15 billion barrels and it was stepped up to 30 billion barrels and now one of the major American oil companies estimates it to be as high as 60 billion barrels. We had from the very distinguished economist with the London Schools of Economics, Pete Odell, indicating that there is a serious underproduction of North Sea oil, bringing that on for domestic reasons. The point is, we are talking about international cooperation. We have to be willing to lay these factors out in terms of both for the Congress and for the American people to find out what our allies are doing, what they plan to do, so we can develop obviously appropriate counterpolicy. Now, is your testimony that they are developing that at the maximum speed possible or not, or what precisely is it?

Senator MCCLURE. Could I interject there? If I recall the testimony correctly, they didn't really identify Great Britain as the one holding back. I think it was The Netherlands and particularly Norway that was holding back.

Senator KENNEDY. It was both. Then he got onto Norway. I am just trying to get the testimony here.

Mr. BOSWORTH. I think in the case of the United Kingdom, Mr. Chairman, they have some very urgent financial requirements which I think, in the near term at least, will tend to insure that they maximize to the technical degree possible their production. Norway is a different case, as I indicated earlier. Norway has made a very deliberate national policy decision to proceed relatively slowly with the development of their oil resources. They have done that and explained it as a decision required in their view to maintain what they consider to be the quality of life in Norway that they wish to enjoy in the future. They do not want to be inundated with petroleum revenues. They consider that they have a resource which is of long-term value to the country and they intend to develop it in a very deliberate fashion. I should say that in the IEA review process we are not reticent in pressing countries such as Norway to accelarate their development process. On the other hand, we do have to take into account that that is a matter of high national sovereignty and the ultimate decision rests with Norway. I think there is some indication that some of their earlier production schedules have already been increased somewhat, perhaps not as much as some would like to see them increased, but somewhat.

Senator KENNEDY. Why don't we continue.

Mr. BOSWORTH. If I could go on to finish quickly, the second and very important element of our international energy policy, of course, involves our relationships with the members of the Organization of

Petroleum Exporting Countries, OPEC, particularly our relationships with the major OPEC producers. Here, Mr. Chairman, our objective is the past few years, and our objective continues to be, to increase very visibly the perception that these countries and their governments have of their own very fundamental stake in the economic and political health and well-being of the industrialized economies and the world in general. I think that on the basis of developments, considerable progress has been achieved in this area. I think it is quite clear that the success we had, for example, at the beginning of this year in avoiding any further increase in OPEC prices was due in very large part to the appreciation on the part of Saudi Arabia, Iran, and some of the other major OPEC countries that their own economic and political self-interest required a prolongation of the period of stability in world oil prices, and that they themselves had a good deal to lose from the economic instability which could result from any increase in those oil prices.

The third element of our policy, Mr. Chairman, is that which we have already discussed rather extensively this morning, and that is our energy policies and initiatives vis-a-vis the non-OPEC developing countries. There I would only refer to the statements that we have made and the information we have supplied. We are attempting to accelerate both exploration and development of particularly hydrocarbon resources in the non-OPEC developing countries for two reasons. One, because while the volumes of oil likely to be available from these sources will not be substantial until well into the next decade, and even then may be somewhat uncertain because of the uncertainty over the resource base that exists in those countries or in some of those countries, any increment in oil supply coming into the world, particularly oil supply coming from countries who large populations and large financial needs, is of great importance to the world supply-demand balance for oil.

The second and very important reason, mentioned earlier by Mr. Bergsten, is to the extent that any developing country is able to reduce its requirements for imported oil it frees up foreign exchange for other developmental purposes and will greatly facilitate economic development process, a process in which we have a very direct stake since these developing country markets have become, in recent years, very important markets for American exports of manufactured goods and agricultural goods.

I think I would stop my summary here, Mr. Chairman.

Senator KENNEDY. Thank you, Mr. Bosworth.

[The prepared statement of Mr. Bosworth follows:]

PREPARED STATEMENT OF HON. STEPHEN W. BOSWORTH

ENERGY AS A CENTRAL ELEMENT OF FOREIGN POLICY

I am pleased to have the opportunity to testify before this subcommittee. Energy has become a central element in the foreign policy of the United States. The success of many of our important foreign policy objectives, as well as our own national security and economic health, depend to a significant degree on the management and amelioration of the energy problem. It is our hope that sessions such as this will produce not only ideas but also the political consensus that this Nation needs if we are to develop policies that will ease and finally resolve this crucial problem.

At the moment, we have a temporary abundance of oil in the world as a result of new production frfom the North Sea and the North Slope and the

slow growth in demand resulting from low levels of economic activity in many of the major oil consuming countries. However, we cannot allow this situation to temper the urgency of mounting effective longterm energy programs. The interests of the United States and other oil importing countries are threatened by our excessive dependence upon imported oil. For the United States, our rising oil imports are a major cause of our large trade deficit and contribute to an erosion of confidence in the dollar in world financial markets. Moreover, we remain vulnerable to an interruption in our supplies of imported oil, despite the various national and international actions we are taking to limit that vulnerability. More fundamentally, our heavy dependence upon imported oil means that we are not the masters of our own destiny. Our ability to develop and carry out policies responsive to our broad economic, political and social objectives domestically and internationally is constrained by our dependence on imported oil and uncertainty reduction in oil imports and the establishment of a more stable world balance between energy supply and demand will restore to us an adequate measure of command over our own affairs.

Unfortunately, the oil supply outlook beyond the next few years is not promising. Unless we take strong and rapid corrective action, we will face a compounding of our economic and political difficulties. Various private institutions, oil companies, international organizations, and government agencies have attempted to project oil demand and supply through 1985 and beyond. Most of these projections conclude that demand for oil at roughly constant real prices will begin to press against available supplies in the not too distant future; they differ only in their prediction of when that might occur. Some of the most optimistic, in terms of energy balances, posit longterm economic growth rates lower than most nations could accept—thus coming up with a cure that may be worse than the disease. It should be noted, further, that economic growth is not just a force for energy consumption. By stimulating a more rapid replacement of the existing stock of capital goods and consumer durables, which were put in place when energy was much cheaper, growth can accelerate a move to more efficient utilization of energy and thus facilitate our economy's adjustment to higher-priced energy sources.

All forecasts of energy balances contain considerable uncertainty, primarily due to the vast number of variables, in such projections. These include rates of economic growth, OPEC capacity and production levels, conservation measures in consuming countries, the availability of alternative energy sources, and non-OPEC oil and gas production. Another important uncertainty is the role of Soviet Union in the oil market in the next decade. However, it seems clear that even with only a moderate rate of economic growth, demand for oil will begin pushing hard against the supply likely to be available by the mid-1980's ,and possibly before. The consequences of this could be painful. The price of oil would rise substantially, causing significant inflation as it worked its way through the economy, and at the same time depressing economic activity. The United States economy would suffer considerable disruption, but we would be in better shape than most. Those industrialized nations more heavily dependent on imported oil could experience severe economic dislocation, which could threaten political stability. The impact would be heaviest on the oil importing developing countries who would find it extremely difficult to sustain even minimum levels of growth and development.

An effective response to the energy problem requires a close coordination of domestic and international policies. If the world is to avoid crippling shortages and soaring prices, we must accelerate the transition of the world energy system away from heavy dependence on oil toward increased reliance on more plentiful conventional sources of energy and the eventual large scale use of renewable energy. The United States, because it is the world's largest consumer of energy and is endowed with large energy resources, has a particularly important role to play in this transition. If we fail to act promptly and effectively to increase the efficiency of our energy use and to develop alternatives to imported oil, the world energy balance will inevitably worsen. At the same time, however, the success of our own domestic efforts could be undercut if other countries do not meet their responsibilities by limiting their requirements for imported oil.

Thus, the global energy problem is one which by its very nature demands close, continuing cooperation both among oil importing countries and between producers and consumers. But the one irreplaceable element in an effective U.S. international energy policy is a strong, effective domestic energy pro-

gram. Without such a national program, our ability to exercise international leadership is seriously undercut.

There are three closely interrelated elements in our international energy policy: (1) to work with the other industrialized democracies to control the consumption of oil, promote development of alternative energy sources, and to prepare a common approach to possible supply shortfalls or disruptions; (2) to work with the major oil producing nations of OPEC to ensure that their oil production and pricing policies take account of the world's vital need for adequate supplies of oil at stable prices; (3) and to promote the development of oil and gas and other energy sources in developing nations, both to increase global energy supplies and to ease the energy constraint upon these nations' economic growth.

THE OIL MARKET

Before elaborating on the elements of our policy, I would like to discuss briefly the oil market context in which the policy must operate. The international oil market has undergone a dramatic change. The buyers market of the postwar era, which lasted into the 1960's, changed abruptly in the 1970's. The emergence of the U.S. as the world's largest oil importer was a major factor in the supply/demand shift in this decade. In addition, oil demand in other countries continued to grow rapidly, the rate of discovery of new reserves fell off, and Saudi Arabia became the residual supplier to the world. These factors set the stage for the assertion of market power by OPEC, a power directly based on these underlying factors of supply and demand.

Producing country governments have taken over the decision-making authority on questions of supply which was previously exercised by the oil companies. OPEC governments set the basic world market price, and though they control the volume supplied, they do not need a formal production prorationing system, since a few producers, particularly Saudi Arabia, are willing and able to contract and expand production as necessary to balance the market.

The companies, however, continue to play an important role in the technical and managerial aspects of exploration and production, as well as in shipping, refining and marketing, even though they are progressively less involved in production and investment decisions and financing in major producing countries. The companies do influence prices to the extent that they force the readjustment of the differentials in price between the marker crude and various other grades of oil by shifting their purchases at the margin among various available crudes. They do enter into long-term contracts with producing countries out of concern for access to supply, which is also a national concern. But they also retain flexibility to shop around for some of their oil so as to maximize their return.

The producers still derive considerable benefit from the presence of the international companies, particularly because of the advanced technology and expertise they offer. It also serves the interest of consuming countries to have world oil production assisted by experienced and proficient firms. However, there are enough examples in recent years to demonstrate that producer governments can reduce or eliminate the companies' presence without catastrophic results to themselves. This suggests the limits on the ability of the companies to dictate terms to the producing countries.

The governments of consuming countries bring certain strengths to their dealings with the producers, and we are mindful of these as we seek to advance our interests. At the same time, we must recognize that while the producing countries have passable alternatives to the goods and services offered by any one or more oil-consuming nations—including, in some cases. doing without them—the consuming countries presently have no alternative to OPEC oil. In this respect, oil is far different from any other commodity; the position of the consuming nations in consultations and negotiations for copper. sugar, and coffee is far more favorable. I would not want to imply that we have no leverage in dealing with the producer countries. We do, but under present circumstances, an international oil policy based primarily on threats, demands or retaliation would clearly be counterproductive.

We have given much consideration to how the government could influence the oil market so that the interests of our nation as well as of the world economy could be best served. It is our conclusion that there are no shortcuts that would ensure us an adequate supply of reasonably priced oil. Our most effective course of action is to implement long-range, comprehensive-

policies aimed at ensuring an adequate supply through increasing oil and gas production wherever feasible, developing alternative energy sources, conserving oil and gas and shifting as rapidly as possible to other fuels. These policies will, of course, also have a substantial effect upon the future price path of oil.

We must take additional steps, however, to reduce our vulnerability to oil price rises. These involve maintaining close communication with the key producing countries to ensure that they recognize that their own economic and political welfare is inextricably linked with the health of the economies of the oil-consuming nations, and that unjustified price rises will be contrary to their own interests.

COOPERATION WITH THE INDUSTRIALIZED DEMOCRACIES

The focus for this element of our policy is the International Energy Agency. An overriding political objective of this organization, and one which we believe it has made significant progress toward achieving, is to make the energy problem into a force that unifies the industrial democracies rather than divides them. Closely connected with this objective are the goals of (1) ensuring that any future supply interruptions will result in a minimum of economic damage and dislocation, and (2) that the member nations will work together to limit their longt-erm vulnerability to supply shortfalls and price rises through reducing their dependence upon imported oil. To meet the first goal the Emergency Program of the IEA is now in place and ready for implementation if it should be necessary. It ensures that the burdens of future supply interruptions would not fall upon a few nations but would be borne equitably by all. By providing the IEA nations with an effective response, it also reduces the possibility that a politically-motivated embargo will be imposed.

The Long-Term Cooperation Program of the IEA is directed at the second goal—reducing dependence upon imported oil through conservation of energy and accelerated development of alternative sources. Last October, ministers of the nineteen member nations made a commitment to work toward the attainment of a collective target of 26 million barrels of oil imports per day by 1985. Obviously such targets are easier to set than to achieve, and success in reaching them depends largely upon the effectiveness of the domestic energy programs of each of the members. However, the IEA will have a significant role to play. It will review progress toward this objective and recommend measures for strengthening national energy programs. The IEA is in the process of conducting its annual review of the energy programs of all member nations. We and other members intend to examine closely the energy policies of all IEA nations and to make strong efforts to remedy any lack of progress toward reaching our collective goal.

There are other important activities of the IEA, such as the collection of information on the oil market, consultation on the members' positions on issues concerning producer and consumer countries, and an extensive energy R&D effort. We have found all of these to be useful, and during the Conference on International Economic Cooperation (CIEC) last year, the consultation function was invaluable.

Generally, we are pleased with the accomplishments thus far of the IEA. Our future assessments will be influenced to a significant degree by the progress of the reduced dependency effort. But this in turn hinges upon the domestic energy program of the United States. We are the key country; unlike any other nation, if we alone fail to do our share, the 1985 target will not be reached.

RELATIONS WITH PRODUCING COUNTRIES

The general objective of this policy is to sharpen the perception of key OPEC nations of their own stake in the economic and political health of the oil importing countries, and to make them fully aware of the importance of the price and supply of oil to the maintenance of this health. It is inevitable that our dealings with these nations encompass a wide range of economic and political issues of mutual concern, and not center solely upon oil. The current price freeze is in part the result of this broad-based relationship with key OPEC nations. We hope that future price decisions will be similarly determined. However, these nations have made it clear to us that the continued consideration of the issues of oil price and supply in a larger economic and political context must be reciprocal and that the producers should not be ex-

pected to continually expand production and hold down prices to accommodate an unchecked growth in demand.

Given the effectiveness of OPEC in setting and upholding prices, the willingness of Saudi Arabia to continue to act as the swing producer, and the prospects for a tight oil market, we see little prospect of a significant lessening of OPEC's market power in the near term. However, our relationships with OPEC producers have contributed to fairly stable oil prices over the last three years. There have been two general increases of 10% during this period; the marker price is currently frozen. This reflects some degree of restraint. However, the trends in supply and demand are such that before much longer, we will come to the end of the period when we can rely on good relations with OPEC nations to bring about an adequate supply at a relatively stable price. Only a parallel effort to control demand for oil will enable our future dealings with key producers to achieve these objectives.

THE DEVELOPING NATIONS

Our two basic interests in our energy relations with the non-OPEC developing nations are (1) to improve the global balance of energy supply and demand by facilitating the flow of private capital and technology into these nations to increase the production of oil and gas, and (2) by means of bilateral and multilateral aid, to assist these nations in developing a wide range of indigenous energy sources to ease the constraints now placed upon their economic growth by the necessity to import high-priced oil.

Given the reluctance of private companies to undertake activities in nations where they perceive political risk, as well as the suspicion many of these nations have of the companies, we believe that the World Bank and the regional development banks can play an important role in helping to combine developing country resources with private sector financing and expertise. We have therefore supported an expanded role in energy development by the international financial institutions, particularly the World Bank. We must, however, be realistic in our expectations about how much the non-OPEC nations can contribute to world oil supply in the medium term.

Non-OPEC LDC oil production is presently 4.5 million barrels per day, compared to OPEC's 31 mmb/d and OECD's 13.5. The potential for expanding LDC oil production significantly is limited by lead times as well as geological uncertainty. Various studies indicate that by 1985 oil production in these countries may be increased to about 9 mmb/d, of which over 1 mmb/d would come from non-OPEC countries in the Middle East. Thus, the potential supply increase by 1985 from non-OPEC, non-Middle East countries is on the order of 3-4 mmb/d, more than half of which would come from Mexico.

Unfortunately, this increase will not even be sufficient to satisfy the group's projected demand for oil in 1985. Thus, except in the case of Mexico, there is little opportunity for significant U.S. import diversification away from OPEC sources.

Despite the limited potential in the LDCs for the expansion of exportable supply of oil and gas in the next several years, there are good reasons to promote exploration and development of energy sources in these countries. Any increase in supply, whether exported or used to replace imports, will help reduce the pressure of demand on oil supply in the 1980's. To the extent that they are able to reduce their dependence on imported oil and gas, developing countries will be better insulated from the economic consequences of high oil prices. Also, they will become less reliant on international lending agencies, more able to sustain stable economic growth, and perhaps less inclined to turn prematurely to nuclear power as a source of new energy supply.

There are many other potential energy sources that could be important to developing nations. These include conventional sources such as coal and hydropower, but also solar, biomass, wind, geothermal, and others. In this area, expansion of bilateral as well as multilateral efforts deserves close consideration. The Department of State is working closely with the Department of Energy and AID on such programs, and we believe they hold promise for making a contribution to the economic development of the recipient countries. They may also result in the prefecting of technologies that can be used throughout the world.

In conclusion, I believe we are now doing or planning to do the things we should, internationally, to ease our energy problems. A strong domestic policy will enable us to do far more. Though we have not been able to find quick and

easy solutions, I do not want to leave you with the impression that we are powerless to influence significantly the price and supply of oil. This nation has economic and technological strength second to none. We have the capability to increase subsantially the development of our domestic resources and improve the efficiency of our energy use. If we take resolute action at home, our international energy policies will be vastly strengthened. Our credibility and influence with producer and consumer countries alike will be substantially increased. We will have demonstrated that we can affect the oil market, that we are in control of our economic destiny, and that we will not only retain, but enhance our role of world leadership.

Senator KENNEDY. Mr. Bosworth, earlier in your testimony you have said it will take so long to bring this product online one would gather the sense that it might not be important to do so. That is clearly not your intention, I don't think, but I don't get that sense of urgency about what the position of the Department is in supporting efforts and recommendations by Treasury to explore and to support efforts in these other areas of potential production. I am interested in what the attitude of the State Department is, what step you have taken, what meetings have been held, what you are finding out from working with both Treasury and the Energy Department, where has it been in terms of the Secretary's conversations with other world leaders; where are we? I don't get it from your statements—I have gone over and read and reread about the developing nations—and I really don't find very much in there to reach this decision.

Mr. BOSWORTH. I would like to correct any impression that we don't view this with urgency, Mr. Chairman, because we do view it with urgency. I, in contrast with Mr. Bergsten, served in the past administration at a time when the State Department was not receiving full interagency support for some of its initiatives with regard to increased multilateral lending for international development and I am pleased to say that situation has clearly changed. We do attach the highest priority to this. As I said in the Conference on International Economic Cooperation which began in Paris in 1976 and extended through the summer of last year, I would personally consider that the new activity mandated for the World Bank, as perhaps one of its two or three most significant accomplishments. I think it is designed to respond very directly to the need to insure a more rapid flow of technology and capital into the developing countries for the purpose of energy development. With regard to our bilateral program, we have been working very actively with AID and with the Department of Energy to respond to the congressional directive to come up with ideas, suggestions, and recommendations as to how our bilateral foreign assistance program can be more adequately shaped and managed to concentrate on the question of energy development in the developing countries, to reduce to the extent possible the degree to which requirements for imported oil constitute a constraint on their development and to insure that the world obtains every incremental barrel of oil supply which is feasible to obtain from those developing countries.

Senator KENNEDY. I draw this impression not only from your own prepared statement but from the action of Mr. Katz, Assistant Secretary for Economic and Business Affairs, in his comments with regard to recommendations that were made, "The United States has more to gain through seeking cooperation from oil producers rather than

confronting it." I think we all agree with that, but that is not what the issue is in exploring the possibilities. "Threatening to cut off cooperation smacks of economic warfare," and no one is suggesting that. It almost appeared that straw men were being set up in terms of confronting the OPEC states. I don't think anyone was suggesting a very aggressive policy for exploring what possibilities and using international agencies.

Then it continues on in the latter part of the report, "At the same time, it is not correct to characterize our policy toward the interest of the U.S. companies in the producing countries as 'hands off,'" and then there is a long explanation of how they are going to have expropriation. Then, "The proposals of the executive branch on how to implement the recommendations is not well founded." It seems to me that the tone here in the statement is we don't want to jiggle the boat very much with OPEC countries and sure we want to give help and assistance to major oil companies, but the ones we referred to, at least in the State Department's comments here, are not so much the small or independent ones, the ones that are trying to get on this process but again are the major ones that may or may not be threatened by expropriation. I think that is the reason that I have reacted and responded in this way to the Department's position. I think you have tried to give us a different sense about priorities, but it is the reason I am concerned about it. Maybe we are just going over and over the same ground.

In your prepared statement, you have the oil companies entering into long-term contracts with producing countries out of concern for access to supply but they also retain flexibility to shop around for some of their oil so as to maximize their return. I think this gets into the question about whether we can really expect the majors to get on out of those other resources unless we are going to have a national policy, which everyone assumes—at this table—and even though we have perhaps strong differing views, we have to develop an energy policy domestically. What we are trying to perceive is what the U.S. policy is with regard to production overseas, how that impacts both the range of different economic considerations that we are going to have to face, balance of payments, inflation, and all the other range of different factors in which this subcommittee has interest. Obviously the role of the Treasury Department is going to be a key, as well as the attitude of privates in this area. That is why we are pressing these issues so strongly.

Mr. Bosworth. I understand that, Mr. Chairman, and I hope my response this morning has managed to clarify, at least in part, the Department's attitude on these issues. We do attach great urgency to them. In fact, in our reply to the GAO we specifically said that we agree with the authors that it is important to encourage development in the non-OPEC oil-developing countries. It was not our attempt to land exclusively on the LDC's. There are a range of possibilities.

Senator Kennedy. You see that relates to the LDC issue we talked about. Then you come down to the recommendations, like in the GAO report, and these are matters that others have testified to about whether the long-term contracts which give OPEC assured access to U.S. markets is really in the national interest. Clearly it is in the oil companies' interest. Is that in our national interest, and

contracts which would permit OPEC to raise price unilaterally, is that in the interest of the consumer, in the interest of our country? Even information about OPEC-oil company contracts to see what those particular arrangements are, as Mr. Sawhill testified, would be very important information to have. Again, that was recommended by the GAO. The key issue is whether the oil companies operating in their interests is identical to the interest of the American consumer and the American public. There are a series of issues that have been raised which I think deserve the thought and reaction and response by the Departments in dealing with them. That is one of the things we had hoped to be able to gain responses by the Department on those issues specifically.

But I think we will present those to you maybe in a written letter form and ask for your reactions to them.

Senator McClure.

Senator McCLURE. Thank you very much, Mr. Chairman. There are three or four areas I would like to explore in a few minutes, if I may. I am struck by the parallels in the two statements that have a glaring gap in both, and they are the possibility or the role of nuclear energy both in the present and in the future and both in the United States and in foreign countries. I recognize the administration has taken a very strong position on the dangers of plutonium proliferation, and that this perhaps constrains government policymakers in statements concerning it, but at the same time the administration has said they are not antinuclear, that there will be a role for nuclear in the United States and around the world in the near future; and yet in both of the statements—and I would refer specifically to Mr. Bergsten, your prepared statement, and Mr. Bosworth, yours also—you both list alternatives of energy that may be available, but neither statement mentions nuclear. I share with the President that concern about the proliferation of plutonium, but I would underscore in that context a statement you, Mr. Bosworth, make, that says we need a strong, effective domestic energy program, and without such a national program, our ability to exercise international leadership is seriously undercut. I agree with that statement. The same thing is exactly true with respect to nuclear policy around the world; without a strong, effective national program, our ability to exercise international leadership in the nuclear field is also undercut.

I have been confident that we would find a way in which we could meet those twin objectives of guarding against the proliferation of plutonium or weapon-grade fissionable materials and at the same time be able not only to have nuclear power but also to reprocess those fuels. Two weeks ago a process was announced as a result of putting together elements of research that had gone on for a long while in which the spent fuel elements can be reprocessed without elevating them to weapon-grade material and do it all in a closed cycle, so the spent fuel goes in one end and comes out as usable fuel and without having been exposed to the danger of plutonium separation because the plutonium is never separated from the fuels. I would hope the administration, and particularly the President, will take a look at that process as being the answer to the question which they themselves pose and then maybe witnesses from the administration won't have to leave such glaring gaps in pages when they appear in both of your prepared statements.

Mr. BOSWORTH. If I could respond briefly to try to clarify this apparent discrepancy in my statement. First, I would wholeheartedly agree that for the United States and for the majority of other industrialized countries and for some of the larger and more advanced developing countries, nuclear energy, by that I mean the lightwater reactor, is an irreplaceable element in their drive to reduce dependence on imported oil; but that is quite irrefutable, I think. I think the statements of the administration on this point over the past several months have confirmed this. Lightwater reactors are an integral development in the U.S. energy program. We have, in the International Energy Agency, a new nuclear subgroup, designed to examine the nuclear question from an energy policy aspect, not in conflict with the examination underway in the International Fuel Cycle Evaluation program by any means, but to insure that the energy side of the nuclear question is adequately treated, because we have concluded that it is an irreplaceable element.

That part of my prepared statement was confined only to developing nations in general; in our view, many of these developing countries have not only adequate but more desirable alternatives at this point to nuclear energy.

Senator MCCLURE. Some developing countries do not?

Mr. BOSWORTH. Some do not. That is why I was careful to say there are some developing countries that can economically use nuclear energy, but the smaller and poorer companies do not have the electric power grids necessary to sustain a thousand-megawatt nuclear plant, and for them, conventional alternatives such as increased coal and in some cases accelerated use of some of the small-scale renewable energy sources, such as solar power, heat pumps, biomas, et cetera, may well be in the near and medium term and even in some cases in the long term, a desirable economic as well as political alternative to a premature movement to nuclear energy.

Senator MCCLURE. I understand that statement, and I appreciate it. I am concerned by the total lack of reference in both your statements to that possibility. When we look at balance-of-payments problems, I am certain that this country, that Iran in December placed an order for $8 billion worth of nuclear goods that might have been placed in this country, and Brazil, a little earlier last year, placed an order that must range between $5 billion and $10 billion in nuclear goods with West Germany which might have been placed in this country. The dollar figure on that has not been stated, but it included the entire nuclear fuel cycle, from enrichment through reprocessing, and a breeder reactor. I don't think either of those countries is going to reverse that decision. We apparently support and want to continue to support the nuclear industry in India. As a matter of fact, the President, while expressing concern with that country for having developed an explosive device and that development having been based upon the heavy water which we supplied them, in December during his visit to India, he agreed to give them more heavy water. I don't understand the inconsistency of policy in those statements, but I am very much concerned that we do not simply rule that out for developing nations or the lesser developed countries as an option where, as a matter of fact, it might be a good option for them, and certainly we ought not to assume that it is the best option without evaluating the alternatives.

I am concerned, too, with what I hear repeated so often that I don't know whether it has become accepted fact or whether it is an attempt to make it become an accepted fact, that our balance-of-payments problem is solely or almost solely tied up with energy or the costs of energy.

Let me read you a couple of statements by economists, one somewhat less liberal than the other, or one somewhat less conservative than the other, depending on what kind of labels we want to put on them. Arthur Okun, in the Washington Post on January 28 of this year, said:

> Others argue invalidly that U.S. oil imports have been the major source of the balance of payments weakness. In fact, oil imports accounted for only about a third of the increase of total U.S. imports during 1977, in large measure an inevitable consequence of our economic growth. Moreover, U.S. imports contribute little to the excess supply of dollars since the OPEC countries have been very willing holders of dollar assets. To be sure, the United States needs an energy bill and I hope the Senate conferees achieve a prompt compromise on what is shaping up as a constructive long-run program. But no conceivable energy bill can lower our oil imports significantly for some years to come.

That is the end of the quotation from the statement by Arthur Okun. Two days earlier, Paul McCracken, in the Wall Street Journal, made this statement:

> If the United States had only passed the President's energy program, so the charge has been hurled at us, the dollar would not be in its present trouble. This accusation does not reflect accurate analysis. That program would have had very little effect on the country's oil import requirements for several years in any case, and that program's failure to face candidly the question of incentives for domestic energy production, oil, gas, coal, and nuclear, could well have augmented our energy import requirements in the years ahead. Moreover, there are more items than oil in our balance of payments. In fact, from 1975, when we had overall a net export surplus, to 1977, the rise in oil imports accounted for less than two-fifths of the rise of our total imports. Moreover, the U.S. trade deficit was further aggravated by an exceptionally sluggish rise in U.S. exports since 1975.

That is the end of the quotation from Mr. McCracken's statement on January 26, as reported in the Wall Street Journal.

