

Y4
.In 8/13
92-1

1040

92-1
In 8/13
244

GOVERNMENT

Storage

DOCUMENTS

SEP 28 1971

THE LIBRARY
KANSAS STATE UNIVERSITY

HEARING

BEFORE THE

COMMITTEE ON

INTERIOR AND INSULAR AFFAIRS

UNITED STATES SENATE

NINETY-SECOND CONGRESS

FIRST SESSION

Pursuant to S. Res. 45

A National Fuels and Energy Policy Study

JUNE 15, 1971

Serial No. 92-1



Printed for the use of the
Committee on Interior and Insular Affairs

U.S. GOVERNMENT PRINTING OFFICE

WASHINGTON : 1971

64-126

AUTHENTICATED
U.S. GOVERNMENT
INFORMATION



4Y
8/18
1-20

DOCUMENTS
SEP 28 1941
THE LIBRARY
KANSAS STATE UNIVERSITY

COMMITTEE ON INTERIOR AND INSULAR AFFAIRS

HENRY M. JACKSON, Washington, *Chairman*

CLINTON P. ANDERSON, New Mexico

ALAN BIBLE, Nevada

FRANK CHURCH, Idaho

FRANK E. MOSS, Utah

QUENTIN N. BURDICK, North Dakota

GEORGE McGOVERN, South Dakota

LEE METCALF, Montana

MIKE GRAVEL, Alaska

GORDON ALLOTT, Colorado

LEN B. JORDAN, Idaho

PAUL J. FANNIN, Arizona

CLIFFORD P. HANSEN, Wyoming

MARK O. HATFIELD, Oregon

TED STEVENS, Alaska

HENRY BELLMON, Oklahoma

Ex Officio Members Pursuant to Section 3 of Senate Resolution 45

COMMITTEE ON COMMERCE

WARREN G. MAGNUSON, Washington, *Chairman*

NORRIS COTTON, New Hampshire

COMMITTEE ON PUBLIC WORKS

JENNINGS RANDOLPH, West Virginia, *Chairman*

JOHN SHERMAN COOPER, Kentucky

JOINT COMMITTEE ON ATOMIC ENERGY

ALLAN BIBLE, Nevada

HOWARD H. BAKER, Jr., Tennessee

JERRY T. VERKLER, *Staff Director*

WILLIAM J. VAN NESS, *Study Director and Chief Counsel*

DANIEL A. DREYFUS, *Professional Staff Member*

CHARLES COOK, *Minority Counsel*

(II)

CONTENTS

STATEMENTS

	Page
Bellmon, Hon. Henry, a U.S. Senator from the State of Oklahoma-----	79
David, Dr. Edward E., Jr., Director, Office of Science and Technology----	104
Hansen, Hon. Clifford P., a U.S. Senator from the State of Wyoming----	31
Lincoln, George A., Director of the Office of Emergency Preparedness----	119
Chairman of the Joint Board on Fuel Supply and Fuel Transport-----	123
McCracken, Dr. Paul W., Chairman of the Council of Economic Advisers; Hon. Rogers C. B. Morton, Secretary, Department of the Interior, ac- companied by W. T. Pecora, Under Secretary, Department of the In- terior; Dr. Edward E. David, the President's Science Adviser and Director of the Office of Science and Technology, accompanied by S. David Freeman, Assistant Director, Office of Science and Technology; Dr. Glenn T. Seaborg, Chairman of the Atomic Energy Commission, accompanied by Commissioner James T. Ramey, Atomic Energy Com- mission; and Gen. George A. Lincoln, Director of the Office of Emer- gency Preparedness-----	3
Morton, Hon. Rogers C. B., Secretary of the Interior-----	85
Ramey, James T., Commissioner, U.S. Atomic Energy Commission-----	114
Seaborg, Dr. Glenn T., Chairman, U.S. Atomic Energy Commission-----	106

COMMUNICATIONS

Allott, Hon. Gordon: Letter to Paul W. McCracken, Chairman, Council of Economic Advisers, dated June 17, 1971-----	81
Hansen, Hon. Clifford P.: Letter to Glenn T. Seaborg, Chairman, Atomic Energy Commission, dated December 7, 1970-----	61
McCracken, Paul W., Chairman, Council of Economic Advisers, letters to: Senator Allott, dated August 6, 1971-----	82
Senator Randolph, dated August 11, 1971-----	46
Seaborg, Glenn T., Chairman, Atomic Energy Commission: Letter to Senator Hansen, dated January 5, 1971-----	59
Smith, Sam, El Paso Natural Gas Co.: Letter to Capt. Edward J. Bauser, executive director, Joint Committee on Atomic Energy, dated April 15, 1971-----	62

ADDITIONAL INFORMATION

AEC response to questions raised in Senator Hansen's letter of December 7, 1970-----	59
Difference between Alaska and the Russian potential-----	58
"Eleven Ways To Reduce Energy Consumption and Increase Comfort in Household Cooling", from Office of Consumer Affairs-----	213
"Government Taking Actions To Meet Summer Power Needs," Office of Emergency Preparedness, May 17, 1971-----	122
"Nixon on Energy," from the Evening Star, Washington, D.C., June 4, 1971-----	50
"President Nixon's Energy Message," by Senator Hansen, from the Congressional Record, June 4, 1971-----	31
"Projected Costs for Coal, Gas, and Oil," supplied by Atomic Energy Commission-----	70
"Report on Crude Oil and Gasoline Price Increases of November 1970," Office of Emergency Preparedness, April 1971-----	137

IV

"Secondary Recovery of Petroleum in the United States," supplied by Department of Interior.....	Page 77
"Survey of Electric Power Problems, May 1971, Office of Emergency Preparedness.....	125
Table 1—Contingency forecasts of demand for energy resources by major sources and uses, year 2000.....	101
Table 2—U.S. demands for energy resources by major sources, year 1970, and estimated probable demand in 1975, 1985, and 2000.....	104
Table 3—U.S. fuel mineral requirement and resources, 1970–85 (cumulative).....	104
Time analysis of the President's energy message.....	49

APPENDIX

Baker, Douglas E., executive committee member, Environmental Coalition on Nuclear Power, Philadelphia, Pa.....	256
"Clean Energy," summary of the President's message of June 4, 1971.....	235
Crawford, W. Donham, president, Edison Electric Institute, New York, N.Y.....	237
Jerard, Elise, chairman, Phi Beta Kappa Environmental Study Group. Citizens Rights Committee, New York, N.Y.....	258
Memorandum on the proposed sulfur tax—The views expressed herein are those of the following listed companies, all of which were represented at March 16, 1971, meeting with Treasury Department officials: American Electric Power Co., Inc., Commonwealth Edison Co., Detroit Edison Co., Duke Power Co., Kansas City Power & Light Co., Potomac Electric Power Co., Public Service Co. of New Hampshire, Southern California Edison Co.....	238
The President's Energy Message.....	260

THE PRESIDENT'S ENERGY MESSAGE

TUESDAY, JUNE 15, 1971

U.S. SENATE,
COMMITTEE ON INTERIOR AND INSULAR AFFAIRS,
Washington, D.C.

The committee met, pursuant to notice, at 10:10 a.m., in room 4200, New Senate Office Building, Senator Henry M. Jackson (chairman) presiding.

Present: Senators Jackson, Anderson, Moss, Randolph (ex officio), Jordan of Idaho, Hansen, Hatfield, Stevens, and Bellmon.

Also present: Jerry T. Verkler, staff director; William Van Ness, chief counsel; Daniel Dreyfus, professional staff member; Mary Jane C. Due, staff counsel; and Charles Cook, minority counsel.

The CHAIRMAN. The committee will come to order. This is the first of what will be a series of public hearings by the Senate Interior and Insular Affairs Committee on the Nation's fuels and energy policies. Today's hearing and the studies which will follow are being conducted pursuant to Senate Resolution 45 which provides for ex officio participation by members of the Commerce and Public Works Committees and the Joint Committee on Atomic Energy.

The subject of today's hearing is the President's energy message which was transmitted to the Congress on June 4. We have a very distinguished panel of administrative officials and Presidential advisers appearing before the committee this morning. It is my hope that today's hearing will result in a thorough, thoughtful, and objective review of the President's message and the administration's plan for its implementation; the identification of areas of policy concern not set forth in the message; and a discussion of the national goals which an energy policy ought to advance.

The problem this committee faces in seeking to develop a national energy policy which is coherent and consistent, realistic and rational, is one of the most pressing facing the Nation today. Finding answers to the difficult questions involved will require the close cooperation of the members of this committee and the administration. There is, in my judgment, no place for partisanship in this study. This is not to say, however, that there will not be differences of opinion over the policy alternatives available and their impact if implemented.

I have reviewed the President's message and, for the most part, I concur with the objectives and the recommendations which are set forth. I was, however, somewhat disappointed with the scope of the message. In many areas, the actions which are proposed are indefinite. It is difficult to determine if any major changes in direction, in policy, or in magnitude of effort are intended.

I was pleased that the research effort on a variety of fuel and energy technologies will be stepped up. It has been evident for some time that we will need all of the flexibility and choices which science and technology can provide if we are to meet our future energy needs within the constraints created by other national goals.

The President's message does not purport to be and has not been characterized as a new national energy policy. The message does, however, reflect changes in emphasis, establishment of some new priorities and funding commitments which clearly alter to some extent the shape of the country's existing, largely de facto, energy policies.

I am sure that the President's advisers and the members of the administration who contributed to the energy message have given substantial thought to the elements that ought to be a part of a national energy policy. As a part of today's hearing, we will want to discuss these elements.

(The text of the President's Energy Message of June 4, 1971 is on p. 260. The summary is on p. 235.)

I am confident that the committee and the administration can, in the weeks ahead, reach a consensus on the broad national goals a national energy policy ought to advance and help achieve. This will insure that differences on how these goals are to be fulfilled will be reduced to differences in the evaluation of factual information and the effectiveness of alternative policies in achieving agreed-upon goals.

I do not view the Senate Interior Committee's national energy policy study as a cause or as an excuse to suspend decisions on energy issues, as so often happens with committee or Commission studies. Some of the areas in which we cannot wait for further studies are the immediate and critical natural gas shortages we face, powerplant siting legislation, air pollution problems arising at powerplants, and the environmental impact of surface mining.

The members of the committee have had an opportunity to review the witness statements which were made available yesterday. In the interest of reserving more time for questions and discussion of specific policies, I have suggested that Chairman McCracken give an opening statement on behalf of all the witnesses.

May I say that we are delighted to welcome to the committee this morning the Chairman of the Council of Economic Advisers, Dr. Paul W. McCracken; the Secretary of the Interior, Rogers C. B. Morton; Dr. Edward E. David, the President's science adviser and Director of the Office of Science and Technology, who is accompanied by Mr. S. David Freeman, Assistant Director of the Office of Science and Technology; Dr. Glen T. Seaborg, who is the Chairman of the Atomic Energy Commission, who is accompanied by Commissioner James T. Ramey; and Gen. George A. Lincoln, Director of the Office of Emergency Preparedness.

Dr. McCracken and gentlemen, we are delighted to welcome you to the committee and I think we can proceed.

STATEMENTS OF DR. PAUL W. McCracken, CHAIRMAN OF THE COUNCIL OF ECONOMIC ADVISERS; HON. ROGERS C. B. MORTON, SECRETARY, DEPARTMENT OF THE INTERIOR; ACCOMPANIED BY W. T. PECORA, UNDER SECRETARY, DEPARTMENT OF THE INTERIOR; DR. EDWARD E. DAVID, THE PRESIDENT'S SCIENCE ADVISER AND DIRECTOR OF THE OFFICE OF SCIENCE AND TECHNOLOGY; ACCOMPANIED BY S. DAVID FREEMAN, ASSISTANT DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY; DR. GLENN T. SEABORG, CHAIRMAN OF THE ATOMIC ENERGY COMMISSION; ACCOMPANIED BY COMMISSIONER JAMES T. RAMEY, ATOMIC ENERGY COMMISSION; AND GEN. GEORGE A. LINCOLN, DIRECTOR OF THE OFFICE OF EMERGENCY PREPAREDNESS

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

First, I want to express my deep appreciation to the committee for this opportunity to appear here this morning. I have prepared a rather short overview statement of the whole issue here.

Last summer, the President directed that a study be undertaken of the national energy situation. The purpose of the study was to develop for his consideration Federal actions that might be taken to alleviate potential shortages of fuels for the coming winter and to assure adequate supplies of clean fuels in the longer run. A Domestic Affairs Council Subcommittee on the National Energy Situation was formed, and I was asked to serve as chairman. The members of the subcommittee included the heads of those Federal agencies with significant involvement in energy matters. These were: the Secretary of State, the Secretary of the Interior, the Secretary of Health, Education, and Welfare, the Director of the Office of Management and Budget, the Chairman of the Council of Economic Advisers, the President's Science Adviser, the Chairman of the Council on Environmental Quality, the Chairman of the Federal Power Commission, the Chairman of the Atomic Energy Commission, the Director of the Office of Emergency Preparedness, and the President's Consumer Adviser. The Secretary of HEW was subsequently replaced on the subcommittee by the Director of the Environmental Protection Agency when that agency was formed.

The specific events that led the administration to undertake the winter study and to form this subcommittee were the brownouts that had been occurring in some of our major cities, sharply rising prices of coal and residual fuel oil, low levels of fuel stocks at some of our major electric utilities, and a shortage of natural gas in some markets. The longer run problem was signaled by a number of developments less recognized outside the industry. New domestic discoveries of crude oil and natural gas, which have been supplying about three-quarters of our energy, did not seem to be growing at a pace sufficient to maintain their share of future supply. Simultaneous with these demand-supply problems was a new concern about the environment which meant that not just any fuel could be used to meet energy demands. The Nation required not only more fuel but cleaner fuel.

From the outset we knew that this country is endowed with abundant natural resources. The problem is not so much one of running out of resources as constructing the Federal programs and policies that

would enable and encourage private industry to develop these resources and convert them to usable fuel and power in homes and factories. Although the long run problems seemed to be far down the road, the long leadtimes necessary to speed up our progress required that action be taken immediately.

In studying these matters the procedure was somewhat different for the near-term winter problem and for the longer run. For the winter we faced immediate and specific problems and had to act directly upon them. There were low stocks of coal at electric utilities, and there was a coal transportation bottleneck that had to be relaxed. Through appropriate actions by the Interstate Commerce Commission this was done. Numerous dealers and consumers informed us that they were unable to purchase adequate supplies of fuel oil. A Joint Board on Fuel Supply and Fuel Transport was created and resolved over 50 cases of alleged shortage. Most of the winter problems were of this sort—clearly identified and requiring immediate action. During the winter no serious shortages of fuel developed.

For the longer run, the problem is not so well-defined, nor is there a unique set of actions necessary to solve it. The size of the aggregate demand for energy in 1980 is itself not certain. For any given demand there are numerous configurations of energy supply to meet it. In the longer run the options open to the Federal Government are much greater, therefore, and a lengthier and more extensive analysis is required to come up with the least costly and most reliable solutions.

The product of our subcommittee with regard to the winter problem was the statement of General Lincoln and myself at a press conference on September 29 of last year. We announced then a number of actions tailored to meet specific winter problems. After this the subcommittee turned to the longer run problem and its efforts culminated in the President's energy message of June 4. Since your committee will be primarily concerned with studying the longer run energy situation, I shall focus my remarks today on that aspect of our work.

The first step in making our long-run study was to define the goal or objective of energy policy. Simply stated the goal is to provide reasonable assurance of supply needed to meet future demands for clean energy at reasonable prices. With this goal in mind, there are three basic questions. First, how much energy will we need in the next decade? Second, from what sources will this energy be supplied? Third, what are reasonable assumptions about cost?

These are difficult questions, and many uncertainties remain. A growing economy of course, also has growing requirements for energy, and during this decade the economy's capability to produce real output will rise roughly 50 percent. While this has been factored into most projections of energy requirements, forecasts of 1980 energy demand have reflected a steady process of upward revision in recent years. In 1962, a Senate committee estimated 1980 energy requirements at 79 quadrillion B.t.u.'s about the same as an estimate made the same year by Resources for the Future. By 1968, our 1980 energy demands were being projected closer to 90 quadrillion B.t.u.'s. And now projections are running in the broad zone of 100-110 quadrillion B.t.u.'s.

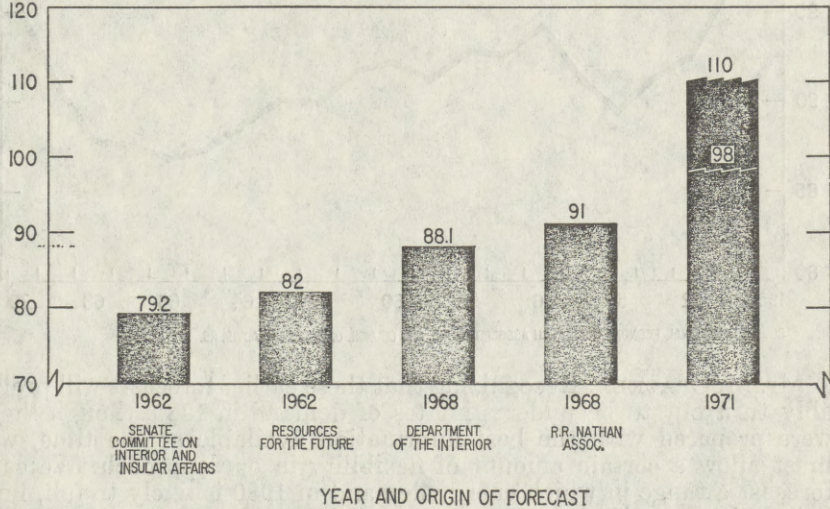
The cause of these revisions is the rapid growth of energy demand in the last 4 years, a growth that was unanticipated in most earlier projections. Indeed, an unexpected development has been a tendency for B.t.u.'s of energy per unit of national output to rise since 1966,

after a long and slow decline extending back for several decades. And Mr. Chairman, there are charts at the back of my statement that indicate that trend.

The CHAIRMAN. That will be included in the record.
(The charts referred to follow:)

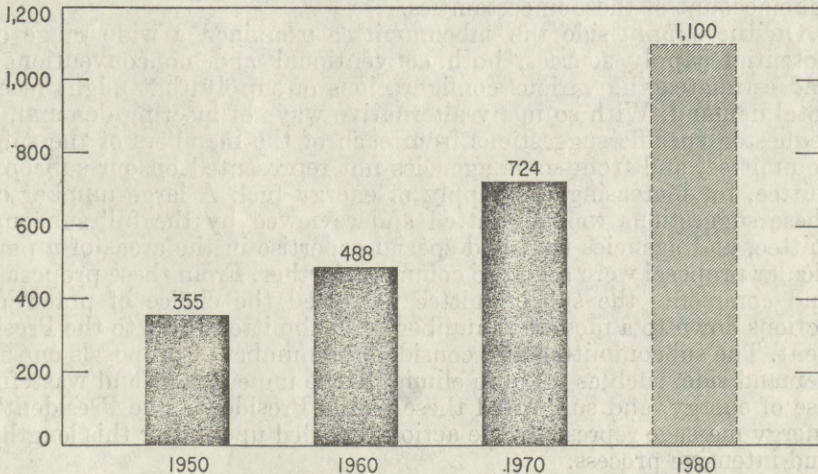
REPRESENTATIVE FORECASTS OF 1980 ENERGY DEMAND

MILLION BILLION BTU'S



REAL GROSS NATIONAL PRODUCT

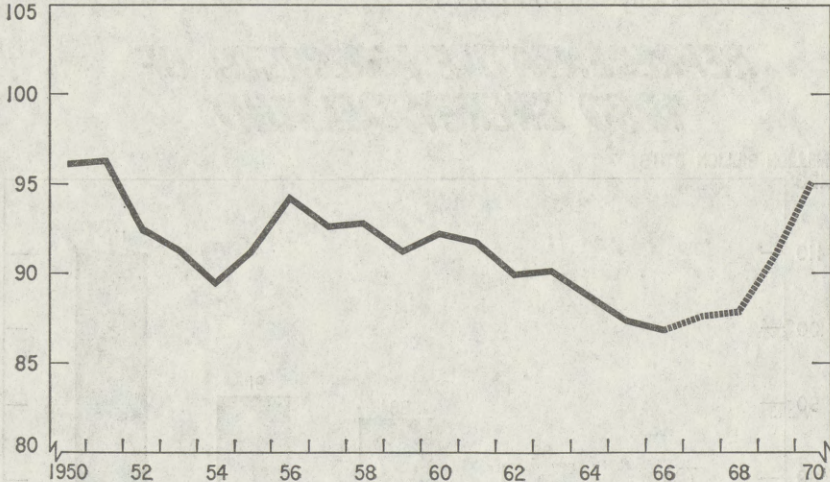
BILLIONS OF DOLLARS, 1958 PRICES



SOURCES: DEPARTMENT OF COMMERCE AND COUNCIL OF ECONOMIC ADVISERS.

BTU'S CONSUMED PER DOLLAR OF GNP

THOUSAND BTU'S PER DOLLAR OF GNP
105



SOURCES: NATIONAL ECONOMIC RESEARCH ASSOCIATES, INC. AND COUNCIL OF ECONOMIC ADVISERS.

Mr. McCracken. Recognizing that these earlier forecasts will probably turn out to be underestimates of demand in 1980, though they were prepared with the best information available at the time, we must allow a certain amount of flexibility in our approach. We can forecast a range in which energy demand in 1980 is likely to fall, but it would be a mistake to base our policies rigidly on any particular figure on the assumption that subsequent events will not modify our forecast. Presently, energy demand of somewhat over 100 quadrillion B.t.u.'s at current real prices appears reasonable, but this is a matter of continuous estimation, and our strategy for energy policies must take account of these uncertainties.

On the supply side the subcommittee examined a wide range of potential supply sources, both conventional and nonconventional, and estimated the various configurations of supply that might meet total demand. With so many alternative ways of meeting demand, I requested specific suggestions from each of the members of the subcommittee, and from some agencies not represented on our subcommittee, for increasing the supply of energy fuel. A large number of these suggestions was submitted and reviewed by the full subcommittee, and agencies that had special expertise in the areas of a particular proposal were asked to comment further. From these proposals and comments the subcommittee narrowed the choice of potential actions down to a moderate number and submitted them to the President. The subcommittee also considered a number of proposals on the demand side, such as ways to eliminate the unnecessary and wasteful use of energy, and submitted these to the President. The President's energy message represents the actions decided upon after this lengthy and intensive process.

The actions taken by the President emphasize direct measures to increase the supply of clean energy; development of the breeder reactor, acceleration of oil and gas leases on the Outer Continental Shelf, a leasing program for our oil shale and geothermal resources expansion of our uranium enrichment capacity, and support for other energy research and development efforts. Some actions will help expand supply indirectly—for example, support for sulfur oxide control devices that will enable us to use cleanly our abundant coal resources, and a system of planning our powerplant and transmission line sites that will help reconcile energy and environmental demands. The President has also announced steps to conserve energy by requiring better insulation on federally insured homes, and to balance energy and environmental needs by proposing a tax on sulfur-oxides emissions that more nearly builds the full social cost of energy consumption into the price of energy.

These actions are a first step toward a national energy policy, but they are not the last word. The organization key to a national energy policy is a single agency that can administer the programs now handled by a number of separate authorities. The President's proposal of a Department of Natural Resources, with a single energy authority responsible for all our important energy resource development programs, would perform this role. For those of us who believe, as I do, that uncertainty about future Government policy can be a deterrent to the rapid development of our energy resources by the private sector, the formation of this energy agency cannot come too soon. In the meantime, our Subcommittee on the National Energy Situation will continue as the focus of energy policy in the executive branch.

The actions announced in the President's message represent what the administration believes to be the necessary Federal response to the energy problem as it is seen now. We must emphasize again, however, that assumptions made with respect to future demand and supply of energy and its price are inevitably tentative, and we must be prepared to modify them as new evidence becomes available.

There are critical substantive questions of energy economics that are unresolved but could be better answered if a more extensive effort were made. We are continuing to work in this area. We regard this committee's decision to undertake a large scale effort as encouraging. I would therefore like to take this opportunity to say what I believe is one important area of further research. A key unknown in the energy future is the price structure that will be required to equate future supply and demand. Meaningful judgments about the volume of energy required in the future and the pattern of prospective sources cannot be made without recognizing the role of price. Sometimes estimates of supply and demand are made without mentioning price and potential supply-demand gaps are estimated that are then assumed to be a measure of the problem. In practice, so long as most energy markets are open and reasonably free these gaps will not actually occur. Any potential gap would tend to be eliminated by changes in prices that would bring the various sources of supply and the different demands into equilibrium. Indeed, the change in the average level of real prices required to equate supply and demand in 1980 would be a better measure of the energy problem than a so-called energy gap which leaves unspecified its assumptions about prices. A

particular gap may require a large or small change in prices for it to be closed. If the price change required is small, the problem is small; if it is large, the problem is large. The gap itself is therefore not a true measure of the problem. Your committee might well consider addressing itself to these complex supply-demand-price relationships in its study.

In conclusion, there are perhaps three important considerations for all of us to keep in mind as we focus on the Nation's energy problems. First, as the President indicated in his recent message, we can no longer, as we have in the past, simply take an ample supply of energy for granted. Second, this problem has an interface with our environmental objectives, and our energy needs and our concerns about pollution must be harmonized. Third, our strategy for policy must take account of the inevitable uncertainties about such matters as the size of our overall energy requirements, the pattern of supplies that can meet these demands, the problems of reconciling our energy needs and our environmental concerns, and the role of price changes in bringing supplies and demands into equilibrium.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Dr. McCracken. We appreciate having your very fine statement.

Dr. McCracken, I have a few questions I want to ask before I turn to my colleagues.

In view of the Nation's heavy dependence on petroleum products, it is a bit surprising to me that there was so little in the President's message about petroleum resources. As you know, at the present time we are importing about 25 percent of our petroleum requirements. I believe I saw a projection which indicated that by the end of this decade, around 1980, this could be as high as 50 percent. Can you tell us what the administration's policy will be with respect to our growing dependence on imports?

To dramatize this in very simple terms, the American public generally thinks that in Alaska we have all the oil reserves we need for this country. There are different figures given on Alaska. I think the conservative figure is that there is a little over 10 billion barrels of proven reserves. Another figure is that it could go as high as 20 billion barrels. We are consuming oil at an annual rate a little over 5 billion barrels a year. The 10 billion figure would be less, therefore, than 2 years supply and the 20-billion-barrel estimate would be less than 4 years. I mention this because you have emphasized how far off we have been in our projections about demand for energy needs. I would like to have your general comments in this area, if you would, and the comments of any other witnesses who wish to join you.

Mr. McCracken. Yes. Well, I might make a general comment, but I think others will want to comment on that question, too.

The message does, of course, address itself to certain aspects of this problem. For example, one part of the message has to do with such matters as leasing and the Outer Continental Shelf. We also do discuss the question of, the particular question of gas. It is true that we have had a problem in gas where the price generally has not been at a market-clearing level and this has tended to deter exploration and development for gas resources. It has also had another effect. It has tended to encourage certain uneconomic uses of gas and we did discuss that.

I think General Lincoln would like to comment on that, too.

The CHAIRMAN. General Lincoln, we are delighted to welcome you.

Mr. LINCOLN. Mr. Chairman, members of the committee, the President's message does address itself centrally to the problems of energy supply and the related problem and very important objective of a cleaner environment and does not address itself directly to our security problem as related to energy. I should say a word on the definition of that word "security." As the committee certainly knows, we are not talking narrowly about the military requirements in the case of security of the Nation. We are talking about the security of our economy, of our whole way of life, which is critically dependent upon an adequate energy supply. But in fact, in my judgment, and I am sure in yours, each of the programs which he proposes to further is in fact also a security program, because it is directed to expanding our supply of energy, that supply of energy which is under our control.

Currently, the United States, according to my rough figures, projected by my scientific friends, is importing about 10 percent of its energy in the form of oil. This is certainly, this proportion is certainly going to be required to increase as we look forward from now to 1980 and perhaps beyond. The question is as to how much it is going to increase, and to borrow a helpful phrase from Dr. McCracken, the configuration of the increase as to mix between products and crude oil, as to mix between oil and natural gas, and as to where it comes from geographically, is one that is of grave concern both to our international economics and also of security, and it is a matter which we certainly have to work forward on policywise.

Now, my office did address this questioned area that you raised—not completely, certainly, but centrally—in a recent report provided on the investigation of the increase in the price of crude oil. That I have submitted for the record. We concluded that, among other things, price alone was not going to be an added instrument or incentive to get you the arrangements we need for oil. We concluded that one needed to look to furthering supportive programs in other fuels and in oil, and I will just mention that one of these was the matter of gas and an arrangement for gas by which you could expect gas to carry their reasonably fair share of exploration; to press the use of coal because coal is something that we have in large quantities; to look more rapidly into the exploration and production of the oil that we are pretty sure we have, which includes Alaska and also offshore oil; and then as the final but not least important point, we have to begin to look to sensible conservation in the use of energy.

The CHAIRMAN. I asked this question because it is so involved. Indeed, the lead times for solutions are long-term. It involves not only the questions of diplomacy—our allies—but it also involves the means of exploiting science and technology, too, as possible alternatives in utilizing resources here—whether it is gasification of coal, or an accelerated atomic energy effort, whether it is oil shale program, or whether it is the development of geothermal steam. We are dealing with such long lead items here that we do have to make some early decisions on a very high priority basis.

The crisis that we faced not too long ago when negotiations were under way in Teheran brings this home. All of a sudden, we were confronted with the possibility of a shutoff of oil for NATO and western Europe. These things tend to cascade down on us. As in the case where

we have a brownout, maybe, in the northeast, or some other place, I am sure we will not get away with saying it is caused by an unidentified flying objects, as one expert suggested some time ago.

Secretary Morton?

Secretary MORTON. Mr. Chairman, this might be a good time to announce to the committee simultaneously as we are announcing it to the public that we have stepped up our schedule of lease sales. I have scheduled a sale in December of this year off eastern Louisiana and we have tentatively set a schedule for two major oil and gas lease sales each calendar year through 1975, chiefly in the Gulf of Mexico, but also including the Gulf of Alaska and the Atlantic coast. This actually moves our first sale from a previously scheduled first quarter of 1972 to the last quarter. I might add that the most recent sale has been a productive one as far as both discovery and development are concerned.

I would like also to comment on the oil shale schedule that we have set for ourselves and I see no reason why we will be unable to make it. We are going to have a briefing ready by the 28th of this month on the program and we are going to try to develop the informational core-drilling phase of the program and get it into actual operation this summer.

So here, we have an on-going program which hopefully will, after all of the environmental statements and all of the other work that has to be done to bring this project into compatibility with the environment, we hope to have a lease sale during the year of 1972.

So these actions by the Department, in order to overcome the lead-time problem which you so aptly described, are in the mill and under way.

The CHAIRMAN. Thank you, Secretary Morton. I, of course, want to ask the obvious question, because it is so relevant. Can you assure the committee that every reasonable and appropriate safeguard is planned in connection with possible environmental hazards that might arise in connection with the proposed lease sale? I notice the one-line statement "no Pacific Coast Outer Continental Shelf oil and gas lease sells are projected now." I assume this has something to do with the geological problem, as in the Santa Barbara area and some other situations that come to mind. I do believe that it would be appropriate if you could comment now on the safeguards that you plan in connection with the lease sale.

Secretary MORTON. Well, as you know, Mr. Chairman, each one of these proposals stands on its own merit, as far as our environmental approach goes and each proposed sale is studied independently, and the environmental impact studies are developed along those lines. The Pacific Co.'s fields that are in production are both on State lands and Federal lands, producing, and are being further developed, with the exception of the 30-some odd lease areas in front of it, in the Santa Barbara Channel, which we have discussed and which we have brought legislation to the Congress to deal with. These choices are made after recommendations by the Geological Survey to the Bureau of Land Management and are chosen specifically for geological reasons and environmental reasons and in the order that the Survey feels is the best way to go.

We are, hopefully, on the verge of even better technology in terms of devices that protect the environment from oil spills and out-of-

control situations. This research has been going on a long time; the oil companies have been most cooperative. And I think the Under Secretary, who looks at this through more scientific eyes than mine, could comment on where we stand today on our environmental controls and where we are apt to be a year or so from now and the progress in this area that has been made. I think that it is a difficult thing. As you know, the human factor is very much a part of it. But if you consider the amount of oil that we are bringing to the market, more and more from more difficult situations and with less and less environmental damage, that is witness itself to the progress that is being made in the area.

I can assure you without any reservation whatsoever that within all of the technical capability that we have at the Department and with the high level in everyone's mind as to the environmental problems, each sale will be given and each development that results from that sale will be scrutinized through our 102 process and every device as it comes along that will improve the environmental situation will be stipulated and incorporated into the development.