In short, the arguments don't really convince me, and perhaps it might even be said that they failed to continue to impress me that energy policy alone is the reason for our balance-of-payments problem or for the weakness of the U.S. dollar. It doesn't make any sense at all to me to pass an energy bill just for the sake of an energy bill if it is a bad one and thereby exacerbate the very problem which is used as an excuse to cause its passage. That is a criticism that many of us have had of the development or the failure to develop an energy policy or an energy program for our country. While I am one of the Senate conferees who managed to come to some kind of a tentative agreement on the natural gas conference, I have no illusion that if we pass that—get the House to agree, get the administration to agree with that compromise—and then we go ahead and find out what the Senate Finance Committee and the House Ways and Means Committee have in mind for us on taxing policy, that the passage of a bill that puts together all of those five elements will be a national energy program, except in a propaganda sense. I suspect it may fool the unwary, but I don't think the people in financial institutions around the world are that unwary. It isn't going to impress the OPEC countries because they are smarter than that. They know more about energy than to be taken in by a bill which is only a part of a

policy masquerading as a policy, and at best that bill, when passed, if passed, is only a part of a policy. It still leaves much to be said about further efforts on conservation, further efforts on alternatives, further incentives for the production of domestic energy supplies. It seems to me that we have some other reasons why we have a balance-of-payments problem. We have some other reasons why the dollar is under assault. The massive, chronic, continuing deficits in the spending by this country have a very large deal to do with the reduction in the value of the dollar. I know that this administration has, well, maybe I should not put it that way—I believe that this administration has shared in efforts to get the devaluation of the dollar under way to reduce the value of the dollar on the international markets in order to stimulate our exports and deal with this chronic balance-of-payments deficit. I think that is a self-defeating strategy, but I believe our administration, rather than stopping it from happening, actively assisted in having it happen. So I think running more deficits is not going to cure our domestic problems, and it must certainly exacerbate our international problems. I hope we will stop using energy as the scapegoat for all of those problems, while confessing that it does share a responsibility for those problems.

Having made that statement, I think it would be fair to allow you to comment, if you would like.

Mr. BERGSTEN. Senator, I think neither the President nor Secretary Blumenthal or I today have ever said that energy is the sole cause of our trade deficit nor the pressure on the dollar in the exchange markets. We have said it is the single most important cause, and I think that is a fair statement. One cannot look back just 1 or 2 years as the Art Okun and Paul McCracken comments did, but one must look to a longer period, to the $40-billion adverse swing over a 5-year period which clearly is a major adverse factor. To be sure, it can be offset by other things.

Senator MCCLURE. To indicate the increase in import costs is an increase in deficits of a balance of payments is inaccurate.

Mr. BERGSTEN. My only point was this is a big additional import cost. Then the question is what does one look at, the trade balance, the current account, the overall balance and how it nets out on the dollar. There clearly are other major factors that have caused our trade deficit to grow. The most important other factor is the difference in real economic growth rates between this country and the rest of the world. Our economy has recovered much more effectively and rapidly from the world depression of 1975 than have our major markets, which has meant that our imports of all goods have simply risen faster than the markets for our exports.

Senator MCCLURE. Except for Germany and Japan?

Mr. BERGSTEN. No, no, Germany's has been extremely sluggish, last year's 2.4 percent compared with our own 5 percent, which meant not only the German market was growing slowly but Germany, which was so keyed to the rest of Europe as a whole was holding down that whole area. Alice Rivlin to one of the committees presented an estimate a couple of months ago that if the rest of the industrial countries had recovered as rapidly from the world recession as we have the U.S. exports today would be $15 billion higher than they are, which would have cut our trade deficit in half and wiped out our current account deficit.

But at the same time both energy and the differential growth rates have contributed to the deficit. It is quite true that OPEC has invested a lot of its money in dollar assets. But I think the question that has been raised in the financial markets over the last few months is whether the United States is going to take action that will bring down its trade and current account deficit. There is a big difference, Senator McClure, between energy and these relative growth rates. The relative growth rates can only be improved by the actions of other countries, and we have spent a great deal of time and effort encouraging the Japanese and the Germans to accelerate their own growth. That is not something we can do. It is up to them. The one thing the United States can do that will have a major impact on its trade balance and the stability of the dollar is an energy program. Again, I would be the first to agree with you that the program now before the Congress and likely to emerge is not an entire energy program. Secretary Schlesinger has commented publicly about the development of additional plans for a supply-oriented part of the program. It is clear, I think, and we get this every day in our discussions with foreign officials, participants in the private money markets, the OPEC countries themselves, that the installation by the United States of at least the first stage of a meaningful energy program is a sine qua non for stopping the erosion on the dollar exchange market.

Senator McCLURE. I think there will be a tendency to heave a great sigh of relief and say now we have that taken care of when as a matter of fact it will be only a fair beginning on getting that taken care of, when, as Mr. Bosworth so accurately stated, there is a long time gap in initiating the program and seeing any results.

Mr. BERGSTEN. The several policy steps that I have laid out in my statement and that we discussed earlier in the hearing this morning are not usually thought of as part of "the U.S. energy program" nevertheless they are things we are doing over time, they will have an impact on world output, and this will have a great effect on whatever happens here in the legislation.

Senator McCLURE. I hope we will continue to pursue the international nuclear fuel cycle evaluation and we will continue to involve ourselves in IAEA realinements and decisionmaking, and I hope we will continue to send signals to the rest of the world in this field, too, that we intend to develop a credible policy, not an incredible one, and I am afraid many of them, if not most of them, that are involved in the nuclear energy area view our developments in this country as almost totally incredible so far.

I hope we can change that. I think we must very soon if we continue to play in that particular area with the rest of the world. If I may, just a couple of other areas very quickly, in your prepared statement, Mr. Bosworth, you make this statement, "Producing country governments have taken over the decisionmaking authority on questions of supply which was previously exercised by the oil companies."

I think it would be a fair characterization to add to that "and not to the advantage of the United States." We have suffered from the decisions which they have made that a part of our problem in energy and balance-of-payments list in that shift in decisionmaking authority which favored the producing countries more than the previous policy had favored the oil companies, and that we have suffered because of it.

I might indicate, too, that is one of the less than happy results of congressional complaints about multinational oil companies. We may have hurt the multinational oil companies, but we did so at great price to the United States.

I don't hate the oil companies so badly that I want to destroy the United States in the process of making sure they understand in the process how badly I hate them. I understand the drift toward assuming that we can solve our problem by excluding oil companies from foreign country investment, a statement made in one of the two statements about if we—let me try to find it.

Maybe that would be a more fruitful way. We are talking about management contracts and service contracts being the way in which U.S. companies can participate in the development of energy in foreign countries, and the statement is made that gives them greater sense of confidence because they can't be expropriated. I don't know what there is to expropriate in a service contract.

Mr. BERGSTEN. That is the point, Senator.

Senator MCCLURE. So the best way to make sure there is no expropriation is to make sure there is no investment?

Mr. BERGSTEN. No; to make sure the form of the investment is one not likely to be expropriated.

Senator MCCLURE. So that can be nonprivate investment?

Mr. BERGSTEN. No; it would be investment by private firms, perhaps in the form of debt rather than equity, perhaps financed through the capital markets rather than through corporate equity, but bringing the private firms in to provide their management, technological marketing expertise in a form that does not run counter to the overriding view of many host countries of their sovereign authority over the subsoil.

Senator MCCLURE. I understand that, but at the same time, one of the major needs in the production of energy is investment. I don't think there is any disagreement on that.

Mr. BOSWORTH. None whatsoever, Senator.

I think it is a historical fact that the developing countries in general have decided for odd and sundry reasons that, in general, equity investment, which implies foreign private ownership over their subsoil, is something that they will not actively permit to happen in the future.

Senator MCCLURE. So, instead of saying to them that we ought to find a way to enhance the opportunities for investment, we are riding with that and saying we ought to accept that as a decision, and we will try to find some way to get investment done in the face of that policy or in compliance with that policy, perhaps I should say.

Mr. BERGSTEN. Senator, we have actually done both, because the degree of viewpoint held along that line by developing countries differs from country to country, and in some countries, including a couple of the cases I mentioned earlier, equity investment is still not only permitted but encouraged.

The form may change. Instead of the foreign oil company coming in with 100 percent of the equity ownership, it might be a joint venture, a 40-percent share by the external participant.

The point here is by no means to rule out equity investment. Where the host country wants that and seeks it and is willing to present a hospitable base for it, we are all for it. But we have to recognize

that in many foreign countries an insistence by an outsider on majority equity participation rules out the investment.

We want to find the most stable possible base to get the investment in for exactly the reason you are saying to get the capital into place.

Senator McCLURE. Again the statement seemed to be mostly silent on the effort of our Government to stimulate the climate conducive to capital investment except in the terms stated here of nonequity arrangements. The best estimates that I have seen, and I am sure you have seen them, too, for the capital investment requirements to meet energy demand are staggering.

Mr. BERGSTEN. I fully agree with that, but it is also, I think fairly clear, that capital doesn't always have to be provided on the traditional equity terms, that there are many routes to get that kind of capital investment, and in many cases insisting on the traditional equity mode may actually reduce the flow of capital both because of the views of the producing countries and the views of the companies that doing it on the traditional mode would not be stable.

It is the same objective, to maximize the amount of capital that goes into the project.

Senator McCLURE. The amount of capital to meet the demand of the industrialized world, and I don't think this includes the demand of the lesser developed countries, which have greater growth demands than the developed countries, for they have to elevate the standard of living of large numbers of people much more dramatically, but just the industrialized countries' energy demand between now and 1985 is probably on the order of $1.5 trillion.

Mr. BERGSTEN. Of course, in the industrial countries there would very seldom be any problem with proceeding on an equity basis.

Senator McCLURE. I am not sure this investment is just within the industrialized countries because this investment may occur elsewhere to meet their demands.

If you add to that the energy demands for the lesser developed countries and the Third World generally, the capital demand to meet reasonable expectations over the next decade or two must be measured in the trillions.

Mr. BOSWORTH. I think there is no question about that, Senator.

I don't think anybody can put a precise number on it, but it is more money than I can actively contemplate and understand. I think, as Mr. Bergsten indicated, the problem here is to find new facilities—new modes of investment—which meet the objective of the host country which in many cases is to retain ownership over their resources, and yet meet the objectives of the private market, the private sector, the private companies, which is generally speaking to have a reasonable chance to make a reasonable rate of return on their investment. It is for that reason that we have concluded that involving the multilateral lending institutions such as the World Bank adds a degree of confidence and stability to these arrangements which we believe will greatly facilitate that flow of private funds and the technology. The technology is really just as important as the capital, and in the case of oil and gas at least is in the hands of the private sector.

Senator McCLURE. I understand that. I wouldn't want to belabor the point, but I would have thought that the United States might be leading the world in trying to explain what market capitalism is

all about, rather than conceding to the forces of government ownership, wherever that may be.

It seems to me I see too little emphasis on explaining what made the United States and too great an emphasis on acceding to their current conceptions of their own national good, without trying to persuade them perhaps their national good could be advanced by stimulating a more open investment policy in order to get what they need for their own country as well as what we need for our economy.

I will not belabor that further. I have one further question and then I will yield to my friend from Utah.

Mr. Bosworth, referring again to your prepared statement, you are talking about the studies which indicate that oil production and oil demand between now and 1985. I just ask you to comment that this is diametrically opposite the projections that were given us yesterday by Mr. Safer of Irving Trust.

Have you seen his testimony of yesterday?

Mr. BOSWORTH. I had an opportunity to read it very quickly, Senator.

I would agree that the figures that are contained in my statement are at least more conservative than his figures. I think it is important though to distinguish between the time frames involved. Again I used the date 1985. As I said earlier, any oil and gas that is going to be produced between now and 1985 will probably come from reserves that are already discovered.

Mr. Safer is talking, I think, about potential reserves which may be there, and I hope very much they are.

Senator MCCLURE. He was not talking about what the reserves were. He was talking about what production would be and that there is a glut of oil on the world market today and that supply exceeding demand will continue through 1985.

Mr. BOSWORTH. It is true there is what I would consider to be a moderate overcapacity of production in the world somewhat above demand at this time. Our estimates are that will probably last for at least the next couple of years.

Beyond that, however, I think we would be substantially less optimistic than is Mr. Safer about the longer term balance of supply and demand in the world.

As I said in my prepared statement, these are extremely difficult things to forecast. Demand in itself is very uncertain because there is such a high degree of correlation between the level of growth of demand for oil and energy, and the level of economic growth in the world.

We could solve the oil problem for the next decade by a protracted 10-year economic recession because then our demand for oil would not grow. If we assume a rate of economic growth which this administration believes is imperative for the general welfare of the world, then it is almost unavoidable that there will be an increase in demands for energy; and in the next decade, at least, a large share of that increase in demand for energy must be met by increased oil.

On the supply side, clearly there are some uncertainties even over the next 7 to 8 years as to how much oil will be available in the world. Our very careful analysis of all the forecasts that have been made, leads us to be, while I hope not alarmists, at least extremely concerned

that the world could face some time in the 1980's a very tight market for oil in which demand would exceed—assuming a reasonable rate of economic growth—the supply of oil likely to be available.

Now, it is impossible to be precise, but it is our view that the dangers of this situation are such that the formulation of U.S. domestic and international policy must take that worst case into account.

We don't mean to be alarmists and we don't mean to plan exclusively on the basis of the worst case, but it is too essential an issue on which to be overly optimistic.

Senator McClure. I appreciate your comment.

I would invite you if you would like to submit for the record more detailed estimates on both supply and demand, economic growth rates and energy growth rates, because I think that will help us in our record.

I might parenthetically note that there seems to be an implicit thread running through all of our conversations that OPEC sets world price and only OPEC responds to world price, and that, if we could somehow get production outside OPEC, that production outside OPEC will be less than OPEC prices.

It didn't take our friends, the blue-eyed Arabs to the north in Canada, long to raise the price of their oil and natural gas delivered to the United States when the OPEC cartel set world prices, and we are expecting to see some increased production of our friends to the South in Mexico, and I don't think we should have any illusions at all that oil or gas production in Mexico will flow to us or anyone else at less than OPEC prices.

So, even though the production may occur somewhere else, until production actually succeeds in having a price effect upon OPEC prices, it will have no effect at all.

I think you would be in agreement with that; would you not?

Mr. Bergsten. Yes; I think that is an essential point that always needs to be brought into the analysis, that by stimulating additional production in a variety of places around the world, we do hope to both diversify the locale of production which has security implications and desirable on those grounds, but also over time to bring pressure on the overall market situation which would in turn determine the ability of anybody to set the price.

One can deal either with the consequences of administrative prices or the causes of them, and what history has shown us is the effective way to deal with them is with their causes, the underlying supply-and-demand situation.

Which means, if you want to work from our side to conserve or cut back on the extraneous use of energy, so over time those two forces together will have the kind of effect on world price we want to see.

Senator McClure. There is a third element that may be involved, and that is political settlements, or lack of them, in the Middle East in particular.

Senator Kennedy. With that happy note I recognize Senator Hatch.

Senator Hatch. Thank you, Mr. Chairman.

I get a little tired of seeing the use of the energy problem as a rationale for some of the mismanagement that is going on.

What worries me about some of the comments you have made, Mr. Bergsten, although I agree with some of what I have read, is that you seem to be crawling through the balance of payments accounts, import by import and export by export, and have come up with ad hoc psychological forces which are affecting the dollar. Meanwhile, I seem to note that the basics are going by the board.

I think the basics are fiscal and monetary policy, the rate at which we print dollars and the tax burden on investment in the United States of America. I really believe that this is where a lot of our problems are coming from.

For instance, I don't understand why we seem to be discouraging the purchase of Mexican natural gas, which would cost approximately $2.60 per thousand cubic feet, while we are so willing to pay $3.50 for Algerian liquefied natural gas.

That is bothering me. At the same time, this administration is not willing to pay our own domestic producers an equivalent amount so they can invest and produce in a more expensive environment.

Mr. BERGSTEN. No one would deny that the underlying economic strength of a country is ultimately the determinant of its exchange rate, and that certainly is an item that the President has stressed, Secretary Blumenthal has stressed and we would all stress in every discussion of this.

If we were trying to go through line by line and analyze our banana gap and our coffee gap, I think that should be held up to ridicule.

Senator HATCH. There has been an emphasis that the energy crisis is our whole balance of payments problem. Yet this bill—I hardly can call it an energy bill—is not going to produce energy, it is just going to transfer billions of dollars out of the private sector and into the public sector, where they will be laundered, and hopefully get them back to whomever the administration can get the Congress to agree it ought to be given back to.

It is all—

My goodness gracious. If we don't swell this energy package, the United States credibility is going down around the world, and that is what is causing the dollar problems.

In fact, it is only about a third of our foreign exchange problem.

It is certainly part of the problem; we all agree to that. But there are a lot of other problems that involve basic monetary policy to which this administration is not addressing itself.

Mr. BERGSTEN. One could agree to the following step: When the deutsche mark or the Swiss franc strengthen against the dollar one can point to the fundamentals in the sense those countries have lower inflation rates than we do.

Senator HATCH. We are printing money and flooding the market with money. We have an easy dollar society now relative to the German and we are pressing our Federal Reserve System to loosen up even more dollars in the hope that we can solve some of the temporary problems that seem to be here.

Mr. BERGSTEN. No; the Fed in fact tightened——

Senator HATCH. I am talking about the administration's pressing the Fed. You have been pressing for an even easier monetary policy.

Mr. BERGSTEN. No; I think it is fair to say that the administration has announced an anti-inflation program that is going to try to

decelerate the rate of inflation over the next several years in order to deal with the external as well as the internal problems.

Senator HATCH. You can't point to one place where they have wanted to bring down the rate of growth of the money supply.

Mr. BERGSTEN. The administration doesn't determine that.

Senator HATCH. Through pressure it does, and that is what they are pressuring. I don't know whether you disagree with that or not Mr. Bosworth, but I don't think you can.

Mr. BERGSTEN. There is one additional point I was going to make and that is the dollar has weakened in recent months not only against the deutsche mark and the Swiss franc but against a number of other countries which have significantly higher inflation rates than we do, and since the exchange rate is a definition of the measure of the relative strength of the countries, one has to look beyond the underlying fundamentals which you quite rightly point to see why it is the dollar has weakened more generally.

Practically every participant in the exchange markets themselves abroad and at home have pointed to concern that the United States was not going to take action to bring its energy under control.

We could discuss at great length whether particularly, the energy program being discussed is the right energy program or whether this additional element was only one-third of the total, but over a 5-year period it was $40 billion and it is feared it will continue to rise sharply in the future in the absence of a tough domestic program. This would continue to hurt our trade balance even if we screwed down very hard on monetary policy and ran a much slower economic growth rate in this country and would still be a major source of difficulty.

I would never say the energy program is a sufficient answer to the international financial problem we have today, only that it is a necessary component of that program and therefore is essential to be done and to be done quickly.

Senator HATCH. If the dollar keeps sliding, it will raise the price of oil. That is the real potential. All the devaluation of the dollar will do is contribute to further inflation.

As you know, the devaluation cheats our people out of their savings and wages and disrupts trade, and I really believe that the Treasury has been pressuring the Fed to start loosening up the money supply, to keep it an easy money situation.

I think that probably plays as big if not a bigger part in the devaluation of the dollar and the problems we have for the dollar worldwide than the fact that we haven't come up with an energy program. In fact, we won't really have an energy program, even if we enact the President's program entirely.

Mr. BERGSTEN. I am not aware of any pressure on the Federal Reserve to maintain an easy money policy. Neither the Treasury or the administration has made any effort to weaken the dollar in the exchange market.

Over the past 3 months, we have taken steps to intervene directly in the exchange markets which had not been done in many years by the Treasury of the United States. We have worked very hard on specific programs, including the energy program and an anti-inflationary program, and we are making a major effort to boost the efforts of our export programs.

We have tried to develop a wide ranging program to deal with all aspects of this question. We worked very hard to avoid an increase in the world oil price last fall and we were successful in doing that thereby avoiding additional charges to our trade balance.

Senator HATCH. It is fair to point out that the foreign exchange desk at the Federal Reserve Bank of New York, dealing in terms of a few hundred million dollars, has been used on a daily basis to smooth out conditions in the exchange markets.

But, if you stop and think about it, such sums are dwarfed by the billions of dollars that are being created each week at the open market desk. Only if the Fed moves to slow the growth of the monetary aggregates, through its open market operations, will the basic trend in the value of the dollar go up.

Mr. BERGSTEN. I wouldn't disagree for a moment that maintaining a stable antinflationary monetary and fiscal policy is essential.

Senator HATCH. They are not doing it, and there is pressure on the Fed by the administration.

The fact is, while we are helping on the one hand, we are hurting on the other. They are both controlled by the same policymakers. In other words, it leads me to believe that we really are inept in this administration and that there is not an effective economic monetary approach by the administration.

Now, you know all I can do is, in my humble way, analyze it as best I can. I would like to see somebody dispute that.

Mr. BERGSTEN. As you know, the underlying economic situation is a tricky one. We have a rate of inflation that is clearly too high. We want to bring it down and the President has indicated measures to bring it down.

At the same time, we continue to have a rate of unemployment too high. The rate of progress last year was good in bringing it down by more than one full percentage point and creating hundreds of thousands of new jobs but we do still face a situation where unemployment it too high.

We need to maintain a growth rate, while stable, that will continue to bring that rate of unemployment down to acceptable levels, while at the same time fighting inflation through a variety of tools.

It is a complex situation. It is not one in which we can devote our policy instruments to either of those two fundamental objectives and disregard the other and therefore it involves walking a tightrope between the two.

Certainly, the objective of maintaining a stable disinflationary economic policy, in part because of its effect on the dollar abroad, is absolutely essential.

Senator HATCH. I certainly agree. Let's change the topic back to oil and energy.

We have seen figures out of the administration that the energy bill will do great things to increase the supply of domestic energy; yet it was the Senate that insisted on the deregulation of natural gas, which of course has promise, while the President and the administration have been insisting upon coal, which has tremendous problems, as anybody can easily see. In the process, they have created great uncertainty in the energy situation of this society, to the point where businesses are not willing to start converting to coal, especially since some of them just converted to only a few years ago at the behest of the Government.

I was disappointed to see Mr. McKelvey basically thrown out of the management of the U.S. Geological Survey. I think he is a great career civil service employee. He and other consultants have pointed out new sources of energy in the Earth's crust, in the North Sea, in fusion, in solar power satellites, and so forth.

I think ERDA is dragging its feet. Where is there any evidence of practical price and investment decisions out of ERDA which will increase domestic energy supply? All we have seen, it seems to me—and I think this is at the crux of it—all we have seen is the administration's efforts to extend its power over the private energy sector.

It seems to me that the bureaucracy has created this crisis, and it has created more bureaucracy in the process in order to have more control over everybody, and I think that is detrimental.

Mr. BERGSTEN. I think you impute a bit too much skill and intelligence to the bureaucracy.

Senator HATCH. I have to admit I don't think there is too much skill and intelligence demonstrated, but underneath the surface there is a lot of skill and intelligence fomenting the growth of the bureaucracy.

I think we would have to agree with that.

Mr. BERGSTEN. I am not going to defend a growing bureaucracy. Some of the questions you raised are among the most serious we face.

It is beyond my competence to talk about the specific activities of ERDA about additional proposals for increasing the energy supply.

Secretary Schlesinger has proposed additional steps beyond the energy package that will begin to increase this supply area. I know the subcommittee will have many here in a few days.

Senator HATCH. You have been patient with my sort of agitation in this area.

I think we probably need to move on, and I want to certainly cooperate with the Chairman. I will reserve some of my questions for Mr. Schlesinger when he appears.

Just let me add that we have ways of solving this problem without ruining our dollar, by the emphasis on appropriate monetary policy. I think you have agreed with me that this is a sensitive area, and we have to give a great deal of consideration to the other two-thirds of the balance of payments and the foreign exchange difficulty we have.

Mr. BERGSTEN. We need both, we need the energy program, the right kind of fiscal and monetary policy, and I think we are giving it a great deal of attention and we are working on both fronts.

Senator HATCH. I thank you very much.

I have been fairly harsh in some of my comments.

Mr. BOSWORTH. I have been quite content to let Mr. Bergsten respond.

I might make two points very briefly, Senator Hatch. I think there is another link between the energy component of our problem and the other component of our problem, namely the differentiated growth rates in the United States, vis-a-vis those in Western Europe. I think quite clearly the slowness with which private investment has recovered in Western Europe from the recession in 1975 is due in some unmeasureable but nonetheless important part to continued private sector uncertainty—particularly in Europe where they are so dependent upon imported oil—over the availability of oil in the future and the price at which it might be available.

They also look at the United States which, because of our weight in the world oil market, has such a key role in establishing the balance of power between producers and consumers in the world market; and to the extent they fail to see a serious and effective effort to bring our oil imports under control, this exacerbates their uncertainty and slows down the recovery of private investment.

Senator HATCH. I would like the administration to consider one thing. I have talked to the leaders of some of the European nations, and I would submit to you that they are more concerned, not with the fact that we don't have an energy program, but with the fact that we have what is called an energy program, which won't work.

As they have examined the President's program, I think they have been appalled by the inability of the greatest Nation in the world to cope with a problem that really can be solved.

Mr. BOSWORTH. I think there is no question that they will expect more from us, and there is no question as Secretary Schlesinger and the President have indicated very strongly that we intended to do more. This is a first step.

Senator HATCH. I would have liked to have seen some way last year that we could have produced some energy, rather than what we did, which was to pass what I consider to be not even a very good conservation bill.

I wanted to raise these points, but I do want to get back to the chairman.

Mr. BOSWORTH. You had one question, if I could respond, on the subject of Mexican natural gas.

We have, as you know, been conducting discussions with the Mexican Government over the possible import of large volumes of Mexican natural gas.

One of the issues which is still under discussion, and we expect these discussions will continue, is the price at which that gas will be imported.

You contrasted the Mexican price with the price which is paid for imported liquified natural gas which, as you know, in some cases is very high. There is, of course, a very major difference and that is that most of the cost of the liquified natural gas is due to the cost of the infrastructure required to deliver that gas.

The actual price to the producing governments, the producing countries, from which that gas is coming, is much, much lower than any of the prices we have been discussing with the Mexicans with regard to the price that would be paid for their natural gas piped into the United States.

Senator HATCH. My point is it is still a lot cheaper to buy from Mexico. And I might add that I understood negotiations with Mexico had been broken off at one point if not now.

Mr. BOSWORTH. I would not characterize them as having been broken off.

Senator HATCH. They have not been carried on with vigor on behalf of this country.

Mr. BOSWORTH. I think there has been some vigor.

There is some relationship as you can appreciate between that question and the question which has been preoccupying the Congress in general, and that is the price which will be paid to U.S. producers of natural gas.

Senator HATCH. I would think that would be No. 1 priority, but it won't be, because they won't ever make what the Mexicans and Canadians will make.

I remember that, on the floor, Senator Jackson asked how can anybody show us that deregulation will result in an increase in gas production, or that we would be awash in natural gas in America.

The fact of the matter is that Canada hardly had enough to meet their own needs until we started paying more, and now they are awash in natural gas.

I think that is something we ought to pay attention to. I am sorry to take as long as I did.

Senator KENNEDY. I will restrain myself about the rate of inflation in the previous administration, the rate of unemployment and the production of money and all the rest of those.

Senator HATCH. I am sure.

Senator KENNEDY. Mr. Bergman, would it be possible for you to come on the 21st? Could you join us on the 21st of March?

Mr. BERGMAN. Yes.

Senator KENNEDY. We will recess now. It has been an informative meeting. I enjoyed it and learned a lot. I want to thank you for your comments and for your statements.

The subcommittee stands in recess.

[Whereupon, at 12:47 p.m., the subcommittee recessed, to reconvene at 9:30 a.m., Tuesday, March 21, 1978.]

ENERGY IN THE EIGHTIES: CAN WE AVOID SCARCITY AND INFLATION?

TUESDAY, MARCH 21, 1978

CONGRESS OF THE UNITED STATES,
SUBCOMMITTEE ON ENERGY OF THE
JOINT ECONOMIC COMMITTEE,
Washington, D.C.

The subcommittee met, pursuant to recess, at 9:30 a.m., in room 357, Russell Senate Office Building, Hon. Edward M. Kennedy (chairman of the subcommittee) presiding.

Present: Senators Kennedy and Javits.

Also present: Jerry Brady, subcommittee professional staff member; Stephen Watkins and Katie MacArthur, professional staff members; Mark Borchelt, administrative assistant; and Stephen J. Entin and Mark Policinski, minority professional staff members.

OPENING STATEMENT OF SENATOR KENNEDY, CHAIRMAN

Senator KENNEDY. The subcommittee will come to order.

Today's session climaxes the third set of hearings held by this subcommittee since 1978 on international oil supply, OPEC and the oil companies. We are fortunate to have as our principal witness the man who can best answer questions raised by previous witnesses and provide remedies for the future, the Secretary of Energy, the honorable James R. Schlesinger.

Ten months ago, Mr. Schlesinger told us he anticipated no real increase in the price of oil into the early 1980's and he has so far been proven right. He also told us a "crunch" was likely to occur, meaning prices would go up sharply, about 1982 unless the United States reduced its demand by adopting the national energy plan. The witnesses who testified before us 2 weeks ago take exception to this view.

Supply and demand will be in an acceptable balance until 1985, not 1982, we were told by Mr. Arnold Safer of Irving Trust Co., New York, providing an important 3 additional years of working room.

Beyond 1985 sufficient oil is available but countries which could produce intend to "hold in" production, according to Mr. Peter Odell of the London School of Economics, London, England. Encouraged by the prospect of higher prices in the event of scarcity, these countries are holding back, making scarcity a self-fulfilling prophecy.

Moreover, much of the world's potential oil producing areas have not yet been explored, let alone brought into production. The world community could push the "crunch" even further over the horizon

if vigorous exploration programs could be initiated in non-OPEC countries. Instead of going higher, prices could decline. This is the testimony which Mr. Bernardo Grossling will give this subcommittee after Mr. Schlesinger is heard.

Is the United States doing all that it can—in its own best interest—to increase supply through exploration and production, and by providing a market to new producers? Or are we, on the other hand, providing secure access to the U.S. market for OPEC and the major, integrated oil companies?

Have we even explored, seriously and thoughtfully, any of several schemes advanced by our witnesses to create more free market transactions? For example, the futures market in oil products advocated by Mr. Safer?

The answer given by previous administrations to those questions has been, "No." But today we have the opportunity to hear from Secretary Schlesinger.

Then there are the questions we discussed with the State Department on March 9. Does the U.S. Government know what information the oil companies provide OPEC? Do those companies help OPEC allocate supply? Do the contracts between the companies and OPEC countries contain stipulations which are contrary to our national interest?

For years the answers to these questions have been masked by all participants, including the Department of State. The hearing 2 weeks ago did not give us reason to believe that times have changed and the State Department's unwillingness to submit to the Congress a plan called for by the GAO to improve the security of all imports was not encouraging. Today, however, we have an opportunity for a more heartening response from Secretary Schlesinger.

We all agree on the need for conservation. We all agree Saudi Arabia plays a critical role. We all agree on the need for increased production in non-OPEC countries.

What we are lacking—and what I hope today's hearings will provide—are specific answers and concrete actions. For a problem of such overwhelming importance and worldwide consequence, small steps carry us a long way.

Mr. Secretary, we are delighted to welcome you here this morning to return to this subcommittee. We know that you have a time problem and so we will mention to the staffs of the various witnesses that Secretary Schlesinger has to leave by 11:30. That gives us 2 hours, but we know he will be hard pressed to answer questions up until that time.

Mr. Secretary, we are glad to have you here and we look forward to your testimony.

Secretary SCHLESINGER. Mr. Chairman, first let me take this opportunity to thank the subcommittee for postponing the testimony from an earlier date to give us the opportunity to get ready. That was most generous of you in a period of some congestion in our schedules at the Department.

Mr. Chairman, I have prepared testimony. I think that it would be superfluous for me to read the entire prepared statement. Therefore, I shall just make some brief comments and then, if you wish, you can turn to the questions of principal interest to you.

Senator KENNEDY. Fine, Mr. Secretary, your full prepared statement will be printed in the hearing record.

STATEMENT OF HON. JAMES R. SCHLESINGER, SECRETARY OF ENERGY

Secretary SCHLESINGER. I thought that your initial statement, Mr. Chairman, was a most excellent summary of the kinds of issues we face. You referred to some views that are different in part from the official views taken by the Department of Energy, and I think we must recognize that we face uncertainties in predicting the future. Indeed, one does not know to what extent OPEC will respond in a variety of ways, to what extent we will have vigorous conservation efforts, and to what extent we will have economic growth.

So there are uncertainties regarding the precise moment and the precise year in which we will have an imbalance between demand and supply at a particular assumed price, the current price level. But we know that that will come some time in the future. The world has a finite amount of oil. Our best projections are that the world production will peak well before the end of the century.

You mentioned in your opening remarks, Mr. Chairman, that the fact of scarcity could become a self-fulfilling prophecy. I think that that is a concern well taken, and to the extent that one looks at the future of possible scarcity, and for reducing prices, it does create a speculative tendency to hold petroleum off the markets; that would augment the difficulties we fear in the future, and bring them closer to us in time.

Mr. Chairman, we face a dilemma: On one hand, do we underscore vigorously what the prospects are in order to induce the appropriate response by our people, by other nations in the world, while there is time; thus providing the kind of information that may induce suppliers to be less rigorous in coming to the market because of prospects of higher prices at a future date? Or on the other hand, do we do as we have done in the past, and continue to fail to call to the attention of the American people what the long-run prospects and what the long-run energy problems are, thereby including complacency, and bringing about a failure on our parts to respond to the prospective emergency and a failure to take advantage of the time to adjust our supply of stock of capital in such a way that we can best go through this transition.

We have chosen, and I believe that the Congress earlier has chosen, to lay the facts, however harsh, before the American people.

Mr. Chairman, we have gone through the prospects, the prospective supply of oil, and I will come later on to qualifications, but there is no question that some time in the 1980's we will face a demand for oil worldwide that will not be met by the capacity to produce oil at prevailing price levels. The consequence of that is not that we will not have market clearing prices. Indeed, if we fail to take advantage of our time to constrain demand, we will face in the future a prospect of rapidly raising prices and adjustment of world oil demand to the available supply by a shrinkage of that demand through recession.

We have a choice that we can make as a nation because we know that markets will clear and will be in balance. We know that we cannot consume worldwide more oil than we produce, and we know, therefore, that whatever oil is produced will be consumed in that time frame. We have a choice and it is a choice that you refer to in your opening statement. We can take advantage of the time that is

available through deliberate policy to constrain the demand for oil and thus be in a better position in the 1980's; or, knowing that markets will clear anyhow, we can go on willy-nilly, ourselves and other nations in the world, and as a consequence find that the market will clear and that we will not consume more oil than we produce. But the way in which those markets are brought into balance will be by rapid increases, and through the decline of gross national product in our country and elsewhere around the world.

The point, Mr. Chairman, is that there are a variety of balancing mechanisms, and we, for our own part, must carefully choose what kind of balancing mechanism we will employ. That is one of the debates, I must say, Mr. Chairman, that lies beyond the issue of whether the crunch point will be 1978 or 1982 or what have you. Some of the projections assume that there will be worldwide recession, and that, as a consequence, demand will not exceed supply at an early date. They are embracing in such projections the very contingency we seek to avoid—a shortage of energy supplies that brings about a decline in our income, and in the employment in our country and other industrial countries.

Mr. Chairman, we now project that the available supplies of oil run between 52 and 54 million barrels a day production in the free world. That assumes either 8 or 10 million barrels a day capacity for Saudi Arabia.

We project an increase of free world capacity to a level of something like 61 to 63 million barrels a day in 1985. That means a capacity for the OPEC nations of 37 to 39 million barrels a day. Based upon the OECD projection of growth in the industrialized economies, and based upon our aspirations for vigorous conservation measures and a reduced linkage between the growth of economic output and the requirements for energy, we project, in accordance with the blue line in our charts, a requirement for petroleum in 1985 of 66 to 69 million barrels a day. That includes U.S. imports of 11 to 12 million barrels a day.

The question is whether through deliberate policy we can avoid that crunch point in 1985.

If you project present trends, some time in the early or middle 1980's we will have reached that crunch point, with a rapid rise in price and all the consequences that flow from it.

I should point out, Mr. Chairman, that this particular straight line in our chart should be bowed upward, paralleling this lower line; thus, it suggests an earlier date for the crunch point than is appropriate. The chart we will submit for the record will be correct.

Those are the problems we face. Mr. Chairman: whether we choose through deliberate policy to avoid an excessive demand for oil over available supplies with a consequence of a downward pressure on income, output, and a sharp rise in energy prices, or whether, through our own failure in this country and other industrialized nations to take action, we will face severe problems in the 1980's, which would include accelerating inflation, rising unemployment, and very severe balance-of-payments difficulties.

I need not tell this subcommittee that those economic problems could result in severe political repercussions, and that the American public, under such circumstances of unemployment and accelerating inflation, would lose faith in the fundamentals of our economic and

political system. We would then be under as severe a pressure as we have been since the 1930's. Those, I believe, are circumstances which we should strive to avoid.

Thank you, Mr. Chairman.

Senator KENNEDY. Thank you very much, Mr. Secretary.

[The prepared statement of Secretary Schlesinger, together with an attached chart, follows:]

PREPARED STATEMENT OF HON. JAMES R. SCHLESINGER

Mr. Chairman and Members of the subcommittee, I am pleased to be here this morning to discuss world oil trends over the coming years and their effects on American energy policies.

In contemplating the world petroleum markets, one cannot help but be impressed with the importance of the domestic energy posture of the United States. Our success or failure as a Nation in curbing excessive demand and encouraging domestic supply, will be crucial over the coming decade. As a consequence, a domestic energy strategy is a prerequisite for a United States international energy strategy—but just as importantly, it is a prerequisite for continued economic and political well-being both at home and abroad.

The United States—and the industrialized West—fact a choice which is both difficult in its potential consequences and yet quite simple in its logic. World economies in the 1980's will adjust to levels of worldwide and, particularly OPEC, oil production. But if those economies are to adjust in an orderly fashion, the groundwork must be laid now for policies that will allow that adjustment to be made without massive economic recession or prices that escalate abruptly as world demand pushes the price of a limited world petroleum supply sharply higher.

If we begin to moderate our energy growth rate now, and decouple the growth in energy consumption from the growth in Gross National Product (GNP), the United States and the industrialized West and Japan may be able to move through much of the 1980's with minimal long-term disruptions.

Oil prices will rise, but they may rise gradually. Growth rates may slow somewhat, but they should remain healthy and reasonably predictable. In short, the industrialized world should not solve its petroleum problem by replacing it with economic and political problems.

The alternative, however, is stark indeed. If growth in energy demand continues at an unconstrained rate, by the year 1980's world oil production will dictate the solution of our energy problems. Prices will rise sharply as a result of a sudden elimination of excess productive capacity. These price rises will inflict serious damage to Western economies, moving these economies into recession. Demand will then be reduced and our supply/demand problem will "disappear." But with it may disappear any chance for sustaining economic growth—and possible maintaining political stability—in the 1980's.

One way or another, our coming oil supply problem will be "solved" in supply demand terms as world markets adjust. The choice which we face is how painful that adjustment will be, how much damage will be inflicted to the economies of the industrialized world and how much political freedom may be lost if we fail to plan wisely and well now.

We have not arrived at this perilous juncture overnight. In the decades since World War II, the world and, in particular, the industrialized economies, enjoyed an unprecedented period of vigorous, relatively stable economic growth. There was a very close relationship between growth in energy demand and growth in economic activity. In fact, for every 1 percent growth in GNP there was a 1 percent growth in energy consumption. Oil demand grew even faster, meeting an ever increasing share of demand for total energy. The reasons are clear: oil offered unique advantages over other forms of energy; supplies were abundant; and oil was relatively inexpensive.

By the early 1970's, the impact of the United States on the international oil market changed substantially because the United States became a significant importer as domestic production first failed to grow sufficiently to meet rising demand and then began to decline. In 1970, United States oil production peaked at 11.3 million barrels per day (MMB/D), and oil imports grew from 3.4 MMB/D in 1970 to 6.4 MMB/D in 1973. Oil consumption by the other industrialized economies and the developing world also escalated as did their imports. While world oil production capacity was still growing, it was not keeping pace with the steep upward trend of demand.

By 1973–74 the underlying forces of supply and demand were such that the countries of OPEC, acting in concert, were able to impose a massive increase in the world oil price. That price has been maintained because the rest of the world has no readily available alternative to OPEC oil.

A large share of the world energy problem is attributable to the United States. It follows that much of the solution must originate with the United States. As the world's largest energy consumer and oil importer, last year the United States consumed 18.3 MMB/D of oil—over 30 percent of the world's entire crude oil production. United States oil imports of 8.7 MMB/D accounted for nearly 25 percent of the oil moving in world trade, nearly double our share in 1970. This excessive reliance on imported oil endangers not only the future economic growth and security of the United States, but imposes economic and political strains on its relationships with other nations which see their economic and security interests similarly threatened.

When the OPEC oil embargo of 1973 occurred, United States oil imports were 36 percent of total consumption. In 1977, oil imports rose to an average 8.7 MMB/D, nearly half of total consumption, from an average of 7.3 MMB/D in 1976. Imported oil alone cost our Nation $45 billion in 1977. For 1978, the Department of Energy expects that oil imports will drop slightly with increases in demand offset by growth in Alaskan production. This expected drop in oil imports is temporary. It is part of a slight and transitory excess of productive capacity, in large part caused by increased production from the Alaskan North Slope, the North Sea and Mexico, and lower rates of growth, particularly in Western Europe. However, increases in world petroleum demand would require a new Alaskan North Slope every six months or a new North Sea every year and a half, and that seems very unlikely to occur. To plan our energy future on the continued finding and exploitation of such reserves would be imprudent. And similarly, to plan for continued slow economic growth as the means for prolonging this temporary respite—even if only by a few years—would be equally imprudent.

Unless we act now to constrain demand and build a new set of incentives to move away from oil and gas to coal and other energy sources, this respite must be brief. The reasons are clear:

High and growing United States dependence on oil imports will continue to place increasing pressure on the cost and availability of international oil supplies which, in turn, will adversely affect our domestic economy;

Because the economies of our major trading partners are even more dependent on imported oil, any further price increase or supply disruption would place a proportionately higher burden on them;

Because the more vulnerable of the industrialized and developing countries must spend a large share of their foreign exchange for imported energy and simultaneously face shrinking export markets as a result of slower growth in other countries, their economic goals and programs are even more seriously threatened by higher energy prices.

The magnitude of the problem we face must be appreciated. Let us take one possible scenario. If the existing level of OPEC prices remains constant in real terms, projected demand for OPEC oil is likely to grow from an estimated average level of about 32 MMB/D in 1978 to a range of 36–38 MMB/D in 1981 and 42–45 MMB/D by 1985. This range of projected demand assumes that the economies of the non-Communist bloc countries grow at a weighted average rate of just over 4 percent through 1985, the rate projected by the OECD.

With this projected growth rate, worldwide demand will begin to be constrained by worldwide supply in the early 1980s. It should be underscored, however that these figures posit the adoption of vigorous and successful energy programs and policies by major oil importing nations other than the United States. And yet even so, by 1985 there is likely to be a gap between worldwide demand and worldwide supply of some 3 MMB/D to 8 MMB/D.

In short, likely projections indicate two conclusions:

First, that variations in demand and supply rates in the industrialized world—outside of the United States—can delay slightly, but not by more than several years, the point at which world productive capacity is exceeded by world demand; and

Second, that these same variations indicate that by 1985 the net deficit position worldwide could be from 5 percent to 10 percent of worldwide demand.

These projections, however, assume one constant which, fortunately, need not be a constant if Government policies and a national ethic of conservation and

increased domestic production prevail. For they assume that the United States continues on its current course of energy consumption, with imports ranging between 11 and 12 MMB/D by 1985.

One of the principal purposes of the President's National Energy Plan, however, was to postpone significantly the date at which worldwide supply would begin to constrain worldwide demand. If the plan were fully implemented, and oil imports in 1985 were reduced to approximately 6 to 7 MMB/D, we would achieve a reduction of from 4 to 6 MMB/D over the otherwise anticipated figures. In other words achievement of our domestic energy goals would eliminate the projected supply deficit of the low end of the 1985 estimated range and would reduce the supply deficit, even if other industrialized nations were not successful in their efforts, to about 2 MMB/D in 1985.

The success or failure of our efforts in the United States thereby acquires worldwide significance. Of course, there are many uncertainties built into any such projection.

A major uncertainty affecting demand for OPEC oil arises from assumptions regarding the future role of the Union of Soviet Socialists Republics (USSR) and Eastern Europe in the international oil market. Today these countries are net oil exporters of about 1 MMB/D. The Central Inteligence Agency has estimated that these countries will be importing on the order of 2.5 MMB/D of oil in 1985, as a result of oil production problems in the USSR, some of which the Soviets have publicly acknowledged. Other studies, however, indicate a range of from 1 MMB/D surplus to one-half MMB/D deficit.

The projection I have outlined assumes that for political and economic reasons, the Soviet bloc nations by 1985 are at equilibrium and net exports at zero. This assumption is optimistic in terms of pressure on international oil markets. It is possible that some combination of lower economic growth, conservation, increased substitution of gas and coal and improved oil production will occur. If any of these rather favorable assumptions prove wrong, then these countries will become net importers and the demand for OPEC oil will be commensurately greater than indicated.

In the seven years from 1978 to 1985, therefore, the world—and particularly the United States—face an important choice. We can continue healthy rates of economic expansion, while at the same time reducing the rate of energy growth and arrive at 1985 with only a small worldwide deficit in petroleum production. In those seven years, we can begin to plan and execute the movement to coal and nuclear power for stationary power sources and begin the liquifaction and gasification of coal to provide energy in those sectors of the economy most heavily dependent on petroleum today.

The alternative is to face a worldwide supply demand imbalance possibly by the early 1980's. At that time, adjustments would take the form not of a planned movement into an economy more energy-efficient and more reliant on alternatives to oil, but of a sharp and unpredictable price increase, a likely worldwide recession and political consequences all to easy to imagine.

The solution to this energy problem will neither be quick nor easy. Action is required on several fronts for some time to come. Fortunately, the essential elements for immediate action are already clear:

A timely and rigorous domestic energy program;

A strong concerted effort with the major oil consuming industrialized nations;

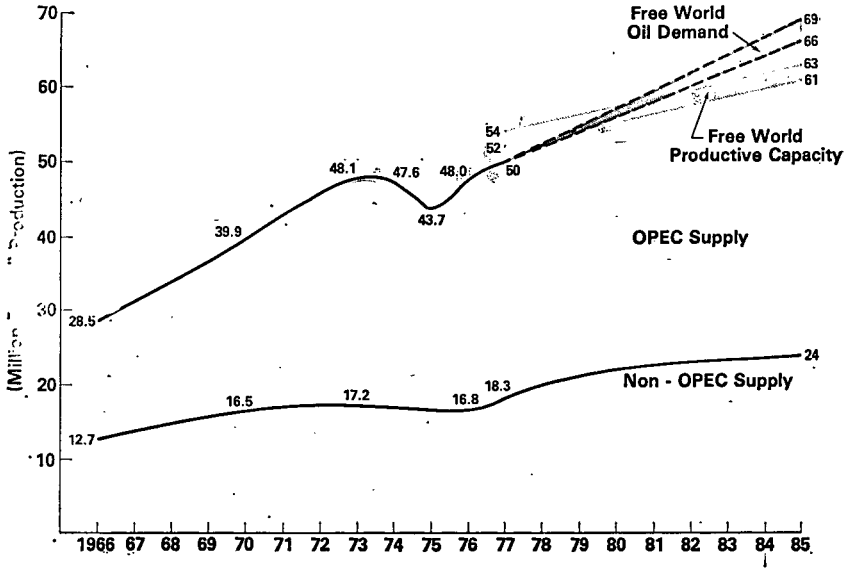
Increasing the cooperation and responsibility of the major oil producers; and

Working with the oil-importing, developing countries to help develop their potential reserves.

The first and most essential step is to enact the President's National Energy Plan. The United States needs a clear and comprehensive national energy policy which will make its energy demand consistent with the replacement cost of oil and which will encourage optimal use of our available fuel resources. Without such a policy, the United States is not credible in the eyes of the world.

Restraint in our energy imports, an increase in our energy supply and a rational policy of energy pricing and use will reduce world demand for scarce energy resources. Just as importantly, it will support our call for international cooperative action on energy problems and restore confidence in American resolve. The United States is a major part of the world's energy problem and must become a major part of its solution.

Free World Oil Demand and Supply 1966 - 1985



Senator KENNEDY. Mr. Secretary, the issues which you have outlined here, about when the crunch is going to come—and that is based upon a variety of different assumptions, which are being modified and adjusted as new information comes to the fore—obviously involve many, many additional issues of public policy; and those underlying assumptions, even if factually correct, still leave the question, how can we best deal with the shortages that we will be faced with?

Now, one of the matters that I would like to direct your attention to, and maybe just to start off, we will run on the 10-minute rule. First of all, in the General Accounting Office, a report that was requested by this subcommittee recommends that the Secretary of State and Secretary of Energy present to the Congress by July 1 a plan for securing supplies by the United States employing policies directed toward swapping.

Senator Javits and I, myself, wrote to the Secretary of State, and we outlined the specific recommendations. We have sent you an informational copy. But the key issues that were raised there were the contractual relationships between the oil-producing companies and members of OPEC. We have not been able to get that type of information, nor do we understand that type of information is available to the administration. In fact, former Directors of Energy Frank Zarb and John Sawhill felt that would be extremely important. Mr. Zarb, I believe, issued regulations to permit the acquisition of that information, but still that information has not been made available.

But just let me mention these items, and you will have a copy of the letter.

Optimum mix between long-term oil contracts and shopping around for shorter term oil supply.

Relative roles of oil companies and OPEC governments regarding oil production decisions, and the effect of tax incentives on company behavior.

As you well understand, there is between American tax policy toward OPEC and the North Sea, and as it relates to other countries around the world in terms of production, "the confidentiality of the IEA data and the ability of Saudi Arabia to vary its crude oil production and the nature and pace of national and multilateral efforts to encourage the proliferation of oil sources," domestically and overseas. And that has been an issue that we have gotten into in the past couple of days in hearings.

But it seems to me that we ought to be entitled to the thinking of the administration on these specific issues. The General Accounting Office feels it is important to look at the oil policy issue in the broader context of our general economic stability. Members of this subcommittee agree that this kind of information ought to be available to us. And I am just wondering if there is any reluctance on your part to develop those kinds of reports for the Congress.

Secretary SCHLESINGER. No, sir. I think that the GAO has raised appropriate questions. It has given these two Departments until July 1 to provide an analysis.

If I may, I would like to make one comment, and that is that a prerequisite for our international oil policy, as covered in my prepared statement, is that until we formulate our domestic policy we are not in a position to have a major impact on the longer term international petroleum markets. So a prerequisite is America's clear willingness and self-discipline to deal with its internal demand situation. But we are prepared to respond on those questions. We will provide you with an analysis by July 1, and we will provide you with whatever information we have at the present time.

There is one area we have out for public comment, a set of proposed rules about how we treat confidential information that comes from the companies, and I would prefer not to make any commitment on that last issue.

Senator KENNEDY. I would certainly agree that we have to move on the domestic side, but I would not necessarily agree that that means we cannot move in these various policy issues that we have raised here.

For example, in the GAO report, the Justice Department's John Schenefield points out that, "In our view, the assumption of passivity on the part of multinational companies may not be warranted. It is unclear what role the oil companies have in setting crude oil prices and production levels."

Then he continues, "To raise these additional questions which basically support the other assumptions," and I just feel it is necessary to answer these as we move along in our domestic policy. And certainly we want and have reported the policy domestically because these issues must be resolved.

Secondly, on the issue of the Alaskan Pipeline, as I understand, the Alaskan Pipeline can move 1,200,000 barrels, and there are sufficient reserves to justify 1,600,000 barrels a day. And at a comparatively small cost increase the pipeline could carry this increased amount; all that is needed is a pumping station.

Since the administration gives the Alaskan oil a special production incentive worth about $30 billion, I can understand it is in the interest

of the oil companies not to move it through the pipelines while they develop their other pipelines. But certainly we could increase our production and get involved in a trading or swapping, and bring more oil into the Northeast and east coast where there is an important need for it.

What can you tell us about the Energy Office position about increasing the production, the balance of payments issue and the value of the dollar?

Secretary SCHLESINGER. Mr. Chairman, we agree with the thrust of your comment. The President has directed us to attempt to increase production from the North Slope. It is running about 800,000 barrels a day. Now, when there are repairs made on the pumping station it should run about 1.2 million. We would like to see 1.5 or 1.6, ultimately 2 million barrels a day. But you pointed to the transportation deficit we presently face on the west coast. We are unable to move that oil from the west coast. We have restraints on our ability to use very large tankers. We operate on the Jones Act. There are a limited number of Jones Act vessels available. There are a limited number of vessels that can go through the Panama Canal. There is a severe transportation problem.

You underscored the possibility of swapping arrangements. We are prepared for those arrangements. The Congress, I think, in the past has spoken quite clearly on this issue; that is, it has been opposed to swapping arrangements.

Such swapping would permit a reduction of the deficit in our balance of payments. It would permit the blending of crude around the world in such a way that the sour crude we produce in Alaska could be more effectively utilized and create a better market for that Alaska crude. It makes a great deal of sense, but we have experienced in the past, I think, that the Senate has been more congenial to the possibility of swapping arrangements than has the House.

Senator KENNEDY. But your point here is that to increase production you do not have the leverage with the oil companies to reach the 1.5 or 1.6 million barrels?

Secretary SCHLESINGER. I think the oil companies would like to produce more. That is——

Senator KENNEDY. You are satisfied that you have the authority and the leverage in terms of the entitlement program to get them to produce?

Secretary SCHLESINGER. Yes, sir. But they have to have a market, and the market for sour crude of the Alaska type is limited on the west coast partly because of the severe air pollution control requirements and partly because the refineries on the west coast are not designed to take sour crude.

That situation can be rectified, but it would take a matter of years. The United States increasingly produces sour crude and overall our refinery capacity is designed to take relatively sweet crude. There will have to be adjustments.

Senator KENNEDY. Senator Javits.

Senator JAVITS. Thank you, Mr. Chairman.

Mr. Secretary, we live in an unreality about the energy bill in that it is not clear that there will not be a wellhead tax and there will be, over a period of years, a decontrol of natural gas prices?

Secretary SCHLESINGER. Well——

Senator JAVITS. And shouldn't we therefore posit our strategy upon what we know is going to be the fact, instead of the illusions which still seem to be spread around?

Secretary SCHLESINGER. We agree, Senator Javits, that given the momentum there should be a natural gas bill that will provide for the possibility of ending controls at some future point in time. The House now appears willing to accept the Senate light at the end of the tunnel by 1985.

With regard to the crude oil tax, no sir. We believe that there is a lively opportunity for the crude oil tax to be passed; that it is far better than the alternatives. They include such matters as the imposition of import fees, which, try as we will to alleviate the pressure on the Northeast, would bear hard on the Northeast. The crude oil equalization tax is the best way indeed, I would say, given the ingenious way to get rid of the bureaucracy involved in entitlement programs and provide uniform prices for refineries without disadvantage to particular regions.

I hope, Senator, that we get that tax through the Senate, and I trust that we can count on your support.

Senator JAVITS. Well, I was not, of course, speaking of my own position.

Secretary SCHLESINGER. May I add, Senator, that Senator Long has indicated he will move rapidly after the deletion of the Natural Gas Act to wrap up tax measures.

Senator JAVITS. We who have been standing by and waiting because these are our own conferees certainly have waited long enough, it seems to me, and the world has waited long enough. And as the administration attributes the fall of the dollar importantly to an absence of an energy policy, and whether you answer yes or no, give us an answer. And I think that is really what we are waiting for here.

The time may be when the rest of us in the Senate have to do something about it. We cannot sit around twiddling our thumbs forever while this deadlock continues. But certainly they ought to have the opportunity to see it through.

My opinion is that immediately after Easter we ought to move. We are expecting these conferees, and I shall do whatever I can about it, and I believe that we simply cannot wait while the interests themselves have this death struggle at the cost of perhaps the solvency of the United States.

Now the other thing I wanted to ask you about, sir, in this discussion, was the situation of the Third World. They are down about $20 billion a year, even at these prices, and they are borrowing —the Third World owes the banks something like $70 or $80 billion of which we are probably in for close to $50 billion and the U.S. banks and the Government around $100 billion, and there seems to be no end to this crunch as far as they are concerned.

What do you think we ought to do about leaning on the OPEC countries to finance the developing countries instead of having us do it? They deposit their money here on short, 7-day call, shopping around for an extra half percent without any regard to what is happening in the world. Then we lend it on what is in effect long term—if it is due in a few years or months, we know it cannot be collected for a long time—how long can that last?

Secretary SCHLESINGER. Senator, you put it very well. We have a structure of international finance at the present time that was never designed to achieve balance given the forces that have been generated since 1973. The equilibrating mechanisms we assume to exist simply do not work.

One can listen to reassuring voices from the financial community that this will come into balance, but I think we should do as you suggest; to encourage the great creditor nations to extend credit to the debtor nations. That was the role that was assigned to the creditor nations at the Bretton Woods Agreement. But obviously I think at that time the Bretton Woods Agreement it was not assumed that the great creditor nations would indeed turn out to be the oil producers such as Saudi Arabia and Kuwait.

Senator JAVITS. To what extent do you play a role in this particular area with respect to authority?

Secretary SCHLESINGER. The authorities of my Department do not extend to such delicate international financial questions, save insofar as we are dealing with the price of oil.

Senator JAVITS. What can we do about it in this sense: The President is coming up to a summit at Bonn with the other major industrial nations. After all, the relation of the OPEC countries to the United States and to the other industrial nations, but certainly to the United States, relates not only to where they deposit their money, but also where they buy everything, and it relates to their security, both internal and external, in terms of the stability of their own countries.

Now in what way do you believe, or can you give us an answer from the President, that the Congress can encourage the President to take a very strong and positive stand at the summit as to what is the responsibility of the major industrial countries in harmonizing their policies, and how a common determination will be implemented, because we know very well how shortly resolutions last, even at the summit, that OPEC countries share far more responsibly than they have this responsibility?

Secretary SCHLESINGER. It would be premature for me to attempt now to answer the question, Senator. Let me get back more precisely to the committee as a whole.