The CHAIRMAN. What is the judgment of your experts about the degree of risk involved in those areas that you plan to sell the leases.

Secretary MORTON. Let me just ask the Under Secretary, who is right here and who is a national authority on this, to respond to it.

The CHAIRMAN. Dr. Pecora, we are delighted to welcome you to the committee.

Dr. PECORA. Thank you, Mr. Chairman. It is always a pleasure.

Mr. CHAIRMAN. I can emphasize that we can never expect zero risk. This is being demanded by a great number of people, but we can never expect it. We can always lead toward it.

The major revisions in our security and safety regulations were made in mid-1969. Since then, additional elements were put into the system to increase the redundancy of the safety system. As recently as a few months ago, additional elements were put into the system. It has been estimated by the petroleum industry that as a result of the new safety devices and regulation stringency that has been imposed in the last 2 years, the ultimate cost of this system's control will be in the order of \$150 million.

The CHAIRMAN. In connection with the leases involved?

Dr. PECORA. Only in connection with added safety measures to the drilling and producing operations.

The CHAIRMAN. In general?

Dr. PECORA. In general.

The CHAIRMAN. Because this is retroactive, do these new standards apply to existing leases?

Dr. PECORA. Yes, sir. All standards would apply to all preexisting leases. Some of the platforms are older platforms and a little more time is being permitted in order to modernize them. But all new platforms and all new drilling follows the standards to the letter of the law.

The CHAIRMAN. As a scientist, and keeping in mind, of course, the need to balance the need for petroleum, with the need to protect the environment, do you believe that this is a prudent thing to do under the circumstances?

Dr. PECORA. Mr. Chairman, it is my very deep impression that we on the Federal side are doing everything we can with the knowledge of technology to make this a prudent operation. Actually, the safety

record in this hazardous industry over the last two decades has not been an extremely hazardous one. The safety controls have been working. There have been accidents beyond any safety measures which have come to our attention, and of course, they are headlined. But basically, we are getting more and more control of the situation.

The CHAIRMAN. And the main contribution here is not so much in the way of new techniques making the operation more safe, but the redundancy features that are built into it; so if one goes, you have a backup?

Dr. PECORA. Yes, sir; that is the basis of—it is a lesson we learned from NASA and it is a very good lesson.

The CHAIRMAN. Dr. David, do you have any comments on this as the President's science adviser?

Mr. DAVID. Not directly, Mr. Chairman. I will say that I think the basic point here is that there is much existing technology which can be applied and which we should insist is applied to these particular cases and I think you have heard that that is the direction the program is going in.

The CHAIRMAN. And you have a good working relationship, of course, with Interior in this regard and with Under Secretary Pecora on the technical side?

Mr. DAVID. Indeed we do.

The CHAIRMAN. I would hope that we have that kind of coordination so that all of the relevant Federal agencies will participate in developing a solution. Here we are talking about an interdisciplinary problem which involves a great deal of what is being done in the scientific community in general, are we not?

Mr. DAVID. Well, as you know very well, Mr. Chairman, there are many different aspects to this safety problem. There are safety aspects that the Under Secretary just referred to. There is also the problem of what do you do after there is an oil spill of some kind and minimize the damage. There is a great deal of research and development in that field, and I would say a lot of new technology which looks promising which is being tested. Some of this is being sponsored in the Interior Department, some of it in the EPA, and some of it is being done by more basic research-oriented organizations as well as the industry itself. We have learned a lot from it.

The CHAIRMAN. We have learned a lot about geology from the results of underground nuclear testing programs. I do not know whether Dr. Seaborg has any comments on the possible contribution of the Atomic Energy Commission from its experience.

Dr. SEABORG. There might be some information there that would be applicable.

The CHAIRMAN. The first thing we need to know, of course, on the leases relates to the kind of environment in which they are drilling. I am just wondering about the long experience the AEC has had in this area—AEC has environmental problems to be concerned about.

Dr. SEABORG. Yes, we do.

The CHAIRMAN. And problems that are not only national but international in the event of certain emissions and other occurrences. I am sure, with your great expertise within the Atomic Energy Commission, that the relevant data and experience will be brought to bear in this effort.

This one program dramatizes the need to bring the Government agencies together and to really zero in on some of these extremely difficult environmental problems. This happens to be an area where there was little concern in the past. Now we are more concerned than ever before to try and find some prudent means for exploitation of the knowledge that we have in this area. Where knowledge is lacking or incomplete, we should step up the research effort to produce the kind of information that we need.

I want to mention the President's message again with reference to Canada. The message indicates that the Canadians are ready, willing, and able to supply oil, gas, and perhaps electricity to the United States. However, I have the impression that there has been considerable discussion in Canada and complaints in Canada about exporting these resources. General Lincoln, do you want to comment on that?

Mr. LINCOLN. First as to gas, I think there are people here more expert than I. I will simply comment that as I recall, the Canadians have not thus far acted favorably on all the requests from American industry for gas and they have some concerns about conserving their resources for Canadians.

As to the matter of oil, first, we have over the last year or year and a half significantly increased the amount of oil that is imported from Canada, particularly when you take into account that the import of natural gas liquids has been free and that is a significant component of the imports. Our State Department handles these matters. They are in consultation with the Canadians, looking toward, as stated in the President's message, an arrangement which will reasonably protect the security of both of us. As is known to everybody here undoubtedly, currently, eastern Canada is 100 percent dependent on imports for their petroleum supply.

Secretary MORTON. Mr. Chairman.

The CHAIRMAN. Yes, Secretary Morton.

Secretary MORTON. I have a little bit of information on that question that might be—

The CHAIRMAN. I just want to announce that Dr. David has an important meeting at the White House and will be excused at this time.

Mr. DAVID. Mr. Chairman, it is a real privilege to be here and take part in this.

The CHAIRMAN. We appreciate your coming. We will keep in touch with you.

Secretary MORTON. Mr. Chairman, if I may, I would like to offer for the record a statement which I hope you will not ask me to read. It is about 40 pages.

The Canadian National Energy Board has forecast that at most, Canada will be able to supply us with not more than 2.3 trillion cubic feet of gas in 1980. Last year, Canadian gas supplied 779 billion cubic feet, or 3.55 percent of our total requirements.

The CHAIRMAN. Well, I think the problem with our good neighbor to the north is that the government in Canada has problems at the provincial level vis-a-vis the Ottawa level. This is a special problem and I believe it is, in part, something which should be discussed in a closed session because of the diplomatic problems involved. I just wanted to raise the question here, because there are some special

problems that need to be worked out. Too many Americans assume that the Canadians will be glad to move the resources in that area under most any arrangement. I do not think that is the case.

Secretary MORTON. Senator, I think one of the things is that the message, to get the record straight, I do not think implied that the Canadians were enthusiastically ready, willing, and able, as you say, to do this. What the President's thrust is, is to develop a better negotiating pattern with the Canadians to explore this whole area, because if you look downstream in time, over a couple of decades, I think you come up with a fairly clear picture that there is going to have to be a continental energy policy. It would seem that because of the lead-times, because of statements or factual information put out by Canadian agencies, we do have to pursue a negotiating relationship with the Canadians. I think that the committee here ought to recognize that.

The CHAIRMAN. I think you are absolutely right. After all, Canada is an independent, sovereign state. Too many times, I regret that a lot of Americans do not think in those terms. They do not mean to be demeaning in their approach, but they just take for granted that the Canadian resources will be available. I believe that a special effort must be made to reach the understanding that I assume you have in mind in connection with a North American continental energy policy, if we are going to make some hard decisions regarding our own policy in the energy area. I am glad to hear you say that.

While this question is being raised, I would like to turn to the trans-Alaska pipeline. Is this matter still a subject of negotiation with the Canadian Government? Could you indicate to the committee what the status is regarding that alternative approach to moving petroleum products from Alaska?

Secretary MORTON. I am afraid my answer is going to be disappointing, because I can only give you a very limited view. Let me do that by recounting the historical events in the last few months in this regard.

The question was raised in discussions with our solicitor in the Department as to what the intent of Congress was in the Environmental Policy Act as to alternatives: Are we dealing with alternative systems? Are we dealing with alternative routes from point A to point B? Or what is the real alternative—what are the real alternatives that the Congress was addressing themselves to in that act? We were never able really to resolve the question and I do not believe it will probably be fully resolved until there are court decisions that address themselves to it.

But in the light of that, I met with the Alyeska oil principals and the applicants for the pipeline corridor from Prudhoe Bay to Valdez, and discussed the Canadian proposition with them and asked them to go to Canada and discuss this with the Canadian Government and with Canadian officials and to touch base with the State Department, specifically with Assistant Secretary Trezise. This they did and they spent considerable time with, I think, both national and provincial government officials in Canada. Two things came out of that visit and those discussions. One was that the cost of the project, of bringing the oil down across Alaska into the MacKenzie Valley, and to Edmonton, was in the order of twice the cost of bringing the oil down from Prudhoe Bay to Valdez, including the maritime aspects of it.

The other thing that was brought out was that the Canadians at this point in time felt that there would be much study to be done and long delays before any Canadian permit could be issued. Now, I have that as hearsay in a sense from the oil principals themselves, though I think that Assistant Secretary Trezise has had several discussions with the Canadians on this matter and I believe it would behoove the committee, Mr. Chairman, in executive session to touch base with the State Department on that matter. But that is the extent to which the Interior Department felt that we could go because of the limitations under which we operate.

The CHAIRMAN. I gather that it has not reached the point of formal negotiations with Canada?

Secretary MORTON. I do not think that it has, sir.

The CHAIRMAN. Is it the administration's position Secretary Morton that the North Slope should as a matter of policy be developed as rapidly as possible consistent, of course, with effective environmental safeguards?

Secretary MORTON. I think, Senator Jackson the matter of transportation, of getting the oil into the marketplace from the North Slope, is the limiting factor in development. As you know we have a multiagency task force working on the environmental aspects of the application for pipeline. Hopefully, the work of our own departments within the Department of the Interior as well as those agencies will be completed during the month of August so that we can put a draft committee, drafting task force, on the 102 statement and that all of the stipulations will be developed, all of the environmental protection devices, and so forth, will be required as part of the permit. And then I think, we will have an opportunity and only then to really look at this objectively and make the decision.

The CHAIRMAN. In other words what you are saying, is that the limiting factor here is the transportation problem; that it is the policy of the administration to develop the resources of the North Slope consistent with the ability to move it out by an environmentally sound program of transportation?

Secretary MORTON. This is very correct. The mission of the Department is, the basic mission of the Department of the Interior is to develop our resources; is to, as far as Government's role is concerned and it certainly is the mission today of the Department to do this in the most environmentally sound way that we have the technology and the energy to do.

The CHAIRMAN. What is the administration's position on the exploration of naval petroleum reserve No. 4?

Secretary MORTON. I am afraid I cannot answer that, Mr. Chairman. Maybe Mr. Pecora can tell me.

The Under Secretary advises me that the Department has not developed a position on that. This would be influenced, I am sure, by the position of the Navy as to what their desires were for it.

The CHAIRMAN. The reason I raise that question is that the Santa Barbara bill proposed exploration of the reserve. I think it would be helpful to the committee if you could let us know in the near future.

Secretary MORTON. Well, let me say this: We developed the proposition in the proposed legislation, Mr. Chairman, to provide funds for this exploration as part of the compensation to the Navy for the oil

that would be taken from the Elk Hills Reserve and marketed in order to compensate the companies who have bought leases in those areas of the Santa Barbara Channel that we want to protect. So we at least have gone that far with it, because we feel that an inventory—it really is not an oil reserve until you know how much oil is there.

The CHAIRMAN. Well, we will be in touch with you about this, because, as you know, this is a part of the overall problem that we face in meeting our petroleum requirements.

Senator STEVENS. Mr. Chairman, could I ask the time frame on that exploration in terms of the Santa Barbara bill?

Do you intend to seek funds for exploration of the petroleum reserve without regard to the Santa Barbara bill, or is that conditioned upon it?

Secretary MORTON. That is part of the Santa Barbara bill, Senator Stevens, and the bill lies before you here in the Senate and also in the House.

Senator STEVENS. I know it is part of the Department's bill, but under the general authority, I should think they would be able to explore, or at least take that inventory of naval reserve No. 4, and determine whether or not that is a viable reserve. Is there any plan along those lines?

Secretary MORTON. This will be a matter of the Department of Defense as to whether—this is their lease, is their reserve, their property. We will, of course, lend all of the expertise and geological help within the competence of our own Department if and when they decide to do it. We tried to put a package together in the Santa Barbara bill that would give them the opportunity to do this which we felt made good sense, because after all, if you have a big reserve like that, a big area like that, it would seem to me to be pretty wise and prudent to explore it and determine the extent of the reserves. But this would be a matter of decision on the part of the Navy itself.

Senator STEVENS. I asked the question only because if that appears to be a viable reserve, it also would depend upon transportation from the North Slope. It would seem to be important to know the total estimated reserve on the North Slope, including the naval petroleum reserve No. 4.

Secretary MORTON. I would agree with you.

Senator STEVENS. Thank you, Mr. Chairman.

The CHAIRMAN. General Lincoln, a question for you. Do we at present have a national contingency plan to deal with critical shortages of electrical power which may develop this summer? This is uppermost, as you know, in the minds of a lot of people, around New York and a few other places.

Mr. LINCOLN. Mr. Chairman, I did provide in my formal testimony a press release, together with a report, which is the estimate of the Joint Board on Fuel and Fuel Transport, of which I am the chairman, on the fuel situation and electrical power situation for the coming summer, and in summary, our estimate was that the fuel situation, barring contingencies such as foreign interruptions or transport interruptions, should not be a problem.

The CHAIRMAN. In that connection, do we have a plan for emergencies which may develop with respect to oil or natural gas, or oil supplies?

General LINCOLN. The answer is a qualified "Yes," as illustrated by what we have been doing in connection with the restrictions on tanker movement and general restriction of supply of about the last year, with an expansion of production, if our own production.

The CHAIRMAN. In the event of an international development of a political nature—not necessarily war, but a political one—might that cut supplies suddenly? Are we prepared to deal with alternative possibilities in that kind of situation? I raise this in light of the great concern that was expressed when negotiations were breaking down with Tehran, when the oil companies were negotiating with the Middle East oil-producing countries. Some of the European countries, which directly affect us, had not more than a few days supply of oil. Are we prepared to deal with that possibility?

Mr. LINCOLN. We estimated quite specifically the various contingencies during this period that you mentioned. In summary we saw a way with some scrambling so that we would meet the requirements of the United States. But, there were problems on sulfur standards due to the fact that quite a little of our residual oil that comes in from the Caribbean is really in part residual oil, in part oil from the Eastern Hemisphere that is used to reduce the sulfur content of the residue. We have had that problem.

And then, of course, there is the second problem that we need to recognize, that our allies in Europe would, within a reasonable time, be in a very grievous situation. In fact, we, the United States, and perhaps Canada—though I have mentioned their dependency—are the only countries allied to the United States, only large countries, certainly, allied to the United States that are not dependent on one small area of the world for their energy supply. I underline energy, because their energy is oil.

Going back to your question about electricity this coming summer. The situation will be tight in some areas, particularly around New York. The Government does have contingencies and arrangements, as do the localities, and with reasonable luck, will get by. Of course, if we have simultaneous breakdowns of several large generating plants, there is going to be trouble.

The CHAIRMAN. How much redundancy do we have in our power grid as we face the summer. When shortages develop due to breakdown in equipment—not shortages in fuel, but an overuse of the facilities—are we in a position to say that we have the kind of redundancy that is needed to prevent one area of shortage from setting off a series of developments that could result in shortages elsewhere?

Mr. LINCOLN. You are talking, I believe, about a situation similar to the blackout that occurred in the Northeast along in 1964-65.

The CHAIRMAN. Yes. One of the peculiarities of the power grid in the past has been that a breakdown in one area can do tremendous damage throughout the system if it is not operated and backed up properly.

Mr. LINCOLN. I believe the scientists and engineers have now double assurance that this will not happen. But I used to be an engineer—it is a long while ago. I think we had better turn to the scientist and ask him to comment.

Mr. FREEMAN. Let the record show that I, too, am an engineer, not a scientist.

The CHAIRMAN. Mr. Freeman, we are delighted to have you here standing in for Dr. David at this time.

Mr. FREEMAN. Thank you, sir.

I believe that it is true that the electric power industry has taken measures to strengthen the grid systems of the country to prevent the kind of cascading blackout that has occurred. The primary device they have used is the installation of small load-shedding devices that tend to localize the occurrence of disruptions of service and thus to prevent the cascading type situation that occurred in 1965. So that while there is no absolute assurance that we will not have a repetition of that, I think the chances of its occurring are much smaller than they were in prior years.

The CHAIRMAN. You think substantial progress has been made to deal with this contingency?

Mr. FREEMAN. Yes, sir. The primary problem is, I think, changed from one of cascading blackouts to the brownout situation of just inadequacy of supply to meet the peak loads in a hot spell in some parts of the East.

The CHAIRMAN. Thank you, Mr. Freeman.

I have one last question that I will direct to Dr. McCracken.

As you know, many are advocating the policy of no growth in energy consumption. Does the administration have or advocate a no-growth policy? You are the Chairman of the Council of Economic Advisers. Maybe you have a conflict of interest. I am saying that on the light side, for the record.

Mr. MCCracken. Well, Mr. Chairman, I do not feel any conflict of interest. I think wearing either hat, I would say no, that is not the policy.

The CHAIRMAN. I mean you subscribe to the concept, I take it, that we have an economy in this country to do both—that is, to meet our economic requirements and do it in such a way as to provide for a quality environment, including clean air, clean water, and clean land?

Mr. MCCracken. Yes. Indeed, I would like to make a further comment about this, that while there are, the question is raised as to whether we should slow down the rate of economic growth—in other words, have we arrived at sort of the posteconomic age, as it were—there is a good deal of reason to think that we are in the early stages of a decade where the demands upon our productive capabilities may be very heavy, both to take account of new things that have come into the picture in recent years and concern about the environment. The evidence also rather clearly suggests that the average consumer still has aspirations for higher levels of living. The important thing is to have a balanced program to carry the development of our resources along to meet our growing needs.

The CHAIRMAN. Is it clear that we do have a tremendous problem because of the rapidity of growth? It took us 200 years to get a trillion-dollar gross national product. The first half trillion took 188 years, the second half trillion about 12 years. I read that we will double the trillion, in terms of current dollars, in a little over a decade.

In other words, we are going to double our output of goods and services. This comes at a time when we have a greater emphasis than ever before, and properly so, on the environment. I believe this feeling stems from just the statistics that I have read. Obviously, the effects of rapid economic growth were not felt to any great extent in the first 188 years.

It seems that we are confronted with one of our greatest challenges in the 1970's—that is, rapid economic growth and also rapid population growth. Can we accommodate this growth and at the same time take care of the needs of those who are not so fortunate as the rest of us—those 26 million people living at the poverty level? Will we be able to meet the social and economic goals and still maintain a quality environment? I think we can. A nation that sends six men to the moon on three different voyages certainly has the scientific and technological competence to accomplish these goals.

I would raise the question, however, that if we are going to provide for prudent economic growth to fulfill our social and economic goals and provide for quality life, the consumer is going to have to pay a price.

Is that a fair statement?

Mr. McCracken. Yes, I think that is a fair statement. In this specific area of energy, our concern, of course, has been to initiate actions which can help to augment the supply of energy in order to minimize the impact of growing energy demands on price. On the other hand, we do have to recognize that as we devote more resources to the production of clean energy, those resources devoted to that are not available someplace else. It does use economic resources.

The CHAIRMAN. Is it not a fact, too, that more and more of the investment in new plant and equipment will be used to meet environmental standards that are being set for clean air and clean water and will not necessarily increase productivity? And in that case, will the cost of meeting environmental standards be passed on by industry to the consumer?

Mr. McCracken. Yes.

The CHAIRMAN. Whether it is a utility bill or whether it is the cost of a piece of paper. Pulp mills have special problems and they are now, in my State, involved in trying to meet some of these problems. But in the end, that cost is going to be passed on to the user, the consumer.

Mr. McCracken. Yes, that is true. And I would want to emphasize that one aspect of an energy policy must be, of course, concern about the conservation of energy. We touched on that a bit in the President's message.

The CHAIRMAN. The avoidance of waste of finite supplies of energy sources, right?

Mr. McCracken. Yes.

The CHAIRMAN. Mr. Freeman?

Mr. FREEMAN. Mr. Chairman, I think that looking at the enormous needs of the 1970's and the 1980's, we should also keep in mind that what the consumer is interested in is a warm home in the winter and a cool home in the summer and the other end products of our other systems, not necessarily in the number of kilowatt hours and the barrels of oil. So that a major new thrust which was in the President's message which I think needs a great deal more attention than it has received in the past is to increase the efficiency of the use of energy at the point of consumption. Our Nation's transportation system is, I think, a vivid example of how goods are moved by truck when they could be moved more efficiently by railroad with much less use of energy; where people could be moved back and forth to town in mass transit systems rather than individual petroleum-consuming vehicles. And we can greatly increase the efficiency of our use of energy while still providing

the end products that the American consumer will be demanding. I think this should be a key element.

The CHAIRMAN. Including the transportation of energy.

Mr. FREEMAN. Yes, sir.

The CHAIRMAN. One of the areas of greatest saving has been the development—we are moving that way; we have a long way to go—of the national electrical grid. You can save billions of kilowatt hours by being able to move your power supplies on a seasonal basis. In the Pacific Northwest, we have an excess of energy during the summer months at a time when California and the Southwest have a tremendous demand for that energy. The west coast power grid has saved us from constructing many thermal stations and hydro dams that would have been required if power were supplied on a purely local basis. I assume this is one of the areas of opportunity that can still be exploited to improve efficiency and, therefore, conserve these finite resources?

Mr. FREEMAN. Yes, sir.

The CHAIRMAN. This concludes my questions. The Chair would like to especially welcome to the committee this morning Senator Randolph, who is the author of the resolution under which we are operating. He is chairman of the Public Works Committee and will be an active participant in the joint hearings that the committee will be holding over the next 2 years. Senator Randolph will have a statement that he will make later.

We want to welcome you. Do you wish to make a brief statement at this time?

Senator RANDOLPH. Mr. Chairman, I would want to accommodate the members of your own committee. I think it is important that we recognize that the hearing and the fuels and energy policy study are in the jurisdiction of the Interior Committee. I appreciate the invitation to join with you on this occasion. If I could have just 1 minute and then defer to the members of the committee, it would be to say, Mr. Chairman, that you acted wisely in calling this hearing to consider the President's message on clean energy. You waited until after the President presented it to the Congress before holding this first hearing under Senate Resolution 45, which we cosponsored and which will attempt to cope with the problems to be encountered in the establishment of a national fuels and energy policy consistent with environmental factors. I believe this was a wise course of action.

Just this comment, which will be a part of my statement, to be followed by the questions that I shall ask later. It is my opinion that, with few exceptions, the President's energy message stresses the pursuit of a series of programs on the hypothesis that a valid national fuel and energy policy already exists. But there is not such a national fuels and energy policy—at least, there is not a coherent, synchronized policy. And the President's message, as I read it, did not include several vital and important topics which it seems to me, Mr. Chairman, and members of this committee, must be considered as we develop a policy on fuels and energy consistent with environmental requisites and goals.

Thank you, sir.

The CHAIRMAN. Thank you, Senator Randolph. I do not think there is any doubt that energy supply is one of the greatest domestic problems we face. It is at the center of decisions regarding economic

growth. We talk about projecting the GNP. We must also speak in terms of the amount of energy that is going to be required. Even though our economy is proportionally more service than production oriented—I think about 60 percent of our workers today are service oriented—we still require a tremendous energy base.

This is especially true, I would say, Dr. McCracken, with the automation going on.

Mr. McCracken. Right.

The CHAIRMAN. Even in the soft hardware area of computers and so on, they do need energy, and while they are service oriented, it does not mean that power requirements are minimized or eliminated.

The Chair has to attend another meeting. I want to express my appreciation to the Cabinet and administration participants here for their helpful comments. This is the beginning of a very difficult task and we look forward to working together and trying to find answers in achieving these goals and objectives. I am asking Senator Moss, chairman of the Subcommittee on Mining, Materials, and Fuels, to preside at the hearings today.

Senator.

Senator Moss (presiding). Senator Jordan?

Senator JORDAN. Thank you, Mr. Chairman.

First, I should like to say that I think the President's energy message is most timely. It comes at a very critical time in the energy needs of a growing economy. Yet this energy crisis did not slip up on us, it did not strike like a bolt of lightning. It has been coming through the years. Even out in my Pacific Northwest, where we have been reliant almost altogether on hydroenergy, we find that the economically feasible hydroplants have all been built, or nearly all been built, and throughout the country, as we turn to fossil fuels, we find that there is a very narrow supply and reserve of gas, a somewhat greater reserve but not an unlimited reserve of oil, with a greater supply of coal.

As I read the President's energy message, I think the overall thrust is that the Nation needs more energy, but it must be clean energy. Dr. McCracken stressed that in his statement when he said that not only must we supply the energy needs, but it must be clean fuel. I would like to direct my line of questioning, Mr. Chairman, to the dimension of the problem as we see it today.

Mention has been made by Dr. McCracken of the fact that the size of the aggregate demand for 1980 is not certain, that 1980 is not the end of time. It is less than 10 years away.

Dr. McCracken, you made reference to the fact that estimates of the need for 1980 have been revised upward from a low estimate in 1962 of 79 quadrillion B.t.u.'s to an estimate now of about 100 to 110 quadrillion B.t.u.'s. I would like for you or some member of this distinguished panel to tell us what is the present annual consumption of energy in B.t.u.'s?

Mr. McCracken. I think I have the figure here—68.8 quadrillion B.t.u.'s. In other words, just under 70.

Senator JORDAN. The consumption in 1970 of about 68 quadrillion B.t.u.'s?

Mr. McCracken. Right.

Senator JORDAN. In other words, we expect it to increase by 50 percent by 1980. Is that what you are saying?

Mr. McCracken. Our estimates now would be in the zone of about 100 quadrillion B.t.u.'s, or slightly more, yes. That would be about 50 percent.

Senator JORDAN. Is that a slowing down in the rate of increase? It seems to me that nationwide, the rate of increase in the use of energy has been in the order of 6 to 7 percent a year. Is that your recollection?

Mr. McCracken. Well, if one looks back—is this total energy? Senator JORDAN. Total energy.

Mr. McCracken. Our total energy consumption in 1960 was 45 quadrillion. It was up to 69 in 1970. There has been one development in our consumption of energy here since 1966, that is very interesting, and it has had an impact on our experience. There was prior to that a longrun declining trend in the energy consumption per unit of economic output; in other words, per dollar of output in real terms. For example, if we use estimate for gross national product priced in 1958 prices throughout, the energy consumption in 1920 was 141,000 B.t.u.'s per dollar of output. That moved generally downward to 1966, when it was about 87,000 B.t.u.'s. But the trend then reversed itself. There is a chart attached to my statement which indicates that and it has moved up to, I think, about 95,000 from 87,000 in 1966.

So one aspect of the additional, of the heavy demand for energy is that for reasons that are not entirely clearcut, this longrun declining trend did not extend on into 1970. I think it has had an impact on our experience here.

Senator JORDAN. Do you calculate that the increase after 1970 is going to show the same rate of climb as your chart indicates between 1968 and 1970?

Mr. McCracken. I think it would not be realistic at this point to make that assumption, at least until we understand a little more clearly what is involved there, because of prior to that, the longrun nature of the declining trend in energy per unit of output or in other words, the increasing economic efficiency with which we were able to use our energy. But one has to recognize that this is one of the uncertainties in planning for the future and it is why one has to be cautious about fixing too rigidly on any one figure as a target.

Senator JORDAN. Well, the demand, it seems to me, is an inexorable demand. Some economies can be made by eliminating waste and increasing the insulation in houses. But this is minimal in the overall rate of increase. Would you agree to that?

Mr. McCracken. Well, yes, I do think that even doing the best we can do in the way of improving the efficiency of our use of energy and conservation of the use of energy, the further growth in our energy requirement is going to be very large. This is indicated by the chart there suggesting a rise up to the 100 to 110 quadrillion zone of B.t.u.

Senator JORDAN. It seems to me that in the matter of, well, space heating, for instance, it makes a lot more sense from an energy efficiency use as well as a cleaner environment to heat electrically and put the fumes and the waste all up one smokestack where an arresting device and cleaning equipment can be used rather than 50,000 or 100,000 separate flues and chimneys, each operating at 50 percent efficiency or less.

Mr. McCracken. Yes; and of course, one part of our energy, of the President's energy program is to explore ways by which coal can be burned cleanly so that we can utilize this vast resource of fuel which we have.

Now, it is true, of course, that if one heats a house with electricity, there is another conversion process; that is, instead of using the heat from burning the coal to heat the house, you use that heat to generate the electricity which heats the house. But certainly, this is, this points up the importance of technological developments to help us to use coal effectively and cleanly.

Senator JORDAN. Well, it makes sense to heat a house with electricity rather than coal from an ecological standpoint.

Mr. McCracken. It certainly does.

Senator JORDAN. That is what prompted the President's energy message and the attendance here of many of you experts.

You mentioned the role of price and I would like to develop that a little bit. As an economist, what does that have to do with it? Are you suggesting if the price of oil and gasoline gets high enough, people are going to go back to using bicycles? What do you read into the role of price?

Mr. McCracken. No, I do not; I did not mean to imply that. What I had in mind in emphasizing this is that sometimes, there are projections of supply and of demand and of different patterns of supply and demand that are made without taking explicit cognizance of the assumption that is being made about price. Now, in the case of gas, for example, the price of gas has probably been uneconomically low and, therefore, has both discouraged the development of our resources there and also, in some cases, has tended to encourage the use of gas for certain types of operations for which fundamentally, some other fuel such as coal, for example, might have been appropriate.

So the point of those concluding paragraphs in my statement was that we do need to be more explicit about the assumptions that we are making in regard to price and the role of price in trying to bring equilibrium into our demand-supply relationships here.

Senator JORDAN. Do you think that the use of energy might be curtailed or restrained if prices were increased 20 percent—30 percent?

Mr. McCracken. The information that we have on price, the relationship of supply and demand to price changes, is still, I think, in an extremely tentative and fairly primitive stage. This requires more work.

I think there are two further comments to make here. One of them is that of course, we want to take as many actions as we can to relax the constraints on supply in order to minimize the additional costs which our energy requirements may impose on users, and that was a part of the President's message. But the other point that I would make is that it may have some relationship to specific areas. I alluded, for example, to the fact that the extremely, the low price of gas in some cases has encouraged its use for generating electricity and that sort of thing where, in the fundamental sense, it might have been better to use some other resource. The result is that we tend to, in a sense, squander this very desirable fuel, a clean fuel, while at other points in the economy, we are short.

Senator JORDAN. I would like to ask General Lincoln a question. Do you anticipate in the foreseeable future that we will have to have an energy board that will say that because of the critical shortage of gas reserves, no more gas will be used for electricity production, we will say, or that we will have to reserve our oil supplies for locomotion, or we will have to go more to coal for the generation of electricity?

Do you see any possibility in the foreseeable future of a rationing board that would say what type of energy will go to what use?

Mr. LINCOLN. Well, as to gas, other than a general comment, you are beyond my expertise. But my general comment is I believe the current administration of gas by the Federal Power Commission and by the companies amounts to some extent to a rationing in that the interruptible arrangements that exist are being interrupted recently as far as industries are concerned. I know there are some gas companies that have had to take the position that they cannot take on any more customers for the time being. The natural forces of the market of supply and demand are to some extent moving now to limit the use of gas.

As far as your question is directed to the mix of the use of fuels as between gas, oil, coal, I make a comment on that that our environmental programs are now implicitly changing that mix by the regulations that have been put into effect. This should be a matter of considerable concern to those who are responsible for our energy supply.

I would hope, in fact I believe, that we of the Federal Government, the legislative and executive branches, will find a way forward over the coming years so that we will not have to go to any regulatory arrangement of the type that you suggest, and that I am sure it is your hope will not occur. If I may, I will ask that Dr. Freeman comment particularly on the gas situation.

Senator JORDAN. Very well.

Mr. FREEMAN. It is my understanding that the Federal Power Commission has a rulemaking proceeding underway at the moment to try to identify the priority uses of natural gas to put itself in position to exercise whatever authority it has to be sure that if there is not enough gas to go around, the most valuable uses of gas do have adequate supplies, the home heating customer and the manufacturing industries that are uniquely dependent upon natural gas. So I believe that there are measures underway for the Federal Power Commission to at least put itself in a state of readiness to exercise such authority if it becomes necessary.