Senator JAVITS. Well, the answers, Mr. Secretary, would extend all the way from—I have been working on a resolution of the House and Senate expressing their determination respecting this. That may be a way not necessarily excluding other ways. What we are discussing may also be a reason for the Senate, itself, acting respecting this long, dragged out conference. Notice I did not say drawn out, but dragged out, while these contestants struggle over what is now a live body, but tomorrow could be a dead one, while they settle their individual interests for gas or oil or control or decontrol.

So I really feel very strongly that the President ought to, while there is plenty of time, prepare for July or whatever—I think the summit is in July—to express himself to the Congress on this score. I think the time has come, and it should not be allowed to go by without it, and I very much hope somebody at Pennsylvania Avenue is listening as we discuss this.

The other thing I would like to ask you, sir, is about what contributions can solar and nuclear energy make to what we are dis-

cussing. Is there anything we should do about that? Some nuclear people talk about a Manhattan-type project for various things. Do you have any recommendations for us on that?

Secretary SCHLESINGER. Senator, at this juncture we have not been making as much use of nuclear energy as we could, and one of the purposes of the legislation that the President sent to the Hill last Friday is to streamline the licensing process, to make better use of nuclear power.

Obviously every barrel of oil saved at this juncture will improve our position in the 1980's; nuclear energy can help provide electric power, so that we can preserve our fossil fuels for other purposes in which uranium cannot substitute for fossil fuels such as moving automobiles and the like.

Solar energy can for the next decade provide an increasing source of hot-water heating and the like. We have certain important, distant opportunities in which solar energy can provide a share of electric power production; first, I believe, through photovoltaic electric power production at dispersed sites. We should explore the possibility of satellites with microwave radiation providing an increasing share of our electric power production here on earth. That is the kind of far out but still conceivable technical breakthrough which I think might fall under your rubric of Manhattan Projects.

Senator JAVITS. My time is up, but I have just a couple more questions.

Senator KENNEDY. Certainly.

Senator JAVITS. Mr. Secretary, would you consider and give us your view on whether we could apply to solar energy the same principles you are acquiring now in the new energy bill for conversion to coal where we will compel, let us say, a new construction or other ways which are open to us, in terms of the constitution, the utilization of solar energy on the grounds that we are in a critical national emergency, and, therefore, that we have a right. We might not otherwise have to undertake this type of national requirement, but that if you build a new building, the hot water has to come from solar, which, under existing circumstances just like you can order conversion to coal, we have a right to order that, and why don't we stop pussyfooting with these——

Secretary SCHLESINGER. We have been dealing with this through the method of inducements through tax rebates either for the household or for industry. Indeed, Senator, we could go beyond those kinds of voluntary efforts and mandate. It should be gradually mandated as we have better feeling for the technology, but we could take the route you suggest and have a mandate requirement for the use of solar heating or solar hot-water heating.

Senator JAVITS. Have any plans been made for that, that any of us could avail ourselves of?

Secretary SCHLESINGER. No; but we would be happy to draw up such plans and if you should wish, we could provide you or other Senators with a drafting service in that regard.

Senator JAVITS. I would deeply appreciate it. I do not wish to take the Department's time, but don't you agree that this is a matter of National interest and deserves the attention of the Department?

Secretary SCHLESINGER. Yes, sir. The critical question with regard to these nearer-term solar types of usage has been the establishment

of a fashion. It is cost effective now for solar hot water and for solar heating probably as well, certainly with the tax rebates which are a part of the tax legislation that lies before you. The difficulty has been in a society that is conservative, in which fashion changes slowly, in which one has to have the enthusiastic cooperation of builders and architects to create that new fashion and to go into a different direction.

The legislation of the type to which you refer could provide a powerful impulse in that direction.

Senator JAVITS. Thank you very much, Mr. Chairman. I yield, but I have a few other questions.

Senator KENNEDY. Mr. Secretary, if we could just come back finally for a few moments about the Alaska petroleum availability. Now that we look back on the current situation we can reach tentative conclusions that the pipeline was constructed in the wrong place. Many of us, myself included, had serious reservations about the construction and direction of the pipeline because of the reasons that we have got the impasse today. It seems to me that in the urgency and rush, as we move on this energy bill, we are not going to get any additional kind of mistakes as we made on that particular issue of bringing the oil into the wrong areas of the country when it is really needed in the industrial areas in the East and the Northeast and other areas. The Maritime Commission has indicated to us that they have the sufficient tankers to comply with the Jones Act and it has also indicated to us—if there is any kind of shortage of tankers—it has the authority and power under existing legislation to use other tankers that are involved in international trade.

Now, the question is really three. One is the stepping up of the production and moving the product back into the areas of the East where it is necessary and needed, and the availability of it. Second, there is the possibility, which would be the most desirable, of swapping various oil, and for us that could be moved back into the East. And third, obviously, is the issue of balance of payments.

Now the Congress has as you correctly pointed out showed some hesitancy about the export of oil outside of this country, but I do not think that the case has really been made to the Congress about the importance of this particular issue. And if it is as we describe it here and as you commented on it, it seems to me to be a matter of importance and of consequence, particularly to those parts of the country where they feel the shortage.

Secretary SCHLESINGER. Senator, the two issues that you mentioned tie together. One of our problems, and it was only a few months ago that we worked hard to persuade the Congress not to have a flat, outright prohibition against any export at all, but that the President has to determine that this is a matter of National security.

One of the problems we have had is the feeling, particularly of members of the House, that when the Alaska Pipeline was authorized that they were assured there would be no surplus on the west coast. They were assured that by the companies, and now at this later date they are asked to come back and permit oil exports, swapping arrangements, because they were misled. That is a difficult feeling, I think, to overcome. But I think that there is no question that we should produce Alaska oil to the maximum, and, therefore, we have only these two options of swapping or of better use of tankers to

move that oil around from Valdez to the east coast and gulf coast markets.

Senator KENNEDY. We will look at the tanker conditions very carefully. One hears different things from the companies involved, which say they cannot get hold of tankers, and from the maritime authorities, who insist there are plenty available. I suspect that there are difficulties, but not so great as the companies are suggesting. Will you let us know?

Secretary SCHLESINGER. Yes, sir.

Senator KENNEDY. Again, just to finish up on the earlier point with regard to the information on the contracts between the oil companies and the OPEC nations, you have indicated that you are working out a provision to insure the confidentiality of that particular information?

Secretary SCHLESINGER. No, sir. We have gone out for public comment on the degree of confidentiality if any, that should be applied. We face a dilemma to the extent that if any information provided us by the companies might be used, say, by prosecutorial authorities in the government, the degree to which the information will be provided voluntarily will be restricted. We are interested, on the one hand, in maximum information, but on the other hand, we may be interested in the use of that information in ways that the companies may not prefer. We are trying to balance these two things.

At the moment we have a rule out for public comment, and I am hesitant to comment further on where we should come out during this period of public comment.

Senator KENNEDY. Well, there is no question in your own mind, or is there, about the need for the administration to have this information in terms of the fashioning and shaping of an energy policy?

Secretary SCHLESINGER. Absolutely not, Senator.

I think that the Congress has mandated that we shall get that information, and the Congress can mandate, I believe, to what use that information should be put. At the moment they have allowed considerable latitude for rulemaking by the executive branch, and we are in the process of attempting to get public comment on those rules.

Senator KENNEDY. Well, included in those rules is the issue about whether you make that available to the Federal Trade Commission or the Justice Department.

Secretary SCHLESINGER. Yes, sir, FTC, the Justice Department, ERA.

Senator KENNEDY. Where are we in terms of rulemaking?

Secretary SCHLESINGER. The period for public comment is closed and we are now reviewing those comments in the hope of reaching a decision in the next several weeks.

Senator KENNEDY. If I could go just to the issue of increasing production from the list of other countries, it seems to be pretty clear from the testimony that the oil companies have consistently discouraged new production outside of areas of their control. After the embargo all of that should have changed and the United States should be promoting oil production wherever it can be found. Yet we have found no reference to this in the national energy plan about increasing supplies in frontier areas. Can you tell us what specifically are you going to do to encourage it outside of OPEC?

Secretary SCHLESINGER. At the time we published the NEP, we believed that providing a domestic framework was preliminary to our international plans and a prerequisite to those plans. We have intended all along to provide two other parts to the NEP: Domestic supply considerations and international plans.

Mr. Chairman, we are projecting almost a 50-percent increase in the amount of non-OPEC oil. However, I must regretfully say, before we get into exploration of the desirable areas, that this is an optimistic assumption with regard to non-OPEC oil. This number should be between 22 and 24 million barrels a day rather than a flat 24 million a day.

The projection is affected by such considerations as whether the Soviet bloc will be purchasing into the world oil markets, which means in OPEC, some time in the early eighties. However, it is a substantial increase.

Your question goes to other areas of the world, in addition to the conventional areas of exploration: Egypt, Mexico, the North Sea and the like, including places such as Argentina, in which we believe there are production possibilities.

I think we must point out two things: First, that the United States has been encouraging movement in this direction. In the case of Mexico we are recognizing Mexican sensitivity. This is now the 40th anniversary of the nationalization of the American firms in Mexico, an anniversary that was recently celebrated in Mexico. There is Mexican sensitivity on the national patrimony.

We have indicated that we are prepared to be responsive and provide whatever technical advice we can. There are major finds in Mexico, and dependent upon the pace at which Mexican Government decides to pursue them, we will be responsive.

In the case of other nations around the world, we face national sensitivities of a somewhat different nature; suspicion of multinational companies. These are suspicions that are difficult to overcome.

We share your hope that in exploration on a worldwide basis we may find additional areas of discovery. We would hope they would come up to the discoveries in the Middle East, but for the present the Middle East has 80 percent of the free world oil reserves. Between now and 1985 we must say that the chances of major new additions elsewhere, with the investment necessary to bring them into play, remain limited.

The political difficulties to which you referred on different occasions must be overcome, and those are difficult to overcome.

Senator KENNEDY. On the quantity that you talk about in the non-OPEC, we have heard some testimony that there is increasingly less desire by non-OPEC countries to produce.

This was true with regard to Norway and may be true with regard to Britain, and this is an increasing attitude in other non-OPEC countries. I would imagine their attitude will be reflected in the amount that is actually produced by non-OPEC nations. What is the administration's assurance that there is going to be adequate production from those who have the capacity to produce?

Secretary SCHLESINGER. We cannot not insure, but we can encourage. The problem is the one I have just mentioned. Eighty percent of the free world reserves are in the OPEC countries. Each of these countries, Britain and Norway, is examining its own depletion

policies as are OPEC producers. One of the issues for OPEC production is what depletion policy will be adopted by individual States.

We are encouraging these countries, the non-OPEC countries, to increase production, particularly in the middle and later eighties, when we foresee these difficulties. They have not resolved that question.

The British, I believe, continue to talk about 2 or 3 million barrels a day production, indicating the incertainty over the maximum rate of production that they can have from their areas to the North Sea.

The Norwegian problem is a different one. They are torn two ways.

Senator KENNEDY. What is the capacity in the North Sea?

Isn't it 12 million a day?

Secretary SCHLESINGER. No, sir.

Senator KENNEDY. By 1982?

Secretary SCHLESINGER. No, sir, at the present time their operations capacity is running between 1 million and 1½ million barrels a day; by 1985 we project about 4 million barrels a day. But that depends upon major efforts on the part of the Norwegians and the willingness of the British to move toward maximum production in their sector of the North Sea. I think that something below 5 million barrels a day is the maximum we can talk about, not anything like 12; 24 million barrels a day is about the present demand in Western Europe in 1978.

Senator KENNEDY. What are international lending agencies doing to encourage growth in exploration and investment through competitive oil companies rather than multinational oil firms? We have had some testimony from the Treasury about some steps that are being taken at the World Bank, other international lending agencies and regional lending agencies.

But I would like to know whether it is your intention in the presentation to the Congress that they would ask for additional financial support. I wonder whether you intend to try and work with the various international agencies in providing technical help which is not otherwise available or in a very limited form to these agencies?

And second, are you going to come to the Congress for additional kinds of resources for this kind of investment program.

Secretary SCHLESINGER. We are prepared in the Department to provide whatever financial assistance is called for. With regard to the financial institutions, the U.S. Government supports the policy of encouragement of the World Bank to move in the direction of providing energy-related loans for non-OPEC developing countries.

I believe that the resources of the World Bank for this purpose are available. As a government, we also support the activities of regional investment banks. although these are outside of the purview of the Department of Energy. I believe that the American Government should and will continue to support the provision of resources, and should increasingly make technical assistance available on request.

Senator KENNEDY. Well, you would be the ones to certainly impact the administration policy in encouraging the regional banks to choose to develop these kinds of efforts; would you not?

Secretary SCHLESINGER. Yes, sir.

Senator KENNEDY. Well, can we forsee at least in energy messages or energy policy that there is going to at least be a feature of invest-

ment for international agencies that are working for increasing production of exploration?

Secretary SCHLESINGER. Yes, sir, there is no question about it. We encourage exploration and investment worldwide. That is a necessary aspect of our policy.

Senator KENNEDY. Well, the amounts that are going into that, as I understand, have been very, very marginal, and it is operating in a very limited area. Given the magnitude of both the problem of developing alternative sources and the impact of those alternative sources over a period of time in relationship to price, and the steps which have been taken to date have been very cautious and quite preliminary when compared to a real policy initiative.

This chart on our right was provided by Mr. Grossling. Each dot represents 50,000 wells. Latin American, Africa, and in other parts of the world you can see really how much exploration remains to be done. This is something that has to be achieved in our international energy policy. I don't know whether you have any kind of reaction to that chart.

Secretary SCHLESINGER. Well, I will comment on your observations first, Senator. We strongly support exploration and investment. In the past, there may have been insufficient vigor behind that program. If so, we will reconsider the program and we will continue to advertise and to encourage these kinds of movements, and we will report back to you directly.

With regard to the chart, I think that the fundamental point is well taken. However, the chart can be misinterpreted. A well in the Middle East, with its vast oil fields, may produce 20,000 barrels a day; whereas, a well in the United States may produce, on average, 16 barrels a day. Consequently the number of wells by itself can not be taken as definitive.

Nonetheless, it does underscore that there are some vast areas of the world, including some sedimentary basins, that have not been fully explored. In the case of Africa, much of Africa is not appropriate in terms of sedimentary basins, but some of it is. And I think that the underlying point conveyed by the chart is well taken.

Senator KENNEDY. As you mentioned, the chart itself is to predict the explorations involved, not the production, and that is the significant factor of it.

Let me ask you whether you are familiar with the article that recently appeared in the New York Times on March 2, about Washington, and business, and the new U.S. strategy on oil. It makes the point that the officials see little benefit in attempting to provide lower prices by breaking the cartel, and jawboning would derail efforts to stop high prices to encourage conservation and develop alternative sources. Was this article a reflection of the attitude within the Department?

Secretary SCHLESINGER. I have not read the article, Senator, so I refrain from extensive comment on it. I understand that the underlying point is conveyed by the chart, that we anticipate that on the order of 3, or 4, or 5 years from now increases in demand may overtake the availability of production capacity and prices would go up. If we had the power now, which it at least questionable, to substantially reduce prices, and if our future in the petroleum market is as bleak as is suggested here, the consequences later would be a hike

in price, a sudden escalation in the eighties, and even more severe economic difficulties than if we approach higher prices gradually by a ramp effect. If we have the kinds of resources laid out, or at least hinted at, in that chart, then, of course, the oil supply conditions would not lead to the conclusions of the sort that have been suggested in this article.

Senator KENNEDY. I would like to move into an area where we have a peripheral area in pricing energy which has enormous impact in terms of the economy, and that is what the employment impact is of alternative energy systems, both of conservation/solar versus nuclear/coal production and gasification, and the skills which are involved in these systems.

In the subcommittee hearings of March 15 and 16 we heard that neither the Department of Energy nor the Department of Labor really has the capacity to tell us in any detail how energy decisions will either create or destroy jobs, or whether a comprehensive plan is being developed to get that information. We accept, obviously, that the employment issue has been a primary factor in the determination of macroeconomic considerations by the administration in saying that if you do get energy it will be x numbers of layoffs, or a real growth in unemployment. But what we have seen is that there really hasn't been the type of analysis that would show that if we go a certain route in terms of alternative energy resources, it will produce x number of jobs and types of skills over a certain period of time, with all of the continuing implications in our economy.

We had some testimony on that, and it was quite impressive. A study done on Long Island showed that conservation and solar energy provides three or four time more jobs at equal or lower cost at the same or better savings of energy. Yet the Department has not really done the kind of detailed analysis on this that you might hope.

I am wondering if you would talk about the considerations that are currently being given by the Department about these alternative energy systems and what we might expect?

Secretary SCHLESINGER. I think this is an important issue. To this date we have not done a comprehensive analysis as you suggest. We should do it, and it should be an early order of business. We have done elements of the problem prior to the development of the National Energy Plan. We did do the calculations with regard to conservation investments—as opposed to additional production. It was inherently obvious that conservation investments not only have the advantage of conserving energy and cost, and they also increase jobs relative to the alternatives.

I believe it is similarly true for solar energy activities, although we have not done as precise calculations as in the conservation area. We should do more in cooperation with the Department of Labor and we will do that.

The Department has been in existence for 4 months now. It is something that is on our list of priorities and we will get to it, Senator.

Senator KENNEDY. One more item to that, Mr. Secretary, and that is on how the issues of competition impact the recommendations that are given to the Congress. Do you bring us any new news about the administration's position generally on the issues of competition, and more particularly, on a moratorium on acquisition of alternative energy systems by existing energy systems?

Secretary SCHLESINGER. We bring you no new news in the area, Senator. The position of the administration continues to be not to endorse such measures until we have greater information. With regard to the first aspect, however, we have selected Mr. William Lane, who I believe is somebody that you know, as the head of our Office of Competition in our Office of Policy and Evaluation. We hope that our analyses with regard to competition will increasingly infuse the development of policy.

Senator KENNEDY. Well, I hope so. We have before the Antitrust subcommittee a competitive impact statement requirement for various agencies. Hopefully they may consider, as they make regulations, the excessive impact.

It seems to me it would be wise policy that a number of agencies, particularly in the energy area, should be authorized to consider the energy impact. That is something that has not been done in the past, and it is important to consider.

I think in some of the examples we deal with that there has been further and further concentration.

In the area of monitoring of the pricing mechanisms, we have in our part of the country probably the most competitive aspects of the energy industry and that is on the heating home distributors.

We are trying to understand better the factors that reflect increasing costs of the cost of home heating oil. There has been some attention given by the Department in working with both the industry and with various consumer groups, which I think have been of interest.

I am wondering whether the more recent shift from monitoring the price from the refiners is going to be a factor to which the Department would give attention. One of the aspects of the price which reflects in the home heating area is the refining price versus what the retail price would be. It seems to me to be a good deal more of a mystery as to what are the pricing mechanisms within the various refineries of this country. I just wanted to see if that was a matter of interest to your Department?

Secretary SCHLESINGER. It is indeed, Mr. Chairman. The Office of Competition will be further developing that point.

I agree with your observations with regard to competition. We have not made sufficient use of competition, and we have an ineffective market mechanism.

We have been too inclined, since 1973, to depend upon regulations which are frequently poor substitutes for the competitive market forces.

With regard to the middle distillates, which are the principal home heating oil, this will not be a difficult area in the future. This is in part because there is a relative decline in the demand for gasoline, which may reduce the upward pressures on distillate prices.

We will prepare an analysis for you and for other Senators and Representatives from tthe Northeast where this a more sensitive issue than it is elsewhere in the country.

Senator KENNEDY. Just while we are talking about the Northeast, we had a number of New England Senators, nine of us, asking about the institution of adjustment on the residual oil and title trust. You recall you intended to push that reform but had to wait for the resolution in the NEA, National Energy Act.

Can we expect the consideration, or favorable consideration, of the act?

Secretary SCHLESINGER. Yes. There's no question about that.

Senator KENNEDY. Finally, on the horizontal moratorium, you are waiting for the data. You would share that data with the other antitrust administrations in considering that?

Secretary SCHLESINGER. As I mentioned before, this matter is out for public comment. Certainly, any data that has not been acquired by the confidentiality rule will be available. How much data might be acceptable depends upon this period of public comment.

Senator KENNEDY. Well, will you, prior to the time that you make a final policy decision, consult with the Antitrust Division of the Justice Department?

Secretary SCHLESINGER. We have been consulting with them steadily, and will continue to do this.

Senator JAVITS. Mr. Secretary, I have two lines of questioning that should not take very long.

One is conservation. Now, we have noticed, for example, some newspaper stories—I have one in front of me from the New York Times of March 15 by dateline; the author is Anthony J. Parisi.

As you read through the article, there is a statement about the fact that your Department of Energy agreed that, even without further energy legislation, imports should not exceed 12 million barrels a day in 1985.

The Agency contends that the energy bill now in Congress can cut daily imports to about 7 million barrels by 1985. Is there anything to that?

Secretary SCHLESINGER. I think that that is essentially right in an unconstrained situation; we project 16 million barrels a day. Given the nature of EPCA and the restraint on automobile gasoline usage embodied in that legislation, we project something on the order of 12 million barrels a day. The purpose of the National Energy Plan is to put it back to 7 million barrels a day.

Senator JAVITS. We are assuming the 12, not the 7, for obvious reasons we have been discussing.

Secretary SCHLESINGER. In this data it is 11 to 12 million barrels a day.

Senator JAVITS. You cranked it in?

Secretary SCHLESINGER. No; we did not crank it in. But if we do a better job of shifting to the alternative fuels, then the moment of the crunch is postponed.

Senator JAVITS. But the crunch is based on 16 to 12?

Secretary SCHLESINGER. It is based on 11 to 12.

Senator JAVITS. Your line is now based on 11 or 12 million barrels?

Secretary SCHLESINGER. Yes, sir.

Senator JAVITS. I notice—and I am sure you didn't intend this to be all inclusive—but I would like to supplement it. You say, in those 7 years we can begin to execute a movement to the call of nuclear power or stationary power services; isn't that true?

Secretary SCHLESINGER. Yes, sir.

Senator JAVITS. And we also had whatever conservation can bring us?

Secretary SCHLESINGER. Yes, sir.

Senator JAVITS. And that is still an indeterminate quantity?

Secretary SCHLESINGER. Yes, sir.

Senator JAVITS. And that will produce the 11 to 12?

Secretary SCHLESINGER. Yes, sir, that depends in part on the legislation you enact.

Senator JAVITS. But the liquefaction of gas and coal will reduce the 11 to 12 million barrels?

Secretary SCHLESINGER. Yes, sir.

Senator JAVITS. Now what about gasahol?

What are the potentials in that?

Secretary SCHLESINGER. Its potential for easing some of the pain associated with farm overproduction is greater than its potential for reducing oil usage.

Senator JAVITS. Well, it has been estimated, but I gather that if that 10 percent is replaced; what would you say about that, briefly?

Secretary SCHLESINGER. In the Department, we are looking at a set of proposals that would require refineries gradually to increase the proportion of synthetics in the total run either of gasoline, or of total production of those refineries. This might get as high as 10 percent by, say, 1990.

But we are drawing upon alternatives in addition to gasahol which have significantly greater potential. Possible alternatives would be either the direct conversion of coal to gasoline, or to methanol, with the problems associated with it.

Gasahol itself I believe would represent about 1 percent of our present gasoline consumption if one were to use the presently estimated excess production or surplus farm production. If we were to require, say, 3 or 4 percent gasahol, we would have to expand our acreage, or it would drive up the prices of fuel dramatically.

So while it can deal with the problem of farm surpluses, I don't think it solves the energy production problem.

Senator JAVITS. What about the urban wastes? Does that have any particular importance?

Secretary SCHLESINGER. Yes, sir, and we hope to do a good deal with that; not only urban wastes, but animal wastes as well.

If we look out a decade, that will make a significant contribution to our energy supplies. Once again, we are attempting to develop technologies that are cost effective that can use resources that we thought never before would be useful.

Senator JAVITS. We have no estimates on that.

Secretary SCHLESINGER. We can provide you with those estimates.

Senator JAVITS. I think it would be interesting to see what could force that figure down.

Secretary SCHLESINGER. Yes, sir.

Senator KENNEDY. Would the Senator yield?

I don't know if the Secretary had the opportunity to visit that plant and factory that burns refuse from the North Shore area. It had no assistance or help from the Federal Government in participation.

It is a private industry, and as I understand, it will be in the black at the end of the year. But it is an absolutely phenomenal concept, and a very simple one. It just keeps refuse at a superheated temperature. When I asked the engineer how he got it started, he said, "With a match." And it uses no other products.

The estimates are from the private sector that they could provide one-third of New York City with power just from the refuse.

Now it is the major supplier of energy from the GE plant, which uses energy for machine tooling and manufacturing jet engines. But it is a very interesting concept, and as the States are increasingly strict in terms of where they are dumping the refuse, and all the other environmental requirements, it is going to be, from just looking at their cost figures, very convincing in terms of economics.

It is something the people in your Department are aware of, but I would hope that at least that concept would not be crossed.

Secretary SCHLESINGER. We are in entire agreement with that. However, I would like to make two points.

The Saugus plant is an excellent plant. We have had some experiments which are technical disasters, and we are still living in an area of some technical uncertainty. Once we sort them out, I think that we can make major use of this possibility.

There is also an economic or legal problem that I think I should mention, because you gentlemen are in a position to help out. As an energy source taken by itself, it may not be price competitive with cheap oil or cheap coal, but frequently we forget that the costs of disposal of solid waste in this manner should also be added to the gain of using waste for energy product production. There may be legal ways of bringing those two things together in a way that provides greater inducements for States and municipalities.

Senator JAVITS. Well, I think that is very sound, and I would like as much help from your estimates as this could contribute. As I listen to you and Senator Kennedy, it is amazing how enthusiastic people have missed, in this case of energy firing, the imagination of the American people to relieve us of this dangerous dependence on this foreign oil source.

At this time, it seems conducive to our spirit and instinct for enthusiasm or for do-it-yourself and show we can do it better than anyone else. It is just amazing to me how we seem to have missed, as a Nation, this fantastic opportunity. Perhaps we can still find the key.

Mr. Secretary, I have just one other line of testimony that I want to review.

It is still a fact that, as you look at that chart Mr. Grossling will orient us into, there seemed to be two sources, aside from the developing North Slope, and the two sources which are seemingly almost blank, and they are the less developed countries, Africa and Asia and the Communist countries, from the point of view of participation in the world market.

I am moved to say that, if by your own prediction that as soon as Nations—the Soviets may be in the market for oil, notwithstanding their vast resources. And the thing I wonder about is we all heard so much about the possibilities, about the exploitations of the natural gas fields of the Soviet Union.

If somebody would be willing to invest $10 to $12 billion a year—I think it is an absolute figure—in the real opening up of those areas, transportationwise and extractionwise. I just wondered, Mr. Secretary, if there is anything we ought to be thinking about in that, and the Soviet Union is a difficult equation; no doubt about it. And yet,

they do have these resources. And many eminent bankers that I have been talking to about economic development for a less developed area of the world think that the East is the most ready for the outreach of expansion of major development, even more so than the traditional countries that we think about: Africa, Latin America, Asia, and so on.

So I ask you a general question, because of your expertise and responsibility in this field: What about that? What about the whole world in the East: Mainland China? That vast number of countries and people? What about them, as we talk about our problem?

Secretary SCHLESINGER. Let me put aside the Eastern European satellites for one moment. I think that there is relatively little potential there, given the geological structures of the region.

With regard to mainland China, the People's Republic, we are engaged in a very careful sounding-out, with the Chinese, given their sensitivities, taking the lead in these activities.

There is potential there, but there is also very great sensitivity, and I think that we must be aware of those sensitivities. We expect to see an increase, at least to some degree, from the People's Republic. With respect to the Soviet Union, that is perhaps the most complex of all. In terms of production potential, and in terms of the relationship to which you refer, we do not know what the potential reserves of the Soviet Union are. In the long run, we suspect that they have substantial reserves.

What we anticipate is a peaking-out of production in the Soviet Union in the early 1980's, but that is simply because of a failure to explore and prospectively exploit the reserves in the Arctic.

That means that although they may peak out early on in the 1980's, they might have a subsequent boom in terms of production at the close of the 1980's.

As we look at 1985, we are facing a period of pressure with regard to Soviet production. The question that you raise of technical assistance depends, of course, on the overall relationship between ourselves and the Soviet Union. While there are markets, unquestionably those markets will depend to a considerable extent on the extension of credit by the United States, rather than by the exchange of goods.

The degree to which we would wish to extend credit to the Soviet Union has been a vexed issue in the Senate, and in the country, generally, in recent years.

I think that one of the points that should be made, however, is that during this period in the early 1980's in which we expect Soviet production to peak out, the Soviets will also be under pressure with regard to foreign exchange. Since exports from these oilfields have been their principal source of foreign exchange in recent years.

The inability to sell oil in prior magnitudes may subject them to a lessened ability to purchase western technology, without the augmentation or extension of credit.

Senator JAVITS. I also implied in that question the possibility and the consideration, not necessarily recommend it myself, not only of technical assistance, but of an investment. So even though you have to extend credit, the question is, if we did extend credit, the likelihood of getting it back in oil and gas was great enough to justify it?

Secretary SCHLESINGER. I should point out, on the technical point, that we do, indeed, have a technical exchange program with the

Soviet Union, on a formal basis, as opposed to an informal basis such as we have had with the Chinese.