Senator JORDAN. I appreciate that. Turning now to another phase of energy source, Dr. Seaborg, the President mentioned in his message the need for developing a breeder reactor prototype in the immediate future. I wish you would elaborate on that somewhat and tell us what is the state of present planning for a pilot breeder reactor plant and when it might be expected to, for some energy from that source to be on the line.

Dr. SEABORG. The Atomic Energy Commission has had a program for the development of a breeder reactor ever since the Commission was created. The Commission has been concerned in the intervening years since its creation on a higher priority basis with the development of the water-cooled reactors have had now reached the stage where they are prevalent, they are the choice of many utilities and are no longer a prime responsibility of the Commission. Having accomplished this, the Commission turned some 3 or 4 years ago to the development of the breeder reactor on a higher priority basis and chose as its first line of development the fast neutron breeder reactor, a reactor that has as its coolant fluid—the heat transfer medium—liquid metallic sodium. This is a reactor system that is known as the Liquid-Metal Cooled Fast Breeder Reactor or the LMFBR.

We have had a good deal of development work on this underway. An important feature, of course, has been the development of component parts, and the fuel cycle—the means of using the plutonium, which is the main fuel in such a reactor. Also, our program includes the design and construction of a fuel test facility, what we call the Fast Flux, Test Facility, the FFTF, which is under construction now at Richland, Wash., and which should be completed in 2 or 3 more years.

We have reached the point of development where we feel that we should now build a demonstration reactor that will demonstrate the feasibility of this concept. We have chosen as a reasonable power level the range of 300 to 500 megawatts—300,000 to 500,000 kilowatts.

The President in his June 4 energy message recognized that this is the next important step in the development of the fast breeder reactor and placed emphasis on this demonstration plant and increased the funding for it, both for the research and development work to support it and for the money that would be required to construct it. We hope to put together an arrangement, including the money that the President has authorized for the Federal contribution, the money from the utility upon whose grid this reactor would operate, and contributions on a broad basis from utilities and industry—we hope that this will be a cooperative venture involving therefor funding by the Federal Government, the utility involved, the reactor vendors, and the utility industry.

Senator JORDAN. Is it the initial plan to go forward with just one pilot plant or two?

Dr. SEABORG. The plan is to go forward with one such demonstration reactor at this time.

Senator JORDAN. Can you give us a target date when that might be completed?

Dr. SEABORG. We have as a target date for the completion of this first demonstration reactor the 1977 to 1978 time period. We hope to put together this package sometime during the remainder of this year and actually start the construction sometime next year.

Senator JORDAN. Thank you.

Senator MOSS. Would you yield? Why was the choice made to have just one rather large pilot plant—it is quite sizable, from your description—rather than maybe two or three alternatives of smaller size?

Dr. SEABORG. It is an expensive venture, of course, and we would hope that it might be possible with one such pilot plant—or demonstration reactor—together with the information that we are going to obtain with our rather expensive Fast Flux Test Facility, which is costing something on the order of \$100 million to construct, together with the exchange information that we are going to receive from other countries that are embarked on the same program, to go on to construct the larger commercial operating plants which would be in the range of 1,000 megawatts, or 1 million kilowatts.

Senator MOSS. Do I understand, then, that there are in other countries some variations of the type that you intend to construct here and that you will have access to the technology?

Dr. SEABORG. Yes, that is right. We have exchange arrangements, agreements, with them where we profit from their experience and they from ours so as to reduce the cost to each party.

Each of the main industrial countries that are embarking on a nuclear power program to help meet their electrical requirements—and

that is about all of the advanced industrialized countries—have chosen the same reactor, the same fast breeder reactor, as the mainstay for their future programs. That includes Great Britain, France, Germany, Japan, and the Soviet Union. They have all chosen the LMFBFR. The reason for this is that we have more experience with this reactor, more research and development work with this concept, and also, it fits in very well with the light water reactor economy, which produces plutonium as a byproduct. In the United States, the timing if we maintain our program, is going to be just about right so that the byproduct plutonium that is produced in the water reactors that are being built today and in the future will be available in sufficient quantity to fuel fast breeder reactors, plutonium burners, in the 1980's, when we hope to begin to build the commercial economic fast breeder reactors on an increasing scale.

Senator JORDAN. Mr. Chairman, I will yield. I have several more questions, but I will yield to my colleagues.

Senator MOSS. I appreciate that. I recognize we are going to have a time problem. We have so many questions that we want to put—I have a number, too. But we will offer opportunities to other Senators and proceed for at least a limited time longer before we recess.

The Senator from New Mexico.

Senator ANDERSON. A moment ago we were discussing the offshore oil leases. I have been informed that in one offshore oil lease bidding, a number of companies which bid on the oil leases and are now unhappy with the course of events and feel that perhaps they have made a bad bargain in purchasing at high prices specific leases.

In other words, some of these companies feel that they paid very large sums for these oil leases and now have discovered that their production potential is not very good and is further compounded by ecological factors. Further, they would like to give up these leases and obtain equal rights in other areas or be bailed out by the Government repurchasing the leases. I feel that a gamble taken by them should be at their risk and not at the expense of the Government if they have guessed wrong. After all, it is their pressure which is brought to bear to put up certain areas for lease bidding.

Senator MOSS. I think, Senator, you are dealing with the sale of oil leases.

Senator ANDERSON. Yes.

Secretary MORTON. There is a 55-year term on the lease to explore the lease to find out what is there.

Senator ANDERSON. But many firms start drilling immediately based on exploration previously done, and really test the oil zones soon after the awarding of the lease. Also, many of these firms may have already found out that a specific lease is not productive perhaps because of bad geology or constraints placed upon their drilling activities. I would hope that the Department of the Interior keeps informed on what is happening in these areas so that the Government is not placed at a disadvantage in any transaction which would require the Government to bail out oil companies because of a bad guess on their part.

Secretary MORTON. I think you are talking about the Santa Barbara situation, are you not, Senator?

Senator ANDERSON. It could be. But there are several other areas in trouble also.

Secretary MORTON. Well, in the Santa Barbara Channel, we did have some problems there, as you know. At the present time, we are operating under a moratorium in some of those areas. Some of these problems have been entirely environmental problems.

Senator ANDERSON. But is it not true that some companies have asked to be relieved of their obligations?

Secretary MORTON. Well, there is a bill before the Congress at this time which would resolve the problem and would be a system through which those particular leases could be bought back by the Government. That bill is before the Interior Committees of both Houses.

Senator ANDERSON. I would hope very much that the Department would look very carefully at the actual facts of the situation before recommending or agreeing to a settlement.

Secretary MORTON. This, of course, would be a matter for the courts to decide as to what the price would be for the repurchase of those leases.

Senator ANDERSON. With reference to another matter, have you or your Department examined the previous studies which were made by the Interior Committee some years ago? If my memory serves me correctly, the committee made two complete surveys of energy requirements.

Secretary MORTON. Our group has reviewed and updated in our own thinking every energy report that has ever been developed, either by the Interior Committees of the Congress or from other sources.

Senator ANDERSON. With reference to the oil lease repurchase, the owners of the bad reserves do, in fact, have some problems. However, I would like to again emphasize that I just want to be sure when you review these problems that you place proper emphasis on both sides of the problem—not just on the oil companies' side.

Secretary MORTON. Obviously, our role, Senator, is to protect the interest of the Government and thereby protect the interest of the people.

Senator ANDERSON. I am sure your goal is that and I ask the question only because I think it ought to be on the record. You have done a fine job and I have no quarrel with it at all. But I do think that these studies were very expensive and they have studied long-range programs for these. Jim Ramey, who is here, was active in one of those and I think they ought to be studied, they ought to be remembered, in making these new studies.

Thank you.

Senator Moss. Thank you, Senator.

The Senator from Wyoming.

Senator HANSEN. Thank you, Mr. Chairman.

Mr. Chairman, first of all, I would like to ask unanimous consent that there be included in the record of this hearing, following the inception of it at an appropriate place, a statement that I would like to have included.

Senator Moss. Without objection, it will be included in the record at an appropriate point.

Senator HANSEN. Mr. Chairman, it is not what the President's energy message says but the omissions, what it does not say, that I find disturbing. Certainly, the commitments it sets forth, such as the

fast breeder reactor, coal gasification, development of use of nuclear power and solar energy, are all worthy goals. They make more sense than exploring Mars, in my opinion. I find no fault with setting up such long-range goals. It is clear that these innovations will not soon be significant factors in our total energy picture, however. It is equally clear that the fossil fuels will remain our primary energy source for the foreseeable future, with oil and natural gas supplying about three-fourths of the total. Except for acknowledging that these conventional fuels have been very low in cost and pledging an accelerated leasing program on the Outer Continental Shelf, the President's message offers little new in the way of revitalizing the search for and development of domestic oil and gas. When domestic reserves of both these fuels are declining sharply as a result of an erosion in exploration and drilling that began in the mid-1950's, can you explain, Mr. Secretary, why there is such a lack of emphasis on developing these vital conventional fuels?

Secretary MORTON. Well, I cannot agree with you altogether, Senator Hansen, that there is a lack of emphasis. Perhaps the easy thing is to look at the new and not consider all the work that is on-going in the areas of the old. Let me just give you the estimates of our Department on the annual use of the various types of fuels that you have mentioned.

In the petroleum field, by the year 2000, the anticipated use is 12—I think it would be best to give all of this in B.t.u.'s. It is 66 quadrillion B.t.u.'s, which is up from 29 billion today in terms of energy. In the natural gas field, it goes from 22 to 50, just about a little more than double. In coal, it goes from 13 to 26; here again, double. Whereas hydropower, for example, it is only a very small amount of the total—only 2.6 percent of the total energy by the year 2000. So when we are—and in nuclear power, we would go from a very minimal B.t.u. level that we are today up to 43 quadrillion B.t.u.'s, which will then be 22 percent only of all of the energy that we use.

Now, in the area of the fossil fuels, we are coming forward with an oil-shale program this year. In the area of coal, we have a multi-program research on the use of coal and at the same time, we have upgraded our research in the areas of the mechanics of extracting coal. We are addressing ourselves in the most vigorous way to the enforcement of the Coal Mine Health and Safety Act.

I think the main factor in the exploration for oil is the economic factor. As you know, in my opinion, we lost a little of the battle when we passed the tax bill of 1969 in this field. I think we dampened the enthusiasm for oil exploration. However, it just is a fact of life that the number of opportunities on shore for oil exploration is less and less every year by reason of the fact that there is less area and less geological opportunity.

But the domestic oil program that we have on the Outer Continental Shelf, which is now producing 10.4 percent of all of the domestic oil that we use, we are accelerating that almost twofold over what the program was sort of originally laid out to be several years ago.

Senator HANSEN. I am pleased that you referred to our having lost a little of the battle, as you did, when the tax reform law was passed a couple of years ago, because I could not agree with you more. I might point out that I read of your speech before the IPAA recently when you emphasized that the extent of our energy crisis is not one of lack of resources but the lack of initiative and capital to convert

those resources to reserves consistent with current environmental and safety needs and then translation of those reserves to the clean fuels America is demanding. It is only, you continued, those with a short-term look at the pocketbook who would urge greater reliance upon imported energy.

I think that this Nation, unless we can change the policy around, as indeed I hope we can, will find out the hard way some facts of life that so far they have refused to face up to. I would call attention to several things: No. 1, the American Association of Petroleum Geologists, a very distinguished group of scientists, well known and including in its membership, I think, our distinguished Under Secretary, who has already spoken this morning, says that they estimate that there are between 107 and 199 billion barrels of oil, depending on the percentage of recovery, and up to 911 trillion cubic feet of gas that is yet undiscovered in this country. Now, when we talk about that on the one hand, what is capable of being found if we go out and make the search for it, and then look at some other facts of life, I am deeply disturbed.

For instance, recently the Petroleum Industry Research Foundation issued a study titled Oil Imports in the National Interest. Part of this report was done by Dr. D. A. Rustow, distinguished professor of political science at New York City University an expert on the Middle East. Dr. Rustow expressed the belief that, one, Russian influence in the Middle East will grow; two, prices and taxes on oil in the Arab States will continue to rise; and three, most petroleum operations by private companies in that area will be nationalized by 1985. Yet despite that, I see that in yesterday's Oil Daily, June 14, there are references to briefings of the National Security Council, the Office of Emergency Preparedness, and others in the executive branch by the Standard Oil Co. of New Jersey and the Shell Oil Co., in which this report says that both of these companies forecast an accelerating dependence on eastern hemisphere oil, one forecasting a need by the United States for 13 million barrels a day for that oil by 1985; and the other going even further, claiming we will have to import 15 million barrels a day by that date.

Now, we are talking about, among these foreign sources, the nation of Algeria. Let me ask you specifically about a special case that concerns me very much. That is the imports of liquefied natural gas from Algeria. Algeria has confiscated American properties developed there. She has kicked the French out. We do not have diplomatic relations with her. Last year, I cosponsored legislation, which I regret did not pass, that would have prevented us importing LNG from Algeria, which has confiscated American properties. Yesterday, I am told, a Federal Power Commission examiner recommended a long-range program for importation of this contraband LNG.

The Department of Interior has proposed to give LNG a classification which puts it outside of any control as to imports. It is disturbing that the Department disavows its responsibility in such manner. I visualize a situation on the east coast, when we have achieved substantial dependence on this LNG, very similar to that which we now find ourselves in with respect to residual fuel. The supply is short and the price has doubled because this area is 95 percent dependent upon imports of residual.

Can you explain or rationalize the policy of the Government? I suggest that you may not subscribe entirely to it, but it is disturbing to me that with the potential we have here at home, we are pursuing a policy which fails to give the incentive that you recognize and you have spoken out repeatedly on and is essential in order to have our dependence placed upon sources fully and completely under American control so as not to jeopardize our national security. Or, rather, do we take the short-range view that price is all important in pursuing policies to hold prices down unrealistically, as we have, and build a dependence upon foreign sources?

Secretary MORTON. Well, first, Senator, on your Algerian situation, the case is before the Federal Power Commission. But since most of your question is directed toward oil import, I think it would be better if General Lincoln addressed himself to the problems that you bring up with regard to oil imports.

Mr. LINCOLN. As you know, Senator, this is a matter of deep and continuous concern to me and to the Oil Policy Committee, which I chair. One of the objectives or, well, the central objective of the oil import program is the national security objective. That is the basis on which it was created; that is the basis on which we mold policy and that is the basis on which it is administered. There can, I think be no doubt that the United States, looking forward over the years of this decade, is going to increase the amount of oil that we import. The amount that will need to be imported and the sources are a matter to be worked out on a policy basis.

Referring back to a preceding statement of mine, the measures that the President proposes are, in my judgment, security measures and they will, among other objectives, move toward reducing the dependence that we would otherwise have on insecure sources for both location and quantity of oil imports.

Just to comment on these forward estimates that people make out to 1985. Certainly, my office, Secretary Morton's office, all the offices that have to deal with this energy problem, are in continual communication with both consumers and industry, and we do listen to the estimates that industry makes and provides. They are a help to us. If you get an estimate looking out to 1985 that indicates that we will be critically dependent, this is a help because we have from now to 1985 to take measures which make that estimate incorrect when 1985 arrives.

Senator Moss. It is going to be necessary, I am sure, to continue now, either this afternoon or tomorrow morning. I would like to find out from the gentlemen who have appeared and who are extremely busy, would it be easier for you to come back this afternoon, rather than return in the morning? Otherwise, we will take a recess and we will resume this afternoon. I know there is a good bit of testimony that we have to cover and we cannot possibly go straight on through now since it is after 12:20 and the Republicans have their policy luncheon today and all of us have commitments we have to keep.

Senator HANSEN. Mr. Chairman, could I just make an observation, and I apologize, I was not thinking, but I do know how vitally important it is to the distinguished senior Senator from Oregon that he be on the floor this afternoon, for obvious reasons. I regret that I took so much time. If he could carry on for a little bit, since he cannot be here this afternoon, would that help?

(Senator Hansen's complete statement follows:)

STATEMENT OF HON. CLIFFORD P. HANSEN, A U.S. SENATOR FROM THE STATE
OF WYOMING

Mr. Chairman, it is most appropriate and encouraging that you should have scheduled this hearing today. The President's recent message to Congress on energy and the Senate's approval of S. Res. 45 for this Committee to conduct an investigation and study of national fuels and energy policy both emphasize the import and magnitude of the energy problem.

Mr. Chairman, I made some comments about the President's energy message the day it was delivered to the Senate and ask that my remarks as they appeared in the Record that day be entered in the record of these hearings. I will not read the entire statement but would like again to emphasize my concern over the immediate and short-term aspects of the energy situation.

I commended the President as I do you and Senator Randolph for recognizing and acting upon what I consider to be one of the nation's most critical problems.

The President's report recognized the major role of private industry in providing our energy and noted that Government can do a great deal to help in meeting this challenge. I agree with the President that the government can do a great deal and one of the greatest things it could do would be to do less in the way of regulation and control particularly in the area of gas pricing and also in recognizing the real need for incentives—price and tax incentives.

And independent producers, the backbone of the oil and gas exploration industry, would feel better had the President made some positive reference to an all-out effort toward self-sufficiency in both oil and gas rather than the implication that the U.S. must become more and more dependent on foreign sources of both oil and gas.

Only yesterday a Federal Power Commission hearing examiner approved an application for importing liquified natural gas from Algeria and other applications are pending for more LNG from Algeria and Venezuela.

The cost of this gas delivered to a utility on the East Coast is more than double the cost of domestic gas delivered to the same point. And while the Federal Power Commission considers price increases to producers of gas for interstate use, utilities are paying up to 38¢ for gas to be used in the state. This is true of present rates in Ohio and Michigan while the average wellhead price paid producers in the Southwest and Louisiana is about half that—that is for gas committed to interstate use.

So it small wonder that producers are reluctant to explore for new sources of gas at greater and greater depths and higher and higher costs without some real assurance of an adequate return on investment.

But the real concern in the east should be the security question.

The east coast since the removal of import restrictions on residual oil six years ago has become more than 90 percent dependent on imports and now is heading toward dependence on imported gas as well.

Oil and gas now supply about 76 percent of the nation's energy and must continue to do so for many years. Consequently, the main emphasis must be on the continued use of oil and gas and the only dependable source of those fuels will be from sources under complete U.S. control.

As a nation so completely dependent on oil and gas—99 percent of our entire transportation network is powered by petroleum—I cannot see how we can sacrifice national security and long-term energy guarantees for the temporary and insecure benefits of lower priced foreign oil.

The oil and gas industry has the capability of developing undiscovered deposits of these fuels sufficient to supply the energy needs of the U.S. for years. But the Congress and the Executive must see that government policies are such that private industry can and will continue to provide the energy that has made this nation the world's industrial leader.

[From the Congressional Record, June 4, 1971]

PRESIDENT NIXON'S ENERGY MESSAGE

Mr. HANSEN. Mr. President, I would like to commend President Nixon for his energy message to Congress which was delivered this morning.

I commend him for his attention to one of the Nation's most critical problems and one which has been begging for top-level action for some time.

Even though the message and its recommendations falls far short of what I had hoped for, the President has at least recognized the existence of the problem.

I have serious doubts, however, that the actions he has recommended "to insure an adequate supply of clean energy for the years ahead" will accomplish that purpose.

It is certainly true that the energy supply problems are due to the rapidly increasing demand for energy and the strong emphasis on environmental protection. But it is also true that we have a gas shortage due to or the result of government pricing policies of the past several years that have imposed unrealistic ceiling rates on the cleanest and most convenient fuel until we have passed the point of using more each year than is being discovered.

And at the same time that additions to both our oil and gas reserves were declining at an alarming rate, both the Congress and the Treasury Department were acting to lessen the incentives for exploration and development of new sources of the fuels which our geologists say are still abundantly available both on and off shore of the continental United States as well as Alaska.

The President's message does recognize the fact that energy has been relatively inexpensive in this country and that during the last decade, the prices of oil, coal, natural gas, and electricity have increased at a much slower rate than consumer prices as a whole.

Energy, the President says, has been an attractive bargain in this country—and demand has responded accordingly.

How true that is. But the President's recommendations do not include the incentives that will be necessary for the energy companies of this Nation to continue meeting the insatiable demand for energy.

The Tax Reform Act of 1969 added some \$700 million a year to the petroleum industry's cost of doing business and took away that much money that could have been invested in exploration for new reserves.

The President's report does refer to recent actions by the Federal Power Commission for greater incentives for industry to increase its search for new sources of natural gas but it avoids any direct reference to the only real solution—elimination of wellhead pricing and a return to free-market pricing of gas along with competing fuels.

The report recognizes the major role of private industry in providing our energy and notes that Government can do a great deal to help in meeting this challenge. But I am afraid those close to the President and advising him on energy policies have fallen far short in visualizing and more accurately pinpointing the problems and some concrete solutions.

The Government could do a great deal, as the President says, and one of the greatest things it could do would be to do less in the way of regulation and control particularly in the area of gas pricing and also in recognizing the real need for incentives—price and tax incentives.

Independent producers, the backbone of the oil and gas exploration industry, would feel better had the President made some positive reference to an all-out effort toward self-sufficiency in both oil and gas rather than the shin-plasters of facilitat-ing imports of both natural and liquified gas.

And the independents would have felt a little more secure had the President mentioned the oil import program which is still under constant attack by those who would sacrifice national security and long-term energy guarantees for the temporary and insecure benefits of lower-priced foreign oil.

Elsewhere in the RECORD today, I have included a report by the American Association of Petroleum Geologists on the Nation's energy problems. These gentlemen visited with some of the President's advisers on energy and I hope their suggestions may be included in the President's recommendations to organize Federal efforts more effectively and unite all important energy resource development programs in a single structure within the Department of Natural Resources.

For too long have energy policies been fragmented among numerous agencies with no overall policy at all nor any long-term program under which the industry could plan.

The President's message is at least a beginning. I do commend him for his attention to alternate sources of fuel from coal and oil shale and the long-term prospects for nuclear power as well as the use of nuclear stimulation for conventional gas production. But the immediate needs for the 1970's and probably the 1980's will come from conventional fuels—oil, gas, and coal.

Oil and gas now supply about 76 percent of the Nation's energy and must continue to do so for many years. Consequently, the main emphasis must be on the continued use of oil and gas and the only dependable source of those fuels will be from sources under complete U.S. control.

The oil and gas industry has the capability of developing undiscovered deposits of these fuels sufficient to supply the energy needs of the U.S. for years. But the Congress and the Executive must see that Government policies are such that private industry can and will continue to provide the energy that has made this Nation the world's industrial leader.

Senator MOSS. Are there any questions you would like to get in right now?

Senator HATFIELD. Just two brief questions.

Senator MOSS. The Senator from Oregon says he has two brief questions. He will be permitted to go ahead on that and then we will take our recess. We will come back to you if you have not finished, Senator.

Senator HATFIELD. Mr. Chairman, I have listened carefully today and I have read the statements, and I think they are very eloquent statements. But there is one factor that I find missing as we crank up this whole program or effort to try to solve our national fuels problem. That is the factor of the public voice, the public role in these policies. I think we would have to confess that the reason we are talking so much about clean energy today is because there has been a great deal of public outflow of demand for environmental considerations that did not exist 5 or 10 years ago. We find this in our hearings on forestry policies. No longer do the experts say it is only a question for the experts to decide; the public has to be cranked in somewhere along the line as it relates to cutting policies and so forth in our timber resource.

I think it is also highlighted by the Secretary's testimony when he says that even though nuclear energy today contributes less than 1 percent of supply, it will grow rapidly. He says that the unexpectedly large demand for electricity and delays in delivery of nuclear plants have resulted in power failures and brownouts.

Last Sunday in the New York Times book review, we have a full page advertisement which says, in effect, advertising a book called "Poison Power" written by two Atomic Energy Commission scientists; we are sending a free copy of "Poison Power" to every U.S. Senator and Congressman.

This obviously will be utilized greatly by the public, whether right or wrong, accurate or inaccurate. The public is involved, the public will become increasingly involved in all of these policy decisions. Therefore, my question simply is what is there in the whole program that has been talked about this morning that provides for or recognizes the role of public opinion or the role of the public to have some say to express their opinion and to either gain greater understanding through dissemination of information of this type or through the counterinformation that would correct this if Dr. Seaborg thinks this is incorrect? I find this true particularly as it relates to the Trojan plant in Oregon which has been sited, which has been contracted, which is under construction. There are those who still expect, possibly some sort of court action, to gain a moratorium to stop this kind of nuclear power development.

Now, we may say it is because of a lack of understanding, but there it is. What are we doing to deal with that and how are we going to accomplish this basic question of cranking in the role of the public in this kind of policymaking?

Dr. SEABORG. Well, I might begin saying, since you made reference to the book, *Poisoned Power*, I think that is a rather one-sided description of nuclear energy as an electricity-producing resource. I might add that Jack Gofman, one of the co-authors of that book—and the same team of Gofman and Tamplin wrote an earlier book along the same lines—Gofman is one of my students. He obtained his Ph. D. with

me. He is a codiscoverer of one of the sources of nuclear energy of great importance, namely, uranium 233—that is, the fissionable isotope through which thorium can be used as an energy source.

I believe that he is presenting a one-sided point of view. I do not know just how we can meet your requirements, your request that the public be adequately informed. But I might say that I have been in the process of the preparation of a book, a broad-ranging book on nuclear energy, that covers all aspects, not only the use of nuclear energy to produce electricity, but all the other humanitarian aspects of nuclear energy—for example the uses of radioisotopes in medicine. It may not be generally known that there are some 8 million treatments per year in the United States in the diagnosis and treatment of disease with radioactive isotopes. And there are many other aspects of the peaceful uses of atomic energy. This book will be published sometime this summer. I would hope that that would have some effect in counteracting this Gofman-Tamplin point of view.

The Atomic Energy Commission has—the Commissioners, myself, and the staff—have spent a good deal of time and energy trying to put the whole picture of nuclear power into the proper perspective. As you know, the Atomic Energy Commission has an almost unique program of public hearings in which the affected public can participate in the hearing process for each nuclear power plant. I think that we obviously do have a problem here of informing the public. I believe that nuclear power is a clean and safe and probably the best source for meeting our long-range requirements for electricity. The breeder reactor about which I answered a question a few moments ago has the advantage that it uses the nuclear fuel resources—uranium in this case—much more efficiently, about 30 times more efficiently, than the water cooled reactors and hence, will extend our uranium resources to a much longer period than if we stayed with the water cooled reactors. It will extend these resources from a period of a few decades to perhaps centuries or even thousands of years. That is one of the reasons why it is so important to develop the breeder reactor. But while it is doing that, it also is being designed in a way where the release of radioactive effluents from it in the course of its operation will be kept to an essentially zero level—just about as close to a zero level as it is possible to obtain.

Also, it will have the advantage that the fuel operates at a higher temperature so that there will be less of a heat disposal problem than there is with the water-cooled reactors.

I should say that in the case of the water-cooled reactors, the release of radioactive effluents is so small now that the exposure, the average exposure to people in the United States, if I may use the technical term, the unit that is used to describe such exposures, is of the order of 0.001 millirem per year, whereas the background radiation to which we are all exposed is of the order of, on the average, about 100 millirems per year. That is 100,000 times larger than the average exposure that the citizens of the United States are getting from nuclear powerplants today. The background radiation varies by a factor of almost 100 percent. If you live in a brick house or a granite house, the background radiation can be 200 or 300 millirems per year, or if you live in a city at a high altitude, like Denver, the background radiation can be some 50 or 75 percent higher than the average.

What I am trying to point out is that just the variations in the background are orders of magnitude greater than the small exposures from nuclear power plants. The extrapolations into the future, when we will have, if our predictions are carried out, levels of nuclear power generation that are much larger than to date, such as those that we extrapolate for the year 2000, indicate that the exposure to the average citizen in the United States from the operation of nuclear power plants will be less than 1 millirem per year and perhaps something of the order of one-tenth of a millirem per year. That is the average. Even those that have the highest exposure at the boundaries of nuclear power plants will have exposures that are only a few percent of background radiation, within the range of variation, so that it is almost impossible to measure the effect, it is so small.

Senator HATFIELD. Dr. Seaborg, I appreciate your reassurance here on this subject. I would only comment that writing a book is going to be very helpful. I am looking forward to reading it. I hope I understand it after I read it. Because it is very easy to understand this language.

Hiroshima next door. Inside one large nuclear plant every year as much long-lived radioactive poisons are produced as in 1,000 Hiroshima-type atom bombs. And suppose an accident should occur, say 1 percent of the radioactivity escaping from a single plant. Then the deadly nuclear contamination would spread over several nearby States and remain for perhaps 100 years or more.

I am not in a position to say that it is one-sided if that is all you care to say about it at this time. All I am saying is when they ask this reader here to clip the coupon and send it to their Senators and Congressmen and ask them to air public debates on the matter so we can air all the facts, as far as we are concerned, they are in the driver's seat at this point. It seems to me this is going to have a great bearing upon whatever policy we undertake and whatever policy we are able to implement.

Oftentimes, I think this type of thing can generate a great deal of public misunderstanding if it is incorrect, or public involvement, and then we have failed to provide that same public with an opportunity to present their views and to crank them into the process and the procedures. Then we end up with a bigger problem than just a fuel problem or an energy problem. We end up with a mass public educational problem that perhaps could have been cared for during the proceedings which we are engaged in here, which I think is a way in which the public can be heard. I hope that our committee, and I am sure the chairman will agree, will invite people like this who have something to say and who deserve some consideration—after all, as you say, he was a student of yours. I am not taking either side of the case at this point, but I am saying we have to provide, I think, some procedure by which we crank in these various viewpoints and are able to alert the public to the facts and to dispel the misinformation if it is incorrect information.

I think that has to do with oil, I think it has to do with hydroelectric energy, I think it has to do with shale and everything else that we talk about in reference to energy.

One last question I have of the Secretary.

Mr. Secretary, you announced this morning these leases. In the President's speech, he said, "I am requesting the Secretary of the Interior to expedite a final decision on whether the first competitive

lease sale should be scheduled for this fall." He is referring here to geothermal energy. Has the Secretary made any determination yet on this recommendation of the President?

Secretary MORTON. Yes, we are in the process now of doing precisely what you addressed your first question to. We are in the process of preparing an environmental impact statement under the National Environmental Policy Act on geothermal leasing. And, of course, this process invites public comment. This is one of the purposes of the bill and we hope that we will have completed those steps so that our scheduled actual nomination and scheduled lease sales can take place late in the fall of 1971.

Might I add, Senator Hatfield, that the powerplant siting bill which is before the Congress is a long-range and a short-range powerplant siting program that does provide extensive opportunity for public participation. The land use bill which is, in a sense, co-related to the development of powerplants and other infrastructure also institutionalizes land-use planning at the States that gives the public a very wide opportunity to participate, not only directly but through their representatives in State government. I feel that we have opened the door to public participation in many of these areas far beyond any point that existed in previous years.

So I agree with you that the public must have the opportunity. For example, we conducted extensive hearings, both in the State of Alaska and here in Washington, on the matter of the Alaska pipeline permit. I say also that in some cases, this causes quite a bit of delay. But I believe under our system, the delay is worth it, that the public is entitled to the very consideration you mentioned. I have always felt that one of the missions of the Congress was to protect the public interest in participating in these matters. This is why the Congress exists. This is why each member of the Congress should go home and spend some time in his district, so that he gets an opportunity to know first-hand what his constituency is thinking in terms of these matters.

Let me assure you that the programs that are carried out in the resource development area are all carried out under mandates of the Congress itself.

Senator HATFIELD. Thank you very much. I appreciate your comments.

Thank you, Mr. Chairman.

Senator MOSS. Thank you, gentlemen. I concur with the Secretary's observation that one of our functions in this committee and the Congress is to get the public involved to the greatest degree we can.

We are now in recess until 2:30 p.m.

(Whereupon, at 12:40 p.m., the committee was recessed until 2:30 p.m. of the same day.)

AFTERNOON SESSION

Senator MOSS. The committee will now resume.

We are pleased to have most of our panel back. Secretary Morton had a conflict and Under Secretary Pecora is sitting in for him. Dr. Seaborg had a conflict, and Commissioner Ramey is here to take on the questions in that area.

I understand General Lincoln will have to leave and we will try to make sure we have asked the questions we want to direct to General Lincoln, if possible, so that he can meet his commitment.

Like most everything around here, we usually find we have more to do than we have time to allot to it and I regret that we had to run into the afternoon. Hopefully we could have been over on the floor where there is a lot going on this afternoon. We will try to proceed, however, with as much dispatch as possible.

We certainly appreciate the responses we have had and I know that members of the committee still have some questions that they would like to ask.

I would like to start off perhaps directing one to General Lincoln. The Senator from Wyoming was questioning you about the import of liquid gas from Algeria and other imports of oil and gas into this country. I wondered how you would assess the importance of that import. That is, since our supplies of oil and gas are limited now, isn't it of some advantage to be using imports rather than further depleting our supplies at a rapid rate?

General LINCOLN. First a comment on gas. All of the estimates that I have seen about the prospects for import of gas indicate that certainly there are possibilities there. We are a long ways down the road beyond 1980, even to 1985 before what you call a significant portion of our gas requirements would be imported.

By the way, all the figures I have seen on price show that price will be substantially above that we are paying now at the well head, very, very substantially, even if this is achieved.

Now, going to the thrust of the other part of your question. Yes; certainly one must recognize this point and worry about it, but I think that it is just a fact of the situation if you don't have your fossil fuel, particularly your oil developed, if you have an emergency where supplies from insecure sources are cut off, you can't turn to these geological estimates that Dr. Pecora produced about the number of billion barrels that exist and expect somewhere between 4 and 10 years before you can get production.

The CHAIRMAN. We are caught on the horns of a dilemma there. You must have the reserves and know that you can get them in case of emergency is what you are saying, although you recognize we are talking about depletable resources. If we are using them to our maximum now will we deplete them that much sooner?

General LINCOLN. Depletable resources, one-time resources.

Now, looking down the road in the time frame we have been talking this morning, 1980-85, beyond, I have faith that as we move into that time period that we will have developed resources we know we have but don't know how to use yet, and one is oil shale where we have massive quantities of B.t.u.'s. We have to find a way to unchain them.

Another is use of coal where we have as much, I guess several times as many B.t.u.'s known as are known in the Middle East, for example.

They are just a couple of examples of what should be coming down the road.

Another is the breeder reactor which we know we can do but is not going to be providing electricity which we now make principally with coal, gas, and third, oil.

1985 and beyond will be making it with a breeder reactor.

Senator Moss. I thank you and I did have a question or two on shale and coal I was going to ask the Secretary. I will now ask Dr. Pecora perhaps.

It seems to me the President's message was quite vague as to what is proposed in respect to the Department of the Interior's oil shale leasing program.

Would you fill in this a little more for me?

Dr. PECORA. I will be happy to, Mr. Chairman. The program was touched upon briefly by the Secretary this morning.

In the oil shale program we are dealing with a series of phases before the actual pilot plants or demonstration plants themselves might be constructed. The first of these is a general statement on what the project itself, the major program it intends to do. Coupled with that is a statement on the environmental assessments of the total program as we see it this time.

Both of those statements will be released within a couple of weeks to the public.

The second phase of that program is to permit informational drilling on the public lands by the private sector. This will enable the Federal Government to obtain information so as to inform itself in a much better way as to where a test lease program might take place, how it should be resolved, and so that a detailed environmental assessment statement may be made on that particular area of the Federal domain.

That phase will be permitted this summer.

Following that will be a call for nominations upon the completion of the informational drilling program. Incidentally, all of that information will be made available to the Federal Government. And in the call for nominations is an expression of interest from the private sector as to what areas or what terrain the private sector would like to see put up for competitive bidding.

Now, that would be presumably in the fall or early winter of next year.

We would need to have public hearings, we would need to have a final general assessment statement of the environmental impact so that the test lease program referred to by the President would be in 1972, at some time in 1972.

Those are the phased sequences of events as we foresee them. An announcement will be made on that, Mr. Chairman, within a couple of weeks.

Senator Moss. We look forward to the forthcoming announcement. You expect by 1972 you would be starting the lease program for development by private industry, provided all of these other steps went along as you expect them?

Dr. PECORA. And provided further that the Secretary of the Interior is convinced that the environment will not be degraded in connection with the program.

Senator Moss. To what extent is this in situ process being looked to in order to get the oil from the kerogen without the traditional mining process?

Dr. PECORA. There are some aspects of this of a technical nature which I am sure the committee is well aware of and the public may not be, and very briefly if I may summarize.

The oil shale in the central part of the rich basins in the three States of Wyoming, Utah, and Colorado contain other minerals that are of interest. Sodium minerals, sodium compound minerals which might be recovered along with a shale oil producing program.

In the past we have referred to this multiple product as trying to get everything out of the pig including the squeals, and if we went into a program that dealt only with derivation of oil from the shale we might not be acting in the best public interests from a conservation point of view, and for this reason the informational program and location of the areas of rich mineral intermixtures would be an important factor in determining what process might be the best process.

Now, the program where accelerated heat due to some nuclear device at depth might be utilized would result only in the elevated temperatures which would cause the kerogen to become fluid and hence extractable, but it would not permit the extraction of these other important minerals and useful minerals in the total conservation concept.

Therefore, this Department has been looking in great detail at all of these various methods to determine what would be in the best public interest.

Senator Moss. Well, do you have instances where you have, say, a sodium lease and you are concerned about whether that would involve removal of the oil shale, too?

Dr. PECORA. Conversely, we do have a situation on the public lands at the present time where some permittees several years ago applied for and received a permit to seek a discovery for sodium minerals. These permittees were successful in making the discovery of, the word is "nahcolite," a sodium bicarbonate, along with other sodium minerals, so that the law has been fulfilled insofar as their preference rights are concerned, only insofar as the sodium minerals, but these sodium beds are inner layered in some places with the oil shale so that we would have to foresee in any mining process, should it be granted, that the sodium minerals would be extracted while at the same time keeping the public interest fully covered insofar as the rich oil shale is concerned.

The sodium permittees if ever they did receive permit to extract would not be permitted to remove the oil rich oil shale.

Senator Moss. Are there quite a number of these claims that are still in litigation or where the Department is trying to determine whether they are valid or not, either for the oil shale, or associated minerals?

Dr. PECORA. You perhaps are referring, Mr. Chairman, to the location exercise that many prospectors use with respect to aluminum.

One of the sodium minerals occurring in the oil shale sequence is the mineral dawsonite, which is a sodium aluminum carbonate hydrated. An attempt was made by many prospectors to file claims under the 1872 mining law with the belief that aluminum was a metal and hence locatable.

On the other hand, the Solicitor, several Solicitors of our Department determined that this mineral was in fact a sodium mineral, and, therefore, not locatable and subject, therefore, to the leasing laws of the early 1920's. These claims have been reviewed and the Solicitor is attempting to remove them as an impediment to a proper leasing program.

Senator Moss. That is in process but hasn't been completed?

Dr. PECORA. That is right, as I understand it, Mr. Chairman, yes, sir.

Senator Moss. I would like to ask a question or two about this coal gasification prospect. In fact I have joined on a bill, as you know, to proceed on efforts of coal gasification.

The President's message states that industry agreed to provide \$10 million a year for coal gasification R. & D. What form does this agreement take? Are you familiar with that?

Dr. PECORA. We have not gotten into the actual format of the agreement yet, but basically the principle is this: The Department has its present program of about \$10 million in a coal gasification research program with pilot plant concepts and the President's message now increases this by \$20 million, of which \$10 million will be from the Federal side and \$10 million from the private side. We would need to develop a procedure which would be acceptable under existing laws, whereby, moneys expended in the pilot research area would be jointly funded on a 1-to-1 basis with the new money, but essentially 2-to-1 Federal-private in the program itself and each of the pilot plant areas under discussion, the funding for that area would be two-thirds Federal and one-third private. And the details of the working arrangement have yet to be made but the indication for the American gas industry is that they will come up with the money but part of the arrangement is that unless they do the Federal moneys would not be available.

Senator Moss. This would be a combined research effort then, not separate Government and private?

Dr. PECORA. That is exactly it. The industry and the Federal Government will join in putting funds into seven different varieties of pilot-plant research so as to make it possible within a few years to select the most amenable to a demonstration plant, and when that stage is reached industry will carry a larger share of the burden because then they are at the threshold of a demonstration plant which is commercially feasible.

Senator Moss. I see. Did you tell me that the Federal expenditure is now at the level of \$10 million and that what we are talking about is an additional \$10 million of Federal money?

Dr. PECORA. Yes; the President's message in a sense sets the stage for the supplemental request for an additional \$10 million on top of the existing \$10 million.

Senator Moss. How long has the Federal program been going on, the one to which we are committing \$10 million now?

Dr. PECORA. It has been in existence since the early 1960's. The year 1964 comes to my recollection. It is less than 10 years of effort in this research in coal gasification.

Senator Moss. Do you think then the addition of just \$10 million more is going to get us to this breakthrough point or would it be more realistic if we are putting in \$500 million?

Dr. PECORA. At our present state we believe that the \$30-million program over the next 3 years should get us to that point of selecting the best combination of techniques to put into a demonstration plant and the big money cost will be in that demonstration plant.

We believe that we are on the threshold of making this kind of a judgment if we could have a few years more to work it out with these various research places.

Senator Moss. I apologize, I got started on a list of questions and I want to give my colleagues an opportunity to ask questions. I may want to come back again. I would like to call on my colleague, Senator Randolph, chairman of the Public Works Committee, under whom I served for about 8 years. We are certainly delighted that you are able to sit with us and participate. Senator Randolph has been responsible for legislation to develop a fuels policy in this country and has been a leader in that area.

We particularly want to have his questions, any questions that you have, Senator Randolph, or any statement you care to make.

Senator RANDOLPH. Thank you very much, Mr. Chairman.

I am appreciative that I have been privileged to sit with the members of the Interior and Insular Affairs Committee during this significant hearing.

I have realized that you members of the committee have the prior claim in this matter, even though I originally sponsored the study resolution. The study, the setting of the guidelines, the goals to be attained must come through the careful attention which you Mr, Chairman, and Chairman Jackson and all members of this committee would give to this important mission. So, during the proceedings today, I have waited until this more appropriate time when I might make a brief statement and inquire of the able witnesses concerning some matters which I believe need clarification.

I reiterate what I said this morning: It is wise procedure to hold this hearing on the President's clean energy message to the Congress, which had very fine purpose. Even though I was critical in saying that it left much to be answered, I nevertheless feel that the message pinpointed many, many areas which have my commendations.

I will not repeat what I said about the President's message except to indicate that I believe we must expand on the assertions that are made in it. We will need additional information as we proceed. And, as I have indicated, I believe there are certain deficiencies in the message to which I will make reference.

One of these would be the relationship between energy and the national productivity. We know that for the past several years the annual energy consumption in our country has grown at a faster pace than has the productivity.

Is that so, Dr. McCracken?

Mr. McCracken. Yes; the evidence being that the B.t.u.'s of energy consumed per unit of output since 1966 have been rising.

Senator RANDOLPH. I remember your reference to that earlier today, at least in an aside.

Now, if we agreed on this point, we are faced then with the need for increasing amounts of energy. Is this not true?

Mr. McCracken. You mean for economic productivity generally?

Senator RANDOLPH. That is correct.

Mr. McCracken. Yes, I think this is proper.

Senator RANDOLPH. And, therefore, isn't it impossible, Dr. McCracken, to forecast the energy requirements of this country even on a short-term basis?

Mr. McCracken. It certainly is not possible in any pinpointed way and I do think a part of our strategy has to be allowed for certain amount of uncertainty.

Senator RANDOLPH. I believe that we can agree that there has to be a continued economic growth. There are those persons who do not advocate continued growth in many segments of our society and our economy. But I believe generally that our people feel there should be growth. If we are to have this, we must meet the energy demand, especially for electric power. That is a problem, as we discussed earlier today, that becomes increasingly difficult. Now, the use of energy throughout the American economy must be evaluated more precisely so that the trend toward economically inefficient use of energy can be reversed.

The lack of correlation between energy consumption and productivity in the past couple of years indicates that it might be not only possible but desirable to decrease energy consumption without adversely affecting productivity.

If, on the other hand, an increasingly larger share of energy is being used for personal convenience—it was mentioned here today that we are interested in a warm house in the winter and a cool house in the summer—rather than for increasing the standard of living, then this use should be and must be recognized so that necessary goals are not compromised by a lack of energy.

I think we must consider how much of the national fuels demand should be supplied from foreign sources, both on a regional basis and, of course, on a national basis.

While it is desirable to supply energy at the lowest possible consumer prices consistent with environmental quality requirements, it can, however, be potentially harmful if we develop an unbalanced dependence on foreign fuels.

An example that was discussed in part today: The trend is toward more and more reliance on foreign residual oil for electric powerplants on the east coast.

Severe problems, I say, might be created for the future by this increasing dependence on foreign sources, considering the vagaries of producer-country policies and the increasing yield of residual oil from the domestic refineries.

Senator Hanson referred to this specifically—to a situation in Algiers.

More and more of the national generating capacity is moving in this direction. It is possible that imports from Canada would relieve our fuel supply problems. But as I understand it, Doctor, that would be only a short-term solution; it would be on a very short-term basis; we could rely upon our neighbors to the north for this relief. And so I believe that all of us can agree, at least in part, we have to examine the desirability, in fact, the need, that there be a power grid that would cover the entire North American continent.

A third consideration is whether or not we should establish a specific fuel mix for various energy purposes—an end-use policy. Prior to the consideration of such a policy, there would be a defining of the mix of energy sources and uses, to the extent possible. For instance, an electrified mass transit system to effectuate reduced reliance on individual motor vehicle, electrical power as opposed to fossil fuels for space heating, and so on. Such a definition perhaps would enhance resource development plans, as well as the research and development programs needed to stimulate a better utilization of all resources.

The current practices of using fossil fuels on a full steam ahead basis could lead to depletion of the total supply—I say it could lead—thus denying certain fuels to processes in which they can best be utilized.

I think this is a matter of concern.

A fourth element is the desirability and/or the feasibility of maintaining and continually improving the efficiency of our energy conservation process. Until recently the trend in power generation has been an increasing efficiency in fuel use.

In the case of oil- and coal-fired steam electric plants, the efficiency remaining is essentially constant. This results from a combination of fuel pricing, plant efficiencies, and, of course, the richness of the fuel itself.

A specific instance of decreasing efficiency in fuel use is seen in the decreasing ratio of transportation miles driven per unit of fuel. Improvements in the energy-conversion efficiency trends could be achieved through technological controls or administrative controls and incentives—probably a combination of the two.

A fifth concern would detail the required procedures and practices for the orderly development of indigenous potential or undiscovered resources, and we heard this emphasized today by Senator Hansen.

Geological surveys indicate that vast quantities of fossil fuels remain to be discovered and can eventually be made commercially available to varying costs. An indication of the ability to meet long-term requirements is the reserve-to-production ratio. For petroleum and natural gas, this ratio has been generally declining due to both increased demand and decreased additions to the proved reserve. It would be imprudent to allow this ratio to become too low. To maintain long-term industry and consumer stability, it is apparent that the annual reserve additions must grow. Potential administrative technological procedures must be developed properly to improve the discovery and recovery of natural resources.

We also must address ourselves to the distribution of future population increases, especially with respect to local requirements for all types of energy. The whole question of people and energy—with all its ramifications (per capita consumption, personal safety, mobility, security, dependence on energy, and so forth)—should be discussed in the light of land use, mass transit, and powerplant location policies.

Future population locations, if allowed to develop unguided, could result in ever-expanding patterns of concentration in certain areas. The increased demand for energy in all segments of our economy in such a situation would place unwarranted burdens on all fuel and energy sources, primarily on their transportation and locations.

Now I have just touched six of these elements. I think they have to be considered, Mr. Chairman, by this committee in recommending national policy, and they are not complete. They are, perhaps, only imperfect expressions, but they are indicative of the level of discussions that must be opened before specific development efforts proceed, such as those mentioned so very well in the President's message.

If the Nation continues as at present, inept policy eventually will be forced on us in the form of a series of uncoordinated programs, which I think we have too much of today.

I am concerned about the funding. The President's message sets forth certain increases in funds for fiscal year 1972 for a series of research and development programs. It is not clear to me, and I am sure

it will be unclear to others, how these funds are related to the recent authorizations and expenditures. Therefore, I am interested in the potential contributions, and I am not clear on this matter.

The following table listing increases in requested funds should be appropriately completed in order to fully understand their thrust:

Program	President's mentioned increases in fiscal year 1972 (millions)	What were the actual expenditures in fiscal year 1971?	What were the actual expenditures in fiscal year 1970?
Sulfur oxide control technology.....	\$15		
Nuclear breeder reactor.....	27		
Controlled fusion research.....	2		
Nuclear reactor safety.....	3		

Additionally, the message lists fiscal year 1972 budget levels for other programs. Again, it must be determined how these levels compare to recent expenditures. These programs are listed below:

Program	Request for fiscal year 1972 (millions)	Actual expenditures fiscal year 1971?	Actual expenditures fiscal year 1970?
Coal gasification.....	\$20		
Coal mine health and safety.....	30		

The message further lists development programs that are either on-going or will soon be implemented. It would be very valuable to know their recent levels of expenditures, as well as to have some idea of planned future expenditures. These programs are listed below:

Program	Actually spent fiscal year—		Planned for fiscal year—		
	1970	1971	1972	1973	1972-76 (cumulative)
Coal liquefaction.....					
MHD power cycles.....					
Underground electric transmission.....					
Advanced reactor concepts.....					
Solar energy.....					

In order to fully assess the efficacy of the proposed energy programs, the omissions in the above three tables should be completed with the most accurate information that can be determined. Who will supply it?

Senator RANDOLPH. We note the President's recommended increases in fiscal 1972 for sulphur oxide control technology research and development amounting to \$15 million.

What were the actual expenditures in fiscal 1971 and the actual expenditures in fiscal 1970? He is talking about increases, you remember. That is why I am asking what were the amounts, the funding in those 2 years. If he talks about increases, I think we have a right to know what has been spent.

Mr. McCracken. Could I supply that information?

Senator RANDOLPH. Yes, at a later time.

Senator Moss. Supply it for the record.

Senator RANDOLPH. And we would like facts relating to nuclear breeder reactor expenditures, noting as we do the increases for fiscal 1972, set at \$27 million by the President. I would like to know also from what points those increases are made above fiscal year 1970 and fiscal year 1971 expenditures.

The message lists fiscal year 1972 budget levels for other programs. It must be determined how these levels compare to the recent expenditures. I think this is highly important. Let's take coal gasification. The request for fiscal 1972 is \$20 million. What were the actual expenditures in 1971 and in 1970?

Coal mine health and safety, \$30 million requested for 1972. What was expended in 1971 and 1970.

The message, Dr. McCracken, further lists development programs that are either ongoing or are soon to be implemented. I think it would be helpful and valuable to know their recent levels of expenditures as well as to have some idea of planned future expenditures. I have listed in this category coal liquefaction, MHD power cycles, underground electric transmission, advanced reactor concepts, solar energy. Who will supply that information I am not sure, but it can be supplied and I know, Dr. McCracken, you will want to see that it is supplied.

Dr. McCracken. I will be very glad to do that.

(The information requested by Senator Randolph and supplied by the Administration follows:)

NOTE.—Numbers show outlays only for agencies with major programs in the areas. Examples of outlays not included are:

Sulfur oxide control—Bureau of Mines, Office of Coal Research.
MHD: NSF, NASA.

Also, the numbers in the first column in parts I and II are sometimes BA and sometimes outlays, as has been noted. Other numbers are outlays only.

TABLE I
[Dollars in millions]

	Increase mentioned in fiscal year 1972	President's February budget for 1972 (outlays)	Estimated expenditures in fiscal year 1972 (outlays)	Expenditures in fiscal year 1970 (outlays)
Sulfur oxide control technology—EPA (budget authority).....	\$15	\$20	\$14	\$8
Nuclear breeder reactor—AEC (outlays).....	27			
(a) Mainline R. & D.	(17)	103	85	86
(b) General reactor technology.....	(6)	29	31	32
(c) Nuclear safety.....	(4)	11	8	8
(d) Demonstration plant.....		10	4	2
(e) Plant and capital equipment.....		58	37	17
Controlled fusion research—AEC (outlays).....	2	30	30	30
Non-LMFBR related nuclear safety including plant and capital equipment (outlays).....	3	26	29	30

TABLE II
[In millions of dollars]

	Request for fiscal year 1972 (budget authority)	President's February budget for 1972 (outlays)	Actual expenditures fiscal year 1971 (outlays)	Actual expenditures fiscal year 1970 (outlays)
Coal gasification (OCR-Interior).....	20	10	8	6
Coal mine health and safety (mines-Interior).....	30	27	8	3

TABLE III.—OUTLAYS

[In thousands of dollars]

	Actually spent fiscal year 1970	Actually spent fiscal year 1971	President's budget planned for fiscal year 1972
Coal liquefaction office of coal resources.....	8,854	6,915	7,705
MHD power cycles.....	3	175	1,025
Underground electric transmission (Interior).....	0	27	1,000
Advanced reactor concepts (AEC).....	26,000	35,000	34,000
(a) Advance converter.....	(20,000)	(29,000)	(28,000)
(b) Gas cooled fus and breeder reactor.....	(1,000)	(1,000)	(1,000)
(c) Molten salt breeder reactor.....	(5,000)	(5,000)	(5,000)
Solar Energy:			
NASA.....	5,064	2,894	1,479
NSF.....	50	100	1,000

Senator RANDOLPH. Mr. Chairman, now I would like to say that perhaps the most important element missing in the message is that of oil imports from nations other than Canada. Without a complete discussion of this and lacking a fuller understanding of import relationship with all of the elements now in the future, I think there is a lack, Dr. McCracken, of cohesiveness to the message. I am not otherwise downgrading the message, but I think cohesion is very, very important. In an effort to conserve time, I would like to have included in the record my comments concerning the effectiveness of the program and a time analysis.

Senator MOSS. That may be included in full in the record.

Senator RANDOLPH. And there are questions, I think they are searching questions—friendly questions, Dr. McCracken—which I would like to ask this afternoon but I shall place these questions with the Chairman for answering. I want to accommodate the progress of the hearing. These questions will be available to those who might want to see them.

Senator MOSS. Would you like to submit them and ask Dr. McCracken to respond in writing and then to put his answers in the record?

Senator RANDOLPH. Yes; I would, Mr. Chairman, if that would be agreeable.

Mr. MCCracken. We will be very glad to do so.

(The answers by Mr. McCracken to Senator Randolph's questions follows:)

THE CHAIRMAN OF THE
COUNCIL OF ECONOMIC ADVISERS,
Washington, D.C., August 11, 1971.

HON. JENNINGS RANDOLPH,
U.S. Senate,
Washington, D.C.

DEAR SENATOR RANDOLPH: I have answered in this letter the questions you submitted to me in writing after the energy hearings of the Senate Committee on Interior and Insular Affairs. I hope the answers are of assistance to you.

Question: Has any consideration been given to the establishment of an energy mix towards which the individual energy sources would aim? For example, should the economy pursue a direction towards "all-electric" sources of energy as opposed to some electric-fossil fuel combination?

Answer: The "energy mix" of the future will depend upon the relative costs of energy sources and the particular demands that arise. To choose a particular mix now and attempt to enforce it in the future would be a mistake. Neither government nor industry can anticipate fully the future costs of and demands for particular resources.

Question: Has any consideration been given to the establishment of a fuel mix for consumer use? For example, could fossil fuels be used only for power generation in an all-electric economy or should each fuel seek its own consumers on a price-competitive basis?

Answer: Again, because there will always be considerable uncertainty, the flexibility of having each resource compete with others in satisfying consumer demands is required.

Question: Are the relative environmental costs of each element well enough established to enable us to select the proper sequence of development programs? Are all the environmental impacts—good and bad—known for a large-scale coal gasification program, including those associated with a dramatic increase in coal requirements?

Answer: The environmental costs of alternative energy sources are not perfectly known. Indeed, costs differ from place to place, and the Nation may put a different value on the environment in the future than it does now. In the light of these uncertainties we will continue to examine each environmental cost and create an incentive for this cost to be avoided. This is, for example, what the President's sulfur oxide tax and lead tax attempt to do.

As each new coal mine is opened to meet the demands of coal gasification it will be treated just as any other mine based on the standards then prevailing. The impact of a coal gasification plant itself will not be known until we have a better idea of just what type of plant will be selected for commercial production.

Question: Federal support for the development of gas-supplied fuel cells is not included in the message. Does this imply that no support will be given to it?

Answer: Currently there is no fuel cell development program for civilian application. There is an industry effort being carried on by Pratt and Whitney with support from some public utilities. On page 6 of the President's message it is stated that his Science Adviser has been asked to review technological opportunities in the energy field and recommend development support where desirable. The fuel cell will be included in this review.

Question: Are we sufficiently assured that the nuclear safety questions will be satisfactorily answered so as to allow the proposed breeder reactor program to proceed as scheduled?

Answer: The objective facts of the nuclear safety question can be determined reasonably well, but whether that will result in a political resolution in favor of the breeder reactor we cannot be certain. We believe the facts support the program strongly.

Question: What contingencies have been considered in the event that the fast breeder demonstration is late by 1, 5, or 10 years?

Answer: In the event of a delay in the breeder demonstration program other power sources would have to be used. The key question is whether a delay would be recognized soon enough to construct alternative power sources. Industry and government will be alert to this problem to insure that recognition occurs sufficiently early.

Question: Has there been sufficient analysis to determine what components of national productivity are contributing more or less to the faster rate of growth of energy consumption?

—To what extent do advertising and marketing procedures and the philosophy of "more is better" result in non-productive uses of energy?

—To what extent would it be desirable or possible to curtail non-productive (i.e. convenience or status) uses of energy in order to improve the availability of fuels for more productive uses (i.e. for increasing standard-of-living)?

—To what extent would it be possible or desirable to reduce, through technological or other means, the energy requirements of individual consumer goods, such as home appliances and individual-use electrical gadgets?

—How can we ever be able to successfully plan for resource availability (considering development, production and transmission) without having valid forecasts of the demand for these resources?

Answer: The rate of growth of energy consumption has exceeded that of GNP in the last four years and thus the ratio of energy consumption to GNP has reversed its downward trend. A number of factors have contributed to the increase in the energy-GNP ratio in the past few years. Electric power consumption, which is growing faster than the economy as a whole, has been exerting an upward force on the ratio that has become larger as the absolute size of the electric power sector grows. This effect had been counteracted since World War II by a rapid increase in the efficiency with which fuels were converted to electric power, but this efficiency improvement began leveling off in the early 1960's. During the

mid-60's efficiency was virtually constant and in 1968 actually began to decline. Also GNP growth was slowing down by the end of the decade and pauses in GNP growth have historically meant an increase in the energy-GNP ratio. Another important factor is the accelerated growth of non-energy uses of energy fuels, such as petrochemicals feedstocks.

The question of "non-productive" uses of energy is a tricky one. What exactly does one mean by "non-productive"? Electric can-openers open cans, electric tooth brushes brush teeth; and electric knives cut meat. Yet some would regard these as "non-productive." Such uses of energy are a negligible factor in total consumption and government restrictions on their use would raise serious questions about individual rights. Government should devote its attention to the more crucial energy problems.

Even though we cannot forecast future energy demand accurately, we do have a range within which demand is likely to fall. As time passes that range narrows. Energy companies will, of course, allow for errors in forecasts by building excess capacity. Actually the situation is not much different from most other industries where future demand is also uncertain and excess capacity is usually developed. Given the importance of the energy sector, however, the government will have to watch developments more closely.

Sincerely,

PAUL W. McCRACKEN.

Senator RANDOLPH. One further sidebar: I was privileged to have the responsibility of cosponsoring with Senator O'Mahoney of Wyoming in the middle 1940's the Synthetic Liquid Fuels Act. He was a Senator and I was serving in the House at that time. I trust that you will draw on those many, many hearings that we had across the country, including, of course, the problems of oil shale in the Rocky Mountain States and other areas of the country.

The work in those days was under the impact, of course, of the crisis condition of our supplies during the war.

I am sorry that we have waited so long to arrive at a time when we will make an all-out frontal attack on the crisis in fuels and energy, keeping in mind the environmental factors and the quality of life which Americans have a right to expect as they conserve and as they use the energy resources of this country.

Senator Moss. Thank you, Senator Randolph. That was a very fine statement and your questions will be submitted to Dr. McCracken and he or whoever else is qualified to get together the answer will supply it in writing and we will place it in the record.

Senator RANDOLPH. I do want to add this, perhaps unimportant observation, but there must be no partisanship in this job we are to do. This is too serious a matter for our country to allow any considerations with even the slightest tinge of partisanship to be injected or to intervene. This must be a job, a very thorough job, and, Dr. McCracken and your associates, we must prove it by what we do and not by what we say. We will be doing less than our job if we don't do it in an objective manner.

I trust the Congress and administration will not allow the matter to deteriorate in any sense because this is a great challenge to a real job of legislative and administrative statesmanship.

Mr. McCRACKEN. Yes, sir.

Senator RANDOLPH. The President's proposed energy program combines technological efforts and administrative procedures. I have attempted to determine how long it will take for each element to start to exert a significant effect on the overall fuels and energy

problem. These time estimates are admittedly approximate but they are primarily based on available information related to the expected performance of each element.

This analysis indicates that the total realistically significant effects will be felt in 5 to 15 years from now but closer to the end of this period. The program elements that will have significant impact within the next 5 years include:

a. Incentives for industry to search for new sources of natural gas; and stepped-up coal gasification; and,

b. Facilitating imports of natural and liquefied gas from Canada and other nations; and,

c. Improving trade in crude oil with Canada.

The success of these elements is very much dependent upon the amounts of fuels that are available, both immediately and later, assuming that these elements are to be continuous. What is lacking is a good estimate of the additional amounts of these fuels to be made available from these elements as opposed to continuing current practices.

A further gross omission in the message is the interrelationship, in time, of the individual elements. For example, what will be the impact on the coal gasification program priority if incentives and increased imports of natural gas do make large quantities of less-expensive gas available? Conversely, what will happen if the gasification program results in large quantities of gas at prices competitive with domestic natural sources and imports?

TIME ANALYSIS OF THE PRESIDENT'S ENERGY MESSAGE

Item	Period of years from now when specific item will have significant effect			
	0-5	5-15	15-30	More than 30
Sulfur oxide control technology.....		X		
Nuclear breeder reactor.....			X	
Coal gasification.....		X		
Coal mine health and safety.....	(1)			
Controlled fusion research.....				X
Coal liquefaction.....		X		
MHD power cycle.....		X		
Underground electric transmission.....	(1)			
Nuclear reactor safety.....	(1)			
Advanced reactor concepts.....		X		
Solar energy.....				X
Outer-shell leasing.....		X		
Oilshale.....		X		
Geothermal energy.....		X		
Natural gas supply:				
Accelerated leasing.....		X		
Gasification demo.....		X		
Incentives.....	X			
Imports.....	X			
Nuclear stimulation.....			X	
Imports from Canada.....	X			
Timely supplies of nuclear fuels.....		X		
Energy conservation:				
Increased efficiency.....	X			
Environmental pricing.....			Indeterminate	
Building insulation.....		X		
Consumer advice.....			Indeterminate	
Developing measures.....			Indeterminate	
Powerplant siting.....		X		
Sulfur oxide emission charge.....		X		
Reorganization.....			Indeterminate	

¹ Not available.

Senator Moss. Thank you very much, Senator Randolph. We appreciate your statement and we do appreciate your sitting with our committee.

Senator RANDOLPH. Thank you.

Senator Moss. And helping us as we try to make the record and determine policy that should be set for this country.

Mr. McCracken, the Evening Star last night had an editorial on the President's message on energy. The thrust of it, I think, is basically that it was an economic document rather than one directed more to the ecology and protection of the ecology while we supplied the energy.

I will read just the last sentence from the editorial. It talks about a contribution of \$100 million and says that that figure justifies quizzically raised eyebrows. "It seems ironic the Nation has spared nothing to unlearn the destructive power of the atom should be so casual about exploiting the atom potential for salvation."

(The editorial referred to follows:)

NIXON ON ENERGY

[From the Evening Star, Washington, D.C., June 14, 1971]

Only the devout Nixonphobes can avoid a twinge of sympathy for the President as he faces up to the growing threat of a national energy shortage. Until now, elected leaders have been able to enjoy the luxury of indifference. Mr. Nixon has the misfortune of being in the hot seat on the day the buck stops, when the looming problem of fuel shortages can no longer be filed away under future problems.

Compounding the President's difficulty is the fact that the day of reckoning on the energy supply has coincided with the dawn of environmental concern. Countering the ravening national appetite for more power is a growing awareness of the terrible cost in environmental degradation that is being exacted by the comforts, conveniences and necessities of modern civilization. A long-range national policy on energy could no longer be postponed. And it could be positively predicted that any such program would be damned by the economists, the ecologists or both.

Now the returns are in. The presidential message outlining a broad national policy to deal with the energy crisis has been presented to Congress. And the outcry is coming from the environmentalists.

They have a point. The energy message is primarily an economic message—reportedly the first of several the President intends to deliver setting forth long-term goals for the country's economic development. The environmentalists within the administration were represented on the committee that prepared the groundwork for the presidential recommendations. But no special talent for inter-lineal reading is required to discern that it was the economic advisers who carried the clout.