One of the questions that must be raised, I think, in the minds of both of you gentlemen is the question of priorities. Senator Kennedy has stressed the possible availability of resources in LDC's and elsewhere. I think that there may be some competition in terms of investment of financial resources: Whether such resources go to the eastern bloc, or whether they go to the lesser developed countries.

I do not know to what extent there is competition between the two, but that would have to be considered.

Senator JAVITS. I assume that while I was away, that you went into the question of our moving into the LDC's?

Secretary SCHLESINGER. Yes, I indicated that we support exploration and development everywhere in the world, and that there are political sensitivities in many countries including the lesser developed countries. We have to be careful about that.

Senator JAVITS. And we also have to be careful with respect to OPIC, which is an important consideration, to encourage private sector enterprise.

Secretary SCHLESINGER. My inclination is to say yes to that, Senator Javits. But I am not sufficiently informed.

Senator JAVITS. We are going into conference on that.

Secretary SCHLESINGER. I will insert something in the record for you.

[The following information was subsequently supplied for the record:]

COMMENTS OF THE OVERSEAS PRIVATE INVESTMENT CORPORATION (OPIC)

OPIC has recently initiated a new policy to offer political risk insurance for investment in the exploration, development, and production of oil and gas in non-OPEC developing countries. Two contracts have already been signed covering investment in oil exploration in Jordan and Ghana. OPIC is currently considering applications for investment in several other countries.

The administration supports this new policy and believes that the availability of this insurance may provide a necessary incentive for investment by smaller U.S. companies in high risk areas. We continue to move cautiously into this sphere gathering experience from which to evaluate the policy's impact on oil discoveries in marginal LDC areas. The comparative energy and economic benefits of this investment compared to alternative domestic investments are not obvious. They will depend greatly on future developments in world oil prices and in the political climate in non-OPEC developing countries. We would therefore not recommend any move to change the present guidelines that OPIC's maximum exposure in this area should be limited to 20 percent of its portfolio.

Senator JAVITS. Lastly, my office called my attention to the fact that last September FEA promulgated some rules that required oil companies to give you certain information on foreign price contracts, et cetera, and the GAO report to Senator Kennedy referred to suggested that you should carefully analyze this data, and report to the Congress as to the extent to which our dependence on foreign oil is changing in character.

Are you aware of anything like that?

Secretary SCHLESINGER. Just in a general way, Senator. We will be prepared to respond to the Congress on the question as to how our dependence is changing in character. With regard to the information itself, to the extent that it involves the possibility of confidentiality, it falls under the rubric that we are awaiting public comments.

Senator JAVITS. Well, why don't you take a look at it and tell us about it.

Secretary SCHLESINGER. Yes, sir.

Senator JAVITS. Thank you very much.

Senator KENNEDY. Can you give us any information as to the interest of the Chinese in purchasing technology from the United States?

Secretary SCHLESINGER. I think at this point all I should say is that clearly they are visibly excited by the technical capacities that are embodied in this equipment, and that the perspective of the Chinese regime has changed dramatically in the last 2 years with regard to taking advantage of foreign technology. So I would expect something to develop.

Senator KENNEDY. Just finally on this, I think you were going to supply some information on these alternative energy sources that Senator Javits mentioned.

Obviously, one of the areas in which there has been development but probably has not gotten the kind of attention that I think it might is wind energy. We are seeing the opening of a dedication of a windmill by MIT scientists down in Cuttyhunk, Mass., and it is going to supply about half of the energy resources for the people in that community.

It is a rather small community out in the Elizabeth Islands off Cape Cod. It is quite impressive in theory, and it is on track and scheduled to be extended.

But nonetheless, wind historically has provided substantial energy resources for farm and agricultural areas. This is an aspect of our energy alternative that I hope you give consideration to.

The other is, we have the recommendations for the Corps of Engineers to identify the 48,000 sites where small dams can be equipped with generators, 3,000 of these sites in New England. As I understand, 300 of these small dams would provide energy for cities as large as Boston.

But you are giving assurance in each of these areas, besides the major items that you have mentioned in your testimony, that they are being given attention as well?

Secretary SCHLESINGER. Yes, sir. I can give you more than generalized information. I believe that these will be embodied in phase II, which we will bring to the Congress shortly. We have the Corps of Engineers vigorously at work to identify these low-head hydro projects.

Major opportunities exist both in the Northeast and in the Northwest, in that they will be able to supply us with, in the area of 20,000 megawatts, or thereabouts, which is a very impressive number. And we will proceed with that.

With regard to wind, there will be elements on that in phase II. You mention the islands off the shore. One of the interesting things about many of the developments in the solar area is that opportunities are provided for these dispersed sites. Wind, photovoltaics, biomass are intercompetitive amongst themselves. However, if we use wind energy at a dispersed site, then there is not a market in that site for the production of electrical power.

Senator KENNEDY. Well, I think the commitment of the Department to move ahead in these areas is important. We have got a vote

on, and we will recess. I just have one other area, and that is your assessment of the future contribution of breeder reactors to energy supplies, both in the United States and in other countries.

Secretary SCHLESINGER. I believe that we must retain the nuclear fission option. We do not know how much uranium there is. If one takes the estimates of ERDA and DOE, the United States could go along well beyond the year 2000 without reliance upon breeders.

But we must develop the technology. We should explore alternatives to breeder technology, and with in the area of greater technology, explore the area of fuel cycles to obtain those with the least risk of proliferation.

I do not think that we have to decide that question as yet. We know that in the long run, if we are to continue to make use of nuclear fission, we will have to turn to breeders. The extent to which we will have to make use of fission is a controversial subject in the minds of many people. It is something to which many people would not commit themselves.

I think as a government we should commit ourselves to the fullest exploration of the alternatives, rather than go along a preordained path.

Senator KENNEDY. On the development of technology, would you also give least-risk priorities to new technology research regarding breeder reactor safeguards?

Secretary SCHLESINGER. Yes, sir. And as you may know, we have had a meeting with the Science and Technology Committee with regard to the breeder program which would not lead to the Clinch River, but would go into a design study for different types of plants, including the sorts of safety features to which you refer. Those would be included in that study.

Senator KENNEDY. I want to thank you very much, Mr. Secretary. I appreciate your following up on these issues. We will recess briefly for a vote, and then we will continue with the remaining witnesses.

[A brief recess was taken.]

Senator KENNEDY. We will come to order.

Our next witness, Mr. Bernardo F. Grossling, is a research geophysicist for the U.S. Geological Survey. Mr. Grossling has been a consultant in the InterAmerican Development Bank, the World Bank, and the United Nations.

Your prepared statement will be included in the printed record, and we look forward to your testimony.

STATEMENT OF BERNARDO F. GROSSLING, RESEARCH GEOPHYSICIST, U.S. GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR

Mr. GROSSLING. Mr. Chairman, it is a privilege to testify before your subcommittee on the possible magnitude of the remaining conventional petroleum resources worldwide.

Although I am a scientist working for the Geological Survey, and have been for about 4 years, I am testifying as an individual scientist expressing my own personal views. I thank the Department of Interior for allowing me to testify on this matter, because on an issue as important and controversial as this one should hear the different views.

And I thank you, Mr. Chairman, in particular, for inviting me.

In the year 1974, the World Bank asked me, what is the petroleum potential of the developing countries in the world? At that time, if I had been pressed for an answer, I would very quickly have agreed with what is known as the conventional wisdom about the oil in the developing countries of the world.

However, the task force of the Bank wanted to make an inquisitive analysis, and I was asked that question. So I decided to investigate the entire problem, and not to merely accept preexisting views.

I approached the subject with great humility in the sense that I did not want to pretend that we knew very much how oil occurs, because we do not. There is a great deal of uncertainty in that.

I wanted to establish what it was that we really knew, and what way the position in terms of world petroleum resources. When faced with the energy crisis, policymakers would like to have firm estimates of the remaining petroleum, but this really is not possible. And a wide range of uncertainty has to be accepted. In reacting to the energy problem, we have to develop strategies that are able to cope with the various outcomes as the petroleum exploration proceeds.

It would not be realistic to assume that future developments would be simply a sequential chain for exploration and development. There will be a number of surprise effects. It is, for instance, well within the range of possibility that the magnitude of the remaining conventional petroleum resources be two to three times larger than that of prevailing views.

It also appears likely that the real costs of the new oil to be found will be significantly smaller than the price set by OPEC or the marginal cost in the United States.

By the way, by real cost, I mean the technical cost when the taxes, the leases, the royalties, and the economic rent of the resource are excluded.

To provide a framework for this brief oral presentation, I will refer to the chart we have over here on the wall. This chart, which I have nicknamed "Window on Oil," highlights one of the most striking features of the current stage of development of world petroleum resources.

Let me explain the chart. The areas within the bars correspond to the gross petroleum prospective areas of the various countries of the world. These are areas which are the prima facie targets for exploration as defined by the American Association of Petroleum Geologists.

If I had put Africa completely, it would be 2½ times as large as what is shown there; what is shown is only its petroleum prospective area.

To the left of the chart are the areas corresponding to the developed economies of the world, both market and centralized economies. And on the right are the developing countries, both market and centralized economies.

Therefore, the chart cuts across politics. It simply resolves the posture with respect to petroleum in industrialized nations and developing nations.

Now, as to the dots, each black dot corresponds to 50,000 wells, both exploratory and development, which have been drilled in the world. A fraction of a dot represents a proportionately smaller number of wells.

Now, the important point is that this chart contains my estimates for all the wells that have been drilled in the world, from the beginning of petroleum exploration through the year 1975. Since then, about two dots will have to be added, of which one and one-half would be in the United States.

Now, the chart shows that there is a striking concentration of drilling effort in the United States. There is a large drilling gap; thus, in the sense of total drilling for petroleum, 77 percent took place here, and only 23 percent in all the rest of the world.

Now, what is even more surprising is that this large concentration of effort still prevails. For instance, in 1977, in the market economies of the world, 56,000 wells were drilled, out of which 44,000 were drilled here in the United States.

Now, it could be said why you have put in that chart the total number of wells, both exploratory and development? I have done it for the exploratory wells alone, and for the drilling footage. Had I shown that, the patterns would have been exactly the same, the conclusions would have been exactly the same. It does not resolve the problem.

When pondering on the considerable concentration of effort in the United States, and what it signifies in terms of how much oil is in the rest of the world, one should keep in mind that even so with the 2.4 million wells that we have in the United States, about half of the oil that was initially recoverable is still in the ground. This bears on the question of how much would be in the rest of the world.

The large concentration of efforts here is also apparent in other pre-drilling activities; that is, activities for petroleum exploration. For instance, in 1977, the amount of seismic onshore work in the conterminous United States was equivalent to 3,700 per month, whereas in Latin America, which has an area 60 percent larger, the effort was only 620.

Now, when I make these comparisons between the effort of petroleum exploration in the United States and the rest of the world, I do not want for a second to imply that our efforts here are excessive. I only want to reflect that the mere projection, for the developing countries, of the past petroleum outcome is a very poor indicator of the true potentials.

Now, in order to provide a basis for estimating the amount of recoverable conventional oil per unit of petroleum prospective areas, I selected major benchmark areas of the world. These areas were the United States, Canada, the U.S.S.R., and the Middle East. I calculated the petroleum outcome, in terms of cumulative production and proven reserves, and the growth of proven reserves, and the estimates which have been published about the ultimate recoverable in those areas. I also examined in a critical manner the amount of oil found as a function of drilling density in an integrated way for key areas in the world.

Now, when I set up the limits for the amount of oil per unit prospective area, I left out the Middle East. Had I taken the Middle East into consideration, my figures would have been four times larger. Therefore, my comparison was greatly influenced by areas like the United States, the U.S.S.R., and Canada.

Now, with this basis, I arrived at the range of 70,000 to 200,000 barrels of oil, and 400 million to 1,000 million cubic feet of gas per

square mile of gross prospective area as indicative of the ultimate petroleum recovery from continental-sized blocks.

It is to be stressed that giant accumulations such as those in the Middle East were not considered in setting the above limits.

Conventional views, on the other hand, hold that in regions such as Latin America, Africa, and South and Southeast Asia extended the ultimate oil recovery expressed in per unit of prospective area would be about one-third to one-half of even the lower range of my estimates.

After having examined critically the possibilities in the various geographic units, a tentative balance sheet for the world oil resources can be put together, as shown in table 8.

The amount of world recoverable petroleum, as of the end of 1975, which would be left in the ground according to the above estimates, would be 660 billion barrels in proven reserves; 500 billion barrels in growth of these reserves; and 1,350 plus to 4,800 plus in undiscovered recoverable resources.

Thus the estimated total amount left of recoverable conventional oil would be 2,500-plus to 6,000-plus billion barrels.

At this point it should be recalled what is not included in the above estimates of the recoverable petroleum resources; namely, enhanced recovery from conventional fields beyond an overall recovery factor of 40 percent; recoverable petroleum from belts of heavy crudes, such as the Orinoco Belt, and another one that appears to exist in Western Madagascar; recoverable petroleum from the Antarctice Continent and its margins; recoverable petroleum from the continental slopes and continental rises; any recoverable petroleum that may be found in deep oceanic areas; and any other exceptionally large petroleum accumulations such as the Middle East.

After asserting that the conventional recoverable world petroleum resources could be, in the upper range of my estimates, two to three times larger than prevailing views, the likelihood that this new petroleum may actually become a reality has to be examined. Moreover, the likely timetable for its development would have to be considered.

A factor which may have inhibited petroleum development in Latin America from a world economy point of view appears to be somewhat of a reluctance of Latin American countries to allow or undertake such development. A country such as Brazil which already has attained a very significant degree of industrialization and which is heavily dependent on imported oil probably is under the additional urgency of finding ways to sustain its manner of economic development. If such a country were to attain in the next two decades or so a high degree of oil self-sufficiency, that factor alone would contribute to ease the energy transition crisis. Currently, Brazil consumes about 800,000 barrels of oil per day. Favorable factors are that Brazil has the largest petroleum prospective area in Latin America; and that a considerable portion of it is in the continental margin which can be developed more quickly than inland basins.

Argentina also has a very important petroleum potential, as judged by the several inland and offshore basins and by the petroleum occurrences already found.

An excellent example of the surprise effect in petroleum exploration is the significant petroleum discoveries made in southeastern

Mexico. As a result of these discoveries the proved oil reserves of Mexico have increased from a level of about 2.8 billion barrels in 1973 to about 17 billion barrels at the end of 1977. And they continue to increase. I would not be surprised if within 5 to 10 years the proven oil reserves of Mexico would reach a level of about 100 billion barrels.

When reflecting upon the intensity and thoroughness of petroleum exploration in the United States, it is proper to ponder how much oil could be found in other countries if the incentives to petroleum exploration were similar to those here, and if an equally aggressive entrepreneurship were applied to the problem.

I am well aware that petroleum resource estimates somewhat larger than the conservative estimates can be misunderstood. It could be argued that such feeling of urgency as may exist about the energy crisis might tend to be weakened. In that respect, the more pessimistic an estimate, the better it would be. However, this question of impact should not hinder the technical examination of petroleum resources. I have endeavored to gauge the possible magnitude of the remaining conventional petroleum resources in the world.

There are three possible scenarios. One, the oil prospects in developing countries would turn out to be as disappointing as indicated in the prevailing conventional wisdom, and the oil resources of the Middle East would be of the order of one 1,000 billion barrels or so. Worldwide conventional oil left would be of the order of 1,700 billion barrels of oil. That is equivalent to 80 years of consumption at the 1976 rate of consumption.

Two, the oil prospects in developing countries would turn out to be as significant as indicated by the upper estimates I have presented, and those of the Middle East would turn out to be of the order of 1,000 billion barrels or so. In this scenario the dominance on oil prices of cartel-type organizations would be weakened.

Three, the oil prospects in developing countries would turn out to be as disappointing as indicated by the prevailing conventional wisdom, but those of the Middle East would turn out to be considerably higher—say, 2,000 to 3,000 billion barrels—than now believed. In this case, there could be a more prolonged dominance on the energy market of the cartel-type organizations.

The implication for the world economy of such scenarios are so vastly different that a flexible strategy would be needed to cover the various possible outcomes as to the world oil resources. To proceed on the assumption that only one of these scenarios would prevail would seem to be dangerous.

Thank you very much, Mr. Chairman.

Senator KENNEDY. Thank you very much, Mr. Grossling, for your analysis and your testimony.

[The prepared statement of Mr. Grossling, together with the chart referred to in his oral statement, follows:]

PREPARED STATEMENT OF BERNARDO F. GROSSLING

A LONG-RANGE OUTLOOK OF WORLD PETROLEUM PROSPECTS

Mr. Chairman, it is a privilege to be asked by your Committee to testify on the important issue of the possible magnitude of the remaining conventional petroleum resources worldwide.

(1) Although I am a scientist working for the Geological Survey, my testimony represents my own personal views. I would like to thank the Department of the Interior for allowing me to testify as an individual expert. In this difficult issue it is most important that individual views may be heard. Concensus views tend to be too conservative, and I would say rather negative.

(2) Policymakers may like a firm basis on which to base their decisions. However, with respect to the magnitude of the remaining conventional petroleum resources worldwide this is not possible. A great range of uncertainty has to be accepted. Rather, what is needed is strategies that may cope with the various outcomes as the action develops. Future energy developments may not be viewed as a simple sequential non-branching process, with no uncertainties as to the path to be followed. I entertain that this view of the events in the energy field in the next two or three decades would not be realistic.

(3) Specifically, it is necessary to contend with unforeseen events as to

(a) the amounts of conventional petroleum resources that will be discovered, and

(b) the real cost of the new oil to be discovered.

It is within the realm of the possible that the magnitude of the conventional petroleum resources might turn out to be more than two or three times larger than conservative prevailing views. It is also even more likely that the real cost of the bulk of this new petroleum will be below the current OPEC set price or the marginal cost in the United States. That this cost factor might have an unfavorable effect upon the development of energy alternatives has nothing to do with examining the possibility that the prevailing cost of the new oil might turn out to be well below present levels.

(4) My intensive study of world petroleum resources was triggered by the question "what is the potential of developing countries" posed to me by the International Bank for Reconstruction and Development in 1974. This work I then continued, and extended mainly on my own. The papers I have published which are relevant to this matter are listed at the end of this report.

(5) The foundations for this report were: previous personal experience with the petroleum inudustry, personal knowledge of petroleum occurrences in various parts of the world, scrutiny of publicly available information, and personal judgements on these matters. No confidential or proprietry information, of government or industry, has been included in the analysis. What is new is the manner of viewing, analyzing and interpreting the public record.

(6) The complexities of the estimation of the remaining conventional world petroleum resources are such that a broad range of views is to be expected. As I appear to differ somewhat from what might be called the conventional wisdom, an opportunity to contribute to a fuller understanding of the prospects of conventional petroleum was needed. I do not hold the view that others are wrong. Rather I want only to explain how I have reexamined the problem independently and have come to significantly different conclusions than the conventional wisdom. I have examined the evidence very carefully, in particular as to the sedimentary basis in Latin America and Africa.

(7) As my departure from conventional wisdom is so significant, I felt it was my duty to express my views on this. Many significant options might be precluded if we were to rely exclusively on the more pessimistic estimates about the remaining conventional petroleum resources. In doing this, I take a constructive view and ask that the argument be examined. Often in matters such as these a momentum of opinion, or concensus, is prematurely formed.

(8) Rather than merely accepting already published estimates, I decided to undertake a candid reevaluation of the issue starting from the fundamental questions. One of these was: how many wells have been drilled in the various world regions to seek petroleum? Surprisingly, there were no published cumulative statistics of the total number of wells drilled in all the world regions.

(9) I will be referring only to conventional petroleum, both oil and natural gas. This conventional petroleum is confined to accumulations similar to those which have been found in the petroleum fields we know now. The petroleum hydrocarbons might be retriveded by primary, secondary, or teritiary methods of recovery. By enhanced methods of recovery, it is possible to recover some of the liquid petroleum and gas from tight formations, and heavy oils. The sedimentary basins might be on continental areas or on the continental margins. Of the latter, only the continental shelf part has been included in the estimates I will mention.

(10) It should be noted that fossil petroleum has been found in various types of accumulations in sedimentary basins, namely: Conventional petroleum

accumulations; heavy oil deposits; tar sand deposits; gas in tight sands; gas from organic shales; gas in geopressure zones; hydrate accumulations; and oil shale.

(11) Petroleum resource estimates may be constrained or bounded by many factors, such as: Geologic possibilities; political access to an area; technological limitations; maximum-cost gates; and environmental constraints.

The uncertainties of petroleum estimates arise mainly because of the uncertainties about: Geologic factors; technological capabilities in the future; and the market price of petroleum in the future.

(12) The methodology which I used to assess the petroleum potential in various regions is fully documented in my publications (Grossling, 1975b, 1976b, 1976c, and 1977). Also, I have identified the sources of the published information which were used. Here I will only briefly summarize the methods used.

(13) For purposes of the analysis, the petroleum data for 141 countries was aggregated into six geographical units corresponding to developed countries (U.S., U.S.S.R, Western Europe, Canada, Japan, Australia and New Zealand), and five geographical units of developing countries (Latin America, Africa and Madagascar, S. and S.E. Asia Extended, Middle East, P. R. of China). Table 1 gives the countries included in the first three units of developing countries. When analyzing the data, the figures for OPEC as a whole (14 countries) were also set apart in each case. In Western Europe countries with market-economies and centralized economies were included.

(14) A review was made of the petroleum outcome in the eleven geographical units in terms of: a) cumulative oil and gas production up to 1975, b) 1976 levels of oil and gas production, and c) end-of-1975 proven reserves of oil and gas, a summary of which is given in Table 2. Examination of Table 2 shows the current dominating role of OPEC in current levels of oil production and in oil proven reserves.

(15) A key element of the study was a picture of the cumulative world drilling for petroleum, both exploratory and development. This was laboriously reconstructed and put together, which required the searching through a vast variety of publications and deciphering incomplete or ambiguous information. Many countries and petroleum companies still consider such data as confidential. What is surprising is that these worldwide drilling statistics had not been put in the public record before. In the search, which was initially undertaken as part of the study for the International Bank for Reconstruction and Development, I was ably assisted by D. T. Nielsen.

(16) The study revealed a large drilling gap in the sense that about 77 percent of all drilling for petroleum in the world had been done in the United States (Grossling, 1976c).

(17) Not only do the cumulative past petroleum exploration efforts appear to have been concentrated in the United States to a large degree, but also a marked concentration of world effort towards the United States continues at present. Table 3 summarizes the 1976 levels of various petroleum exploration activities. The total number of wells drilled, that is both exploratory and development is summarized in Table 5. The data again shows an overwhelming concentration of efforts towards the United States.

(18) The most indicative of pre-drilling petroleum exploration activities are geophisical surveys. Table 6 summarizes this data for the period 1961-1976. Despite the large cumulative geophysical studies in the past in the United States, it is revealing that even now surveys several times more intensive than in the developing regions are considered worthwhile.

(19) Table 7 summarizes the relative variation, with respect to the 1961-1972 average levels, of the total geophysical expenditures in the various regions. It is surprising that there is no apparent increase of the geophysical activities in the developing regions after 1973, despite the substantial increase of the oil prices which took place then.

(20) To provide a basis for the estimation of the ultimate recoverable petroleum per square mile of gross prospective area I examined resource petroleum estimates for four 'benchmark' regions. Also, I used similar data from other areas. The benchmark regions, each over one million square miles of prospective area, are: conterminous United States, Canada, U.S.S.R., and the Middle East.

(21) Furthermore, in setting the limits for these estimates I considered:

A lower limit defined by an upper bound for the expected results of past petroleum outcome, when examined critically in terms of drilling density,

A lower limit defined by low estimates for the centerminous United States,

The expected results of the past petroleum outcome in the three developing regions, and

An upper limit defined by the upper limits for the U.S.S.R. estimates.

(22) In this manner I arrived at a range of 70,000 bbl to 200,000 bbl of oil, and of 400 million to 1,000 million cu. ft. of gas per square mile of gross prospective area as indicative of the ultimate petroleum recovery from continental siz blocks. It is to be noted that the giant accumulations in the Middle East were not considered in setting the above limits. Conventional views, on the other hand, hold that in regions such as Latin America, African, and S. and S.E. Asia Extended, the ultimate oil recovery expressed per unit of prospective area, would be about ⅓ to ½ of even the lower range of my estimates.

(23) The original intent, when this work was started, was finding opportunities for new discoveries on a worldwide basis. That effort directed attention in the three developing regions that I have mentioned. However, after having examined critically the possibilities in the various geographical units, a tentative balance sheet for the world oil resources can be put together, as shown in Table 8.

(24) For each major unit the following basic information is given in Table 8: Factor (a)—cumulative oil production to the end of 1975; Factor (b)—proven recoverable oil reserves to the end of 1975; Factor (c)—expected additions because of growth of the recoverable reserves; Factor (d)—undiscovered new recoverable resources; and Factor (e)—estimated ultimate recovery.

The sum of factors (a), (b), (c), and (d) equals factor (e). The oil left in the ground equals the sum of factors (b), (c), and (d) above. The data for factors (a) and (b) is rather acurate. Factor (c) has been calculated by a simple projection of (b). Factor (e) has been obtained by the regional estimation analysis methods I have outlined before. And finally factor (d) is obtained by subtracting from factor (e) the sum of factors (a), (b), and (c).

The factor with greatest uncertainty is (e). The uncertainty of factor (d) is mainly a reflection of the uncertainty of factor (e).

(25) In Table 8 also are shown estimates for factor (e) corresponding to: (1) the aggregate of the developed regions, (2) the aggregate of the three developing regions considered (Latin America, Africa and Madagascar, and South and South East Asia Extended), and (3) the Peoples Republic of China. Lastly, the factor (e) for the Middle East is given. The figures "1,000 or over" in Table 8 indicates that the ultimate recoverable oil resources of the Middle East could surpass 1,000 billion barrels.

(26) The amount of world recoverable petroleum as of the end of 1975 which would be left in the ground, according to the above estimates ,would be: 660 billion barrels in proven reserves; 500 billion barrels in growth of reserves; and 1,350 (or over) to 4,800 (or over) billion barrels in undiscovered resources.

Thus the estimated total amount left of recoverable conventional oil would be 2,510 to 5,970 billion barrels. As the 1976 world oil consumption was 21.2 billion barrels, the amount left would be equivalent to 118.4 to 281.6 years of consumption, at the 1976 rate. On the other hand, if consumption were to increase at an assumed constant annual rate of three percent, the amount left would be exhausted in 51.3 to 76 years.

(27) At this point it should be recalled what is not included in the above estimates of the recoverable petroleum resources, namely:

enhanced recovery from conventional fields beyond an overall recovery factor of 40 percent,

recoverable petroleum from belts of heavy crudes, such as the Orinoco Belt and another one that appears to exist in Western Madagascar,

recoverable petroleum from the Antarctic continent and its continental margins,

recoverable petroleum from the continental slopes and continental rises,

any recoverable petroleum that may be found in deep oceanic areas, and

and other exceptionally large petroleum accumulations, such as in the Middle East, that might be discovered elsewhere.

(28) Technological improvements should lead to increments of the recoverable resources estimates, this is the first time in section 27 above. No commercial accumulations of petroleum have been discovered yet in the continental slopes and rises; but the great uncertainty about the geologic factors involved precludes, at this point, either to write them off with a zero resource potential or to assign to them some arbitrary figure for their recoverable petroleum. The important question is to acknowledge that here we have a frontier of petroleum geology, and the undertaking of its exploration requires imaginative and positive geologic views. It would be ludicrous, for instance, to hold up a picture of subjective probabilities of occurrence of petroleum in deeper parts of the continental margins without having made actual observations on it by means of boreholes.

(29) After asserting that the conventional recoverable world petroleum resources could be, in the upper range of my estimates, two to three times larger than prevailing opinion, the likelihood that this new petroleum may actually become a reality has to be examined. Moreover, the likely timetable for its development would have to be considered.

(30) A large proportion (roughly ½) of the still undiscovered world petroleum lies in developing countries other than those in centralized economies. Of the petroleum in developing regions, about 34 percent would be in Latin America, about 35 percent in Africa and Madagascar, about 25 percent in S. and S.E. Asia Extended, and about six percent in the P. R. of China.

(31) A factor which may have inhibited petroleum development in Latin America from a world economy point of view appears to be somewhat of a reluctance of Latin American countries to allow or undertake such development. But with the more than quadrupling of oil prices since 1973 the situation seems to be starting to change.

(32) A country such as Brazil which already has attained a very significant degree of industrialization and which is heavily dependent on imported oil probably is under the additional urgency of finding ways to sustain its manner of economic development. If such a country were to attain in the next two decades or so a high degree of oil self-sufficiency, that factor alone would contribute to ease the energy transition crisis. Currently Brazil consumes about 800,000 barrels of oil per day. Favourable factors are that Brazil has the largest petroleum prospective area in Latin America, and that a considerable portion of it is in the continental margin which can be developed more quickly than inland basins. Brazil already appears to be seeking forms of outside collaboration for the development of its petroleum resources. Here the petroleum energy option, that is to develop the country's petroleum potential, is to be given a try. Further international collaboration might speed up the outcome.