Not that environmental considerations were completely overlooked. Every suggestion for increasing the national energy output is accompanied by assurances that the method must, of course, meet environmental requirements. But despite the ecological litany, the emphasis is unmistakably on business as usual. Threatened shortages of oil are to be met by an increased use of oil resources, specifically in the environmentally hazardous areas of oil shale exploitation and offshore drilling. No mention is made of a need for national belt-tightening. No mention is made of lifting oil import quotas, beyond a proposal for the removal of restrictions on Canadian oil.

There can be no argument with the contention that immediate sources of energy must be tapped. But there is a disturbing implication in the message that, if a more efficient method of using fossil fuels can be found, the real problem will be solved. There may be, as the President says, enough energy in the oil shale deposits to meet our needs for the next 150 years. But that comforting knowledge must not be used to take the urgency out of the search for clean energy sources.

The message contains encouraging verbal support for research in clean energy. First, we are told, the breeder reactor must be developed. Then, at some unspecified date, we can look for the development of the unlimited and nonpolluting energy source: Controlled thermonuclear fusion. To finance these projects, and to carry on research in such areas as coal liquification, gasification, magnetohydrodynamics and solar energy, the message proposes a federal contribution of \$100 million.

That figure justifies a quizzically raised eyebrow. It seems ironic that the nation that spared nothing to unleash the destructive power of the atom should be so casual about exploiting the atom's potential for salvation.

It could be the ultimate irony.

Senator Moss. What comment do you have to make on the view that was expressed there by the Star in this editorial?

Dr. McCracken. Well, Mr. Chairman, I read that editorial myself last night with some interest. As an economist, I think I probably resisted the idea that injecting into this economic considerations was in some sense demeaning the operation. It seems to me that it has been very important for us to see the economic aspects of the kind of program that can be responsive to our energy needs. And in my own statement this morning I was reemphasizing the importance of certain aspects of that. But I do think that the message has laid out rather explicitly a balanced program which endeavors to find moneys or reconcile the Nation's very understandable concerns about environment with the economic aspects of the problems which we must take into account if we are to make progress on this.

The CHAIRMAN. Well, there seems to be a complaint in that we are devoting far too small amounts of money to the solving of pollution and environmental problems.

It is your position that adequate funding is called for in the message to make the kind of progress, the kind of breakthrough that we need to make to preserve environment while our delivery of energy goes up?

Mr. McCracken. Yes, sir; I do think that the message itself is balanced in that sense. The message calls for a greater degree of activity in research, too, so that we can learn how to burn cleanly our coal resources. It calls for research activity both in the gasification of coal and in the liquefaction of coal because these would be other possible routes to utilizing our coal cleanly.

There can always be differences of opinion at the margin as to whether at any point in time we should have a little more or a little less, but I do think this is a strong program that will enable us to move forward with both our energy concerns and our environmental concerns.

The CHAIRMAN. Perhaps I ought to direct this to Dr. Pecora. There are several bills now in the Congress that would ban strip mining because of its environmental effect.

How does one as a matter of policy evaluate the trade offs between surface and underground mining in view of the health and safety hazards to the miners underground and yet the environmental disturbance by the strip miner.

Dr. PECORA. Mr. Chairman, I think your question hits to the very heart of the whole problem. If we consider underground mining in contrast to surface, open pit strip mining, without a question of doubt the underground mining is the more hazardous to human life and safety. There are so many things that can go wrong underground. There are a great many more underground mines than there are surface mines, particularly in the coal industry.

It is my general recollection that about 25 percent of the coal mines are small family-type mines whereas the large strip operation is above the surface with mechanical equipment, it is capital intensive versus labor intensive, but, nevertheless, on the safety issue which you raised, surface mining is a safer operation than underground mining.

On the other hand, on the basis of efficiency in production, without a question of doubt open pit mining can operate more efficiently with lower grade materials because the costs are lower. So there is that aspect to consider in resource development.

Finally, one must admit that even in surface mining there are some wastes that can occur. A very thin seam, for example, may be passed through in order to get at a larger seam. So economics perhaps ought to be considered in this general formula.

But in general, if one anticipates the character of the engineering system of surface mining, one can predict the change or alteration of the landscape, one can plan and factor back to recover as much as possible of the original landscape and to reclaim and restore more so than was done several generations ago. And it would seem to me that one has to pass a judgment based on the individual deposit, how unique is it, is it subject to surface mining or is it subject to subsurface mining, and this is an engineering kind of analysis which must take in many more factors than in the past were taken in.

Senator Moss. Your position then is that each case has to stand on its own particular facts and you can't say we should to the surface side or go to the underground side?

Dr. PECORA. I would say in most cases each situation is considered on its own merits but on the point of view of economics and total rate of recovery, an open pit large surface operation is generally preferred for the purpose of getting out the resource in a shorter period of time which would permit backput into the restoration and reclamation concept. This is difficult to do underground. It is rather difficult to repair the underground galleries and drifts and tunnels so that eventually one must look forward to some surface subsidence if the underground operations are not too deep.

Senator Moss. On page 31 of Secretary Morton's statement he points out that small increases in the efficiency of recovering gas and oil from geologic formations could add significant amounts to our supplies of these fuels.

Have you any specific recommendations for increased research and development in this area?

Dr. PECORA. Of course the petroleum industry and the Bureau of Mines on the Government side both have addressed themselves to this recovery ratio. In our normal calculations of a given potential deposit of oil or gas one considers the total amount in place, the fluid in place in the spaces of the geological formation, and that which is normally recoverable through normal pressure reductions during the drilling and producing operation. So that basically man is leaving behind in the geologic reservoirs a large part of the very reserve he is attempting to bring forth.

Secondly methods of recovery have, therefore, been developed to help induce more fluid motion through these procedures of the reservoirs so that a higher and higher proportion of the fluid can be recovered. And it has been calculated by a number of people, and I am familiar with one by the Bureau of Mines of our Department, that a 1-percent increase in the percent recovery, that is, if a given reservoir through pressure reduction gives 20 percent up of what it has in oil, a 1-percent increase, 2 percent, for the whole U.S. production increase, 2 percent, for the whole U.S. production would be practically equivalent to a 1-year supply. Therefore, a great deal of effort by petroleum

reservoir engineers is being expended in methods of improving their secondary rating the depressurization of the reservoirs.

This is a very important part of our resource picture and the research that is going on is great both in industry and in Government.

Senator MOSS. Have you recommended increased research in this area?

Dr. PECORA. The President's message does not address itself to increasing the effort but to retain the effort that is going on at the present time.

Senator MOSS. You felt that there is a satisfactory effort being made at this time if it is continued?

Dr. PECORA. Much of the effort, of course, is in the private sector where the actual experience with producing fields has taken place and our engineers and geologists in the Department of the Interior are observing and working with some of these test places. But it would seem to me at this time, we could put more effort in the area, but industry itself, which is the primary beneficiary of the improvement campaign, is well aware of the program and is doing a great deal of work in the area.

Senator MOSS. The Secretary, on page 33 of his statement, points out the inadequacy of basic geologic information on uranium deposits. Are the Department's mapping efforts in the uranium districts being expanded?

Dr. PECORA. For many years the Atomic Energy Commission addressed geological survey to increase its activities in determining potential reserves of uranium and it was difficult for the geological survey to apportion more than a given amount of its total funds for general geologic exploration and mapping to this area of work.

In spite of the interests of the Atomic Energy Commission and our appropriations were such that a substantial part of the budget was put into this area, but this as in other areas could stand, of course, increased activity if resources were available.

Mr. RAMEY. I might mention the Atomic Energy Commission did supplement those funds, particularly in the 1950's when there was a national defense interest in acquiring uranium raw materials. In the last few years we have recommended that the level of effort, particularly on the public lands, be increased. This was considered by the Public Land Law Review Commission. But to date there has not been additional funding going into it.

Senator MOSS. And AEC is not supplementing that, any of the research at all.

Mr. RAMEY. No, sir.

Dr. PECORA. In a new Department of Natural Resources should this develop, sir?

Senator MOSS. We are working on it.

Dr. PECORA. It would be a very simple matter to take problems of this kind under one roof for overview and this would be an advantage of a grouping of various responsibilities in one major department.

Senator MOSS. Would the activities of the AEC be included in the new Department as visualized by the President, or would they remain outside?

Dr. PECORA. It is my understanding, and supplemented by remarks from my colleagues, that that portion of the energy resource, that is, uranium resource, would be undertaken by the Department of Natural Resources.

Senator Moss. Uranium resources would be within the Department of Natural Resources; is that your understanding?

Mr. RAMEY. That is correct.

Senator Moss. But R. & D. remains outside? How about that?

Mr. RAMEY. Yes, sir; in the field of nuclear power development and research and development generally, in the atomic energy field, this would remain with the Atomic Energy Commission. However, in the area of atomic power development, the overall planning and the budgeting would be accomplished in the new Department of Natural Resources.

The AEC staff and its laboratories would remain intact but they would have to get their money and overall planning through the new Department.

Senator Moss. Much of the Federal responsibility for energy is administered by the regulatory agencies. I was concerned that there are no recommendations in the energy message or in the reorganizational message concerning these regulatory agencies, for example, the Federal Power Commission.

Perhaps Dr. Pecora could respond as to why they are left out.

Dr. PECORA. It is my understanding, sir, that the role of the regulatory agencies was considered in the departmental reorganization plan but that no judgment or decision has yet been reached as to how to apportion them because so many of them go across the board, so we will have additional discussions on this in subsequent months, I am sure.

Senator Moss. I expressed myself before on it but the functions of air and water pollution control are left out of the natural resources and it seems to me they logically belong there. The fellow charged with the duty of supplying energy and exploiting our natural resources ought to also have the burden of pollution control. It is recommended that it be done in a way that preserves the environment.

Is there any logical reason for keeping out of natural resources the the environmental preservation function?

Dr. PECORA. Others perhaps can amend these remarks, sir, but it seems to me the setting of standards on the basis of health does not properly belong in the Department of Natural Resources. However, research on energy resource materials which enter the system and hence can contribute to the pollution of the environment can be carried on within the Department of Natural Resources and at the present time abundant work is going on in several bureaus within the Department of the Interior which I would consider to continue under the new purview.

Mr. RAMEY. Mr. Chairman, in the nuclear field, of course, the Atomic Energy Commission does license and regulate the nuclear power industry and also conducts extensive research and development on environmental effects of radiation. We have found this to be a very necessary relationship at this particular stage of development. Perhaps 10 or 20 years from now, when plants get more standardized and the need for close technical liaison between those who are developing the reactors and those who are regulating it isn't as important, they might be separated.

Senator Moss. Dr. McCracken, in view of the growing concern about the concentration of ownership of energy in this country, there seems to me to be a conspicuous absence of any mention of the problem

in the President's message. The FTC is undertaking a study of this but it would have been useful to have some mention of the magnitude of the problem and what might be done about it.

Can you tell me what measures will be taken to assure that carrying out the President's energy package will not result in further concentration of economic strength among the major companies and in the several parts of the energy industry.

Mr. McCracken. The program that is laid out here does not, of course, envisage exonerating the companies from the normal overview of the antitrust division of the FTC. The presumption would be that those operations would be, that those agencies would be watching these operations as they do industry generally.

Senator Moss. But wouldn't it have been better to have some mention of this in the message because it seems to me we are having a considerable growth of such concentrations.

Mr. McCracken. One aspect of this about which questions have been raised has to do with the extent to which the ownership, say, of coal resources by oil companies may have a deterrent effect on the development of our coal resources. The last time I looked at these figures, which now has been some months ago, I believe it is correct that these so-called captive mines have been increasing their coal production at least as rapidly as the industry generally.

I would want to emphasize, however, that the consideration of antitrust and the importance of the preservation of competition are very important in this area as they are in the economy generally and the full force of Government is concerned with these things and will continue.

Senator Moss. Thank you.

Senator Hansen, you were asking some questions and we interrupted you. We will go back to you if you would like to complete your questioning.

Senator Hansen. Thank you very much, Mr. Chairman.

I think maybe a further response has already been made to the question that I posed just before lunch. I was concerned about some developments that seemed to me not always to indicate that we were going in the right direction. I spoke about the rise in cost of oil and gas in the Middle East, the increased taxes, an increasingly defiant attitude toward foreign investors over there. That sort of thing seemed to me to underscore the need for being certain that we have supplies adequate, first of all, to make certain that our national security is not in jeopardy.

Earlier this afternoon, I believe, you posed a question. I won't try to repeat it. But I think generally you said in addressing a question to General Lincoln, if it wouldn't be well to use imports, to use foreign sources of energy rather than to continue to use ours, to save our own, because we were dealing with the finite. And I think you implied a declining resource in this country.

If I could be permitted just one observation I would like to say this. There is no question at all but what we will be using increasing amounts of energy coming from foreign sources, in my judgment, as time goes on and I am not disturbed about that, I will be disturbed if we place sufficient reliance upon those foreign sources as to ignore our own very significant resources in this country and fail to make the search for oil and gas that does cost more money these days and

that can be encouraged only by giving greater incentive to the industry to go out and make this search. If we fail to do that, then I think we are headed for trouble, I think we are headed for trouble because there is nothing more dear than something that is owned by another person that we have to have.

The way to be sure that the best long-range interests of all Americans are protected in my judgment is to be certain, first of all, that we have within our own country, and available to us, our own oil and gas, without any question about the benign attitude of a foreign neighbor. This is the best guarantee we have that we will be in a position to bargain with foreign suppliers, and so long as we have a pretty good supply here it would seem to me, and I don't mean to imply I am saying anything that is contrary to your thinking, Mr. Chairman, but just in order that the record might disclose my feelings, I think this is important—that we go ahead with development now. A lot of people say we are just about out of oil and gas. I don't know whether we have talked about the Outer Continental Shelf, but within the continental limits of our own country the estimates made by the American Association of Petroleum Geologists is very significant, when you speak about 911 trillion cubic feet of gas and the rate, I think, is around 22 trillion cubic feet a year that we are using. We have got a pretty good supply, if we will go out and find it.

Now, I won't pursue that further except to say that in the horizon we have other sources. We already know about coal in my own State of Wyoming. It is estimated if we were to develop all of the known coal resources down to a certain level—I have forgotten what depth this would be—but not below a depth that would be beyond ability to produce, I am told that we have enough coal there to supply all of the energy needs of this country for the next 500 years, and maybe more than that. At least that is a very minimum.

We have got oil shale and then we have got uranium. My guess is that the best way to be assured that we have all of the energy supplies we need in this country to carry out the missions that I think are laudable is to be self-sufficient. We have been generous and we have been helpful in trying to develop the underdeveloped nations and we have been helpful in trying to bring about a degree of peace to the rest of the world. If we are to be successful in this continuing mission, the first thing we have got to be certain of is that we have adequate supplies of energy.

Three-fourths of all of our energy right now comes from gas and oil and more than 99 percent of all of our motive power comes from gas and oil. So while these other resources undoubtedly will be developed and I hope that we will get on with the job of coal gasification with the development of the techniques to convert coal into electrical energy by MHD, and if we get on with the development of our oil shale, I think that we can be certain that into the distant future there need be no shortage of energy. But, too, for a good many years, the United States will depend heavily on oil and gas.

Having said that I would like to ask Dr. McCracken what is your committee's evaluation of the contribution which nuclear stimulation techniques can be expected to make in helping meet our growing need for natural gas as a clean fuel?

Mr. McCracken. I think probably Commissioner Ramey might want to respond to that, he would be closer than I.

Mr. RAMEY. We believe that nuclear stimulation techniques, the Plowshare program as applied to the development of gas reserves, particularly in the area of Wyoming, Colorado, and down into New Mexico does offer an opportunity for increasing that gas reserve about a hundred percent. And we, as you know, have conducted a couple of rather successful underground test explosions on fracturing the rock. The last test is still being evaluated in terms of the results of the stimulation experiment, but we are quite optimistic. This has been carried on in cooperation with industrial participants and I believe they are also quite optimistic about it.

Senator HANSEN. If I understand you, Dr. Ramey, you said that you think that it could result in a doubling of the reserves that we now have?

Mr. RAMEY. Yes, sir.

Senator HANSEN. But I hope that the press won't miss the importance, the great importance of the statement you have just made, because when you talk about doubling our natural gas reserves in this country, you didn't speak about doubling them all over, but only in that area, and they are not insignificant there. It seems to me that is a very important statement that you have just made and I am quite impressed.

It is understood that further Government efforts will be required to develop devices suitable for such stimulation if its commercial potential is to be realized. Shouldn't this work have been included under research and development goals along with coal gasification and the fast breeder in your judgment, if you would care to comment?

Mr. RAMEY. Well, the Plowshare program was mentioned, I believe, in the energy message as an area to be encouraged. Probably the judgment was made that, since it is in a somewhat earlier research and development situation, certainly than the fast breeder and perhaps your gasification, additional expenditures at this stage would not be merited.

Certainly the levels at which this program is being conducted are quite modest, and our agency like all research and development agencies, you can always spend more money and do better in its research and development program. So I am sure we would have been happy to have had some more but in any kind of a message like this, they have to determine priorities and this was one that didn't get that high a priority.

Senator HANSEN. If I may, Mr. Chairman, I just want to make one observation. I think the eastern press has tried to make quite a point of the concentration of various energy resources in the hands impliedly of fewer and fewer people, fewer and fewer corporations. Let me say that outward there may be some reason to give credence to that implication, but for those persons who think that the last coal mine has been purchased and that there are no further coal resources available, I would like to give them the name of the Governor of Wyoming and the public land commissioner out there. We have coal high grade, I mean high grades in terms of low-sulfur coal running out of our ears. I was in southwestern Wyoming just last week at the dedication of the Jim Bridger Power Plant which will represent an investment in excess of \$300 million that is being built jointly by Idaho Power with two other companies. Our good friend from Idaho

is right here and he was spoken of by a number of persons from his State, along with Pacific Power & Light. I think it will be about a one and a half million kilowatt-hours generation installation that they are putting in there, and that not only our Wyoming State lands but the U.S. public lands as well are underlaid with tremendous coal resources. So I hope you will help me in telling people who think that the last sack of coal has been acquired by conglomerates, that is just not true, we have lots of it out there and if they want to make an investment it is available to them.

If I may, I would like to ask unanimous permission that there may be included in the record at this point some figures provided me by the American Association of Petroleum Geologists that sets out their estimate of the size of Alaska as compared with Russia. Alaska is roughly one-fifteenth the size of Russia. Proved and probable resources of oil in Alaska in the opinion of the AAPG is 20 billion barrels, which is 25 percent of the total proved U.S. reserves. There is estimated by them three times that amount in Alaska.

They estimate that we have 19 trillion cubic feet of gas in Alaska. Russia has in their opinion 30 times that amount. Proved-plus-probable-plus potential shows 150 billion barrels of oil in Alaska with seven times that much, 850 billion in Russia, 200 trillion cubic feet of gas, 20 times that amount in Russia. Then they speak of the Arctic Islands.

(The table referred to follows:)

DIFFERENCE BETWEEN ALASKA AND THE RUSSIAN POTENTIAL

Alaska	Russia
104,000 square miles-----	15 times (1,562,000 square miles)
<i>Proved plus probable:</i>	
20,000,000,000 barrels which includes (25 percent of total proved U.S. reserve) ..	3 times (66,000,000,000 barrels)
19,000,000,000,000 cubic feet-----	30 times (667,000,000,000,000 cubic feet)
<i>Proved plus probable plus potential:</i>	
150,000,000,000 barrels-	7 times (850,000,000,000 barrels)
200,000,000,000,000 cubic feet-----	25 times (5,000,000,000,000 cubic feet)

Arctic Islands:

No oil.

10,500,000,000,000, proved and probable.

10,000,000,000, proved and probable plus potential.

350,000 000,000,000 cubic feet, proved and probable plus potential.

Senator HANSEN. I would like to ask permission that the press release here taken from this morning's Washington Post, it is very short, let me read:

Moscow, June 14, UPI.—More than 6,500 miles of pipeline are under construction to carry oil to Europe and Asia from the Soviet Union's huge, untapped petroleum fields.

Soviet Oil minister Valentin D. Shashin, speaking to the eighth World Oil Congress at its opening session Sunday, hinted the Soviet Union could become one of the world's major suppliers of oil.

"There are vast areas of the Soviet Union not yet thoroughly explored or still lying untapped and whose combined oil and gas bearing areas cover some 7.4 million square miles—nearly half the total area of the Soviet Union," he said.

Just let me conclude, Mr. Chairman, by saying that if we will make the search for oil and gas that we can make, if we give the proper encouragement to industry, to private investors, I am certain that we will find in the long run this encouragement by Government will pay off very well for our citizens because it is the best way of assuring that the price of the important source of energy will be down, will be at a reasonable level, and if we want to make certain that we have to pay dearly for it, then I say all we have to do is to ignore our own potential in this country to place ever increasing dependency upon foreign supplies and we are going to pay through the nose. We have already seen what can happen in the Middle East.

Mr. Chairman, I ask that an exchange of correspondence which I had with Chairman Seaborg concerning nuclear gas stimulation be printed in the record at this point.

Senator Moss. Without objection, so ordered.

(The material referred to follows:)

U.S. ATOMIC ENERGY COMMISSION,
Washington, D.C., January 5, 1971.

CLIFFORD P. HANSEN,
U.S. Senate.

DEAR SENATOR HANSEN: Thank you for your letter of December 7, 1970 on the Plowshare nuclear gas stimulation program. The Commission also thinks that the nuclear gas stimulation program is one of the more promising means of increasing the nation's gas supply in the short term, and we appreciate your support and effort on its behalf.

I am enclosing answers to the questions raised in your letter. If we can provide additional information, please do not hesitate to ask. Again, let me thank you for your support.

Cordially,

GLENN T. SEABORG,
Chairman.

AEC ANSWERS TO QUESTIONS RAISED IN SENATOR HANSEN'S LETTER OF DECEMBER 7, 1970

1. I understand there is approximately 300 trillion cubic feet of natural gas potentially recoverable with nuclear explosions. In view of the current natural gas shortage, is there a possibility of speeding the development of the technology to meet the near term energy needs, say in five years?

Recognizing the impending shortage of natural gas, the Commission has been designing a program which if initiated in FY 1972 would permit the introduction of substantial quantities of nuclear stimulated gas into the pipelines by 1975. The program we are developing consists of four explosive development tests to develop a small diameter low tritium, temperature and shock resistant explosive suitable for nuclear stimulation, one multiple explosive basic effects experiment and five joint government-industry application experiments. These latter experiments would be aimed at (1) developing data on explosion effects—particularly the multiple explosion technology needed to maximize stimulation and minimize unwanted effects such as ground motion and radioactivity and (2) developing more efficient and hopefully lower cost fielding and safety operations and procedures. We believe that the proposed experiments and associated research can be conducted over a four year period at the end of which a sufficient number of the fields included in the Bureau of Mines 317 trillion cubic feet estimate of gas potentially available by nuclear stimulation could be developed. A chart outlining the four year program is attached. Because this is a research and development effort, considered to be the minimum program to achieve the objective, it must be recognized that there is some risk that unforeseen experimental results might necessitate additional work.

2. What would the cost for such a program be to develop nuclear explosion technology for natural gas stimulation to a point where it is possible to recover large quantities of gas and make them available for public use? What share of the cost would be borne by industry?

The program discussed in question one would cost approximately \$85 million over a four year period. We would expect that industry would fund the major part of the joint experiments included in the joint program as it did in Gasbuggy and Rulison and that the industrial concerns involved will continue their internal research and development effort, thereby accounting for about half of the costs of conducting the program. We believe that the AEC's statutory safety responsibilities, its unique capability in the areas of nuclear explosive design and basic phenomenology make it desirable for the government to continue to pay for these parts of the development program.

3. What is the current budget situation as far as AEC contributions to industry commitments to gas stimulation projects?

The FY 1971 Plowshare budget contains \$500,000 for joint government-industry projects, \$455,000 of which is committed for post shot work on Projects Rulison (\$445,000) and Gasbuggy (\$10,000). The remaining \$45,000 are undesignated funds currently available to respond to new industrial proposals for joint experiments.

Execution of joint industrial experiment, however, is but a part of the work which must be done. The major portion of the FY 1971 Plowshare budget is devoted to other gas stimulation program work needed to carry out the complete gas stimulation effort. Approximately \$5,500,000 is involved in this fiscal year, about evenly divided between work in an explosive design for the natural gas application; and a general research and development effort concerned largely with development of improved technical understanding of the nuclear explosion stimulation mechanisms, development of economical fielding systems, and gas stimulation experiment planning and analysis.

4. Is this potential Plowshare gas reserve on federal or private land and what is the estimated return to the Federal Treasury from attendant gas royalties?

Most of the gas resources included in the Bureau of Mines estimate are located on public land. It is estimated that the return to the Federal Treasury from attendant gas royalties would approach \$12 billion if all of this gas is recovered.

5. How many gas stimulation projects are now in the planning stage and what is the timetable?

Feasibility studies have been completed by the companies for three gas stimulation projects and the projects are currently in the project definition or planning stage. This stage consists of a program of investigation, evaluation and planning to determine the potential project's technical feasibility and safety, and whether the project offers the prospect of significantly enhancing the production of natural gas. The three are: (1) Project Rio Blanco with CER Geonuclear Corporation on leaseholdings owned by Equity Oil Company in Rio Blanco County, Colorado; (2) Project Wagon Wheel with El Paso Natural Gas Company located in Sublette County, Wyoming; and (3) Project WASP with a joint venture group of companies headed by Oil & Gas Futures Incorporated also located in Sublette County, Wyoming.

The project definition study for Rio Blanco is expected to be completed within six or seven months. At that time, environmental and other reviews should require perhaps another two or three months prior to acceptance by the government of the project definition report. Wagon Wheel is on a somewhat similar timetable but may run slightly behind Rio Blanco. WASP is somewhat more difficult to predict since a schedule there will be determined only after a second exploratory hole can be sited and drilled. Any WASP project would appear to be probably at least 18 months off.

6. Are other agencies of the federal government, such as the Department of the Interior, the Federal Power Commission, and the Office of Science and Technology, aware of the gas stimulation projects?

The Department of the Interior is an active participant in the gas stimulation program and one of the contractual sponsors of both Projects Gasbuggy and Rulison. The Commission has kept the Office of Science and Technology and the Federal Power Commission advised of the progress in the program and has sought their advice and assistance as appropriate. All of these have been consulted on the four year program described in the answer to question one.

7. Have you submitted the possibilities of gas stimulation projects to the White House Energy Study Commission now looking into U.S. energy needs for the next five years or to the Committee in the Department of the Interior which is also looking into long-term U.S. energy requirements?

In response to a request from the White House Energy Study Committee, the Commission has submitted for consideration the four year program discussed above. We have also provided data to Interior's energy study.

8. I understand that recovery of gas from oil shale may also be feasible from underground nuclear explosives. Are any oil shale tests in the planning stage?

The use of nuclear explosions to fracture underground deposits of oil shale for subsequent in-situ retorting has been studied for some time. While techniques for the production of gas from oil shale could probably be developed, most experts feel the shale oil would be more valuable and less costly in a liquid state. Several years ago, the AEC along with the Department of the Interior cooperated with a number of interested oil companies headed by CER Geonuclear Corporation in doing the Bronco feasibility study. Currently, no shale oil projects are in the planning stage. However, we are informed that CER has completed a feasibility study of the potential of developing by nuclear explosions leasehold interests belonging to the Western Oil Shale Corporation in the Uintah Mountains area of Northeastern Utah.

9. What proportion of the cost of the gas stimulation projects already conducted has industry borne and has any gas been sold from these tests?

To date industry has invested approximately \$30 million in the development of the nuclear gas stimulation technology (see chart below). Approximately \$12 million of this has been in support of the two joint government-industry experiments conducted to date, Projects Gasbuggy and Rulison. No gas has been sold from these experimental wells.

AEC ESTIMATES OF INDUSTRY INVESTMENT IN NUCLEAR GAS STIMULATION

[In thousands of dollars]

	Joint projects ¹	Preproject activities ²	R. & D. ³	Total
Fiscal year—				
1965			500	500
1966			1,000	1,000
1967	1,500	1,000	1,000	3,500
1968	1,000		1,500	2,500
1969	3,500	2,000	1,500	7,000
1970	3,000	4,500	2,000	9,500
1971	1,000	3,000	2,000	6,000
Total	10,000	10,500	9,500	30,000

¹ Based on negotiated Government-industry sharing arrangements for Projects Gasbuggy and Rulison.

² Estimate of exploratory drilling activities, etc., exclusive of project agreements. Estimates cover work on Gasbuggy, Rulison, WASP, and Wagon Wheel.

³ Estimate of funds required to support permanent staff to follow nuclear stimulation technology with key companies actively participating in program.

ATTACHMENT TO QUESTION 1

4-YEAR EXPERIMENTAL PROGRAM FOR NUCLEAR STIMULATION

	Fiscal year 1972	Fiscal year 1973	Fiscal year 1974	Fiscal year 1975	
Explosive tests	Test	Test	Test	Test	
Basic phenomenology experiment	Multiple explosive experiment				
Joint industrial projects	Simultaneous tangent chimney	Pilot experiment in cost reduction and sequential firing in gas field	Sequential tangent chimney deep	Pilot experiment sequential firing through barren region	Sequential tangent fractures deep
Total experiments (10)	3	3		3	1

DECEMBER 7, 1970.

HON. GLENN T. SEABORG,
Chairman, Atomic Energy Commission,
Washington, D.C.

DEAR MR. CHAIRMAN: May I express my sincere appreciation for the most excellent briefing your Mr. George Quinn, John Kelly, and other members of the Atomic Energy Commission staff conducted for the Senate Interior Committee last week at my request.

I am impressed with the great potential the Plowshare Program has, particularly the gas stimulation project.

I have addressed a letter to Dr. Paul W. McCracken, Chairman of the Council of Economic Advisers, expressing my interest in the Plowshare Program as a valuable source of both short and long-term energy and as a possible solution to the current gas shortage.

A copy of that letter is enclosed.

Since the briefing, a number of questions have occurred to me and I would appreciate it if you could give me the benefit of your answers or opinions to the following:

1. I understand there is approximately 300 trillion cubic feet of natural gas potentially recoverable with nuclear explosions. In view of the current natural gas shortage, is there a possibility of speeding the development of the technology to meet the near term energy needs, say in five years?

2. What would the cost for such a program be to develop nuclear explosion technology for natural gas stimulation to a point where it is possible to recover large quantities of gas and make them available for public use? What share of the cost would be borne by industry?

3. What is the current budget situation as far as AEC contributions to industry commitments to gas stimulation projects?

4. Is this potential Plowshare gas reserve on federal or private land and what is the estimated return to the federal Treasury from attendant gas royalties?

5. How many gas stimulation projects are now in the planning stage and what is the timetable?

6. Are other agencies of the Federal government, such as the Department of the Interior, the Federal Power Commission, and the Office of Science and Technology, aware of the gas stimulation projects?

7. Have you submitted the possibilities of gas stimulation projects to the White House Energy Study Committee now looking into U.S. energy needs for the next five years or to the Committee in the Department of the Interior which is also looking into long-term U.S. energy requirements?

8. I understand that recovery of gas from oil shale may also be feasible from underground nuclear explosives. Are any oil shale tests in the planning stage?

9. What proportion of the cost of the gas stimulation projects already conducted has industry borne and has any gas been sold from these tests?

Again may I thank you and the most capable team who represented you at the briefing.

With kind regards.

Sincerely,

CLIFFORD P. HANSEN,
U.S. Senate.

EL PASO NATURAL GAS CO.,
El Paso, Tex., April 15, 1971.

Capt. EDWARD J. BAUSER,
Executive Director, Joint Committee on Atomic Energy,
Capitol Building, Washington, D.C.

DEAR CAPTAIN BAUSER: I appreciate this opportunity to respond, on behalf of El Paso Natural Gas Company, to the supplemental questions posed in your letter of March 29, 1971. Those questions and my responses are set forth below.

1. *You suggested increased funding for the Plowshare program to permit Government assistance and participation in experiments "as proposed by industry." What level of funding do you feel would suffice to encourage more industry proposals and more industry participation?*

The minimum level of funding required to encourage more industry proposals and more industry participation in the Plowshare program should be such that Government research and development on underground engineering could be maintained at the Fiscal Year-1971 level plus sufficient additional funds to enable those specific projects being studied by industry and towards which industry is clearly making substantial expenditures to go forward without delays due to lack of Government funds.

The dollar amount budgeted for each project must be sufficient to cover explosive fabrication, transportation and detonation plus those independent site evaluations and review procedures which are necessary for the AEC to fulfill its public safety and environmental responsibilities. It is highly desirable, if not essential, that AEC have sufficient funds to enable its laboratory personnel to apply the most advanced techniques available to the task of predicting the nuclear effects of each experiment and to collect data beyond that required for the specific

project in order to further refine its unique predictive capabilities. In addition, some flexibility needs to be worked into the AEC's funding procedures so that the AEC could start to work on a project as soon as it has been proposed by industry even though funds for such project have not been budgeted for at the beginning of that particular Government fiscal year.

Twelve million dollars would be an appropriate amount to accomplish these objectives for Fiscal Year 1972. Such an amount would provide the money detailed in the response to Question 2 plus a reserve of one million dollars to initiate projects which may be proposed before Fiscal Year 1973 funds are requested and appropriated.

2. *There is \$200,000 in the AEC FY-'72 budget allocated for joint industrial projects—most likely Rio Blanco and Wagon Wheel. Do you feel that level of funding will permit you to meet your schedule of detonation early in FY-'73 (fall of 1972)? If not, what more would you wish to see programmed for the next year and how would you suggest it be utilized?*

The \$200,000 in the AEC FY-'72 budget allocated for joint industrial projects is not adequate to permit meeting El Paso Natural's proposed schedule leading to the Wagon Wheel sequential detonations early in FY-'73 (fall of 1972).

Work done pursuant to the Wagon Wheel Project Definition Agreement (executed December 24, 1968) has been such that the detailed planning and field preparation for Wagon Wheel are more advanced now than either Gasbuggy or Rulison were when the contracts to conduct those experiments were executed. The proposed schedule includes an additional fourteen months so that the AEC can develop the capability for sequential nuclear detonations in a single well and so that an environmental statement can be prepared in compliance with the requirements of the National Environmental Policy Act.

The National program set forth in Dr. May's testimony before the Committee on March 23, 1971, reveals that $3\frac{1}{2}$ million dollars for explosive R&D plus an explosive test and $1\frac{3}{4}$ million dollars for the explosive service for Rio Blanco and Wagon Wheel are required during FY-'72. It is El Paso Natural's understanding that if this $5\frac{1}{2}$ million dollars plus other items for a total of eleven million dollars is made available for Plowshare in October of this year, the explosive test required to perfect sequential firing may be possible in April or May of 1972. If that test is successful; explosive system preparation for the five sequentially detonated explosives desired by El Paso Natural may permit the Wagon Wheel detonations to take place in the spring of 1973.

It appears that the only possibility for executing the Wagon Wheel experiment early in FY-'73 (fall of 1972) is for AEC to re-program one to two million dollars this fiscal year. These funds would permit development of sequential firing to commence before the FY-'72 appropriation. The FY-'72 appropriation would then have to include the remainder of the eleven million dollars set forth in Dr. May's testimony.

3. *If it would not reveal data you feel is of significant business confidence, can you advise us of the amount of El Paso's financial investment in Plowshare to date?*

El Paso Natural's method of accounting has not been designed to break out all costs associated with Plowshare. However, a reasonable approximation to that total is developed below:

Gasbuggy: The estimate of \$2,269,000 which has previously been submitted to the Joint Committee on Atomic Energy by the Atomic Energy Commission is a reasonable estimate.

Wagon Wheel: As set forth in my response to the question by Representative Price on March 23, 1971, El Paso Natural spent approximately \$8.3 million in the Pinedale Unit. \$4.4 million was for eight wells in the Unit and associated research which lead to the decision to evaluate nuclear stimulation. The remaining \$3.9 million has been spent for additional geologic studies, site evaluation studies, a 2500 foot water well, an exploratory well to 19,000 feet and prediction activities as a part of Wagon Wheel Project Definition.

Gas Storage: The search for a location suitable for constructing underground storage for natural gas through use of nuclear explosives, which was described in the paper Dr. Randolph presented to the AIEA Panel in January, 1971 has an estimated cost of 0.5 million dollars.

Total estimate: Adding the above estimates reveals that El Paso Natural's financial investment in Plowshare to date is approximately \$11,000,000.

4. *On page 5 of your statement you indicated that predicted levels of tritium in Wagon Wheel will be $\frac{1}{2}$ of the Gasbuggy event. What is that prediction based on and is the device upon which you are counting presently available from AEC?*

The prediction that the concentration of tritium in gas from Wagon Wheel will be $\frac{1}{2}$ of that observed in gas from Gasbuggy is based upon an unclassified statement from Lawrence Radiation Laboratory to the effect that the residual tritium from the five 100 kiloton nuclear explosives will be less than one gram. It is our impression that the device upon which we are counting is dependent upon favorable results from both Miniata and a future NTS test of a ruggedized explosive designed for sequential firing.

5. *You stated that the Pinedale Field should provide about 25 billion cubic feet of gas per well in a 20-year period.*

(a) *How many wells would be created in the Pinedale Field?*

Estimating the number of wells which will be created in the Pinedale Unit requires consideration of ground motion effects and the variation in reservoir properties with position. Approximately 25 wells could be stimulated in the manner proposed for Wagon Wheel in that portion of the Unit which has been demonstrated to be similar to the Wagon Wheel location in reservoir properties and with the ground motion constraints which are being applied to the Wagon Wheel experiment. If additional drilling reveals that the reservoir properties are similar out to the boundary of the Pinedale Unit, it may be possible to complete in excess of 100 wells with nuclear stimulation.

(b) *What would be the approximate schedule for development of that field and how many explosives do you estimate would be required?*

It is anticipated that approximately two years after the Wagon Wheel detonation will be required for production testing and data analysis to provide a definitive basis for the decision as to whether field development should be undertaken using nuclear stimulation. If the decision at that time is favorable, stimulation of 15 to 25 additional wells with four to five nuclear explosives per well will be desired during the next few years.

In hypothesizing development beyond this first increment of 15 to 25 wells, consideration must be given to the following factors:

1. Several hundred thousand acres in the vicinity of the Pinedale Unit may be suitable for developing gas production through use of nuclear stimulation.

2. The rate of development of a new industry in this sparsely developed portion of Wyoming will be influenced by:

- a. Government capability to supply the required nuclear explosives,
- b. Rate of development of a major drilling industry in the area,
- c. Rate of development of housing, schools, commercial services, etc. for a greatly expanded work force in the local area, and
- d. Availability of capital.

Consideration of these factors has resulted in the judgment that field development in the Pinedale Unit and surrounding area could proceed by stimulating 10 wells in 1976, 20 in 1977, and continuing to increase the number by 10 per year to a peak of 50 wells during a year in the first half of the 1980's. This peak rate of development would provide direct employment for 1500 to 2000 people. Assuming that three additional jobs are created in service industries and that each employed person supports two others, leads to a conclusion that during the early 1980's, field development and operation could support a local population in the vicinity of 15 to 20 thousand people—several times the present population of the northern portion of the Green River Basin—and involve investment at a rate of about 200 million dollars per year.

6. *On page 7 of your statement you pointed to a "significant contribution" in meeting gas needs by the end of the decade if commercial technology is available in 5 years. Could you be a bit more precise in your estimate of the amount of gas you feel might be available in this manner?*

Three areas in the Western United States are being subjected to detailed evaluation for gas production with nuclear stimulation at the present time. A rough estimate of the amount of gas that might be made available by nuclear stimulation can be derived by assuming that: (1) two of these areas are developed starting in 1976; (2) studies not yet initiated result in similar development of two additional areas with a time delay of three years; and (3) these areas each have an average ultimate potential of 250 wells. These assumptions lead to the conclusion that gas produced from the Western United States following nuclear stimulation could approach one trillion cubic feet per year or a few percent of the national supply before 1985.

7. (a) *Does El Paso Natural Gas Company look at Plowshare and gas stimulation as a long-term proposition or one which will provide say a 10 or 15 year stopgap before we run out of natural gas altogether?*

(b) *If we buy a ten-year supply of gas, is the investment in Plowshare worth the effort and cost?*

Numerous authoritative forecasts have revealed that the United States is now entering into an energy deficient era. Forecasts extending through 1985 clearly indicate that fulfilling national energy requirements in a manner consistent with air and water pollution standards will require increased reliance upon import of fossil fuels from foreign sources. Forecasts extending beyond 1985 are less definitive due to the difficulty in forecasting the potential of major break throughs such as gasification of coal or creating a viable oil shale industry.

The one thousand wells hypothesized in the response to Question 6 would result in producing about one trillion cubic feet of natural gas per year in 1985. The energy content of that quantity of natural gas is approximately equal to the one-third of the combined output of all hydroelectric dams in the United States, and therefore would obviously represent a "significant contribution" toward meeting the national demand for clean energy.

It is anticipated that means of supplying the national demand for energy from domestic sources which will be adopted during the 1980's will involve a cost of about one dollar per million BTU and have an environmental impact at least as significant as nuclear stimulation. Thus, the monetary value of one trillion cubic feet of additional natural gas in the 1980's is anticipated to be approximately one billion dollars. The associated annual revenue to the Federal and State Governments through royalties and taxes may be in excess of one hundred million dollars—more than the Government investment required for the research and development to perfect the technology.

El Paso Natural regards Plowshare results to date and these observations as adequate to justify the modest investment on behalf of Government and industry which is required to accomplish the time scale for experiments which have been proposed by companies who have made substantial investments in natural gas reservoir stimulation research.

I apologize to the Committee for not being responsive to this question as phrased. However, it is essential that we recognize that the voracious appetite of the United States for energy combined with enhanced concern for the environment has reached the point where a high degree of success in all domestic programs to increase energy supply will not supply the demand during the next few decades. I am confident that as the public becomes more aware of the relative environmental consequences of various sources of energy and the magnitude of the energy shortage facing the Nation, Plowshare will be regarded as an excellent investment.

I again express my appreciation for the privilege of appearing before the Joint Committee on Atomic Energy and responding to the supplemental questions relating to the AEC's Plowshare program on behalf of the El Paso Natural Gas Company. Please do not hesitate to call upon me at any time.

Sincerely yours,

SAM SMITH.

Senator HANSEN. Thank you, Mr. Chairman.

Senator MOSS. Thank you very much, Senator Hansen. With regard to this discussion about nuclear stimulation for gas, the President mentioned it in the message but I notice that the request for fiscal 1972 for this purpose has been dropped to \$5 million from \$7½ million in the current fiscal year.

Is there any reason for that? Isn't that inconsistent with his calling for further experimentation with this nuclear stimulation?

Mr. RAMEY. Mr. Chairman, I think the purpose of the level for fiscal 1972 is to permit further evaluation in the planning of an experiment on gas stimulation for fiscal 1973. It did represent a little bit of a pushing back of the development. Of course, you make your decisions on your budgetary program way back almost 1 year before you finally come in with your requests, and, finally, in this case with the President's message on energy. So our plans are too that we would hope to go for another Plowshare program experiment in fiscal 1973 in the gas stimulation area.

Senator MOSS. Do you think \$5 million will be enough to permit you to have a field project?

Mr. RAMEY. To do the adequate planning and evaluation of the Rulison test and to be ready to try to work something out again it will have to be a cooperative project with industry.

Senator MOSS. Dr. Pecora, with reference to the Department of Interior figures on national reserves of oil and gas, where do you obtain your data?

Dr. PECORA. Mr. Chairman, from several sources. I must say that, of course, the most direct source of information is from industry itself. Fortunately many of our engineers and geologists by reason of their supervision of activities on the public lands require the information to be made available to the Federal Government on a confidential basis and under the law this information is proprietary and may not be released to a third party.

Coupled with that direct observation and acquisition of drilling and reserve information on the lands we supervise, other sources of information such as acquired by ourselves through our field surveys, enable our geologists to make resource potential calculations based on geologic terrain, geologic history, geologic configuration. So I would say the Department of Interior needs to develop some basis for figures for use of the Executive and the Congress but that we are in a stage now, sir, of acquiring more direct information through the appropriation procedure. Both the Senate Overview Committee and House Overview Committee recognized that both of the Appropriation Committees have been favorably disposed in recent years in permitting more funds for the acquisition of information directly by the Federal employees, particularly over the last 2 or 3 years in acquiring seismic information through group shoots or through information in the field done under contract by our own researchers. So that the information we are getting has more recognition of a direct observation rather than acquiring information from industry itself if I may underscore the validity of this program, members of our committee would be very pleased to hear of some results of the last Outer Continental Shelf sale held in west Louisiana, December last year.

You may recall that there had been a moratorium of about 2 years for wildcat general sales and the sale in last December has been giving us some results which I will report to you now.

I should state first that the information which led to the geological survey to recommend certain tracts for this west Louisiana sale were based first on a premise that we wanted to have a high potential for gas because a potential gas, and second high competition. In the last sale held by the Bureau of Land Management, 116 tracts were put out and the highest bids totaled \$846 million. Apart from that income into the Treasury, here is the record thus far. Fifty wells, 50 exploration wells have been drilled on 28 of these 116 tracts and the record results are astounding. Twenty-three discoveries have now been added to our energy resources reserve picture. There are 13 gas fields, three oil fields, six combined gas and oil fields, and the extension of one oil field. But of significant importance is the fact that three of the gas fields are major gas fields.

Now, it should be borne in mind, of course, only the juicy tracts are drilled first by the knowledgeable winners of those leases and only five of these 28 tracts have yielded, have come up dry thus far. And

we have 75 percent more of the tracts to be reported on over the next couple of years. But this will underscore some of the comments that have been made at this hearing thus far, Mr. Chairman.

First, the leadtime has not been as great as we had anticipated. If there is a shortage, an incentive, the companies having won those bids will get in there and drill. Second, the results are coming on in timely fashion, not only in the recovery, not only in the estimate of potential reserves that can yet be produced, but the economic support that is going on in that region. These discoveries thus far, in only 6 months since the sale have brought about an infusion of about \$10 million into the economy of the Gulf of Mexico, particularly in the west Louisiana area. These funds will probably cause a direct employment of about 1,000 people. They will result in production platforms to be constructed, pipelines to be constructed, transportation services by air and by boat, so that in addition in responding to the energy resource needs, this sale has proved very important in bolstering the economy of this region, all the time under the environmental assessment surveillance that we have given it and I believe that if this program continues in the accelerated fashion as suggested by the President and announced by Secretary Morton this morning that the same kind of record can be achieved in the subsequent 5 years because the Federal Government is receiving funds to make its own increase and information gathering systems to assist it in putting out those tracts for lease which have the highest potential.

Senator Moss. I express my appreciation for that summary. We had discussed this in an earlier hearing when the sale was authorized. I am glad to hear such good results from the drilling there.

The Senator from Oklahoma, Senator Bellmon.

Senator BELLMON. Thank you, Mr. Chairman.

President Nixon's energy message, June 4, properly took note of the fact that this Nation must be willing to invest money in broadening its energy supply base to avoid even greater energy supply shortage in the coming years. But, however, in light of our current crisis I fail to understand why this administration, like those before it, continues to skirt the immediate problems of meeting our national energy needs when clearly these problems have brought us to the brink of crisis?

I want to say I realize fully the crisis we face was not created by the decisions of this administration but rather by decisions of past administrations and also by some action by Congress which have made investments in the oil and gas industry and other traditional energy sources rather unattractive.

I want to congratulate the President and the administration for taking the initiative of sending this energy message to the Congress. It has gone certainly much further than any previous administration in recognizing the critical problems we face in seeking a long-range solution.

I feel if the Government had shown the same kind of vision 10 or 20 years ago we probably wouldn't face the brownouts and other evidence of shortage of energy which we see now. But at the same time, Mr. Chairman, I am afraid that this administration is making some of the same kind of mistakes that past administrations have made because nowhere in the President's message can I find any real encouragement for the domestic energy industry.

The President has asked this Nation to invest millions of dollars in resources for new energy sources but I would like to ask Mr. Pecora why the administration has not made the country aware of the need for investment to bolster the development of traditional resources upon which we presently depend for 75 percent of our energy needs?

Dr. PECORA. Senator, it is my opinion that the message does move in that direction.

Senator BELLMON. Can you find the language?

Dr. PECORA. Yes; perhaps the language has not been as straightforward as I read the message, but I consider it a well-conceived effort to emphasize the need of our conventional fuels to hold us up while we are playing catchup ball with the whole energy picture.

Senator BELLMON. How does the President propose in this message to encourage the traditional energy industry to play catchup ball? There is nothing in here about any upward adjustment of price; there is no mention in here of increased research funds for secondary recovery. He does mention allowing more activity on the offshore areas, but in your opinion is that going to be enough?

Dr. PECORA. I don't think any one part of this program will be enough to catch up in this ball game. We will have to be on top of it continually. But it seems to me, if I may, sir, on the more positive side, to determine that the Outer Continental Shelf should be opened up on an accelerated basis is meeting the requirements not only of our program for accelerated exploration and discovery but also meets with the requirements of the industry itself that wishes to develop its future reserve in oil and gas.

The opening up of public lands not only in oil shale but in geothermal energy, largely through the interest of the Congress itself, is a wedge opening up into the future for immediate action.

I believe there are some positive aspects of this program, sir, which are addressing themselves to conventional areas which are going to hold up this country while the nonconventional will be developed to the demonstration stage.

Senator BELLMON. Realistically, how important will geothermal energy sources be, say, within the next 10 years?

Dr. PECORA. From the point of view of electrical development, I don't think they are going to be a substantial factor in the national picture. Locally, yes; but from the point of view of supplying in addition to electricity, supplying hot water or heat, which will save electricity in many areas, I think it can be a more important factor than just development of electricity.

Senator BELLMON. According to your information, Mr. Pecora, what percentage of this Nation's energy requirements will be met by oil and gas in 1980?

Dr. PECORA. The Secretary had some figures in his message on this point. I recall that at the present time the oil and gas at the present time occupies a position of about—I have got the numbers here—you were speaking of total energy, were you not?

Senator BELLMON. Yes.

Dr. PECORA. I am sure we have the numbers but we can break them down as the Secretary read them to you this morning.

Senator BELLMON. Will it be dramatically different from our present division of energy sources?

Dr. PECORA. Yes; I believe that in spite of the increase of conventional and quasi-conventional areas, oil gas and oil shale, that the great demands projected over the next 15-30 years will require a substantial additional source of energy, and this is what we are looking to toward the breeder reactor. Our percentage relationship, as I recall the table in the Secretary's statement, that petroleum at the present time makes up 43 percent of our energy resources and in the year 2000 will only make up 34 percent, but, nevertheless, of a larger amount. So it will still be an important part of the picture.

Senator BELLMON. I believe you are mistaken. At the present time I believe petroleum makes up over three-quarters of our total energy.

Dr. PECORA. Oil and gas make up about 78 percent. Oil by itself makes up 43 percent and the balance would be gas, and to make the figure complete, the gas makes up 32.8 percent at the present time.

Senator BELLMON. Oil and gas together amount to about three-quarters?

Dr. PECORA. Yes, sir.

Senator BELLMON. Do you expect that to be much different than in the year 1980?

Dr. PECORA. Expect that to be 60 percent or less. About the year 1980 I would imagine that would be between 60 and 70 percent, so with increased energy requirements oil and gas still will play a major role over the next 15 years.

Senator BELLMON. These new sources that the President mentions, the fast breeder reactor and gas from coal, synthetic gas from coal, what will be the cost of energy from those sources as compared to energy from traditional sources?

Dr. PECORA. I wouldn't have any opinion to the price structure but presently about 83 percent of our electric power at the present time, referring only to electric power, is generated by the burning of fossil fuels, and we would expect that this by the year 2000 would drop to about 33 percent. But these changes, I think, are only predicted in a general trend rather than by absolute terms.

Senator BELLMON. Well, now, Mr. Secretary, the criticism that has been leveled at the traditional energy industry in the country has been that their prices are too high. If you remember, the Areta Commission pointed out that this country could save \$5 billion a year by importing its petroleum needs from the Middle East and now the President comes to us and says we are going to invest money in the fast breeder reactor and coal gasification and get clean energy. He doesn't say anything about the cost of this kind of energy.

What is this cost likely to be?

Dr. PECORA. The total cost I think ought to be taken up by another member of the panel.

Mr. RAMEY. I think the fast breeder will be expected to become commercially competitive with coal, oil, and gas in the mid-1980's, and it is our belief that it will be somewhat cheaper, but not a lot cheaper than those other energy resources. Traditionally, or economically speaking, the capital cost of building a nuclear powerplant is higher than a fossil-fired plant. The cost of fuel, of nuclear fuel, and particularly for a fast breeder plant, would be substantially cheaper and the unit cost of energy from such a plant then, combining and particularly for a fast breeder plant, would be substantially

cheaper and the unit cost of energy from such a plant then, combining both the capital and the operating costs, as I say, would be a little bit cheaper, we believe.

Senator BELLMON. Cheaper than present costs of energy from fossil sources?

Mr. RAMEY. Be cheaper than the projected costs of coal, oil, and gas in that period.

Senator BELLMON. What are you projecting the cost of the oil and gas to be in this?

Mr. RAMEY. I don't have those figures. I can provide them to you for the record.

(The data referred to follows:)

PROJECTED COSTS FOR COAL, GAS AND OIL

Due to the many new factors and variables which have recently been introduced into the pricing of fossil fuels, estimates on projected coal, oil, and gas prices are not available from a single authentic source. In arriving at the estimates quoted in the following paragraphs, members of the Commission staff have obtained input from other Government Agencies including the Department of the Interior and the Federal Power Commission, as well as from a number of industry people and expert consultants in the field.

In 1970 coal prices in the United States averaged about \$7.30/ton (31 cents per million BTU) delivered to the purchasing utility. In addition to fuel, capital and other expenditures exert a strong influence on the cost of electricity. Any capital and other outlays required for mine safety, restoration of stripmines, sulfur removal equipment and other environmental measures would also increase the cost of producing electricity from coal. It is estimated that the overall price for delivered coal for the production of electricity will increase over one-third by 1985; in 1970 dollars, average prices for such coal are estimated to be about \$11/ton or 47 cents per million BTU.

Utility gas prices in 1970 averaged 27 cents per million BTU. The FPC controls the price of gas and has recently been allowing modest price increases. Although the actual consumption of gas will remain somewhat constant until 1990, it will constitute a continuously decreasing fraction of utility fuel in the future. It is estimated that gas prices will double by 1985. In 1970 dollars, average gas prices will be an estimated 55 cents per million BTU.

The average price of residual oil burned in power plants before 1970 was about \$1.80 per barrel (30 cents per million BTU). The average price of this oil in 1970 rose to approximately \$2.10 per barrel (36 cents per million BTU) largely due to the use of the more expensive low sulfur oils needed to meet air quality requirements. Although the future price of oil will be subject to many relatively unpredictable influences, it is estimated that the price of oil to the utility industry will increase by one-half by 1985. In 1970 dollars, average oil prices will be an estimated \$3 per barrel (50 cents per million BTU).

Senator BELLMON. The reason I follow this line of questioning is that if my information is correct, the Federal Power Commission presently allows, the highest price that they allow natural gas to be sold at is 26 cents per thousand, but the British right now, who rely on coal gas for 14 percent of their total gas supply, are paying 22.7 cents per therm of coal gas, which is only equivalent of 210 cubic feet. In other words, they are paying just about five times as much for their energy from coal gas as we are paying for natural gas, and here the President asks us now to spend a lot of money to gasify coal. He doesn't tell the people of this country this is going to cost them five times as much based on the British experience as they are paying now for natural gas.

Dr. PECORA. I think you are quite right in the direction of your information because our independent information from the coal gasification area leads us to believe that these pilot plants if they are

successful in yielding a demonstration plant producing pipeline gas from coal would be in the range of 60 to 80 cents per thousand cubic feet. This is public information.

Senator BELLMON. If we were to allow the price of natural gas to go up to 60 cents a thousand, which is where we hope to get the coal gas, how much additional supply would this country be able to furnish of natural gas?

Dr. PECORA. I wouldn't be able to answer in a quantitative sense how much more would be brought out but I could answer very affirmatively there would be a strong incentive to find more gas, more natural gas to build up his reserves supply. At the present time the current price in natural gas is acceptable from the gas on hand but I have been led to believe by a number of statements both in magazines and in the press and in public statements from representatives of industry that the present price doesn't encourage going out to seek a new supply because of the risk that is involved. And I do believe that the purpose of the 5-year accelerated offshore program is to determine whether or not substantial quantities of natural gas can be found under the existing incentives for bidding and producing and selling of gas.

Senator BELLMON. Do you feel if our own regulatory agencies were to take a more realistic route in pricing of natural gas that they would have need for the emphasis the President places on coal gasification?

Dr. PECORA. I think the need is there anyway, Senator, because natural gas is more finite and the problem of finding it and transporting it from deep waters always will be present.

It appears to me that because of the finite character of natural gas in the future and great abundance of coal as a fossil fuel, that the setting a stage for a transformation of coal to pipeline gas is a rather prudent insurance that we might be taking. But insofar as price is concerned, Senator, I beg you, I must transfer that question to one of the other members of the panel. But incentive is the important thing.

It seems to me what the President's message is doing in itself, first, I consider well conceived plan, is to concentrate in the immediate future on our conventional fuels of oil and gas, considering the quasi-conventional oil shale coal gasification, getting ready for a future situation.

Senator BELLMON. Let me interrupt at this point. How does the President's message show that it is the intention of this administration and this Government to concentrate on the traditional sources of energy? I can't find anything in here that encourages me, if I were in the oil business, to drill a single oil well. There is no mention of any higher prices nor of any guarantee that we won't flood this country with relatively cheaper energy from the Middle East.

Dr. PECORA. I must confess that the message does not go into the other subjects that you have brought up, Senator, but the fact that the message does emphasize that the public lands will be opened up at an accelerated rate for industry to seek and to discovery, I think, is a very important part of the entire program.

Senator BELLMON. What about the reserves that exist in other areas than the offshore or on public lands? I would imagine, without knowing, most of these reserves are not located on public lands.

Dr. PECORA. Yes; I think you may recall an earlier report to your committee, Senator, where we calculated about 50 percent of the resources, not reserves, of the resources of coal and natural gas are on the

public land, and an equal amount on private land, but we felt a greater proportion of uranium and oil shale were on public lands. And it is only in that, in that context do I think that the opening up of the public land is important.

Mr. McCracken. Senator, could I make a comment on this? There are two or three aspects of your question which I might comment on. But on page 8 of the President's message where he alludes to the natural gas issue, the third point there alludes to Federal efforts to augment the available supplies of natural gas. Recent actions by the Federal Power Commission providing greater incentive for industry to increase its search for new sources of natural gas and to commit its discoveries to the interstate market.

This is alluding to the issue of the artificially low price at the well-head which has the effect of both discouraging competition and also of leading to certain use of gas which might more appropriately have been handled in other ways.

Senator BELLMON. Dr. McCracken, this action by the Federal Power Commission applies only to new gas?

Mr. McCracken. Yes, sir.

Senator BELLMON. It does nothing to help give the companies the economic incentive they need to really get out and develop our apparently abundant but untapped gas reserves in this country.

I can't see that the Federal Power Commission has ever done anything that would encourage the industry or enable industry to meet their responsibility.

Mr. McCracken. Well, the wording of the part of the report which I just read, of course, alludes to the recent actions of the Federal Power Commission. It would, of course, not be appropriate to intrude into the responsibilities of the FPC except I have commented here on the general question of price in relationship to the gas issue.

I believe the Federal Power Commission now does have an open rule on which this issue is being considered.

Mr. BENNETT. It is my understanding the Commission does have under advisement both for the Permian Basin and for other areas generally the possibility of reopening the outstanding adjudication setting the prices for some of the older fields. They may or may not do it but for the purpose of a Presidential message, Senator Bellmon, you are in a very delicate area if you expect the President to suddenly say now the Federal Power Commission, an independent agency of the Congress, if you will, you should raise the price of gas.

Senator BELLMON. Do you feel the President—

Mr. BENNETT. Dr. McCracken, on the other hand, in his Commission, in their annual report, filed last February, I believe it was, specifically pointed out the economic reasons why gas should be priced on a competitive basis with other fuel, and, of course, a lot of us have been making speeches in this regard but it is another thing for the President of the United States to set out and say the Federal Power Commission, you do thus and so, because it is an independent agency.

Senator BELLMON. Mr. Bennett, have you ever seen an oilwell drilled with speeches?

Mr. BENNETT. No, sir.

Senator BELLMON. My point is there is nothing this administration has done now except this business of adjusting upward the price of new gas that gives any encouragement to the traditional energy

industries. The last thing the President did on this was to criticize the industry very sharply when there was a 7-percent increase in the price of crude oil. And there has been nothing so far as I know up to this point that he raises this very bitter taste that the industry has so far as this administration is concerned. It was the Retter report that criticized the industry for gouging the American people to the tune of \$5 billion a year and the President came along and rapped them on the knuckles for raising the price 25 cents a barrel, and there has been nothing done by the President and a lot of us were hoping when this message came out he would give some indication that he realizes that we have a crisis and that the only answer on the short term is to encourage the domestic energy industry to move ahead with the development of new supplies from traditional sources, and to me this is the disappointing thing about this message.

Dr. McCracken. Senator, I don't think it is quite correct that the message does nothing to try to augment the supply of fuel.

Senator BELLMON. Can you point out what it does? That is what I am looking for. I have read this message with great interest.

Dr. McCracken. Yes, I think there are several actions. For example, the acceleration of oil and gas leases is one action which apparently according to the Under Secretary were already in the threshold of getting supplies because of this action.

Senator BELLMON. This was done before the President's speech.

Dr. McCracken. Well, this has been a part of our energy program and many of these programs here, to be reasonably successful in such matters as learning how to burn coal cleanly, or in the various other research activities. These will all have the effect of augmenting supplies or relaxing the constraints on supplies in order so the supplies can more adequately serve our needs.

Now even on the price question, there is one allusion in the report here to the recent actions of the FPC which will provide some additional encouragement in regard to gas. But I think it is correct that report does not deal with measures to try to augment supplies.

Senator BELLMON. Maybe those two very slight mentions satisfy you, I hope they satisfy the industry, but I am a little concerned that they won't.

Mr. McCracken. Could I make one further comment?

I think the report here does point out here on page 6 that the reason this accelerated leasing is so important is so large a proportion of the Nation's remaining—I am reading from page 6 again—over half of our Nation's remaining oil and gas resources, as about 40 percent of our coal and uranium and about 80 percent of our oil shale and some 60 percent of our geothermal energy sources, are now located on Federal land, and that is why I have emphasized the actions that were taken in this area.

Senator BELLMON. Dr. McCracken, I want to ask you another question. If the information I get is accurate, none of the things we are doing now or things that we are likely to do will make it possible, that is, if we keep prices at roughly the present level, none of these things are going to make it possible for the traditional energy to meet the increasing demands and we are probably going to become increasingly dependent upon foreign sources for particularly our crude oil. Do you agree with this generally?

Mr. McCracken. Well, I would like to, I want to make two comments about that.

In my statement this morning I did conclude with the emphasis on more analysis about the interrelationships of supply and demand and price. I think this is an area that does require further analysis and in that sense I would wholly support the view that we need to bring price more explicitly into our thinking here.

Now, I don't think there is any question but what the foreign imports and foreign oil are going to be increasing in the years ahead.

Senator BELLMON. Then I would like to ask you or perhaps the representative of General Lincoln at what level do you feel the security of this country will be threatened by reliance upon oil from insecure foreign sources? Can we get by at 20 percent? We are roughly at 25 percent. At what point do we endanger this Nation's security?

Mr. BENNETT. No real effort has been made to quantify that peril point, if you wish to put it that way.

As you know, only some 3 percent, for example, of our crude oil imports have been coming from the Middle East or the Eastern Hemisphere areas as we rate as being least secure. A great deal will depend naturally on how much more we can expect from secured sources like Canada and Venezuela.

I don't think anyone has ever set an actual arithmetical peril point, but I think we all recognize that there is one and the oil policy committee, I can assure you, every meeting practically is looking at the policy which happens to be before it, or action at that particular time with the approach as to what it might or might not mean in terms of reaching a peril point.

I think some of these estimates that you heard about this morning where it was predicted that we might even get up to 50 percent reliance on Middle East sources, would mean that we were definitely at or beyond the peril point.

This might be my personal opinion but I think the majority of those on the oil policy committee would consider that to be beyond the peril point and we certainly hope that we don't reach that degree of dependence, and I think that as an integral part of the oil import program the oil policy committee and the departments that make it up will all have in mind taking those actions which appear reasonable and feasible to prevent reaching that point.

Senator BELLMON. The reason I raise the question is that every year since I have been involved with government our demand for petroleum goes up and every year our reserves go down and every year our reliance upon imported oil and now natural gas increases. And I am a little surprised to hear you say that you have never really established a level at which you feel the Nation's security will be jeopardized.

Mr. BENNETT. Our imports from those sources deemed to be insecure sources have never reached anywhere near peril point of magnitude, Senator Bellmon. Most of our imports are coming from Venezuela as well as Canada. That is where they are coming from. Only a small percentage comes from elsewhere.