(33) Argentina also has a very important petroleum potential, as judged by the several inland and offshore basins and by the petroleum occurrences already found. The potential seems to be such that Argentina could conceivably be an important exporter of petroleum within a decade or so. It may be that the economic impact of the new oil prices would result in a quick development of the petroleum resource potential. Argentina has a variety of other natural resources, however. Most economists would agree that with or without petroleum the country would be prosperous. Therefore a degree of negotiation as to the rate of petroleum development, in a context of international cooperation, might be helpful.

(34) An excellent example of the surprise effect in petroleum exploration is the significant petroleum discoveries made in southeastern Mexico in the Reforma Area. As a result of these discoveries the proved oil reserves of Mexico have increased from a level of about 2.8 billion barrels in 1973 to about 17 billion barrels at the end of 1977. And they continue to increase. I would not be surprised if within five to ten years the proven oil reserves of Mexico would reach a level of about 100 billion barrels. For comparison, we recall here that the current Saudi Arabian proven oil reserves are about 149 billion barrels. Before 1972, Mexico would have been projected as a net oil importer in the 1980's. Apparently no one foresaw then that in a rather tiny corner of Latin America a discovery of such a magnitude could be made.

(35) When reflecting upon the intensity and thoroughness of petroleum exploration in the United States, it is proper to ponder how much oil could be found in other countries if the incentives to petroleum exploration were similar to those here, and if an equally aggressive enterprenuership were applied to the problem.

(36) I am well aware that petroleum resource estimates somewhat larger than the conservative estimates can be misunderstood. Even when I have presented these estimates as a broad range, from a value little higher than conventional wisdom to an uper limit much higher, only the upper limit might be focused on. It could be argued that such feeling of urgency as may exist about the energy crisis might tend to be weakened. In that respect, the more pessimistic an estimate the better it would be. However, this question of impact should not hinder the technical examination of petroleum resources. I have endeavoured to gauge the possible magnitude of the remaining conventional petroleum resources in the world, uninhibited by the impact that such an estimate might have.

(37) Having thus displayed the range of the various possibilities about the extent of the remaining conventional world petroleum resources, various possibilities emerge. Of these the following stand out for policy consideration:

Scenario 1: Maximum Oil Crunch.

Scenario 2: The Oil Option.

Scenario 3: Long-Term Dominance of An Oil Cartel.

In Scenario 1 the oil prospects in developing countries would turn out to be as disappointing as indicated in the prevailing conventional wisdom, and the oil resources of the Middle East would be of the order of 1,000 billion barrels or so. Worldwide conventional oil left would be of the order of 1,700 billion barrels of oil. That is, equivalent to 80 years of consumption at the 1976 rate of consumption.

In Scenario 2 the oil prospects in developing countries would turn out to be as significant as indicated by the upper estimates I have presented, and those of the Middle East would also turn out to be of the order of 1,000 billion barrels or so. In this scenario the dominance on oil prices of cartel-type organizations would be weakened.

In Scenario 3 the oil prospects in developing countries would turn out to be as disappointing as indicated by the prevailing conventional wisdom, but those of the Middle East would turn out to be considerably higher (say 2,000 to 3,000 billion barrels) than now believed. In this case there could be a more prolonged dominance on the energy market of cartel-type organizations.

(38) The implications for the world economy of such scenarios are so vastly different that a flexible strategy would be needed to cover the various possible outcomes as to the world resources. To proceed on the assumption that only one of these scenarios would prevail would seem to be dangerous.

TABLE 1.—*Developing Countries Included in each Ad Hoc Regional Group*

Latin America: American countries south of the United States, including the Caribbean countries.

Africa and Madagascar: All countries in the African continent and also the Malagasy Republic.

South and South East Asia Extended: (a) On the Asiatic Mainland: Afghanistan, Bangladesh, Bhutan, Burma, India, Khmer Republic, Laos, Nepal, North Korea, North Vietnam, Pakistan, Peninsular Malaysia, Sikkim, South Korea, South Vietnam, Sri Lanka, and Thailand.

(b) In the Western Pacific: Brunei, Indonesia, Papua-New Guinea, Philippines, Sabah, Sarawak, and Taiwan.

TABLE 2.—COMPARISON OF RELEVANT FACTORS FOR REGIONS CONSIDERED

Region or country	Relative prospective area [1]	Oil (millions of barrels)		
		Cumulative production [2]	1976 production [3]	Proven reserves
Non-OPEC—Africa and Madagascar	1.62	2,423	204.4	11,422
Non-OPEC—Latin America	1.53	13,802	668.2	15,226
Non-OPEC—South and Southeast Asia Ext	1.01	2,539	205.9	5,609
United States of America	1.00	122,317	2,968.4	39,782
OPEC	.93	141,704	10,940.3	444,970

[1] B. F. Grossling estimates.
[2] To 1975; various oil industry journals, and USGS and USDM published statistical data.
[3] To end 1975, "World Oil," Feb. 15, 1976, p. 132.
[4] To end 1975; "Oil and Gas Journal," Dec. 29, 1975.

TABLE 3.—COMPARISON OF 1976 LEVELS OF PETROLEUM EXPLORATION

Region or country	Relative prospective area [1]	Exploration activities			
		Geology [2] (party-months)	Onshore seismic [3] (crew-months)	Offshore seismic [3] (crew-months)	Number of exploratory wells
Africa and Madagascar	1.62	52.5	649.2	25.1	[2] 171
Latin America	1.53	194.6	505.0	54.0	[2] 439
South and Southeast Asia Ext	1.01	43.8	236.3	52.2	[4] 206
United States of America	1.00	([5])	2,843.4	296.1	[6] 9,234

[1] B. F. Grossling estimates.
[2] "Am. Assoc. Petroleum Geol. Bull.," vol. 61, no. 10, p. 1578–1896, 1977.
[3] "Geophysics," vol. 42, no. 5, p. 1070–1084. 1977.
[4] Data for India and Afghanistan not available.
[5] Not applicable. Geologic fieldwork for petroleum nearly completed. Figure for Alaska: 22.9 party-months.
[6] "Am. Assoc. Petroleum Geol. Bull.," vol. 61, no. 8, p. 1121–1156. 1977.

TABLE 4.—EXPLORATORY DRILLING FOR PETROLEUM IN DEVELOPING COUNTRIES AND THE UNITED STATES

[Number of wells—in parenthesis percentage with respect to 1971 figure]

Region or country	Relative prospective area	Years— 1971	1972	1973	1974	1975	1976
Africa and Madagascar	1.62	251 (100)	224 (89.2)	179 (71.3)	189 (75.3)	212 (84.5	171 (68.1)
Latin America	1.53	538 (100)	542 (100.7)	488 (90.7)	506 (94.1)	408 (75.8)	439 (81.6)
South and Southeast Asia Ext[2]	1.01	[3] 214 (100)	[4] 199 (93.0)	[5] 295 137.9)	251 (117.3)	[2] 300 (140.2)	[2] 206 (96.3)
United States of America	1.00	6,922 (100)	7,539 (108.9)	7,466 (107.9)	8,619 (124.5)	9,214 (133.1)	9 234 (133.4)

[1] Estimated from data in "Am. Assoc. Petroleum Geologists Bull.," Foreign Developments issues, and North American Drilling Activity issues, 1972–1977.
[2] The yearly fluctuations for this region are much influenced by incompleteness of the data. On the other hand, the 5-year trend is significant.
[3] Data for Burma not available.
[4] Data for India and Afghanistan not available.
[5] Data for Afghanistan not available.

TABLE 5.—1977 DRILLING ACTIVITY[1]

[Exploratory plus development]

Region or country[2]	Wells	Average depth[3] (feet)
Africa and Madagascar	620	7,896.8
Latin America	2,380	6,700.9
South and Southeast Asia Ext	901	5,424.8
Japan	25	[4] 8,715.4
Australia and New Zealand	92	[4] 7,213.8
Western Europe	595	8,336.6
Middle East	805	7,654.9
Canada	6,280	3,200.9
United States of America	44,207	4,642.5
Total	55,905	

[1] "World Oil, Aug. 15, 1977, p. 45.
[2] U.S.S.R., Peoples Republic of China, and centralized economies of Eastern Europe not included.
[3] Figures for 1976.
[4] Average for 1975–76.

TABLE 6.—TOTAL GEOPHYSICAL EXPENDITURES FOR PETROLEUM EXPLORATION

[In millions of dollars]

Year	Region or Country United States	Africa	Latin America	Far East
1961	[2] 273	[2] 73	[2] 47	[2] 14
1962	[2] 235	[2] 60	[2] 53	[2] 12
1963	[2] 238	[2] 53	[2] 51	[2]15
1964	209.8	52.2	43.8	20.8
1965	250.3	59.4	51.1	35.5
1966	[2] 359	[2] 99	[2] 78	[2] 55
1967	[2] 232	[2] 154	[2] 92	[2] 74
1968	225	134	82	66
1969	285.9	125.4	95.8	89.7
1970	[2] 200	[2] 66	[2] 92	[2] 43
1971	[2] 210	[2] 84	[2] 110	[2] 140
1972	262.5	136.7	102.7	85.8
1973	368.6	134.4	130.0	90.0
1974	510.3	129.6	207.0	123.8
1975	516.5	122.9	147.6	74.3
1976	496.9	117.8	94.7	47.0

[1] "Geophysics," Geophysical Activity Report, yearly issue, 1962–1977. est: B. F. Grossling's estimates based on projections from data.
[2] Estimated.

TABLE 7.—RELATIVE VARIATION OF TOTAL GEOPHYSICAL EXPENDITURES FOR PETROLEUM EXPLORATION[1]

Region or country	Relative prospective area	1961–1972 average	1973	1974	1975	1976
Africa and Madagascar	1.62	100	147.0	141.8	134.5	128.9
Latin America	1.53	100	173.6	276.4	197.1	126.4
South and Southeast Asia Ext.	1.01	100	166.1	228.4	137.1	86.7
United States of America	1.00	100	156.3	216.3	218.9	210.6

[1] Calculated from data in table 6.

TABLE 8.—BALANCE SHEET OF ESTIMATED OIL RESOURCES

[In billions of barrels]

Geographical unit	Cumulative production to 1975	Recoverable proven reserves end of 1975	Growth proven reserves	Undiscovered recoverable resources	Estimated ultimate recovery
United States	122.317	32.682	42.487		
Canada	7.479	7.100	9.230		
Western Europe	7.284	27.538	35.800	346 to 1,971	875 to 2,500.
Australia and New Zealand	.816	1.775	2.307		
Japan	.186	.025	.033		
U.S.S.R.	47.193	80.400	104.520		
Latin America	47.291	35.376	29.869	224 to 848	336 to 960.
Africa and Madagascar	20.564	65.092	41.685	223 to 873	350 to 1,000.
South and Southeast Asia Ext.	9.123	19.609	14.293	181 to 597	224 to 640.
China, P.R.	2.400	20.000	26.000	27 to 172	75 to 220.
Middle East	85.857	368.410	193.213	352 or over	1,000 or over.
Total	350.510	658.007	499.437	1,353 or over to 4,813 or over.	
Recoverable oil left in the ground by end 1975				2,510 or over, to 5,970 or over	

Author's Publications Relevant to Subject

Grossling, B. F., 1975a, "Latin America's Petroleum Prospects in the Energy Crisis": U.S. Geological Survey Bulletin 1411, 40 p.

Grossling, B. F., 1975b, "In Search of a Statistical Probability Model for Petroleum-Resource Assessment": U.S. Geological Survey Circular 724, 18 p.

Grossling, B. F., 1975c, "Las Perspectivas del Petróleo Latinoamericano y la Crisis de Energía," in: America Latina y los Problemas Actuales de Energía, Fondo de Cultura Económica, Mexico, p. 520–563.

Grossling, B. F., 1976a, "Posibilidades Energéticas Regionales han sido Subestimadas": Siderurgía Latinoamericana, Nr. 191, p. 27–30.

Grossling, B. F., 1976b, "The Petroleum Exploration Challenge With Respect to The Developing Nations," in: The Future Supply of Nature-Made Petroleum and Gas, R. Meyer (Edition), Pergamon Press, p. 57–69.

Grossling, B. F., 1976c, "Window on Oil," The Financial Times Ltd., London, 140 p.

Grossling, B. F., 1977, "A Critical Survey of World Petroleum Opportunities," in: Project Interdependence: U.S. and World Energy Outlook through 1990, Committee on Energy and Natural Resources, H. of R., U.S. 95th Congress, Committee Print 95–33, p. 645–658.

Window on Oil Chart

The accompanying chart, nicknamed "Window on Oil", highlights one of the striking aspects of the present stage of development of world petroleum resources.

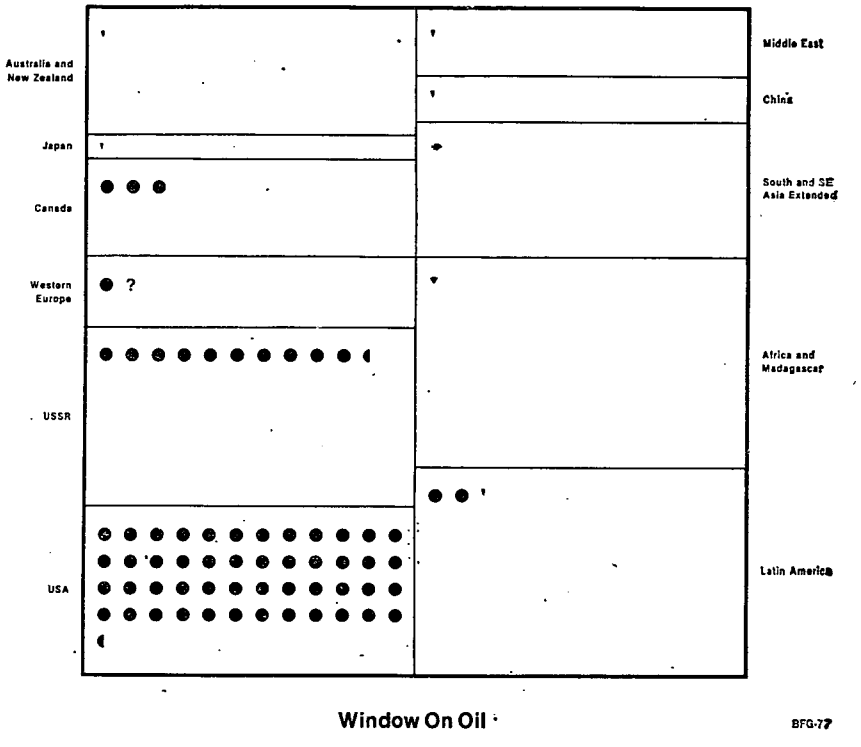
The areas within the bars are proportional to the size of the gross petroleum prospective areas in the various countries. Onshore prospective areas and those in the continental shelves are included. The antarctic continent is not included.

The left part of the chart corresponds to the developed countries and the right to the developing countries. Market-economy and centralized-economy countries have been assigned to the proper group. The partitions correspond to the geographical units chosen to unravel the petroleum situation.

Each full dot in the chart corresponds to 50,000 wells, with exploratory and development. Fractions of a dot correspond to numbers of wells proportionately smaller than 50,000.

The chart contains the estimates by B. F. Grossling and D. T. Nielsen for all the wells which have been drilled for petroleum in the world to the end of 1975. The estimated total number of wells is about 3.2 million, of which about 2.4 million are in the United States.

The chart reveals a large drilling gap. This in the sense that only about 23% of all drilling for petroleum in the world has been done in countries other than the United States.



Senator KENNEDY. To continue now, Mr. Grossling, would you not agree that there are probably finite limitations on the amount of oil and petroleum? With your estimates you move the line down the road in terms of what we are going to face at the moment of truth. But at least it is within your estimates, even if they are right. When do we reach that moment of truth? Would we delay it another 20 years, given the exponential growth in terms of energy consumption?

Mr. GROSSLING. Yes.

Senator KENNEDY. If that is the case, aren't they the stock measures of exploration? It is your point that we should find out about these other areas, and we should permit the competitive forces to work so that we could stabilize the price market while we move toward these alternative energy systems, and be required to go

crashing ahead with all the implications and repercussions of a hastily received energy policy.

What is your view?

Mr. GROSSLING. This is really a very important question. First, as to the citing of a larger resource figure, I do have a great sense of urgency as to the energy problem. I think that, aside of the fact that the oil bridge might be two to three times larger, we still have to consider that the economies of the world, and the industrialized nations, run on oil.

So we have so much oil left. The question is, what do we do with that oil? Now the economies of the world keep running on oil. The GNP is oil. And the new alternatives, fusion, coal, oil shale, and so forth, are really produced by oil, by investing in that type of oil. Therefore, one could say the real problem is a strategy. How do we use these resources? Should we let the world's economy drag along, waiting, contracting, and more or less wasting effort? Or do we constructively use that oil and go full steam ahead to produce the quick alternatives in my feeling, rather than to shrink?

Conservation is very important, but I think it should be full steam ahead with a definite plan to solve and use petroleum. We have to build the alternatives. If we waste it, there would probably be little time to build the rest, because the rest comes from the prime movers of energy, which run on oil, and it has to be the United States, Western Europe, Japan, and the U.S.S.R. that will do it. And if their economies are not viable, the whole system collapses.

Senator KENNEDY. What is your assessment of the reasons why the production is being held back? Make three or four specific recommendations as to how to deal with that.

Mr. GROSSLING. One, we have to be extremely selective, if I may, Mr. Chairman, exemplify some of the problems. Because there is no one simple answer. In Latin America, as I know it very well, the countries there have a great deal of other resources. They don't have only oil and sand. They have oil and many other things too. And they have been very nationalistic in developing the petroleum resources.

When I speak of nationalism, I mean defending your own country. There is no implication of value. So that factor has held petroleum development back, and also the fact that they have other resources. But with the advent of the energy crisis, with the new prices, countries which are very nationalistic are changing.

An example is Brazil. Brazil is inviting the private corporations. Argentina might do that also. So in Latin America it is specifically national policy. And in Africa, in part it was economics, because some of the oil inland could not be brought to the coast when the price of oil was a little over $1 per barrel, so there was economic cutoff.

Then technology was cut off. Most of the offshore wells, until 10 years ago, were around New Orleans. Therefore the technology to develop the continental margins was simply not available.

Then there was civil chaos, and that was in Southeast Asia. We have had several wars which distorted the whole pattern, and discouraged development. This explains why we came to this peculiarity; in all of Africa, there were about 12,000 wells drilled for petroleum, and in all of Southeast Asia about 25,000 wells were drilled.

Now, when we look from here to the future, I think economic pressures, simply the fact that oil is expensive, but once the constraints are overcome, then the new oil is not going to cost as much as the oil we have now. I refer to the bulk of the oil. But I do not hold that the price will come down to those levels. But we can expect pressure on the market, for example, when countries that now pay $4 to $5 billion a year for imported oil cease to do so.

Senator KENNEDY. Well, we also ought to be doing more through the international lending agencies, such as the World Bank, to encourage this process to move more rapidly forward, and use other mechanisms than just the price mechanism.

Mr. GROSSLING. I think so, Mr. Chairman. Until now, very little has been done. In fact, I think probably the World Bank was the first one to move into this area, but they haven't done much as yet, and their role would have to be very selective.

In some countries, there is very little public knowledge of the petroleum resources. To establish a level of confidence at the national level, a lending agency like the Bank could provide that to some countries.

I think the policies, for instance, in the United States, was not to lend to national oil companies. I think that has to be changed, because obviously they are here to stay. The policy of not lending to such agencies should be reversed. I think before it was almost taboo to deal with the national oil companies.

Senator KENNEDY. What do you believe to be the importance of Mexico and their resources to the United States? You commented on it in your testimony. Maybe you could elaborate on it. How big is the reserve as compared to the Middle East?

Mr. GROSSLING. The figure I have in my prepared statement is about 17 billion barrels. Now, that was as of Dec. 31, 1977. That figure contains the equivalent of gas, which is about 3.6 billion barrels. I called Pemex's office in Mexico City, yesterday, and they gave me a very interesting figure. They use two classifications: Proven reserves, and probable reserves. Proven reserves, are what you are sure to have. Probable reserves is the extrapolation about the size of the fields that have already been discovered. And that figure is 31 billion barrels.

Now what does it mean, in terms of what do we compare it with? Mexico went from 2.8 to 17 in 5 years. The 31 billion barrel figure is equivalent to our own proven reserves. Now, when we look at where this oil came from, it is in a tiny corner of Mexico. That is a rather small place, but if you look at the geological framework of that part of Mexico, they have tackled, in a very rough way, about a third the prospective area they have in this province.

Now, in the third of the area that they have tackled, they could do three or four times more drilling, because their strategy was not to pick one field, develop it, and produce it. Their strategy was magnificent: try to spread very quickly and find the dimensions of the resources. They are still running after the limit of the resources. There is a growth factor as to the broad area. There is a growth factor as to filling in, in the area that they already tackled.

Now, the proven reserves, I think should be multiplied by 2. The total possible growth is 20 times. This could even be larger, because the area that we have is an anticlinorium, and on both sides it is

bound by basins. Moreover, they haven't finished with deeper drilling, and the formation believed to be the source of the oil is beneath them. They haven't touched it.

Here we have the elements of surprise. What if we were to rely only on the current reserves, that simply would be fooling ourselves? It would be a great shortsight.

Senator KENNEDY. Is there anything else you would like to add with regard to Venezuela, for example?

Mr. GROSSLING. In Venezuela there are two interesting factors that ought to be mentioned. First is the fact that Venezuela just nationalized the oil in the petroleum industry. Without reflecting on that, the thing to notice is that the gross petroleum prospective area is not totally drilled; only about half of it has been drilled. The drilling work, in the prior concessions, was only limited to the concession areas by the drill. Half of Venezuela is prospective areas and remains to be explored.

Then the second question is the Orinoco belt of heavy crudes. There is a very large belt that runs about 700 miles from the border of Colombia to the Orinoco delta. It is, on the average, 50 miles wide. There is a large accumulation of heavy crudes, and the estimates of the oil in place is 3,000 billion barrels.

Now it could be produced today at $4.50 per barrel. But they don't want to do it. They are waiting, because they are shooting for a larger oil recovery. If we were to assume that the recovery is 20 percent, they are aiming at between 16 and 20 percent, so if we were to assume that 80 percent of this belt were economically accessible, then the amount of recoverable petroleum would be 640 billion barrels of oil. Now this is a third of the world oil resources of the conventional wisdom.

Senator KENNEDY. What you are pointing out is that it is extremely plausible, based on the geological information, that this major reserve has existed in close proximity of Venezuela and Mexico, and still we are very strongly dependent on Middle East reserves. And this presents, for both Venezuela and Mexico, interesting policy opportunities, as well as pricing opportunities.

I would expect the energy issue had not really been fully valuable to these countries.

OK, let me just finally ask you, if we moved to develop in more aggressive ways these alternative sources of oil, do you think that could have some effect on pricing? Or what would you see over any percent in the future? I mean, Venezuela is in support of the pricing, and goes to the other countries as well. What can you tell us, in your own view, would be the impact on pricing with the development of these other sources?

Mr. GROSSLING. Well, the basic economic factor that one would have to consider is that the cost of the bulk of this new oil would be way below the current prices. So if anything, I would expect downward pressures. It could not be that this new oil would try to boost the price upward. It would tend to bring it down.

Now, a great deal depends on who controls this oil. Were OPEC to control it, we would be sunk—or the U.S.S.R. So it is important who finds the oil, and who controls it. What access do we have to the oil?

Also, the long-range policies as to petroleum resource development of this kind of petroleum leaves great room for negotiation and broad studies. These are difficult things to discuss in a short question.

Senator KENNEDY. Thank you very much. We would like to stay in touch with you. You have been very helpful with your testimony, and we appreciate your presence very much.

I am wondering if you could take the chart with you that has been supplied to us by the Department of Energy, and give us a little note on whether you agree with that. If you give us a comment on that, we will make it a part of the hearing record.

[The following information was subsequently supplied for the record:]

RESPONSE OF BERNARDO F. GROSSLING TO SENATOR KENNEDY'S REQUEST FOR COMMENTS ON CHART[1] ENTITLED "FREE WORLD OIL DEMAND AND SUPPLY, 1966–1985"

The chart to which I am referring is labeled "Free World Oil Demand and Supply, 1966–1985".

Because of the issues I have been studying, it is proper for me to comment only briefly on the curve corresponding to non-OPEC supply. This curve projects the supply to rise gradually from a low of 16.8 million b/d of oil in 1976 to a value of 24 million b/d of oil for 1985, but still with a rising trend in 1985.

What I have been studying is mainly the possible magnitude of the petroleum resource base of non-OPEC countries. These countries provide significant contributions to the non-OPEC supply. Estimates of the potential provide a clue to the long range prospects (10–30 years). But I have not made short-term projections (of the order of five to ten years) for the oil supplies.

Data on annual geophysical expenditures and exploratory drilling for the non-OPEC developing countries show that there has not yet been a marked response to the 1973 oil price increases. Several factors may have precluded a more intensive search.

Because of the time lags involved in exploration, I feel that the non-OPEC supply projection up to 1985 as shown in the chart should be basically correct. There is only one exception to this. Between now and 1985 there may be a substantial increase of oil production from Mexico. By 1985 Mexico's production could conceivably have reached a level of two million b/d, or maybe more. It all depends on the exploration outcome in the Reforma area and western shelf of the Yucatan Peninsula.

On the other hand, for the period 1985–1995 I expect a considerable increase in the petroleum production from non-OPEC developing countries. But this question is beyond the time limits shown in the chart.

Senator KENNEDY. Our final witness is Elihu Bergman, who is the executive director of Americans for Energy Independence.

Mr. Bergman has wide experience in the national economic development assistance field.

Mr. Bergman.

STATEMENT OF ELIHU BERGMAN, EXECUTIVE DIRECTOR, AMERICANS FOR ENERGY INDEPENDENCE

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

I am accompanied by Tina Silber, who is our director of the Government relations of AFEI. And I would like to start with a personal digression if I might.

It is a particular pleasure for me to appear before you this morning, because, until coming down here a few months ago I was an adoptive constitutent of yours while on the staff of Harvard for the past 6 years. We lived in Lexington, and our children grew from

[1] "See chart on p. 110."

babies to childhood and entered the public schools in Lexington. I even had the opportunity to enjoy involvement in that fascinating world of Massachusetts politics. I was a member of the Massachusetts delegation to the 1976 Democratic platform committee, where I served on the international relations task force.

Because of this adoptive constituent relationship, I really am proud that you are taking the lead in this extremely important dimension of the energy issue. by opening and expanding the discourse on contesting the unilateral price-setting power of OPEC.

We, as a group, are also gratified that having heard some distinguished specialists and experts, and members of the Government, you now are providing the opportunity for a public interest group such as ours to express our concerns in this matter.

The hour is late, but I have a short prepared statement which I will read, if I may, and a policy statement of my organization, which I would like to submit for the record.

Senator KENNEDY. It will be included, without objection, in the hearing record.

Mr. BERGMAN. Thank you, Senator. We at Americans for Energy Independence are a nationwide coalition of individuals and groups with diverse interests who share a common conviction that an ample and reliable supply of energy is an essential condition for a healthy American society.

Our concept of a healthy American society reflects the objectives valued by a broad cross section of the American people: One, a growing American economy; two, the opportunity for all Americans to improve their condition in life through the social and economic mobility provided by economic growth; three, a national security and foreign policy capacity insulated from manipulation by foreign energy producers; and four, a strong foreign trade and payments capability which facilitates constructive U.S. international economic policies.

I should emphasize that as a public interest coalition our commitment is not energy for energy's sake, but to energy as a means of achieving some desirable end goals. Now, oil is a critical ingredient of our national energy supply, and imported oil, increasingly so. We are here to express alarm and anger that the U.S. Government has surrender control of our imported oil supply to a foreign cartel whose motives and actions are hostile to the interests of the United States and our allies.

We are disappointed that our Government has made no effort to remedy this condition of international bucaneering, which has created a grave threat to the political and economic well-being of the Western developed nations, and has consigned the underdeveloped nations to a perpetual cycle of poverty. Unrestrained oil prices, unilaterally established by the OPEC cartel, by draining purchasing power out of the free world, have created an epidemic of economic stagnation that restrains social progress and erodes political institutions. Every per barrel increase of $1 in the price of oil decreases world purchasing power by $12 billion. We suffer inflation and unemployment here at home, and the consequences of this loss have been devastating to a carefully nurtured structure of global economic relationships.

We have observed a virtual conspiracy of silence on the issue within the context of national energy policymaking.

Worse still, we are being asked to accept a national energy plan which proposes to institutionalize OPEC's extortionist policies by imposing a tax on U.S. crude oil at the wellhead to make sure that our own oil prices are in line with the cartel's.

We call for action and leadership by our Government now, at an opportune juncture, when the glut condition of the international oil market beckons us to emerge from a self-inflicted syndrome of impotence.

Nowhere is this state of national paralysis better demonstrated, Mr. Chairman, than in the executive branch response to the Comptroller General's report on foreign oil pricing, which was prepared at your request. The GAO report states that the United States has rendered itself unnecessarily vulnerable to pricing decisions by foreign oil suppliers. It suggests that remedial action is in our national interest and entirely within our national capability.

The GAO tells us that the behavior of our Government fosters a continuing reliance on the OPEC cartel, while discouraging the diversification of oil supply sources outside OPEC. It suggests that the United States is not powerless in dealing with the cartel; that we have leverage at our disposal to influence the international oil market in our interest. The GAO would require the submission of plans not later than July 1, 1978, by the appropriate Federal departments, including specific actions, and legislative authority necessary for their accomplishment, addressed to, among other things:

One, modification of existing terms of access to OPEC oil.

Two, improvement of the security of U.S. imported oil supplies at reasonable prices.

Three, diversification of U.S. oil sources to non-OPEC countries.

Following receipt of these plans, the GAO recommends congressional hearings on their adequacy.

These findings and recommendations are not a vehicle for confrontation, they do not envision hostile actions; they reflect nothing more than good common business sense, exercised in our national interest.

Yet, the executive branch response to this valuable and sober analysis has been nothing short of a total put-down. The Department of Energy states, in so many words, that it has considered and dismissed the remedies proposed by GAO, and warns that the GAO proposals create unwarranted expectations.

The Department of State, repeating its tired old litany of justifications for continuing to do nothing that might rock OPEC's boat, recommends that the GAO proposals not even be considered by the executive branch. And the Treasury Department takes the ludicrous position that the U.S. Government should not involve itself in the oil importing process, which it views as "private international transactions."

Senator KENNEDY. What was your reaction to Secretary Schlesinger's willingness to respond on these?

Mr. BERGMAN. Well, I thought it was good as far as it went. And also I heard the testimony of the State and Treasury witnesses approximately 10 days ago, expressing a willingness to respond.

But what really disturbs me about the Secretary's testimony this morning was that he said action in the international arena would have to await action on the domestic side.

Now, it seems to us that parallel actions on both sides would best serve the national interest.

Senator KENNEDY. I agree there.

Mr. BERGMAN. Private international transactions, indeed. It is abundantly clear that transactions in the international oil market, whatever the commercial structures in which they occur, assume a unique significance in the panorama of American national interest. We are not dealing in markets involving breakfast cereals or cat food. The international oil market intersects the American public interest more than any other market structure. And the participants in this market, and those affected by it, recognize this special quality.

It is astonishing that the Treasury fails to admit this reality. And it is depressing that the executive branch stubbornly resists opening its mind to credible analyses, such as we heard here recently, that identify opportunities for price competition in the international oil market, and an expansion of oil sources and supply.

In AFEI's statement of policy, which was submitted for the hearing record, we propose a program for effective national energy policies which we are convinced would enjoy the support of most Americans. In addition to stressing the need to maximize our domestic energy production capability and adopt conservation measures to insure the most efficient utilization of our energy supply, we also focus on the need—and opportunities available to the United States—to contest monopolistic control over the pricing and flow of world oil.

On the international level, we suggest that U.S. Government policy be directed at two objectives: One, provision of incentives for the development of new oil sources outside OPEC that correspond to American economic strategic interests.

And two, creation of a more competitive market for existing oil sources by encouraging bargaining in the marketplace and discouraging identities of interest between selling countries and marketing companies.

Our position is buttressed by the GAO analysis and by the recent testimony before this subcommittee, which established once again that the time is ripe for major U.S. efforts to dilute the influence the OPEC cartel exerts over our energy supply and our economy. There is likely to be an approximate balance between the growth of oil demand and the increase in non-OPEC supply sources between 1978 and 1981. Virtually all of the increases in world oil demand during this period will be met by new supply sources such as the North Slope of Alaska, the North Sea, Mexico, and a variety of smaller, but still significant, oil production gains in other parts of the world.

As a result of this new competition, OPEC could become vulnerable to consumer pressures for lower oil prices, provided that U.S. tax and purchasing arrangements are revised. Existing arrangements minimize these pressures and impede the operation of normal market forces.

One of the principal pegs on which OPEC cohesion rests is the special relationship between its member countries and some international oil companies. Each OPEC member, acting individually, seeks a secured outlet for its crude oil; some of the international companies receive "preferred access" to that oil in return.

Furthermore, the relationship between OPEC and these international oil companies has been strengthened by the Internal Revenue Service's practice of allowing the companies to credit OPEC royalty fees against U.S. taxes owed by the companies.

American companies operating overseas are entitled to offset legitimate taxes collected by countries in which they operate as credits against their U.S. tax liabilities. Royalty payments, however, are profit-sharing arrangements, and therefore are not properly creditable under U.S. law. The fixed-price-per-barrel charges set by OPEC clearly constitute royalty fees, not taxes.

The royalty arrangement was instituted some 25 years ago as a means of providing indirect U.S. economic aid to underdeveloped Arab nations deemed friendly to the West. Whatever justification once existed for this subsidy, it now is unquestionably obsolete. Yet the preferential U.S. tax treatment associated with this obsolete concept continues not only to cost the American taxpayers billions of dollars, but to compound our energy problem by maintaining an incentive to purchase OPEC oil at the expense of developing domestic and non-OPEC foreign sources of oil. This condition is inconsistent with U.S. energy and economic objectives.

A competitive oil market in which the United States can bargain more effectively for our supply requires an expansion of the diversity of oil sources outside OPEC. U.S. policy should be aimed at the creation of incentives and instruments for the development of such non-OPEC sources.

A number of particular options should be considered for this purpose, none of which are mutually exclusive, and a number of which could function in tandem. For example, Export-Import Bank authority and capitalization could be expanded to supply and guarantee financing for U.S. firms involved in oil exploration and production ventures abroad. Alternatively, an autonomous Petroleum Production Authority might be created for this purpose. Authorization and capitalization within U.S. foreign aid programs could be established for exploration and production ventures in underdeveloped countries.

The United States should use its considerable influence in international lending institutions to encourage the development of new and diverse fuel sources. Earmarked capital contributions could be considered as a means of doing so.

The structure employed by the United States to import oil is a key factor in the competitive quality of the oil market. A number of changes have been proposed in this structure for the purpose of making the market more competitive, and to increase our bargaining capability within it. All of these suggestions warrant urgent consideration.

Among them are proposals for variable import quotas and tariffs, for a system of competitive bidding for the right to sell foreign oil in the United States, and for an organized exchange market for oil products.

Yet the Carter administration, like the Nixon and Ford administrations before it, remains unwilling to challenge the OPEC-established status quo. Indeed, the New York Times reported just last week that the administration now envisions a new strategy of "conciliation" with OPEC—as opposed to, presumably, the old strategy of conciliation.

Prof. Morris Adelman of MIT, a highly respected analyst of international oil markets, share our misgivings. He wrote AFEI recently:

"You refer * * * to the need for creating competition, and the proposal for a system of competitive bidding for rights to sell foreign oil in the United States. This proposal was presented to the then-President-elect Carter's Economic Task Force, and they recommended it. (See Oil and Gas Journal, Jan. 10, 1977.) When the plan was explained to Mr. Schlesinger, his reaction was: "It would work. But do we dare let it work?" (See New Republic, May 21, 1977, and Washington Post, July 10, 1977.) Clearly, the administration does not want any such thing as more competition in world oil. Perhaps they are right, but the reasons have never been stated, let alone defended. A congressional inquiry could do the Nation great service.

We endorse the GAO position that the appropriate committees of Congress follow through on its recommendations to assure expeditious action by the executive branch.

We hope, Mr. Chairman, that the Congress will take the lead in this critical area of national interest, as it has done with constructive impact in other areas of foreign policy. Clearly, we cannot expect the executive branch to do so in the absence of the special sort of motivation that only Congress can provide.

On behalf of the Board and the members of AFEI, I want to congratulate the subcommittee for focusing national attention on this issue, and to thank you for inviting us to express what we believe is the legitimate and increasing public interest in international aspects of the energy crisis.

The Nation and the world await our authentic commitment and credible action.

Thank you, Mr. Chairman.

Senator KENNEDY. Thank you very much for a very fine statement. And you are right on target with the kinds of issues that we have been considering here. We will include the policy statement at this point in the record.

[The policy statement referred to follows:]

AMERICANS FOR ENERGY INDEPENDENCE: POLICY STATEMENT

INTRODUCTION

Americans for Energy Independence (AFEI) is a non-profit coalition uniting members of the business, labor, academic, scientific, industrial, consumer, conservation, ethnic and religious communities throughout the nation in pursuit of effective national energy policies. For AFEI, the concept of "energy independence" involves the freedom to make energy policy choices that are responsive to U.S. national interests, a capability which can be derived only from an uninterrupted access to reasonably priced supplies of required energy products, and a primary reliance on domestic energy resources.

Little has been done to improve the security of this country's energy supply beyond preaching and the production of paper programs. Official vacillation, drift and delay have aggravated the energy crisis, confused the American public and undermined our confidence in national leadership.

In the absence of effective energy policies, the United States now is experiencing a stagnating economy, a pattern of record balance of payments deficits, declining export markets, increasing inflation and high unemployment. These coditions threaten to pauperize America and worsen the economic plight of the most disadvantaged sectors of the American population.

Members of the AFEI coalition, whatever their particular interests, share a conviction that an ample and reliable supply of energy is an essential condition for a healthy American society, whose ingredients include: (1) a growing American economy; (2) the opportunity for all Americans to improve their condition in life through the social and economic mobility provided by economic growth; (3) a national security and foreign policy capacity insulated from

manipulation by foreign energy producers; and (4) a strong foreign trade and payments capability which facilitates constructive U.S. international economic policies.

To achieve these national goals, AFEI advocates:

1. Vigorous development and utilization of the major available domestic sources of energy, particularly those to meet near and intermediate term requirements.
2. Accelerated research, development and demonstration programs on new energy concepts, with priority to those which promise significant short-term benefits as well as longer-term potential.
3. Streamlined regulatory procedures designed to encourage rather than frustrate the construction and activation of energy producing facilities.
4. Exercise of reasonable environmental safeguards in the development and utilization of energy resources.
5. Realistic conservation measures to increase energy efficiency and reduce energy waste.
6. Actions to create more competitive market conditions for transactions in which the United States engages with the foreign suppliers of oil and other primary energy products.
7. Rapid accumulation of the Strategic Petroleum Reserve.

Conservation is a vital instrument for raising national energy consciousness and for achieving more efficient utilization of scarce energy resources. At a time when most Americans are oblivious to an energy problem, the concept of efficiency and thrift in energy use is the most effective vehicle for communicating the energy message on a personal and individual basis. In addition to raising citizen awareness, a successful national effort to conserve energy will extend and expand the domestic energy supply.

The parallel requirements of developing an energy supply and achieving effective environmental protection need to be reconciled in the national interest. Among the parties involved in the process, some advocates of environmental protection have blurred the distinction between critical and non-critical issues. Others have been reluctant to respond to legitimate environmental concerns. The nation and the consumer are victims of the resulting stalemate.

It is the responsibility of the Federal Government to achieve balance between these two vital concerns, to work with the private sector and state and regional authorities in streamlining procedures which now permit environmental disputes to fester indefinitely, and to expedite industrial development of technology which can minimize environmental damage in the course of energy development and utilization.

An energy capability consistent with American economic needs and social values requires a national commitment to expand the U.S. energy supply. Americans For Energy Independence provides a platform from which concerned Americans can join forces for effective national energy policies. This can be done through a variety of channels, including the provision of information, the education of fellow citizens, the expression of public interest to elected and appointed officials and in the courts, and the evaluation of policy decisions and results.

I. ENERGY DEVELOPMENT AND PRODUCTION

Investment to create enormous new energy capacity is necessary to provide the energy supplies for a growing economy and the related job opportunities required for a healthy modern society.

The nation must assign priority to the near-term and expensive job of developing known domestic energy sources with proven technologies and production capabilities. This commitment must focus on developing and utilizing the vast coal reserves of America; increasing the role of nuclear power in the total energy mix; expanding exploration and exploitation of domestic oil and gas reserves; providing for the rapid employment of these resources to meet national needs; and assuring sufficient electric generating capacity, including a prudent reserve for peak and emergency periods to supply growing residential and industrial demands. Incentive programs to provide the investment for implementation of these objectives should be reviewed, and where necessary, strengthened.

Economically recoverable coal reserves in the United States are estimated at a minimum of 250 billion tons, exceeding the energy potential of the world's total oil reserves. American high-grade uranium reserves may equal the energy of 6,000 billion tons of coal. Yet the United States is in danger of suffering critical electricity shortages in the 1980's because efforts to press the most abundant fuels into service have been frustrated at all levels.

AFEI endorses proposals to reduce dependence on foreign oil by increasing emphasis on U.S. coal and uranium resources in the near term. But it is inconceivable that these abundant resources can be used to meet energy needs unless immediate action is taken to untangle the increasing web of obstacles impeding the mining, processing and transportation of fuel resources, and the construction and activation of electric power generating and supporting facilities.

In contrast to the 4-5 year period during the 1950's and 1960's, it now takes 10-12 years for regulatory approval and construction of a commercial nuclear powerplant. Comparable delays are extending schedules for coal-fired plants, and the opening of a new coal mine now takes as long as seven years.

AFEI calls for comprehensive federal and regional programs to eliminate the obstacles which continue to block the nation's energy progress. Many of these obstacles, though bureaucratic in nature, are inspired by ideological bias, and can be solved only by strong and determined leadership. The obstacles include: Overlapping governmental jurisdictions; inconsistent and constantly changing regulatory and enviromental requirements; the absence of deadlines for critical decisions in the development sequence; cumbersome licensing and siting procedures; and indiscriminate legal challenges to the construction of energy facilities.

With respect to oil and gas, the United States should develop domestic resources both on-shore and off-shore, including the Continental Shelf. Techniques for enhancing secondary and tertiary recovery of oil, and shale oil extraction, should be pursued. Likewise, appropriate technologies should be developed to facilitate the production of natural gas from new and unconventional resources.

The lack of accurate information regarding the extent of domestic oil and gas reserves, and uncertainties about the environmental impact of developing certain finds on the Shelf, have impeded progress in this important area. The Federal Government must clarify policies and take the actions that would enable the country to maximize the use of Outer-Continental Shelf reserves. To do so, the Secretary of Energy must have access to the best available information on these resources.

Technologies which can reduce the proportion of scarce resources used for gasoline and other such fuels are also a priority need. For example, a mixture of gasoline with alcohol can be used as an automotive fuel. A mixture of this nature would allow the reduction of the oil component in gasoline by substituting a substance which can be derived from diverse renewable sources, including agricultural and forest products and wastes. In recognition of these promising possibilities, AFEI calls for immediate implementation of a national alcohol fuel program.

U.S. long-term needs require accelerated research, development and demonstration programs on the most promising of the various alternative energy concepts and resources. Where the technology is ready, demonstration programs must be aggressively pursued with the private sector to obtain realistic information on potential benefits and liabilities of the alternatives, to both assure adequate supplies and permit informed choices among U.S. energy options. These efforts should focus on the demonstration of synthetic fuel technologies, such as coal gasification and liquefaction; the breeder; the conversion of wastes into alcohol or methane; solar heating; and geothermal energy. Efforts should also be pursued on fusion and expanded use of solar energy.

The capabilities of American universities, which provide much of the research base upon which U.S. technology rests, must be fully utilized in the effort to develop new energy sources. The American research community should be assured sufficient public and private funds for the training of scientists and engineers to staff domestic energy industries and to conduct continuing research and training activities. The Federal Government should also allocate adequate funds to support goal-oriented industrial research, development and demonstration, which provide the vital link between basic experimental research and commercial application of new technology.

The Federal Government should act to eliminate product price and regulatory uncertainties, which deter private industry from undertaking energy demonstration projects. Where industry is unable to accept the economic risks involved, the Federal Government itself must continue to take the lead in financing demonstration projects. This government investment in projects where scientific promise exists should aim at creating processes and products that ultimately would be available for private use, and would attract sufficient private investment for normal commercial development.

II. ENERGY CONSERVATION

AFEI advocates the adoption of vigorous and realistic conservation programs by the public and industry, and at the federal, state and local levels of government. The most effective and equitable approach includes policies for both mandatory and voluntary conservation, consistent with the requirements for economic growth and full employment.

The role of business and industry in a successful national conservation effort is three-fold: pursuit of energy-saving technologies and machinery for industrial, commercial, governmental and consumer use; consumer energy education through advertising, distribution of informative materials, and other programs; and efficient conservation practices which will set an example in spirit and in fact for individual citizens.

Since some 65% of the nation's energy is consumed by business and industry, efforts in this sector can make a substantial impact on total energy savings. Because of the requirement for cost-effective behavior in profit-making enterprises, the cost factor can be critical in conservation decisions on the part of business and industry. Higher prices or taxes on the use of scarce fuels, along with appropriate tax and investment incentives for commercial conservation, are most likely to motivate the installation of energy-efficient equipment and the conversion to use of more plentiful fuels.

While business and industry may be inclined to use energy more efficiently primarily because of the profit motive, consumer purchasing patterns and lifestyles indicate that individuals who can afford to choose between economy and convenience frequently opt for convenience. Americans are willing to drive to work at high costs; pay high prices for prepared fooods; and pass up refunds on returnable bottles in favor of disposable beverage containers, all in the name of convenience.

As an incentive for conservation, prices have only limited impact in reducing individual energy usage. Because of the relative inelasticity of consumer energy demand, AFEI recommends against placing sole or even primary reliance on the pricing mechanism to achieve conservation among the American public. The price mechanism should be employed where it is likely to be effective, but the terms of its employment should reflect a recognition that the imposition of sharply higher prices to achieve conservation would cause disproportionate suffering among lower income groups and the rural population unless accompanied by measures to alleviate this effect. In addition, higher energy prices tend to divert consumer spending from other sectors of the economy.

Where technically feasible, mandatory measures can take some of the guesswork out of achieving individual consumer conservation. The mandating and publicizing of realistic minimum efficiency requirements for major energy-using consumer products is a more appropriate tool than a penalty tax system, which could merely widen the gap between socio-economic groups, while aggravating an already serious national inflationary condition.

AFEI favors measures such as an outright ban on "gas-guzzlers" rather than a tax on their purchase. Until minimum efficiency standards can be reconciled with the special transportation needs of large families, a less stringent mileage standard should be temporarily mandated for station wagons, which normally are purchased as necessities, not status symbols.

AFEI also favors measures which address the convenience factor in individual energy conumption. For example, parking should be limited in urban locations served by public transportation, and "fringe parking" facilities expanded; public transportation facilities should be improved; carpool/bus-only lanes should be designated on appropriate commuter routes and highways; and the 55 mile-per-hour speed limit should be vigorously enforced.

III. ENERGY AND TRANSPORTATION

Transportation accounts for approximately 26% of total U.S. energy consumption, and automobiles alone use 40-50% of U.S. oil imports. In addition to the significant use of energy, and the implications for conservation, transportation is also a critical factor in the supply side of the energy effort.

The means must be found to bring an increased volume and variety of U.S. energy sources to the market. A national energy program which fails to include a comprehensive multi-dimensional transportation plan cannot effectively deal with the energy problem. The Federal Government must begin immediately to develop national transportation policies which will serve U.S. energy policy objectives.

A key to the success of any gasoline conservation program will be the availability of reasonably attractive alternatives to automobile travel. Comfortable, convenient and economical urban/suburban mass transit systems—bus, subway or above-ground rail, in accordance with the needs of each community and the relative economic merits of each mode—should be a top priority. The effort to discourage excessive automobile use must be designed to avoid the imposition of hardships on an already hard-pressed working public.

In inter-city travel, federal policies should facilitate increased reliance on public transportation in the roles for which each mode is best suited.

AFEI supports incentive programs for the development and use of electric and other non-petroleum fueled vehicles. In addition to a potential for reducing gasoline consumption, they would simultaneously reduce the automotive exhaust pollution problem.

With respect to commercial transportation, existing legislation and regulations—such as the backhauling prohibition, which requires thousands of trucks to return empty to their point of origin at an annual energy cost of approximately a quarter of a billion gallons of gasoline—should be examined and re-evaluated in the context of potential energy savings.

The role of transportation in delivering U.S. energy supplies is of paramount importance for the new emphasis on coal. The locations of major coal deposits, far from industrial markets, have inhibited their fullest development and utilization. Railroad track deterioration has severely limited production, even in Pennsylvania's well-located anthracite coal fields. Since more than 60% of the nation's coal is moved by rail, there is a critical need to repair, modernize and expand rail networks. The Federal Government must insure that rail and alternative means of transporting increased quantities of coal to the points of utilization are provided through timely policy decisions and appropriate subsidies.

The modernization of American transportation systems will contribute not only to a more efficient U.S. energy capability, but also to a healthier American economy, by providing opportunities for increased investment and employment.

IV. THE INTERNATIONAL OIL MARKET

Monopolistic control over the pricing and flow of world oil supplies presents grave and unacceptable threats to U.S. economic, social and strategic interests. AFEI views the failure to address this problem, in the context of both the energy crisis and the dangerously increasing U.S. balance of payments deficit, as a most serious gap in the national energy program.

The timing is now critical for major efforts to dilute the powers of the Organization of Petroleum Exporting Countries (OPEC). There is likely to be an approximate balance between the growth of oil demand and the increase in non-OPEC supply sources between 1978 and 1985. Virtually all of the increases in demand during this period will be met by new supply sources such as the North Slope of Alaska, the North Sea, Mexico and a variety of smaller, but still significant oil production gains in other parts of the world. As a result of this potential new competition, augmented by increased production of U.S. energy resources, OPEC could become vulnerable to consumer pressures for lower oil prices, providing that existing tax and purchasing arrangements are revised so as not to impede normal market forces.

One of the principal pegs on which OPEC cohesion rests is the special relationship between its members and the international oil companies. Each OPEC member, acting individually, seeks a secured outlet for its crude oil; in return, the international companies receive "preferred access" to that oil.

The relationship between OPEC and the international oil companies has been further strengthened by the Internal Revenue Service's practice of crediting OPEC royalty fees against U.S. taxes owned by international oil companies. This practice not only has cost the American taxpayer billions of dollars but, by increasing the incentive to purchase OPEC oil, it has encouraged dependence on OPEC and retarded development of domestic and alternative foreign sources of oil.

U.S. Government policy in the international oil market should be directed at two objectives:

1. Provision of incentives for the development of new oil sources that correspond to American economic and strategic interests.

2. Creation of a more competitive market for existing oil sources by encouraging bargaining in the market place and discouraging identities of interest between selling countries and marketing companies.

Several mechanisms have been proposed to achieve these objectives and all of them merit consideration. For example, financial incentives could be employed to encourage new ventures in places that are compatible with American interests. Conversely, tax preferences should not be employed to sustain continued reliance on OPEC cartel sources. Other instruments, to which equally serious consideration should be accorded, involve changing the mechanisms employed to import oil. Among these are proposals for variable import quotas and tariffs, and for a system of competitive bidding for the right to sell foreign oil in the United States.

The United States should use its considerable influence in international lending institutions to encourage the development of new and diverse fuel sources.

Senator KENNEDY. Before we close, Mr. Bergman, you mentioned the Adelman plan. One of the other alternatives that Mr. Safer commented on was the futures market. I am wondering if you want to make any comment on that, what you think the relative strengths of each are.

Mr. BERGMAN. Well, I think the two might be linked together. We referred to the possibility of creating something akin to the options of the market. Perhaps if oil import quotas were established, which has been one of the suggestions of the administration, they might be established along a time frame which would allow the rights for oil imports to be traded in a futures market.

I believe this is what Mr. Safer was referring to. It is a very intriguing plan, and if we can do it with frozen orange juice, why can't we do it with oil?

Senator KENNEDY. You think it is functional and workable?

Mr. BERGMAN. The exchange markets in New York, both the securities markets and the commodities markets, have been developed to a highly sophisticated state, and I think they would be developed of managing an oil futures market. Yes, indeed, it is feasible.

Senator KENNEDY. Your organization for energy independence seems to have a broader objective than simply a narrow, literal sense. It is accurate to say that the independence you are talking about is independence from monopoly markets?

Mr. BERGMAN. Yes. This is a very important statement, Mr. Chairman, and I am glad you made it. The organization picked up its name about 3 years ago when we were talking about Operation Independence, and, indeed, in the anxiety of the oil embargo, we were thinking about independence from foreign sources. But this is not what we mean now by independence.

We mean independence to make choices about our energy supply in our national interest. We do not mean autarchy.

Senator KENNEDY. OK. I want to thank you very much.

The subcommittee is adjourned.

[Whereupon, at 12:10 p.m., the subcommittee adjourned, subject to the call of the Chair.]

[The following information was subsequently supplied for the record:]

NORTH TEXAS STATE UNIVERSITY,
DEPARTMENT OF ECONOMICS,
Denton, Tex., February 23, 1978.

Senator LLOYD BENTSEN,
Vice Chairman, Joint Economic Committee,
Washington, D.C.

DEAR SENATOR BENTSEN: Based upon an article of mine published last summer in the *Petroleum Independent*, Mr. Jerry Brady of the Joint Economic Committee staff telephoned me on February 9th requesting my views on potential

domestic oil and gas reserves. I was advised that there would be hearings on March 8 and 9 to inquire into the extent of those reserves and was told that any written comments I might choose to make would be entered into the record.

I believe the present magnitude of usable reserves of oil and gas is not the critical problem. What is critical is the rate at which we increase usable reserves. In that regard, what is most vital is bringing into widespread use superior exploration technologies which are in being within the industry but only barely appreciated and barely used.

Just as the quantity of physical reserves of oil and gas are directly related to the cost-price differential, so are the quantity of physical reserves directly related to technological innovation. Any technology which, in addition to finding petroleum in structural traps, will also find petroleum in stratigraphic traps, in porosity traps and as accumulations under lava beds, will "create" more usable domestic reserves than can be considered to exist by projecting future discoveries behind conventional exploration technology (seismic and subsurface geology). With lower than existing finding costs, a superior technology will still further add to reserves due to its cost reducing effect.

A single individual can perceive a complex economic mechanism only through his own particular point of reference. My interest and involvement in petroleum exploration technology has been in the application of geochemical prospecting, and stems from an intimate knowledge of its relatively heavy use by Crown Central Petroleum Corporation, a company with whom I was employed for seven years and which had earlier achieved amazing success with the method in the mid-1940's but which nevertheless refused to acknowledge that success and effectively stopped using the method in the late forties. This phenomenon, I later found to my surprise, was hardly unique to Crown Central. Determining which of several methods used was responsible for a discovery is a complex determination.

Since 1955 I have followed petroleum geochemical prospecting and the several articles I have written, and some other pertinent references, are attached herewith and made a part of this letter. In its early days, petroleum geochemistry was used prematurely. Later, too sparse a density of soil sampling and insufficient depth of drilling unfairly prejudiced the industry against the method. Recent revival of interest in petroleum geochemistry may be attributed to rumored offshore success by major oil companies and their sustained and continued use of the method.

What has become apparent to me is that our petroleum supply problem (our capacity to find and produce large new quantities of relatively cheap domestic crude oil and natural gas) is not a resource problem nor even a technological problem but is, in fact, a problem in economic organization.

Briefly, the beginnings of geochemical prospecting for petroleum should be attributed to Laubmeyer in Germany, Sokolov in Russia and Blau in the United States. For well over forty years geochemistry's leading theoretician and practitioner has been Dr. Leo Horvitz of Houston. The basis of geochemical exploration is the (almost) directly vertical migration of the lighter components of oil and gas to the surface from an oil and/or gas accumulation at depth. The ideal measurements are the emanating hydrocarbons themselves; methane plus ethane and heavier hydrocarbons which are found in the soil over petroleum accumulations. Geochemical prospecting is a generic term and there are many different techniques and measurements used. Certain geochemists analyze secondary reaction products caused by the effect of the vertically migrating hydrocarbons upon constituents of the soil.

I would guess that about 1 percent of today's petroleum exploration is geochemical exploration of any kind. Hydrocarbon geochemical prospecting by means of soil analysis is no longer "invention", it is beyond even "innovation"; which may be defined as a new process' early commercial application. It is mired in the early phase of the "diffusion" stage; which stage may be defined as the widespread use of an innovation achieving a broad economic effect. The snail's pace of that diffusion is the root of our domestic oil and gas shortage. What is needed now is not "research" and not "development" but active, widespread controlled "demonstrations" of the efficacy of the method.

The market economy, reasonably ideal for production, is neither ready nor willing nor was it ever designed to broadly disseminate highly secret results of marginally used technological processes. What each company knows or thinks it knows about exploration technology it keeps to itself. Further, most independent oil companies, even large ones, do not have the tenacity to seriously evaluate new exploration technologies. As long as it is profitable to use standard

or conventional methods, they will be used instead of promising but complex new methods.

Emerging into the "diffusion" stage, and yet still deep into the "innovation" and even "invention" stage (but nevertheless commercially available and even now effective) are inexpensive methods of identify hydrocarbon emanations at the soil-gas interface. This is in contrast to geochemistry's more traditional soil analysis at shallow depths and water analysis at the sea floor. Transmitted energy is aimed at the ground level and absorbed by any emanating hydrocarbon gas molecules which then move to a higher energy level. The gas molecules, returning to their original energy level, re-radiate a characterizing signature. The receiving unit is tuned to identify the re-radiated energy. Such units are presently being operating out of both helicopters and vans. Research work using lasers, undoubtedly much more refined, has been performed by Stanford Research Institute and financed by the USGS. My experience with the USGS indicates, that even in these abnormal times, it would take thirty years plus for the Stanford Research Institute work to be "diffused" through 50% of the industry.