Senator BELLMON. Do you feel you can really call oil from Venezuela a secure source, or from Canada?

Mr. BENNETT. I think you had better talk to the State Department on that score. I wouldn't want—

Senator BELLMON. I think their opinion—

Mr. BENNETT (continuing). To judge otherwise. And I know and you do, too, that the President of Venezuela was here not too long

ago and conferred with President Nixon and I certainly wasn't privy to their conversations and I doubt very much the United States, the administration today, would classify Venezuela as an insecure source.

Mr. FREEMAN. I think the record shows in each emergency that has come up Venezuela has proved to be a very secure source of oil and if you look at the fact that we have reasons to rely on the imports from the Western Hemisphere as being secure imports.

Senator BELLMON. I think you will also find a lot of those tankers went to the bottom of the sea during World War II and I doubt very much if the oil did us very much good.

Mr. FREEMAN. Some of those tankers were coming from Texas to New York.

Senator BELLMON. That is true. We also get a lot of oil in pipelines.

Let me ask Dr. Ramey a question. The promise of nuclear energy, I think most of us agree, is significantly behind schedule. If my information is correct, in 1962 the Atomic Energy Commission estimated by 1970 total electrical energy produced by atomic power would be 43 billion kilowatt-hours. In 1970 only 19 billion kilowatt-hours was actually produced from atomic sources. Clearly our nuclear energy specialists have been too optimistic in the past in their projections and I am curious if anything has changed now so that we can feel that the projections that apparently lay behind the President's message are going to be any more accurate?

Mr. RAMEY. Senator, I don't have that particular figure that you have there. We do know that in 1962 the Commission did make some estimates in its report to President Kennedy, in terms of the future of the atomic power program. The estimates for 1970, as I recall them, were quite low, only one or two percent of the total electric power requirements of the country.

Another interesting figure that the Commission made that I do know was the estimate for 1980 looking to the commercial application of nuclear power. We made an estimate of around 40 million kilowatts of power to be in operation in 1980, and this would have been 10 percent of the total capacity of the country.

And then along in 1965-66, there began to be a surge of orders by the utilities for light water nuclear powerplants. We started looking at our estimates and realized that they were too low, and we came up with an estimate of around between 130 million kilowatts and 170 million kilowatts with 150 as sort of the median. And although in this very early period of around 1970-71, there have been some delays on specific plants, we believe this 150-million-kilowatt figure is still going to be met.

This year, for example, there have been, as I recall, 14 plants ordered already and our estimate was for this year that approximately 20 would be ordered all year. The industry, I believe, figures there will be somewhere near 25 to 30 plants ordered this year.

So we don't believe that the Atomic Energy Commission, the utilities or the Federal Power Commission, have been overly optimistic as to what the nuclear industry would do in the 1970's and especially 1980 or 1990.

The amount of power that we estimate for 1980, as I mentioned, would be around 25 percent of the total electric capacity. The year 1990 might be 45 percent. Again though, the amount of power produced by coal and oil and gas fired plants, of course, would increase tremendously

in total volume by reason of the very large increase in demand, but it is true that nuclear power will be producing a much larger proportion.

Now, I think where people got the idea, that of over optimism occurred in the mid-1960's at the time of the large surge of orders by the electric equipment companies. In 1966-67, for example, about 50 percent of the total capacity ordered in those years was nuclear and people then, not the Commission and not the utility industry, but others looking at this may have thought it was going to continue in that proportion.

We said based on our experience with the utility buying, that annual total orders goes up and down and the mix goes up and down. And so the proportion of nuclear orders has gone down some and, as I say, it is coming up some now. But we believe the estimates have been pretty good over the years.

Senator BELLMON. Well, I am glad to have that information. It makes me a little more confident that we may be able to come out of the energy crisis we are in, although I am of the opinion we are going to have to rely on our traditional sources for the next couple of decades.

Mr. RAMEY. We believe also, because, as I say, by 1990 of the total electric energy produced, more than 50 percent will be produced by fossil plants. One of the important things about the President's message is that it covers all sources of energy, and it tries to encourage the newer ones but it also takes into account the conventional ones.

Senator BELLMON. Dr. Pecora, there is one other question I would like to ask of you. Information that I have had shows that there is probably at least 100 billion barrels of oil remaining in these zones where we have already recovered some oil and a great deal of this oil could be recovered if we undertook to develop new technology for secondary recovery.

As I was coming in you were testifying on this and I missed part of what you said, but apparently it is the position of the administration and Department of the Interior this kind of research ought to be done by the individual companies. Is this true?

Dr. PECORA. Some work in this area is being done by reservoir engineers both of the Bureau of Mines and Geological Survey, Senator. However, much greater amount of work in research in the area has been done by companies themselves because they stand to benefit, therefore, they have been very much interested in progressing in the area of research.

Senator BELLMON. To me there is a problem here because the information that a company gains with its own funds is certainly privileged information, it isn't made available to other companies. Is this generally true?

Dr. PECORA. In general it is true but there is an awful lot of trade-offs among companies in areas of general information. All of the information developed, of course, by the Department is available to the public at large.

Senator BELLMON. Do you feel the Department or the Federal Government is providing sufficient support for research and secondary recovery?

Dr. PECORA. I believe that the amount of work that is being done in my personal opinion can be increased; yes, can be increased with good results.

Senator BELLMON. Do you feel that these old zones offer some immediate hope for helping to solve the energy shortage that the country now faces?

Dr. PECORA. I am inclined to take the view, Senator, for many of the older horizons that it is too late to get back in where wells are in an inactively producing stage but in the senile stage it is not too late. I am inclined to think that had secondary recovery been a major effort several decades ago we would have had a better conservation practice. So we have got to think of the mature, senile, and juvenile wells and fields today to achieve this greater conservation return.

Senator BELLMON. The President's message as I read it makes no mention of figures in secondary recovery.

Dr. PECORA. It does not specifically mention it by topic but the program is continuing in the Department of the Interior.

Senator BELLMON. Is it in any way accelerating?

Dr. PECORA. Well, I don't think we can say there is any acceleration to that program in particular. I don't know the amount of funds that are expended. I would be very happy to introduce it into the record if you would permit me to.

Senator BELLMON. I believe it would be helpful to know that.

Senator Moss. That may be supplied.

(The information referred to follows:)

DEPARTMENT OF THE INTERIOR

SECONDARY RECOVERY OF PETROLEUM IN THE UNITED STATES

Using the best present technology, no more than one third of the oil present in domestic reservoirs is economically recoverable through the use of primary and secondary, or stimulative, methods of production.

Of the 400 billion barrels of oil discovered in the United States to date, about 100 billion barrels has been produced and consumed and about 200 billion barrels is classified as being unrecoverable. Of the remaining 100 billion barrels, 39 billion barrels constitute proved reserves (economically recoverable with existing technology). The remaining 61 billion barrels is believed to be physically, but not economically, recoverable with existing technology. This oil, and probably part of the 200 billion barrels now classed as unrecoverable, might be recovered by improving present methods of recovery.

An informal report by the American Petroleum Institute to the Bureau of Mines in 1965 estimated that about 6.6 percent of the petroleum industry's research expenditures went into secondary-recovery research. Current estimates are not available; however, if the percentage is valid today, the industry is spending about \$30 million annually on secondary-recovery research. Many of the results of that research are considered to be proprietary in nature by the major companies conducting the research and are not available to the industry at large, including thousands of small independent producers. The current research effort of the Department of the Interior amounts to about \$425,000 annually.

About 30 percent of the current domestic production is attributable to secondary-recovery methods, or to fluid injection. These methods include the injection of water, miscible fluids, polymers, emulsions, steam, and air in in-situ combustion projects. It is apparent that even small increases in the efficiency of recovery through stimulative techniques would add appreciably to increased production from known deposits, increases in proved reserves, and domestic self-sufficiency in petroleum supplies. Such increases are obtainable through technologic improvements resulting from an increased research effort on secondary-recovery techniques.

Senator BELLMON. Mr. Chairman, there is only one other question and then I would like to have this statement I have here made a part of the record. But it seems to me that the problem we have here is that the country has been led to feel that prices of energy from traditional sources, coal and gas and crude, are too high, and that the

administration or that the Government is making a mistake in not allowing energy to come in from foreign sources, and that rather than encouraging the domestic industry, the traditional and domestic industry to meet our needs, we should now turn away from them and turn to the direction of the exotic new energy sources that the President talked about in his message. And as I have tried to understand this since it seems to me even if we are able to succeed dramatically in the field, it will be at least 20 years before we can hope for a major impact on meeting the energy requirements from the reactor and coal gasification and geothermal sources and other possible new developments. And in the meantime we are going to have to rely upon the domestic industry, but the domestic industry, the traditional energy industry isn't probably going to be able to meet this new responsibility or greater responsibility unless they are given some relief in better prices.

Am I generally on target or not?

Dr. PECORA. You are making a lot of sense. Yes; I think basically this is the future we are looking to, that the costs for finding new deposits will increase, the costs for keeping the environment acceptable will increase. All of these costs have to be borne by someone and it has to be the consumer. So the trend is up, a positive direction as we look to the future.

Senator BELLMON. The price trend is up?

Dr. PECORA. The trend of cost to the consumer is on a positive slope into the future.

Senator BELLMON. I suppose that depends upon your viewpoint. You mean it is going to be getting higher?

Dr. PECORA. Yes, sir. What I am saying is the factors that have to be considered in any cost formula are increasing.

Senator BELLMON. Do you suppose, Dr. Pecora, if the oil and gas industry found it necessary to raise their prices again that they might do it without the President criticizing them or—

Dr. PECORA. Sir, I would have to abstain from a question like that. I wouldn't know what the reaction would be.

Senator BELLMON. Perhaps Dr. McCracken would have the answer.

Dr. PECORA. I am sorry to put my colleague on the spot.

Dr. McCRACKEN. Thank you. Well, I do want to comment on this further on this price question Senator Bellmon has raised and I want to emphasize again that I did conclude my own statement this morning by urging the committee, and it carries forward, explorations to do a thorough study of the interrelationships between the supply and demand and price for energy demands and supply.

Now, on this question of price of oil, there are, of course, cross currents, and there is a difference here between the relatively shortrun situation and the longer run. If the President in the message had taken the position that in the short run here and now oil prices should be higher, we would have to explain why that is true on the basis of the fact that allowables, for example, have been cut back. And I find myself frequently asked the question the other way, why should we be paying a relatively high price for domestic oil? General Lincoln in his analysis to which he alluded this morning made the same distinction here between what may be necessary for the longer run and what the immediate situation would seem to warrant.

Certainly the one thing we want to do is to take as many actions as we can to augment the supply of energy with as little increase in cost to the consumer, users of energy as possible. And that explains the heavy emphasis in the message on things that would relax the constraints on supply.

On the question as to whether if there were a rise in price would that be featured in the next inflation alert as it were in the Council of Economic Advisers, I would not want to say now that it would not be.

Senator BELLMON. You mentioned oil and gas.

Now, let's remember that a great deal of energy comes from coal and a lot more probably should and will, but one of our big problems is the artificially low price of natural gas has kept coal from being developed.

Dr. McCracken. Yes; that is absolutely correct, and I would like to allude to, I think, three pages in the economic report in which we discuss precisely this issue, that we had prices of natural gas which are not at a market clearing level and which distorted both the use of gas and held back the supply. And the message itself alludes to the same problem. So I think we have tried to indicate a sensitivity or responsiveness to the price issue that is imbedded in this very complex problem.

Senator BELLMON. Mr. Chairman, I would like to ask unanimous consent that the statement I have made be a part of the record.

Senator Moss. Without objection it may go in at this point.

(The prepared statement of Senator Bellmon follows:)

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

MR. BELLMON: Mr. Chairman, President Nixon's Energy Message June 4th properly took note of the fact that this Nation must be willing to invest money in the broadening of its energy supply base to avoid an even graver energy supply shortage in coming years. However, in light of our current crisis, I fail to understand why this administration, like those before it, continues to skirt the immediate problems of meeting our national energy needs, when clearly those problems have brought us to the brink of crisis.

The President has asked this Nation to invest millions of dollars in research of new energy sources. My question is why the administration has not made the country aware of the need of investment to bolster the development of traditional energy resources upon which we presently depend for 75 percent of our energy needs? Such an unbalanced policy makes no sense, because it intensifies the very problem it is apparently intended to solve. It will lull the country into thinking that the energy crisis is being met when in fact the solution the President is seeking is at least 10, perhaps 20 or 30 years down the road. What does the country do in the meantime?

The problem is how to meet a rapidly growing demand for energy that promises to at least double in the next 20 years when our production capacity presently is incapable of meeting the demand and it is not growing fast enough to keep up.

The present production rate of domestic crude oil is an average of 9.2 million barrels a day while consumption is an average 14.6 million barrels a day. We must import the difference. The average rate of production of natural gas is a little more than 60 billion cubic feet a day, while the daily demand is already a little more than 61 billion cubic feet.

The Office of Oil and Gas reports there are about 100 billion barrels of oil known to exist in zones where first recovery methods were not sufficient to extract the remaining reserves. This resource would supply our national needs for nearly 20 years. Yet our government is spending only \$330,000 a year on research to find new methods of secondary recovery. I question why we are not doing more particularly in light of the administration's willingness to spend millions researching new sources of energy.

The Administration has asked for an outlay of \$77 million to fund development of a nuclear breeder reactor plant that will take an estimated 15 to 20 years to become effectively operational. The progress to date in development of nuclear energy indicates we'd be taking a poor gamble in counting on nuclear power as a substantial source of energy even in 20 years. The Chairman of the Federal Power Commission Mr. Nassikas, said earlier this year that the nation's oil and gas requirements will almost double in the next 20 years so that if nuclear technology does not fulfill its promise on schedule, we might continue to be significantly more dependent on oil, gas and coal resources than anticipated into the 21st century and beyond.

Mr. Chairman, nuclear energy's promise is already significantly behind schedule, giving us every reason to believe, as Chairman Nassikas has warned, that our present dependence on oil and gas for 75 percent of our energy needs is going to increase. In 1962 the Atomic Energy Commission estimated that by 1970 total electrical energy produced by atomic energy would equal 43 billion kilowatt hours. In 1970 only 19 billion kilowatt hours of electrical energy was actually produced from atomic energy. Clearly our nuclear energy specialists have been too optimistic in the past in their projections. Their promises for the future may also be too promising. Unfortunately, optimism will turn no industrial wheels nor will it light and heat our homes.

The Office of Emergency Preparedness took note in its April report that domestic crude oil proven reserves have declined markedly since 1968 and that our proven reserve situation is unsatisfactory when measured in national security terms. Furthermore the report stated that from the initiation of the oil import program in 1959 crude oil prices have increased only 11.6 percent while wholesale prices for all commodities have increased 17.8 percent.

Yet late last year the President took the oil industry to task for raising the price of crude oil by 25 cents a barrel. He announced in December measures including increasing Canadian oil imports, and wide open production from offshore leases to help restrain the increase of oil and gasoline prices.

It would seem to me, Mr. Chairman, that our government might learn from its mistake in holding down the price of natural gas and thus discouraging further exploration that a similar policy toward the oil industry would be catastrophic. But we don't seem to learn. Last year we saw the number of exploratory oil and gas wells drilled fall to the lowest level in 22 years, though our nation is yet far from realizing the full potential of its oil and gas resources.

We are no longer self-sufficient in the production of oil and gas to meet our demands. Government and industry have clearly recognized our self-sufficiency will be dangerously threatened within 10 years by increased reliance on foreign oil supplies unless we encourage greater production, more exploration and improved technology through a government policy providing substantial economic incentives and a better pricing system. But we have before us, instead, a message from the White House which encourages investment in exotic expensive energy sources that might or might not be operational in 20 years.

From his statement it appears that the President has wiped the oil and gas industry out of the nation's energy future. The administration's present energy policy virtually ignores the realistic economic needs of the traditional energy industries and the new policy is silent. The net results of such a policy will put this nation on crutches or in bondage to the powers which control the valves to our energy supply.

Two additions to the President's energy message are essential: First, a clear indication that the administration realizes and accepts the fact that energy economics are distorted and that a realistic price for domestic oil and gas is needed to enable the traditional energy industry to meet national needs before new energy sources come on stream; second, a sharp increase in research funds to accelerate secondary recovery of known crude reserves.

Senator BELLMON. That is all I have, sir.

Senator MOSS. Thank you, Senator Bellmon.

Senator Jordan had to leave and indicated he had one or two more questions that he would like to submit in writing to members of the panel, and I would ask if other members of the committee do have questions that they still would like to have answered, submit them in writing and I am sure you gentlemen would all respond in reasonable time so we could put them in the record.

(Subsequent to the hearing Senator Allott submitted questions to Mr. McCracken. The answers follow:)

JUNE 17, 1971.

HON. PAUL W. McCracken,
Council of Economic Advisers,
Washington, D.C.

DEAR DR. McCracken: As principal spokesman for the Administration at the recent hearings conducted by the Senate Committee on Interior and Insular Affairs concerning the President's Message on Energy, I am addressing this letter you and will appreciate your early consideration and response to the questions posed herein. Unfortunately, a touch of virus prevented me from being present at the hearings, and therefore, I have resorted to this written inquiry which will be included in the record.

As you know, the Senate Committee on Interior and Insular Affairs recently conducted hearings in five Southwestern States relative to coal-fired power plant siting in that area. During the course of those hearings we heard many comments to the effect that energy rates, especially electrical energy rates should be increased in order to encourage of a more limited use of electricity.

1. Could electric rates be increased under present law on this basis, that is, to discourage individual consumption of electricity?

2. Would such rate changes have the affect of reducing electric power consumption, assuming their legality?

3. Upon which economic group would higher power rates fall most heavily?

We have heard proposed that power rates be structured so that large users pay more per kilowatt hour on the theory that this would promote economy of utilization.

1. How workable is the above suggestion and what are its prospects of achieving the desired goal?

2. What alternatives would be open to large users of electricity? Do you believe that they would generate their own power? If they did, how would this affect power rates for the individual home consumer?

3. Could such a reversed rate structure cause industries requiring large amounts of power to relocate in other areas and even relocate out of the country?

The President's Message provides for some energy conservation measures, such as, improved insulation of housing and requiring the listing of operating power requirements of large appliances. These measures are commendable.

1. What other possible measures are you considering for energy conservation?

2. What impact would restrictions on the sales of electric can openers, toothbrushes, knives, etc., have upon power and upon the economy generally?

I was impressed by the provision of the President's Message directing the Secretary of the Interior to "begin the orderly formulation of an oil shale policy . . ." This, I believe, is the first time such a directive has been issued by any President of the United States since the Mineral Leasing Act was adopted in 1920. Is this not correct?

1. The President's Message contemplates the first test lease to be let next year. Can you provide additional details as to what is contemplated; i.e., how many test leases, and where? What preleasing activities will be authorized?

2. As you will recall, an earlier test lease program was tried by former Secretary Udall. However, most people knowledgeable with respect to oil shale declared that the proposed program was conceived in such a way as to predetermine failure. Later events proved them right and Secretary Udall rejected all bids. What steps have you taken with respect to the proposed leasing program for oil shale to prevent a similar failure?

The Message states that ". . . in cooperation with industry, the government is funding a research program to develop new and less expensive techniques for burying high voltage electric transmission lines".

1. With whom have such contracts been negotiated for the research mentioned in the President's Message?

2. Does this research program include super-conductive electric transmission?

3. If the research program does not cover super-conductivity, why not?

4. What consideration and analysis has been given to the potential helium requirements for super-conductive transmission?

In recognition of the fact that some of these questions may fall in the area of expertise and responsibility of other members of the panel, I have provided copies of this letter to the other members. Your early attention and response will be appreciated.

Best regards.

Sincerely yours,

GORDON ALLOTT,
U.S. Senator.

THE CHAIRMAN OF THE
COUNCIL OF ECONOMIC ADVISERS,
Washington, D.C., August 6, 1971.

Hon. GORDON ALLOTT,
U.S. Senate,
Washington, D.C.

DEAR SENATOR ALLOTT: This is in response to your letter of June 18 posing additional questions with regard to the President's Energy Message.

We have set out below the questions and answers on electric rates, energy conservation, oil shale policy, and research to bury economically high voltage electric transmission lines.

Electric Rates

Question #1: "Could electric rates be increased under present law on this basis, that is, to discourage individual consumption of electricity?"

First, it should be noted that there is considerable variation among the various state and Federal regulatory statutes and precedents with respect to the authority to change electricity rates. The Federal Power Commission regulates the rates charged for electricity at wholesale for resale in interstate commerce under the Federal Power Act. Under that Act, the Commission is, upon complaint or upon its own motion, empowered to change rates for service subject to its jurisdiction only if it finds existing rates to be unjust and unreasonable, or discriminatory or preferential. If it so finds after notice and opportunity for hearing, it may fix new rates, but such new rates must be just and reasonable and not unduly discriminatory or preferential. It is, therefore, doubtful that the Federal Power Commission could under present law, raise the entire level of rates charged by electric utilities for the purpose of discouraging the consumption of electricity. That is especially true if the new rates would result in total revenues that were not in line with the total cost of service or if they would result in individual customers or groups of customers paying substantially more for service than the allocated cost of service to those specific customers or groups. We believe that the legal situation in most states is such that the regulatory commissions would be limited with respect to rates subject to their jurisdiction in much the same manner as the Federal Power Commission.

There are many publicly-owned and cooperatively-owned systems whose rates are subject to neither state regulation nor regulation by the Federal Power Commission. We are unable to state whether the rates charged by these entities could be increased under present law for the stated purpose. Such systems, however, supply less than 25 percent of the total power consumed in the United States.

Question #2. "Would such rate changes have the effect of reducing electric power consumption, assuming their legality?"

Statistical studies indicate that, given enough time, changes in the price of electricity are inversely related to consumption. That is, one would expect less power consumption in the long run if rates are high. That is not equally true for all types of power use, however. While there are some basic electricity requirements, such as for lighting and small appliances, which would probably be little affected by moderately higher rates, other power demands for major household appliances and large industrial uses would probably be influenced to a greater degree. That, however, is partly attributable to the fact that there are substitute fuels for many of these purposes, assuming that the prices of these substitutes would not increase materially. It is also partly attributable to the fact that some very large industrial users have the ability to generate their own power if public utility rate regulation makes purchased power too costly.

Question #3: "Upon which economic group would higher power rates fall most heavily?"

If all systems raised the general level of their power rates substantially, the ultimate impact would be likely to resemble a regressive tax, falling most heavily on low income groups. Industrial and commercial buyers purchase about two-thirds of the electricity generated. Increases in these power costs, to the extent they are passed on to consumers in the form of higher prices for goods and services, would have a final impact much like an excise or sales tax, falling heavily on low income groups. To the extent that competition in the sale of such goods and services prevents sellers from passing along higher power costs to consumers, the short-run impact upon such sellers is likely to be in the form of reduced profits, although over the long run the higher power costs probably will be recovered through higher prices. Similarly, in residential markets power consumption often increases

less than proportionately as income rises. Therefore, if higher power rates are proportional to power consumed, it follows that low income residential buyers will be burdened most heavily—again the impact is regressive.

Even if residential rate structures were redesigned so that the initial impact would be greatest upon higher income individuals (i.e., those using large amounts of electricity for space heating, air conditioning, and other high use appliances), it is unlikely that high income consumers will bear the full impact. First, given sufficient time, there will be a tendency for these users to avoid the higher cost by switching to substitute fuels. Second, to the extent that such uses as space heating and water heating are heaviest during off peak seasons or during offpeak hours the revenues from these services are used, in part, to help cover overhead plant costs. If the demand for these services is substantially reduced, the remaining small appliance and lighting customers will have to bear a larger part of the utility's total capital cost, including fixed charges for periods when generating and transmission facilities are underutilized. One aspect of low night heating rates is that these relatively affluent customers, who might otherwise heat with alternative fuels, help to pay some of the fixed costs of plant and equipment.

Question #4: "What alternatives would be open to large users of electricity? Do you believe that they would generate their own power? If they did, how would this affect power rates for the individual home consumer?"

As suggested above, large users have a variety of alternatives to paying higher rates for electricity. Resources for the Future has recently estimated that well over 90 percent of our total power requirements can be satisfied by two or more basic sources. Fuel oil, coal, self-generated power, and natural gas are all possibilities.

Various industries generate substantial quantities of their own electricity. Certainly higher commercial power prices that are not cost related would tend to encourage more self-generation.

To the extent that the loss of these large loads either (1) forces utilities to adopt relatively inefficient smaller scale production techniques or (2) represents a loss of offpeak business, the remaining consumers will have to bear a heavier burden of fixed capital costs.

Question #5: "Could such a reversed rate structure cause industries requiring large amounts of power to relocate in other areas and even relocate out of the country?"

It is quite true that a number of industries are significantly influenced by electric power costs when making new plant location decisions. Fixed costs would, on the other hand, mitigate strongly against any actual relocation of existing plants. If rates were raised equally throughout the Nation, that would produce relatively little change in industrial location patterns internally, but it may cause some firms to expand abroad rather than in the United States.

Question #6: "How workable is that above suggestion and what are its prospects for achieving the desired goal?"

As indicated in the answers to the preceding questions the suggested rate increases are not likely to have the desired impact. Rather, they are more likely to lead to an undesirable end result. Any proposal to establish a price structure in any industry that is unrelated to costs runs headlong into the foremost rules for economic efficiency. It would distort society's allocation of scarce productive resources and divert consumer expenditure from its optimal course.

Energy Conservation

"What other possible measures are you considering for energy conservation?"

The question of energy conservation arises because some energy is consumed to the point where the social costs exceed the benefits. Mere contraction of energy consumption for its own sake would not lead to an optimal use of our energy resources. We are there exploring those areas of consumption where social cost may exceed benefit.

For example, when sulfur oxides are emitted in the burning of fuels, costs are incurred by society that are not borne by the fuel user or the consumers of the end products. The President's proposed tax on sulfur oxide emissions was the response to this situation..

There is one situation in the short run that deserves special attention and that is the shortage of electric generating capacity in some regions of the country. Where capacity is short, excessive consumption by individuals and firms can have damaging effects such as blackouts and brownouts. The Federal Government is therefore eliciting cooperation from industry and consumers to conserve energy, particularly electric power, and has developed a program to reduce electric power consumption by the Federal Government itself. The enclosed materials illustrate part of this effort.

"What impact would restrictions on the sales of electric can openers, tooth-brushes, knives, etc., have upon power and the economy generally?"

These items have a negligible effect on overall energy consumption and on the economy. Furthermore, it is difficult to see the grounds on which one could attempt to curtail their use. So long as individuals regard the benefits from their use as greater than the price paid and the price paid adequately reflects true social cost, then there would seem to be no case for intervention. If the price did not reflect social cost, then the price should be changed.

Oil Shale Policy

"The President's Message contemplates the first test lease to be let next year. Can you provide additional details as to what is contemplated; i.e., how many test leases, and where? What preleasing activities will be authorized?"

The tentative timetable for the Proposed Prototype Oil Shale Leasing Program calls for the first leasing to begin in December of 1972. A maximum of six leases is contemplated—two each in Colorado, Utah, and Wyoming. The competitive sales single leases would be scheduled at 2-week intervals to permit unsuccessful bidders at earlier sales the opportunity to re-evaluate their position and determine whether to bid on any of the remaining lease tracts.

Prior to commitment to the actual leasing program, informational core drilling will be authorized to gather resource, geologic and hydrologic information on the basis of which industry would nominate tracts for leasing consideration. These data are also needed to evaluate environmental effects of development on specific tracts. After assembly and analysis of pertinent data and consultation with the individual Governors' Panels a supplement to the recently released draft environmental impact statement will be published next spring describing expected impacts of development of nominated tracts. Public hearings will be held in the summer of 1972. After full review a decision on whether to proceed with leasing of specific tracts will be made and a final environmental impact statement published and submitted to the Council on Environmental Quality and the lease sales scheduled.

2. As you will recall, an earlier test lease program was tried by former Secretary Udall. However, most people knowledgeable with respect to oil shale declared that the proposed program was conceived in such a way as to predetermine failure. Later events proved them right and Secretary Udall rejected all bids. What steps have you taken with respect to the proposed leasing program for oil shale to prevent a similar failure?

The tabular summary below contrasts what appears to have been critical differences between the 1968 test leasing effort and the provisions of current proposed program.

Program element	1968 effort	1971 proposed program
Tract selection.....	Federal Government alone.....	Individual nominations after informational core drilling.
Lease size.....	Limited to a minimum commercial size.....	Adequate reserves for full commercial operation (legally authorized acreage).
Lease terms.....	Lease cancellation penalty for nonproduction within 10 years.	Provides for full 20-year term of lease with escalating royalties after 10 years to induce production.
Environmental controls.....	Strict open-ended requirements with any unknowns and no relief for operator.	Strict requirements which will be defined in lease. Provisions for crediting costs of additional extraordinary requirements against royalties.
Patents.....	Rights to Federal Government and controlled assignment.	Patentee retains full rights.

RESEARCH TO BURY ECONOMICALLY HIGH VOLTAGE ELECTRIC TRANSMISSION LINES

1. With whom have such contracts been negotiated for the research mentioned in the President's Message?

a. Arthur D. Little, Inc. Massachusetts Institute of Technology.

2. Does this research program include superconductive electric transmission?

a. Yes.

3. If the research program does not cover superconductivity, why not?

4. What consideration and analysis had been given to the potential helium requirements for superconductive transmission?

a. Potential helium requirements for superconductive transmission have been carefully analyzed and it is believed that helium supply is adequate to meet any foreseeable needs.

Sincerely,

PAUL W. McCracken.

Senator Moss. This has been a long day of questioning, and I am sure a little bit trying perhaps for the witnesses who have been before us. We do appreciate, though, the very candid and good responses that we have had. We have a considerably better understanding of the President's message and program now. This hearing is just the beginning. We are going to start on a long search to find answers, if we can, to these problems that have been raised and further study of the President's program as it has been set out.

We thank you all for giving your time today and helping us in these questions that we have. With that we will call the hearing in recess subject to the call of the Chair.

(Whereupon, at 4:50 p.m., the hearing was recessed subject to the call of the Chair.)

(The prepared statements of Secretary Morton, Dr. David, Dr. Seaburg, Mr. Ramey, and Mr. Lincoln follow:)

STATEMENT OF HON. ROGERS C. B. MORTON, SECRETARY OF THE INTERIOR

INTRODUCTION

In his message of June 4, President Nixon affirmed that the United States, after enjoying many years of cheap and plentiful energy, is now entering a period of increasing demand for energy and growing problems of supply. The beginnings of this condition are already apparent in the seasonal difficulties being experienced by certain areas in meeting peak demands for electricity in the summer and fuels for heating in the winter. These problems are still local and ephemeral in scope and duration. They are produced by a progressively failing supply of domestic natural gas; a steady decline in proved reserves and productive capacity in crude oil in the conterminous United States; by restrictions upon the production and use of energy in all forms imposed by environmental considerations; and finally, by a growing dependence for energy upon sources over which our nation has no control.

As the President noted in his message, a time lag is certain before the results of any curative action will be visible. It is therefore all the more important that the reforms we now undertake be viable over the long term; that they comprehend the whole range of factors bearing upon energy production and use; and that they be oriented to a coherent set of mutually-supporting energy policy objectives.

ENERGY AND NATIONAL OBJECTIVES

The importance of energy to an industrial society such as ours has been well established and there is general agreement that a continuing flow of energy is absolutely essential. It therefore is appropriate to begin the description of energy objectives with a mention of security, or reliability, of supply. It is also evident, as we look to the prospective growth in our population, work force, and general economy in the years ahead that the supply of energy must be a plentiful one—adequate to sustain the increase in energy consumption implicit in the growth of these other factors. There is the further requirement that energy be provided the Nation at the lowest cost consistent with the other objectives to be realized.

To this summary statement of national energy needs and objectives must be added a number of corollary goals related in some way to the production and use of energy. There is the need to make the resources on the public domain available for development in a timely and efficient manner; for minimizing waste in energy production and consumption through proper conservation measures; for seeing that the specific needs of national security are provided for; for encouraging the development of new energy sources; and for insuring that public health and the environment are adequately safeguarded from the deleterious effects of energy extraction, processing, transport, and use.

In many important respects, these goals are competitive and contradictory, and the actions and policies adopted to serve them frequently work at cross purposes with one another. The goals of security of supply, low cost, and pollution abatement, for example, are at their extremes mutually incompatible, and government policy which has to accommodate them all is necessarily a compromise.

There is, in addition to the inherent conflict between objectives, the fact that

the various Federal, State and local government organizations often act independently and on an *ad hoc* basis in pursuing particular goals as they relate to particular kinds of energy. This has important implications for the other sources whose prospects are affected by the advantage such action gives to the geographic region, form, or source of energy thus favored.