The belief that the world beats a path to the door of the man with the better mousetrap is a debilitating and dangerous myth. In the field of petroleum exploration, not the myth but the converse is true. The high risk image (and reality) of exploration forces both exploration managers and investors (and especially investment counsellors) to seek the most popular exploration methods even if they don't work particularly well. The preferred, perhaps the necessary, way to drill a dry hole is on seismic or on "controlled" subsurface. A manager, whether he's running a pension fund or an exploration program, will never get fired for doing what everybody else is doing.

During World War II it was decided that the impedances of institutional practices and traditional habits of financing would not be permitted to stand in the way of maximizing war production. Only after we become able to acknowledge that we have, in being, the technology to sustain our intermediate term domestic petroleum needs will we be able to focus upon ways of achieving self-sufficient domestic production by going outside our normal way of doing things. In World War II we achieved seemingly unattainable heights of production, including the rapid introduction of new technologies, by creating novel sources of financing. Even the Federal Reserve Banks made direct industrial loans to those firms and individuals who had the knowledge, the capacity and the will to do the seemingly impossible. Despite the administrative pitfalls that are readily apparent, selective efforts of that kind are called for. Normal commercial practice, however sympathetic we are to its ideology, simply will not do the needed job in time of war or war's equivalent.

Sincerely yours,

MARTIN J. DAVIDSON,
Associate Professor.

Enclosures.

[Reprinted from July 1963 issue of World Oil]

GEOCHEMISTRY CAN HELP FIND OIL IF PROPERLY USED

(By Martin J. Davidson, president, Davidson Geochemical Oil Co.)

NEW INSTRUMENTATION AND BETTER UNDERSTANDING MAY RESTORE ITS STATUS TO MAJOR OIL-FINDING METHOD

PETROLEUM GEOCHEMISTRY appears to be staging a comeback as an exploration tool, as emphasis progressively develops both on deeper drilling and on stratigraphic traps. From 1859 through 1930, a period which might be called the "macro" stage of petroleum geochemical prospecting, geochemistry was a very important oil-finding method because it was both obvious and logical, and drilling was relatively shallow and, therefore, cheap.

As more experience with deep drilling is acquired, and the reaching of depths hitherto believed to be extreme becomes routine, petroleum geochemistry, now in the "micro" phase, should assume greater importance in exploration.

Geochemistry is divided into two major divisions—organic and inorganic. As an applied science, inorganic geochemistry is the search for metallic ores. An example of the application of inorganic geochemistry is the burning of leaves of certain trees, subsequently determining the zinc content of their ashes and then gradually zeroing in on the deposit.

Organic geochemistry includes consideration of coal, lignite, peat, etc., in addition to petroleum. Much of the effort that has gone into organic geochemistry has been invested in fundamental studies which have little or no direct bearing on practical petroleum exploration. By no means have all the theoretical questions been answered, but available empirical evidence makes it clear that petroleum geochemistry deserves to be used more widely than it is at present.

The basis of petroleum geochemical exploration is the concept of vertical migration of hydrocarbons from the petroleum accumulation straight up to the surface.

The central theme of petroleum geochemistry is that there exists a column of earth over a petroleum accumulation which differs from other columns of earth that are not over a petroleum accumulation, and that the column of earth over the petroleum accumulation may be determined by various different measurements at the surface. Soil samples, or samples of air pumped from the soil, are analyzed to determine the presence of certain "indicator constituents."

Vertically migrating hydrocarbons react with certain components of the soil to form "secondary reaction products," e.g., soil wax, paraffin dirt. Other constituents that can be measured at the surface and which are believed by some geochemists to indicate petroleum are trace metallic elements, chlorides, sulphides, etc. The presence of these constituents are subject to numerous variables, the most significant of which is the nature of the soil itself.

The soil constitutent which is most independent of variables is the "ethane and heavier hydrocarbons." The most common, if not the only, source of ethane and heavier hydrocarbons in the soil is petroleum accumulations. Hydrocarbon geochemical analyses of downhole cuttings confirm the surface anomalies, though their main purpose is to indicate the proximity of accumulations both laterally and at depths below the total depth of the well.

In addition to the measurement of soil constituents, there is the measurement of radiations, both thermal and radioactive, as well as biological and botanical measurement. None of these is truly a geochemical method even though each may depend upon the vertical migration of hydrocarbons from the petroleum accumulation to the surface. The term geochemistry as now used in petroleum exploration confiines itself almost exclusively to the surface measurement of hydrocarbons and secondary reaction products.

Megascopic phase of geochemical prospecting.[1] The earliest known application of geochemistry is drilling behind easily observed oil and gas macro-seepages. The literature is detailed [2 3] with instances of these successful early geochemical discoveries. Except for some oil fields of the eastern United States, Mid-Continent and Rocky Mountain regions, practically all the great oil fields of the world were marked by oil and gas issues near the crests of anticlines or the apices of domes.[4] As late as 1940 it was observed that visable evidence of oil and gas was responsible for the discovery of more petroleum than any other prospecting technique developed to that date.[5]

Another aspect of the megascopic phase of geochemical prospecting is the role that paraffin dirt is reputed to have played in the discovery of early U.S. Gulf Coast oil fields.

This greasy-looking surface soil, presumably formed from hydrocarbon seepages, has long been regarded as an index of underlying petroleum [6] and has been described in detail by Barton.[7 8] Davis [9] synthesized paraffin dirt, which consists largely of microbial cells, by flowing natural gas and air through soil samples for a period of 18 months.

The first wells at Spindletop and Pierce Junction are reputed to have been drilled because paraffin dirt was present. Oil operators often bought fee land where paraffin dirt was found.

During the megascopic phase of geochemical prospecting, it was relatively easy to obtain confirmation of the maco-seepage or "paraffin dirt" deposit, after discovery of the field.

Unfortunately, there has been a tendency in the United States to grossly undervalue the role of surface evidences of petroleum deposits.[10] The overemphasis of geologists and geophysicists on structural anomalies has been recognized and deplored.[11 12 13] The great bulk of the time, money and effort that has gone into development of exploration instruments, methods and techniques has been to find abnormal structure.[14]

Microscopic phase of geochemical prospecting.[1] Through it is an over-simplification, petroleum geochemistry, as the term is now used, refers to micro-seepages and/or to the effects of micro-seepages of hydrocarbon gases which are believed to indicate a petroleum accumulation.

See footnotes at end of article, pp. 161–162.

Given a petroleum accumulation, be it any form of structural or stratigraphic trap, it must be recognized "that petroleum in its reservoir is in no way a closed system. Through the roof rock petroleum constituents diffuse and/or effuse selectively toward the surface." [15] It is well recognized that gases do migrate through seemingly impenetrable barriers like glass.[16] It has been observed, too, that the earth's crust consists of a near infinite number of "crytocracks" as small as one or two molecules wide.[17]

While diffusion is recognized, it is effusion which is the significant mechanism in microscopic geochemical prospecting.

Effusion, or effusize processes, is that concerned with the migration of light petroleum components due to difference in pressure between the reservoir pressure and the atmosphere. Direction of effusive flow, therefore, is usually vertical, as the vertical component is the shortest. Such type of migration takes place in accordance with Darcy's law.[18] Depending on Darcy's law, the magnitude of effusion would depend on the difference between reservoir pressure (hydrostatic and hydronamic pressures) and surface pressure. Increase in reservoir pressure would increase the instability of petroleum . . . the higher the pressure, the better the halo developed over petroleum field.[19]

Horvitz [20] observed that a hydrocarbon anomaly taken over a recently discovered accumulation (or one not yet discovered) will show a greater contrast between the low background values and the value constituting the anomaly, and will show a lesser contrast over the same anomaly after it has produced for some years. When the field has been depleted or is in its last stage of production, the surface anomaly will completely disappear.

While geochemistry makes no claim to eliminating risks inherent in petroleum exploration, use of geochemisry, especially when used with other exploration methods, should effectively decrease the present high cost of finding new reserves. Geochemistry requires more geology, not less of it, to be used properly.

Geochemistry's record in oil-finding. The discovery rate reported in the literature is imposing. "Geochemical Surveys of Dallas claims 25 discoveries out of 98 first class prospects surveyed from 1942 to 1957, 73 of which were drilled, for a success ratio of 34 per cent . . . Horvitz reports finding 109 geochemical anomalies over an 11-year period (1942-1953) of which 39 were drilled, yielding 23 discoveries, or a success ratio of 95 per cent." [21 22]

Rayflex Exploration Company of Dallas is reported to have successfully forecast 14 out of 17 producers, four of which were exploratory wells, using a variation of the Russion soil-air techniques.

Renewed impetus toward geochemistry has mainly been nourished from abroad. V. A. Sokolov [23] of the USSR reported, "Under favorable geological condition, the proportion of correct predictions is rather high—about 70 per cent. For instance, in the North Caucasus (Kuban), predictions made by gas surveys were confirmed in 13 cases out of 17. Similar results were obtained on Sakhalin, Azerbaijan, etc."

Russians are using petroleum geochemical methods extensively,[24] and the Soviet Union, both in application and in theoretical research, is doing more and spending more on geochemistry than is the U.S. oil industry. A course in petroleum geochemistry is required in Russia for all student petroleum geologists, and a Russian textbook on the subject has been translated into English.[25] The conflict between the "theorists" and the "empiricists" exists in Russia just as it does in the U.S.[26]

French and Italian companies have long done laboratory studies of geochemistry. The Organic Geochemical Section, U.S. Geological Survey, has confirmed reports that the French experienced significant success using petroleum geochemistry in the Sahara.

In Israel, about $50 milion was spent to find oil via "conventional" exploration methods. Only one oil field and a few small gas reservoirs were found.

In 1957 an Israel geophysicists traveling in the U.S. was shown successful results of a geochemical program performed for a major oil company in the Denver-Julesburg Basin. With only the discovery well drilled, hydrocarbon geochemistry delineated the outline of a stratigraphic trap now producing from some 25 wells.

Partly due to this experience, a geochemical test program was instituted wherein "blind" soil samples taken in and around Israel's sole oil field, were analyzed. The field (Heletz) was mapped from blind data, showing both the productive area as well as the limits of the field. Lapidoth Israel Oil Company has been engaged in an extensive geochemical exploration program, with soil samples being analyzed in the U.S.

Hydrocarbon geochemistry is credited with the discovery of Kohav, Israel's second oil field and first oil discovery in seven years. Kohav is a stratigraphic

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trap just north of Heletz, and was drilled solely on geochemistry. Three step-out locations attempting to extend Heletz and Kohav fields were condemned by geochemistry prior to drilling and subsequently were drilled dry.

A survey of new approaches to oil finding was written by Amalendu Roy [27] of the Department of Geology and Geophysics, Indian Institute of Technology, Kharagpur. A geochemical paper was presented by Soliman [15] of the Geology Department, Ain Shams University, Cairo, Egypt, wherein he cites over 50 fields and "areas investigated" in the U.S., Canada and the USSR, in which geochemical methods have proved successful in extending existing fields and also in exploring others unknown before their application (p. 16)." [15] Unfortunately, this is merely a citation and not the 50 detailed, documented case histories that are so badly needed.

Debnam,[28] of the Canadian Geological Survey, reported on a project to establish whether hydrocarbon anomalies can be detected in glacial deposits. Soil-gas was extracted by distillation under reduced pressure, and hydrocarbon components were determined by gas chromatography.

Results indicated that distinct hydrocarbon anomalies occur in the (surface) glacial material either directly above or in a halo pattern around the oil and gas pools, though the depth of pools varies between 1,600 feet and 8,500 feet. Correct interpretation of anomalous hydrocarbon patterns in areas of interest should make possible the discovery of pools within traps which can be located only with difficulty or not at all by geophysical methods.

Horvitz [29] first recognized these two distinctly different types of surface patterns. In general, the better oil fields produce halo-type anomalies.

New discoveries on old geochemical anomalies resulting from deeper drilling or improved hole evaluation also have created new respect for geochemistry. One company that drilled heavily behind geochemistry in North Texas and Oklahoma during the 1940s and had roundly "condemned" the method for almost 20 years recently became aware that more than half of these "condemned" geochemical prospects now are producing fields. Another company actively engaged in geochemical exploration during the 1940s recently discovered that nearly 65 percent of its production was coming from the 8 percent of its leases which were acquired solely on geochemistry. The production was from two fields, both of them stratigraphic traps.

The one-well South Friendswood Field, Harris County, Texas (geochemical data of which were presented at the AIME annual meeting in 1954), came to life again when casing was being pulled from the old hole. The well now is a good producer. Humble Oil and Refining Co. recently drilled a successful confirmation test. Prior to the drilling of the discovery well by Ivy Mineral Company, the prospect had been condemned by seismograph.

More than any other single factor, the high cost of finding new U. S. reserves is responsible for the renewal of interest in petroleum geochemistry. The finding cost of new oil reserves now probably exceeds $1.50 a barrel. The trend to offshore and to deep drilling is due largely to the seismograph's need for more "virgin" areas after exhausting the search for reasonably shallow onshore domestic reserves. This approach tends to do little more than substitute high development and lifting costs for high finding costs.

Low-cost oil-finding needed. The only way to lower finding costs is to use a method that will find the kind of traps, etc.) that the seismograph cannot find effectively. It is logical to expect that future large onshore domestic reserves will be found in stratigraphic traps.

"Nearly one third of the important oil fields in the U. S. are stratigraphic traps, discovered by random drilling rather than by scientific exploration methods. 'Strat traps' are fairly common and make up a tremendous undeveloped oil reserve." [30]

The new emphasis on natural gas as a primary exploration objective, instead of an accidental by-product of the search for oil, focuses renewed attention on the significance of the vertical migration of hydrocarbon gases. Conselman [31] recently suggested that geochemical prospecting should be re-evaluated.

Wanted: published geochemical case histories. What is required more than anything else is the detailed reporting in scientific journals of geochemical case histories. There have been a few case histories published,[32 33 34] but many more could and should be published. Oil companies are reluctant to release old data.

Anyone familiar with Geophysical Case Histories [35] can appreciate the difficulty and the time required to gather and to publish the necessary geochemical case histories. Ultimately, it will be done, when the real need for such reporting will have diminished.

Why geochemistry has not been more widely used. What successes geochemistry achieved during the 1930s, before it was properly refined as a method,

See footnotes at end of article, pp. 161–162.

could not compare with the phenomenal success of the reflection seismograph and of subsurface geology based upon electric logs. Both of these tools found their first extensive use at about the same time that modern geochemistry first appeared.

There was no real awareness of how severe a limitation is involved in geochemistry's inability to determine the depth of the accumulation. Geochemistry is best used when the exploratory well can be drilled to basement.

Geochemistry was often used as a poor man's seismograph. More often than not this resulted in insufficient geochemical sampling over too limited geochemical sampling over too limited an area which, in turn, made it difficult—or impossible—to provide satisfactory interpretation.

Properly applied geochemistry is not an inexpensive tool. Generally it is cheaper than seismic but more expensive than detailed gravity.

Many a seismic or subsurface discovery was made on the second or third wildcat drilled, but geochemistry almost never got a second shot at a discovery, as did the other methods. All too often a well was drilled strictly as a "long shot" with no subsequent attempt to reinterpret the data or to drill a second well.

The mistaken belief that geochemistry is at best only a crude reconnaissance tool worked against any effort to subject it to serious tests as a meaningful and effective oil finding tool.

As seismograph and subsurface geology, based on electric logs, gradually became the entrenched exploration tools, geochemistry found itself grouped with more highly questionable exploration methods. The result was real apprehension on the part of many exploration people to espouse, or even recommended trying any "non-conformist" method.

As improbable as it seems, companies and individuals who used geochemistry with success denied it and/or belittled geochemistry's role in discoveries. Equally unbelievable was their failure actively to pursure geochemistry on their own.

One company denies that its best field is a geochemical discovery even though the seismic anomaly, shot after the acreage had been leased on geochemistry, has been proven by extensive drilling to be spurious. More than one company has refused to permit publication of its geochemical success on the grounds that it did not want to be hurled into the midst of controversy.

The conflict between the "theorists" and the "empiricists" has been responsible, and continues to be responsible for much of the industry apathy regarding the use of geochemistry. The "theorists", whose backgrounds tend to be laboratory-orientated, maintain with seeming reasonableness that first more must be learned about the origin of petroleum, its migration and accumulation before oil and gas can effectively be found by geochemistry.

Great sums are spent on pure research, often far removed from any relationship to oil-finding. Because such efforts do produce knowledge of some sort, they are mistakenly believed to be a serious and meaningful attempt to evaluate geochemistry. The weakness of the purely theoretical approach is to be found in the numerous commercially valuable scientific accomplishments in all fields of science which have been based mainly on empirical knowledge.

The weakness of the empiricists' argument is in the lack of available data. The number of detailed and extensive geochemical surveys that have been fully tested are relatively few, and the difficulties in getting them published are many. The empiricist is always in the position of projecting from the specific to the general. A mass of published, detailed case histories is required to quash the belief that geochemical discoveries are purely fortuitous.

New instrumentation helpful. In recent years much money has been spent in the development of analytical instruments to measure infinitesimally small quantities of matter. One such breakthrough resulted in the hydrogen flame chromatograph, which has enabled many laboratories to measure hydrocarbons in the range of a few parts per million (by volume). In the earlier days of geochemistry, there were few laboratories which could measure hydrocarbons in the critical range.

Partly as a result of the new instrumentation, the U. S. Geological Survey has budgeted funds for work in petroleum geochemistry which will be directed toward "research on techniques, surveys of selected areas, and publication of results of labortory and field investigations." [36] It is expected that the survey's work will be expedited for the purpose of benefiting the industry and the economy.

FOOTNOTES

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Is Our Pre-Drilling Info Deficient?

(By Martin J. Davidson, associate economics professor, North Texas State University)

ARE WE DRILLING "LESS SMART" WELLS BY IGNORING GOOD GEOLOGICAL TECHNIQUES?

"We have no projects active in the area of exploration since we do not yet have program authority or funding for such activity. The fact that the oil industry is spending substantial amounts of its research budget on geophysical research and development and that this area is extremely proprietary, restricts the Government's role, so that ERDA has chosen not to fund any of the many proposals for exploration research and development that it has received."

This is a stirring example of the placidness which prevails in the government's "all out attack" on the domestic petroleum shortage. It was ERDA's response, last October, to a proposal to demonstrate existing—but not yet broadly accepted—petroleum exploration technologies in the search for stratigraphic traps in frontier provinces. Concerning this issue little has changed with the new administration and there has been no stated reversal of this policy in the Carter energy plan.

To those of us petitioning Congress for IPAA last June 6th and 7th regarding modification of the Administration's Energy Bill it became apparent that "petroleum exploration" are words to be shunned. That ERDA is strongly supporting pilot plant demonstrations in geothermal exploration and in uranium exploration makes it harder to swallow this put down of oil exploration.

The Carter administration acts as if downgrading petroleum exploration is a cheap trade-off in order to enhance the success potential of a) energy conservation and b) the all too certain conviction energy plants are needed now. No such trade-off exists with regard to pilot plant demonstrations of tertiary recovery production methods. It seems to be assumed that it is easier and cheaper to recover the marginal barrel in the ground than it is to *find* the next barrel possible; certainly an unsubstantiated assumption.

To the credit of the Carter administration it must be said that ERDA's Bartlesville Energy Research Center will be drilling three wells in Greenwood County, Kansas, on a combination of dual level airborn magnetics/detailed gravity and hydrocarbon geochemistry. Although the project was well reported in the *Tulsa Daily World*, April 10, 1977, and in the *Oil and Gas Journal*, May 17, 1976, and May 30, 1977, no one in Congress seemed to know or care anything about the effort. With all due regard to the Bartlesville group's awareness, there exists an aura of reinventing the wheel which surrounds the entire project.

Nor is the industry without egg on its face. Peripheral exploration methods are being used to some degree—repeatedly and continuously—by a few of the most sophisticated majors and independents, and sporatically and inadequately by firms who may be willing on occasion to risk the use of a peripheral method but who are unable or unwilling to learn how to use those methods efficiently.

Knowledgeable users are not about to broadcast their techniques or even to relate their successes of those techniques, energy crisis or no energy crisis.

The most optimistic estimate of domestic petroleum reserves must, of necessity, be based on historic discovery rates claimed by their proponents. Applying higher discovery rates to new areas, and to highly worked-over old producing areas, would not physically increase possible and potential reserves, but would provide an awareness, which we do not presently possess, that greater domestic reserves do, in fact, exist.

Democratic government runs on the squeaky door principle. But with so much to squeak about, it's no surprise that American producers have overlooked the opportunity to perform a vital role in reducing the domestic oil and gas shortage. Deregulation and thwarting divestiture are the good fight, but they have drawn our attention from the underlying reality that effective, widespread use of new or misunderstood exploration technologies (especially to find stratigraphic traps where there is little or no subsurface control) is a valid and important avenue toward solving our energy problem.

The exploration methods whose effectiveness under field conditions need to be convincingly and publicly demonstrated are many: electric, magneto-telluric, geochemical, multi-level magnetics andothers. These are general categories of methods and there are many totally different, specific subcategories of these methods, some of which may be useless. *It is important that a useless specific* method not be permitted to condemn all other specific methods within the same general category.

The president of a distinguished international scientific society, primarily concerned with hard-rock mineral exploration, observed last year that "There appears to me to be a hang-up in the petroleum industry with respect to the use of geochemical methods, the reasons for which are not clear . . . We hear much today about energy crisis in many parts of the world. To me there seems to be only one crisis and that is in the research and employment of new methods, particularly geochemical, in the discovery of oil and gas deposits. I am sure that if geochemical methods were properly employed in the search for oil and gas we should find many more of these hydrocarbon deposits at a minimal cost."[1]

It is almost axiomatic that the independents' style of operation is to spend the greatest possible portion of funds available on actual drilling and the least possible on pre-drilling exploration. This stems from having seen too many dry structures and from too literal an acceptance of the dictum "you've got to drill it to find it." This has led independents to drill less-smart wells than effective pre-drilling exploration would have jusified.

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[1] Report of Dr. R. W. Boyle (Geological Survey of Canada) to the annual meeting of the Association of Exploration Geochemists, *Journal of Geochemical Exploration*, December 1976, p. 394.

In a total of 32,199 new field wildcats drilled by the industry between 1969 and 1974, sixteen majors had a significant (1MM bbls. or bbl. equivalents) discovery rate of 5.0 percent and independents a significant discovery rate of only 1.9 percent. The distinction is even greater with regard to reserves per significant discovery. The majors found 14.7 million barrels (or barrel equivalents of gas) per significant discovery compared to the independents' 5.3 million. These figures exclude all the large reserves found by the majors at Prudhoe Bay on the North Slope.[2]

(Ed. note: The following is a report by the AAPG.)

Since 1969, the independent segment of the petroleum industry has drilled about nine out of every ten New Field Wildcat wells in the United States. Significant exploratory successes during this same period were about two percent, or about one out of every 50 wells drilled.

Independents made 75 percent of the New Field Wildcat discoveries; however, to obtain a complete picture of exploration during this time period, the results must be measured in the light or reserve additions. Their 75 percent dicovery rate of New Field Wildcats yielded slightly more than one-half of the oil and gas reserves found in the United States during the past five years. The majors with only 25 percent of all successful New Field Wildcats discovered slightly less than one-half of the oil and gas reserves. This does not include all of the large reserves found by majors at Prudhoe Bay. Most of the majors' exploration occurred in the high-cost and high-risk environments of offshore Artic and ultra-deep inland drilling where the average discovery size has been substantially large.

It is clear that both independents' and majors' efforts are vital in oil and gas exploration. Each segment contributes approximately equal shares of reserves discovered while exploring in somewhat different environments of risk and costs.)

About 85 percent of the most expensive pre-drilling scientific data have been generated by the majors and about 85 percent of the less expensive subsurface well log data have been generated by the independents. Since 1960 significant domestic US discoveries have maintained themselves at nearly constant levels even though the number of wildcat wells has decreased. Of 198 gas discoveries larger than 100 billion cubic feet, 135 were discovered behind major oil company science. Independents discovered 63 by their own science and drilling. Applying new exploration techniques, many new discoveries are being made that could not have been found using 15-20 year-old methods. But not enough discoveries have been found because there is insufficient utilization of sophisticated exploration techniques.

Majors look so good because they drill more deep holes, more off-shore holes and more out of the way holes. The point is, however, that it is the pre-drilling exploration data, at least some of which is acquired using supposedly proprietary techniques, which permits them, rationally, to drill expensive wells. Only when independents learn to put a premium on pre-drilling exploration and learn to utilize the newest techniques effectively will their discovery rates significantly improve.

Most disturbing is ERDA's claim that because there is a proprietary aspect to research and development the government's role should be restricted. This is not to say that the government should perform an exploratory function. But in the area of demonstration (which large companies may not care to share with others) one might imagine where our farm sector would be today if the Department of Agriculture had not demonstrated new agricultural technologies. Without detracting from the vigor and energy of the American farmer it was the Department of Agriculture's determined and successful effort to demonstrate new technologies to the farmer that is largely responsible for the great production and for the very vitality of today's agriculture.

The independent oil and gas producer, like the independent farmer, must learn to use the most fitting new technology of exploration. Only a relatively few independents are conducting truly knowledgeable pre-drilling wildcat operations, and those who are wildcatting on a dearth of scientific data will soon cease as the tax laws tighten and as rising costs consume available monies.

It is true that the proprietary nature of R & D delays the diffusion of new technology throughout the industry, but most tragic is the fact that many non-proprietary techniques exist, often with neither majors nor independents possessing the will nor the sophistication to use them effectively.

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[2] J. R. Jackson, Jr. "Independent/Majors: Their Exploratory Role," *Oil and Gas Journal* February 7, 1977 pp. 95-96 (condensed version of a paper in the *Transactions of the Gulf Coast Association of Geological Societies,* 1976.

The seismic service and equipment industries have done a great job with improving their technologies and applying them, and they continue to do so. They are, however, fast pricing themselves out of on-shore exploration if they have not already done so for most independents. The increasing costs themselves are an indication that the curve of technological innovation in the seismic industry is rapidly flattening.

The attack on a government support of civilian research, especially when a critical social problem is involved, has been a long and losing one. The domestic oil and gas shortage is a social problem if it is nothing else. It is also a critical security problem as we may learn to our dismay when the Russian oil fields eventually take over the "swing position" in world petroleum production that is now enjoyed by the Saudis.

It is the purpose of this article to energize the oil industry and most especially the independent sector of the industry to utilize exploration methods that, because of ignorance or otherwise, have languished in the wings too long.

The basis of petroleum geochemical exploration is the migration of hydrocarbon gases to the surface from undiscovered oil and gas accumulations directly below. Surface manifestations of the reservior may take many forms (trace metallic elements, chlorides, soil waxes, etc.), but the most reliable indicator and the one most independent variable is the vertically migrating hydrocarbon microseepages themselves, particularly ethane through pentane.

Gases, like helium and hydrogen, do migrate through seemingly impenetrable barriers such as plate glass. Whether the reservoir trap is structural or stratigraphic, petroleum constituents both diffse and effuse though the reservior's roof rock toward the surface.

The earth's crust itself consists of a near infinite number of cryptocracks as small as one or two molecules wide. It is largely through such cryptocracks that effusion occurs. Effusion is the significant mechanism which accounts for the vertical migration of hydrocarbons and, following Darcy's Law, occurs as a consequence of the pressure differential between the reservoir and the atmosphere.

An increase in reservoir pressure would increase the stability of petroleum, and the higher the pressure the better the surface hydrocarbon indication over a petroleum field. A hydrocarbon anomaly taken over a newly discovered accumulation (or one not yet discovered) will show a greater contrast at the surface between the low, background hydrocarbon values and the values constituting the anomaly. After several years of production, soil analysis will show an anomaly with lesser contrast. When the field has been depleted, or is in the last stage of production, the surface anomaly will completely disappear. Repressuring an old field will restore the contrast to the surface anomaly.

The Germans discovered modern petroleum geochemical exploration, but it is the Russians who have most aggressively utilized it. While little meaningful information is currently coming out of the USSR, it was reported some years ago that under favorable geological conditions, correct predictions were achieved 70 percent of the time. In the North Caucasus area, geochemical anomalies were confirmed by the drill in 13 out of 17 cases. Similar results were achieved on Sakhalin, in Azerbaijan.

In 1960, it was reported that the Soviets were using petroleum geochemical methods effectively. The degree to which geochemistry is contributing to the USSR outstripping the US in current production cannot be ascertained. A course in petroleum geochemistry had long ago been made a requirement in all petroleum geology curricula and at least one Russian textbook on the subject is known to exist.

Properly applied geochemistry is not an inexpensive method and attempts, usually by independent operators, to skimp in sampling density have often caused wells to be drilled on insufficient data with negative consequences. Ideally, sampling should be performed on a quarter-mile grid, but as a practical matter, in the initial search pattern, samples should be taken a quarter-mile apart on existing road systems or on traverses no greater than two miles apart. The quarter-mile grid, or one approaching that density, should be used to pin down the prospect. By itself, geochemistry is incapable of determining the depth of a reservoir and shallow dry holes drilled into a thick sedimentary section do not condemn the geochemical prospect.

Using raw data, provided by the Geological Survey of Canada, on 4500 geochemical samples taken over a large area which included some producing oil fields, it was shown by Davidson & Spalding that anomalous ethane points over oil fields occurred as a purely chance phenomenon unrelated to the oil fields only one time in 200 million situations.

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