This conflict of objectives, and the pursuit of them by separate administrative entities, has contributed in no small degree to the predicament in which we now find ourselves. In many instances we have gone about the solution of one problem as if it were the only one we had to contend with, with no concern for the impact of our actions upon other elements of the energy economy, and with a certain naive faith that if we created, staffed, and financed an organization dedicated exclusively to the demands of a particular form or source of energy, we could somehow solve its problems forevermore. And, gradually, over the years, we built up a hodge-podge of miscellaneous organizational units, each dedicated to its own concerns, which in many cases proliferated and grew to where they overlapped, duplicated and interfered with the functions of other units.

The result has been that we have, certainly at the Federal level, a series of administrative arrangements that are essentially oriented to solving a series of discrete problems, rather than to the pursuit of a comprehensive long range policy for energy. The President's message comments on this deficiency, and his proposals for its remedy are now before the Congress.

ELEMENTS OF ENERGY PROBLEMS

A number of elements comprise the milieu in which our energy problems must be considered and solved.

First there are the peculiar properties of energy itself as they are reflected in its various forms and uses. The forms in which we use energy have a great deal to do with our vulnerability to its interruption. Ninety-six percent of our primary inputs of energy are derived from fossil fuels occurring naturally in solid, liquid, or gaseous form. We have built a massive inventory of equipment to consume these fuels in these particular forms only. This is especially true in the case of transportation, which for all practical purposes is wholly dependent upon liquid fuels, and is due to remain that way for many years to come. Even including those electric generating plants and factories which have standby equipment available to utilize alternate fuels, the national potential for substituting one fuel for another over the short range is extremely limited. A study made by the National Petroleum Council on Emergency Fuel Convertibility in 1965 indicated that only about one-fourth of the energy used by industrial plants (including electric generating stations) could be substituted by other forms within a 30-day period, and that less than 5 percent of the energy consumed by households and commercial establishments had any potential for substitution during such an interval. Given longer periods, the degree of interchangeability among fuels for stationary uses can be substantial, and we are witnessing such a conversion now as residual fuel oil is being called upon to substitute for coal and natural gas in power plants and factories. But this is a process extending over the medium term, and emergencies, by definition, are events of the short term. The conversion process, moreover, is not symmetrical: it is much easier to convert from coal to oil than from oil or gas to coal.

Other properties also limit the degree to which we can insure against the hazards of interruption to energy supply. Fossil fuels are consumed in such enormous volumes that strategic stockpiling is feasible only for relatively short periods. Electricity cannot be readily stockpiled at all. Energy is totally consumed as it is used; there is no reclaimable residue that may be recycled for future use. Rationing can lengthen endurance on a given stock, but only to a limited degree, and rationing beyond even a relatively modest level quickly begins to inhibit the nation's capacity to act. And, of course, neither rationing nor stockpiling is any answer to the problem of assuring a steadily expanding supply of energy over the long term future. Thus, a continuous, uninterrupted flow of energy is critical to our nation, and more than that, this flow must be in terms of specific energy forms. All the coal in the world will not make our automobiles go or our airplanes fly, nor will a plentiful supply of natural gas avail the householder whose furnace is built to consume No. 2 fuel oil.

The second element worthy of note is the imbalance that has developed between the rate of consumption of our energy resources and our known domestic supply of them. We are currently in the position of depending upon oil and gas for three-fourths of our energy supply, although these commodities comprise only a

small fraction of our fossil fuel resources. By contrast, coal, which accounts for the largest share of our potentially producible resources of fossil fuels, supplies barely one-fifth of our annual energy requirements. Other resources, such as our enormous deposits of oil shale, remain submarginal at present levels of cost and technology, as do the various processes for converting coal into liquid and gaseous fuels.

Third, this imbalance between the kinds of fuels we now need and the kinds that our past choices have made available is going to be further aggravated by environmental safeguards which operate upon the production and use of certain domestic energy forms. Foremost of these are the sulfur content requirements that now make it impossible to use most of our Eastern coals in large metropolitan areas. In other areas environmental consideration have come head to head with plans for the leasing and development, drilling and producing of oil and gas properties on the Outer Continental Shelf; with the proposal advanced for the construction of the Trans Alaska pipeline; with the decreased efficiency and hence greater fuel consumption of automobile engines designed to use the new low-lead gasolines; with the siting and operating of nuclear power plants. All these constraints have their impact on energy demand and availability. They have the net effect of increasing costs, narrowing the consumer's range of choice, and to the extent that the gap is filled by foreign oil and gas, diminishing the security of our energy supply.

Fourth, whatever efforts we choose to make to solve our fuel problems in terms of domestic supply will require a series of specific acts of national policy related to each other and to a coherent set of long term goals. They will involve large commitments of capital—private, public, most likely some of both. They will require extensive periods of time for development from inception to commercial reality, measured in years and decades. They mean in almost every case, some interference by government in the operation of the marketplace. And they will demand an organization for formulating and articulating these energy policies that does not now exist.

ENERGY DEMAND

Long-range forecasts have limited reliability as vehicles for making quantitative assessments of the future. They can, however, furnish useful guides as to the general conditions that might be anticipated at a certain time in the future if the assumptions on which they are based bear some reasonable relationship to the realities which later develop.

In the case of U.S. energy consumption, the Bureau of Mines has made a projection to the Year 2000 which assumes, among other things, an average annual increase in real GNP of 4 percent; population at 1.6 percent, and industrial production of 4.4 percent. The average annual increase in energy consumption calculated under the selected assumptions was 3.5 percent. This compares with an average annual increase rate of 3.4 percent for the 30-year period ended 1970; 3.6 percent between 1960 and 1965; and 5.0 percent for the five years between 1965 and 1970.

The sizeable jump in the rate of increase in energy consumption since 1965 has not yet been fully explained. Various factors have been cited, including the rapid growth of air conditioning; expanded use of home appliances in general, including electric space heating; and more intensive processing of our industrial raw materials such as aluminum. Of more importance to the future, it is not known whether this sudden increase in energy consumption rate represents merely a temporary departure from the long-term historic trend, such as has happened in the past, or whether it reflects a permanent shift in the balance of energy consumption factors which will be reflected in higher growth rates over the future.

Obviously, it matters greatly over a thirty-year period whether energy consumption increases at an average annual rate of 3.5 percent or 5 percent. If the latter rate should turn out to be more nearly correct than the former, then all energy requirements would have to be adjusted dramatically upward.

Estimates of future U.S. energy demand are presented in Tables 1 and 2. Table 1 presents a Year 2000 base forecast modified to show the effects of a high and low range of nuclear energy development. The range of energy inputs varies from a low of 166 quadrillion Btu to a high of 239 quadrillion Btu, the lower figure reflecting the offsetting credits to energy inputs to power generation which may be expected from the extensive use of breeder reactors, which produce more fuel than they consume. Table 2 presents preliminary data on U.S. demand for energy resources in 1970 and the current Bureau of Mines forecast of demand for energy resources by major sources, for the years 1975, 1985, and 2000. The indicated

gross energy input of 192 quadrillion Btu in the Year 2000 reflects the compound growth rate of 3.5 percent annually, mentioned earlier.

Whether our actual demands for energy at the turn of the Century correspond to any of these incomprehensible large numbers, or something even higher, the implication is plain enough. Our requirements in the final three decades will involve the findings, production, processing, and distribution of a staggering amount of fuel minerals—far in excess of anything we have so far managed to supply from domestic resources.

ENERGY RESOURCES AND SUPPLY PROSPECTS

Let us now consider the status and outlook of the energy resources that must supply the total energy demand just populated. It was noted earlier that these demands must be met, not merely as a gross requirement of so many Btu's or kilogram-calories, but more importantly in specific quantities of certain energy forms: as electricity, or as liquid, gaseous, or solid fuels. It is important to consider these energy supplies in terms of form, rather than of source and kind; that is, the focus should be on liquid fuels, not merely petroleum, and gaseous fuels, not merely natural gas. The liquids and gases that may be derived from oil shale, coal, and tar sands serve the same purpose as those occurring naturally, and should be considered in the same calculus of supply and demand.

To convey some idea of the volumes of the various forms of energy that will be required, a series of orderly energy balances have been estimated (in Table 1) which just satisfy the total estimated demand and which project certain shares of the total to be supplied by the various energy forms. These balances are intended function only as working hypotheses, to represent the volume and market share which each energy form may be expected to supply if all the governing assumptions turn out to be correct. To the extent that any component fails to provide the share projected for it, the other components must either fill the gap, or total supply will be proportionately less.

ENERGY RESOURCE AND SUPPLY OUTLOOK—ELECTRICITY

Electricity is a secondary form of energy; that is, it represents the conversion of a primary form of energy—coal, gas, oil, uranium, falling water, natural steam—into another form—electricity—at an intermediate point along the way from the point of origin of the primary energy to the ultimate consumer. This is in contrast to primary energy forms which are utilized by the ultimate consumer's own equipment.

Except for hydropower, this conversion is accompanied by a great loss of energy in the form of heat. On average, less than a third of the Btu's going under the boiler of a thermal electric power plant emerge at the buss bar in the form of available electrical energy. The very best steam electric plants attain an efficiency level of 40 percent; the nuclear plants now being built approximate the general nationwide average for plants of all types of 32 percent. There is, moreover, a transmission loss of 5 to 10 percent of the electrical energy between the power station and the point of use.

Thus to the extent that the use of electricity grows at a more rapid rate than the use of primary forms of energy in the nation's households, factories and commercial establishments, the overall demand for energy inputs expands differentially with respect to the increase in energy actually used by consumers. The homeowner who installs electric air conditioning in his home may use only 16 million Btu's over the summer season, but he creates a demand at the power plant for 50 million Btu's which must be supplied in the form of primary energy. Electricity is clean, convenient, and indispensable for many energy applications. It is also by far the costliest form we use in terms of resource demand, and it will remain so, at least until breeder reactors become a reality.

Presently, about 83 percent of our electric power is generated by the burning of fossil fuels, 16 percent came from hydro-generators, and slightly more than one percent from nuclear. These shares will change dramatically over the next three decades. Hydropower is expected to shrink to 7 percent of total supply by 2000, and nuclear is expected to rise to 60 percent, with the realization of the breeder reactor. Fossil fuels would be required to supply the remaining 33 percent.

The small share of nuclear power in the current total is deceptive of the outlook for this component. The 19 plants operating in 1970 were for the most part relatively small installations, with a total generating capacity of 7100 megawatts. Currently 55 plants are under construction, and 44 more have been contracted

for and reactors ordered. Although, these plants represent nearly 100,000 megawatts of generating capacity, and the Atomic Energy Commission expects further construction to bring the total of nuclear generating capacity to 148,000 megawatts by 1980, rising to 447,000 in 1990 and to 903,000 megawatts in 2000. The misgivings about nuclear power that characterized 1968 and 1969 seem to have been dispelled, and orders are again on a strong upward trend. In 1970, 19 units were announced with a total capacity approaching 18,000 megawatts.

Historically, the use of electricity has doubled every ten years, and this strong growth trend is expected to continue. Until the past few years the industry has been able to keep pace with the soaring demands for power. Since 1965, however, the planning uncertainties produced by the short-lived surge of orders for nuclear plants in 1966 and 1967, combined with the delays in getting new capacity on line forced by construction difficulties and the growing public awareness of the environmental impact of power plants, has reduced the cushion of reserve generating capacity the industry has relied upon to cover peak load periods. As a result, power failures are occurring with increasing frequency, and brownouts, voltage reductions and selective load shedding have been necessary to enable many electric utilities to maintain service.

Fuel availability has also been a problem in certain areas over the past two years, for reasons that have amply been set forth in other analyses. These fuel problems are ephemeral, and are being solved by the operation of normal market forces. These solutions come at the expense of other problems, however, which will be discussed later in the context of national security considerations.

Looking beyond these immediate problems of capacity and fuel availability, consumption of electricity may be expected to triple over the next fifteen years, rising from 1500 billion kilowatt-hours in 1970 to 4500 in 1985. Over the succeeding 15-year period, a further doubling of consumption is anticipated to a total of about 9000 billion kilowatt hours in the Year 2000.

This growth is premised upon the introduction of more efficient nuclear plants than the present light water reactor which consumes about twice as much fissionable material as it produces. An interim improvement, the high temperature gas-cooled reactor, may raise gross thermal efficiency to 40 percent or more, but the problem of supply will not really be solved until a breeder reactor is developed which will stop the prodigal expenditure of enriched uranium which must be processed at enormous expense and effort to provide the fuel for the present "burner" reactors. Only when nuclear reactors are able to generate, and utilize, more fissile fuel than they consume will it be possible to meet the requirements for nuclear reactor fuel in the year 2000. The successful commercial development of breeder reactors would stretch the world's presently known uranium-thorium base by thirty to forty-fold, and would permit the continued expansion of fission-generated power well into the next century. The growth of nuclear capacity that has been projected assumes the commercial entry of the high temperature gas-cooled reactor about 1980, and of the breeder reactor about 1990. If the President's request for additional funds to advance the date of the demonstration plant to 1980 is approved, the entry of the commercial breeder reactor will be earlier than our estimate. Each year we can save will prevent the waste of a significant amount of our scarce low-cost uranium resources.

Should the rapid expansion of nuclear generation materialize, fossil fuel requirements for electric power *in toto* may increase at only 2.3 percent a year between then and the Year 2000. Gas will probably grow little if at all from its present level, and oil will cease its growth after 1985, and thereafter shrink rapidly as nuclear plants take over a steadily growing share of the power generation market. Coal will accordingly be the major fossil fuel contributor to this segment of the energy economy, assuming ways can be found to permit it to meet air quality standards. Consumption may rise from 326 million tons in 1970 to 535 million in 1985, and to 780 million tons in 2000. This represents an annual growth rate of 3.3 percent during the first 15-year period, and 2.5 percent for the second, rates deemed well within the coal industry's ability to accommodate.

ENERGY RESOURCE AND SUPPLY—SOLID FUELS

Aside from inconsequential volumes of wood and petroleum coke, the term solid fuels can be equated with coal and its derivative coke. Coal has virtually disappeared from the transport and residential markets, is of small importance to commercial heating, and is moderately significant (26 percent of the total) in total industrial consumption. It is the dominant factor in electric power generation, furnishing about 55 percent of the primary energy input to power generation in

1970. In that year, approximately 600 million tons of coal were produced. By comparison, it is estimated that 390 billion tons of coal are commercially recoverable reserves under present economics and mining practices (from estimates resources of 1.6 trillion tons).

This says something about the general availability of coal in the United States, but not much. Again, the problem is the availability of specific kinds of fuel in particular market areas. The imperative need at this time is for bituminous coal containing one percent sulfur or less, with a low ash fusion temperature for use in cyclone burners to raise steam for electric power production in the part of the United States lying east of the Mississippi River. By and large, there is not enough coal available in this region to meet these peculiar requirements. There is plenty of low-sulfur coal in the United States, but most of it is sub-bituminous coal and lignite located a thousand miles or more west of the Mississippi. The low-sulfur bituminous coal that does occur east of the Mississippi is for the most part of high ash fusion temperature and therefore unsatisfactory for use in existing equipment. Moreover, it is of great value for metallurgical use and much of the production is captive to the steel industry or committed to export markets under long-term contracts.

There is plenty of three and four percent sulfur bituminous coal in Illinois and the Appalachian Basin, but it may not be burned in most large metropolitan areas, and the restrictions against its use are spreading to encompass state-wide areas as well. To the extent that low-sulfur coal of suitable burning qualities cannot be obtained to substitute for the high-sulfur coal that is now enjoined from use, consumers are having to convert to alternative fuels. This has resulted in a spectacular increase in demand for residual fuel oil, almost all of it imported, along the East Coast. In the North Central region, where residual fuel oil has never been a factor in the fuel economy, there have been urgent requests for relief from the restrictions imposed against residual fuel imports.

Although research on the removal of pollutants from stack gases has been under way for a number of years, commercially viable technology is not yet available. The processes under active investigation suggest that substantial capital and operating costs will be involved in any removal process. The facilities needed are very extensive, so that retro-fitting existing plants with removal equipment will be difficult, and in some cases physically impossible. Disposal of the residue may be a problem in some processes. An intensive effort will be required to enable coal to carry its share of the load as a solid fuel. The \$15 million the President is requesting is aimed at this essential objective.

The alternative to cleaning stack gas emissions is to reduce the sulfur content of coal to acceptable levels prior to burning. The problem is that most sulfur occurs in coal either as iron pyrite or bound into the organic structure of the coal itself. Conventional coal preparation does not affect the organic form, so that the optimum amount that may be removed in this stage is that occurring in the pyrite. Even here, the pyrites may be finely disseminated throughout the coal, so that fine crushing is necessary to separate them from it. In many cases even the removal of the pyrite would not reduce sulfur content to acceptable levels. Processes must therefore be developed which free the sulfur that is chemically bonded to the coal. The Department of the Interior programs aimed at achieving this effect will be discussed later. It is enough to note here that they are not expected to be commercially significant for several years.

While a great deal of attention has been paid in the past year or so to the production difficulties being experienced by coal, the critical deficiency to be remedied is not supply availability but market acceptability. It is proper to say that the coal industry has learned to live with the prospect of growing but orderly intrusion of its market by nuclear power, and with the constraints imposed by the Coal Mine Health and Safety Act. Production in 1970 increased by 30 million tons over the previous year, covered all requirements, and permitted a modest amount of stock-building. A more serious problem is that posed by the growing restrictions on its use by the imposition of air quality standards. The real challenge of the future will be to develop the means to enable coal to make its proper contribution to the energy needs of the United States.

Energy Resource and Supply—Gaseous Fuels

Natural gas supplies one-third of the Nation's total energy requirements, including approximately half the demand of residential, commercial, and industrial consumers. One-fourth the needs of steam electric power plants is also supplied by gas.

For many years before air quality standards imposed their special requirements for clean fuels, gas consumption far exceeded the growth rate of other fuels, aver-

aging an annual increase of six percent between 1950 and 1970. In 1970 gas again led all other primary forms of energy with a gain in consumption of 7.2 percent. Significantly, this disproportionate increase was due largely to increased use of gas in generating electric power, which ran 11.9 percent over 1969.

Just as significantly, the level of proved reserves of natural gas in the conterminous United States dropped in 1970 for the third successive year to 265 trillion cubic feet.¹ This is 28 trillion cubic feet below the level at the end of 1967. The reserve-to-production index is currently 12 to 1, compared with 20 to 1 in 1960. Local shortages have begun to appear, pipeline companies are desperately searching for new sources of supply and some have even bought back gas from their distributors for storage, prospective customers are having to look to other fuels, and even established customers are being denied additional service. We have the making of a widespread shortage in gaseous fuels which will arrive in full force within the next few years, despite anything we might do. While this will in all probability have little effect upon existing residential customers, prospective consumers of all types will have to look to other fuels, and existing industrial customers will be forced to transfer more and more of their demand to alternative sources of energy.

The dimensions of the Nation's supply problem can be told briefly. Demand for gas last year was 22 trillion cubic feet. By 1980 we would use 33 trillion cubic feet if we could get it—which we cannot. Between now and 1980, our gross requirements on this basis would come to 275 trillion cubic feet—an average of 27.5 trillion cubic feet a year. Against this formidable requirement we have to note the following facts:

Our past five years' additions to proved reserves have averaged 15.2 trillion cubic feet a year. The best five-year period we ever experienced averaged less than 22 trillion cubic feet annually. The largest addition in any single year was 24.7 trillion cubic feet, in 1956.

The Canadian National Energy Board has forecast that at most, Canada will be able to supply us with not more than 2.3 trillion cubic feet of gas in 1980. Last year Canadian gas supplied 700 billion cubic feet, or 3.5 percent of our total requirements.

Liquefied natural gas is now imported in token amounts to cover peak-loading requirements of a few East Coast utilities. If all goes well with the current proposals for importing LNG in larger volumes, we might expect as much as 0.9 trillion cubic feet from this source by 1975.

Alaskan gas will not be forthcoming before 1975, and there is no certainty as to the volume that may become available. To convey some idea of the logistics involved, a 48-inch pipeline will carry 2 billion cubic feet a day—roughly $\frac{3}{4}$ of a trillion cubic feet annually. This is approximately half the amount of a single year's increase in demand at current rates.

Synthetic gas from coal is being actively researched. One pilot plant has been completed, another is expected to be completed later, and additional plants are being considered. Commercial production is possible in the 1975–80 period, though not in significant volumes until late in the decade.

These facts suggest persuasively that we shall have an extremely difficult time meeting the demand projected for gaseous fuels, and that in all probability the full demand will not be met in the early part of the period, say the next five to ten years. This admittedly gloomy outlook for gas supply stands in vivid contrast to the estimates made by the most knowledgeable people in the business as to the occurrence and extent of the natural gas resources in the United States. The Potential Gas Committee, a group of esteemed scientists and engineers with many years of experience in their professions, has made a systematic, basin-by-basin survey of the natural gas resources of the United States. The Committee's estimate, from its findings, is that there is at least 260 trillion cubic feet of natural gas remaining to be discovered in known fields; that another 335 trillion cubic feet can be found in new fields within provinces that are now producing oil and gas; and that another 632 trillion cubic feet might be found in new provinces that are not now productive.² The gas resources are here, apparently, in adequate

¹ The American Gas Association credits the Alaskan North Slope with reserves of 20 trillion cubic feet of associated natural gas. This gas will not be available to markets before 1975 and its production will be regulated by the production of crude oil from the same reservoirs.

² The U.S. Geological Survey has approached the problem of estimating natural gas resources in a different-but equally valid-way from the Potential Gas Committee, and estimates 2,370 trillion cubic feet of natural gas recoverable under current technologic and economic conditions remain in the United States, including both onshore and offshore. An estimated 4,330 trillion cubic feet of marginally economic resources of natural gas is present. Most of these resources are undiscovered.

volume to support all anticipated demand at least during the interval required to develop supplementary sources from coal. The challenge is to find them in accumulations large enough and accessible enough to be attractive to investment in domestic gas producing ventures.

ENERGY RESOURCES AND SUPPLY—LIQUID FUELS

In 1970 the United States consumed 14.7 million barrels a day of petroleum products, which comprised 43 percent of all energy supply that year. Of this total, 23 percent was imported; the remainder was derived from crude oil and natural gas liquids produced within the United States. By and large, this balance reflects the operation of oil import controls under current policies. Recent projections indicate a steady rise in consumption of liquid fuels at an annual increase rate of 2½ to 4 percent until 1985, depending on the availability of gas during this period, so that in that year consumption will be about 27 million barrels a day, some 12 million barrels a day above the current rate. The average over the period would be around 21 million barrels a day.

Unless a marked and early improvement occurs in exploration and discovery success, recovery efficiency, and investment in oil producing activities in the United States, there appears little chance that domestic production can keep up with this strong upward trend in demand. Should this condition prevail, a steadily increasing share of the market must be supplied by imported oils or synthetic liquids produced domestically. By 1985 as much as 45 percent of our total supply may come from these sources, even with North Slope production available.

For the past several years the levels of drilling and exploration maintained in the United States have not been able to prevent declines in both proved reserves and in productive capacity. Not only has exploratory effort fallen off, but more importantly, results per unit of effort expended have declined even more drastically. Where only 30 wells were needed to find a field capable of producing as much as a million barrels of oil in the late 1940's, nearly sixty were required in the five-year period ended in 1963. Parenthetically, the initial amounts of oil discovered per foot of exploratory hole drilled declined from more than 50 barrels between 1946 and 1950 to about 10 barrels in the comparable period twenty years later.

This deterioration of the petroleum supply base proceeded concurrently with a steady upward trend in demand for liquid fuels so that by 1967 the United States was no longer self-sufficient in oil; that is, its imports were more than its unused productive capacity. In the three years since then, productive capacity has actually declined while both demand and production have risen, so that our dependence upon imported oil is currently increasing by about three-quarters of a million barrels a day with each year that goes by. Before 1975 our most optimistic expectation is that U.S. production, except for the North Slope, will be at effective capacity, at a rate of about 12½ million barrels a day, including gas liquids, thereafter to decline gradually to 11¼ million barrels a day by 1985. By 1980 some 2 million barrels a day may be available from the North Slope, rising to 3 million barrels a day in 1985. Therefore, unless our domestic exploration and development is intensified, all of the remainder would have to come from other sources—either imports of natural petroleum or liquid fuels derived from coal, oil shale, and tar sands. This gap, to be made good, would be a little short of 8 million barrels a day in 1980, and about 12 million barrels a day by 1985. Here again, as in the case of natural gas, there is an astonishing gap between the potential of our resources and the performance of our domestic oil industry. Those who know the most about the occurrence of petroleum in the United States estimate that we have found less than half the amount of discoverable oil in the United States; specifically, that another 436 billion barrels await discovery, compared with the 388 billion barrels that had been found as of the end of 1968. This was the conclusion of a report released last year by the National Petroleum Council, containing the results of a two-year study done in collaboration with the American Association of Petroleum Geologists.

It should be noted that this is an estimate of discoverable oil. The Council makes no judgment as to how much of these undiscovered resources will actually be found, noting that future discoveries will be determined by the interplay of economic, political, and technological factors.

The U.S. Geological Survey has addressed itself somewhat more specifically to the volume of undiscovered oil that may actually be considered worth finding by prospectors. It has estimated that when found, some 430 billion barrels of crude oil—260 billion barrels on shore and 170 billion barrels off shore—is re-

coverable under current technological and economic conditions. The problem is that we have not found this oil, and are as yet not making sufficient effort to do so.

Even were we to find and produce as much as half the undiscovered oil estimated to remain in the United States, we would still need supplementary sources of liquid fuels well before the turn of the Century. The development of our natural petroleum resources can, however, buy time to permit the development of these sources on an orderly basis under terms that will meet the criteria we require for security and adequacy of supply.

The fact remains, however, that imported oil will be the principal supplementary source of liquid fuel available for several more years. Limited expansion of present import levels can be expected from Canada and Venezuela, but these can be expected to fill only a small part of the incremental demand; proved reserves of these two nations combined are substantially less than our own, even without counting the North Slope. Moreover, incentive for oil companies to increase exploration and production in Venezuela has been substantially reduced, and in the absence of large discoveries in the Canadian Arctic and elsewhere, the potential of Canada is limited to that of the Western Canadian Basin.

Accordingly, most of the increased supply from foreign sources must come from the Eastern Hemisphere, and specifically the oil exporting nations of North Africa and the Middle East which hold 85 percent of all free foreign reserves of crude oil. The supply base is ample; despite increases in production averaging 12 percent a year since 1960, the reserve-to-production ratio in that region in 1970 was 57 to 1—six times that of the United States. Even with the recent increases in producing countries' "take" that have been won in the past year, and increased tanker rates, oil from these sources is still cheaper than domestic oil, and considerably more so than our cost estimates of the liquid fuels derived from other hydrocarbon sources such as coal and oil shale. Only token amounts of liquids from these latter sources can be expected before late in the current decade. The gap between demand and the capabilities of domestic production between now and 1980 will therefore in all likelihood be filled by foreign oil, most of it from North Africa and the Middle East.

ENERGY RESOURCE AND SUPPLY—OTHER ENERGY SOURCES

There are, it should be noted, a number of other potential sources of energy, including solar energy, tidal energy, geothermal energy, controlled thermonuclear fusion, and the energy derived from waste disposal operations. None of these has any near-term national significance, although geothermal energy can make worthwhile contributions in the immediate vicinity of geothermal fields. Energy derived from waste disposal is likely to be so costly as to be non-competitive with other sources. Its value can, however, be properly considered as a set-off against the costs of refuse disposal.

MAJOR PROBLEMS AND OPTIONS

One of the problems to be dealt with in energy matters is national security. Another is maintaining some sort of balance among energy forms and sources. The decision we must make, in its barest, most direct terms, is whether or not we wish to accept the risks of being dependent for an expanding portion of our energy supply upon sources over which we have little or no control, or whether we are willing to support the investments in exploration, development, production, manufacture, and transportation necessary to increase our domestic energy supplies.

If we were to accept the premise that energy will always be available to us from foreign sources—and this means oil, mainly, and natural gas in limited but growing volume—then we could leave the energy balance up to the normal operation of the market place. As coal was shunted out of its markets because of air quality restrictions, and as the supply of domestic gas and oil continued to fall farther and farther behind demand, the deficiency could be made up readily by oil imports, supplemented after 1975 by LNG.

If such an arrangement is acceptable, we could spare ourselves the expense and effort of trying to make a clean fuel out of coal. We could bypass the environmental problems implicit in large-scale oil shale mining and retorting operations, in offshore drilling and production of oil and gas, and we could spare ourselves further concern with the impact of the Trans-Alaska pipeline on the environment of that state. For awhile, foreign oil could fill the widening gap between demand and domestic supply of liquid and gaseous fuels, and, in addition, effectively substitute for coal to whatever degree is made necessary by air quality standards.

Under the trade patterns implicit in free market conditions for energy, we could envision the virtual disappearance of coal and domestic oil from the Eastern Seaboard, which would become largely dependent upon waterborne imports for its oil supply, and for an increasing share of its gas as domestic supplied declined. By 1985 it is probable that this region would be dependent upon overseas imports for as much as three-fourths of its energy supply, with half of it coming from the Eastern Hemisphere.

The West Coast, similarly isolated, would fare about the same. Oil imports, which now fill 25 percent of District V demand, would swell to 70 percent by 1980 and to 75 percent by 1985. Most of these imports would be from the Eastern Hemisphere. To the extent that Canadian and domestic natural gas failed to satisfy demand, the difference would have to be made up from overseas imports of oil and LNG.

Elsewhere in the United States the balance between foreign and domestic oil and gas would reach equilibrium as conditioned by factors governing supply and demand in each major consuming region. The South Central region could probably subsist about as it is now doing on its indigenous supplies of oil and gas. The heavily populated, highly industrialized North Central region would undoubtedly shift extensively to oil as domestic gas supply dwindled and restrictions upon coal usage became more onerous and widespread. Foreign oil, in steadily increasing volume, would enter pipelines at the Gulf of Mexico for destinations in the Midwest.

This, in general terms, is the logical, foreseeable outcome of permitting our energy supply patterns to be shaped by the random currents of economic advantage, working within the necessary fuel constraints imposed by environmental protective measures.

But there are some very good reasons why we should not permit ourselves to become dependent upon foreign sources for energy in any case. The long record of political upheavals and local wars that has featured Middle East and North African history has been dutifully cited many times and in many places as proof of the unreliability of oil supply from those areas. These criticisms continue to be valid. Now, however, a new factor is present.

The novel element is the profound change in the historic relationships between the oil exporting nations, their oil company concessionnaires, and the consuming nations of the Free World that has now become evident. This change is in essence the public verification of a shift in relative advantage that has been yeras in the making. In 1950 both Europe and Japan depended upon indigenous coal for 85 percent of their energy supplies. Now, both are dependent upon imported oil for about 60 percent of their energy, and more than four-fifths of this oil in each case comes from the oil producing countries of the Middle East and North Africa. This increase in relative dependence upon imported oil by Europe and Japan was accompanied by a massive increase in absolute consumption of oil by the Free World at large: from 10 million barrels a day in 1950 to 40 million barrels a day in 1970. During this period the concentration of proved reserves of crude oil in the Free World substantially increased: where in 1950 the Middle Eastern and North African countries held little more than half the total reserves, in 1970 they accounted for 80 percent—half being in the possession of three countries alone.

The gathering momentum of these events expressed itself in the clear assertion of bargaining superiority of the oil exporting nations we have been witnessing since the middle of 1970. Over a few months the play moved from Libya's bargaining with its concessionnaires in the fall of 1970, to the unilateral action of the Venezuelan government setting new and higher prices in the closing weeks of that year, continuing through the concerted action of the Persian Gulf nations that won further price concessions from the producing companies in early 1971, and returning again to the negotiations concluded by Libya in April for further price increases. These actions reflect a confidence—and a competence—that the Organization of Petroleum Exporting Countries (OPEC) did not have as recently as five years ago. More to the point, these gambits all worked, and a legend of success has been laid that will be exploited to its fullest in the months and years to come. The balance has now been tipped in favor of the oil exporting nations, and within a single year, between two and two and a half billion dollars annually has been added to the fuel bill of the Free World, and this will increase with each succeeding year under the terms of the agreements that have recently been consummated. Future terms of trade may more and more conform to the aspirations of the nations which between them now control 80 percent of the Free World's oil reserves, and their demands may not always be stated in purely economic terms.

There is no question but we have ample resources in toto, as shown in Table 3. We have merely failed to develop certain forms—specifically liquids and gas—in

the volumes required by our specialized consuming equipment. We have only recently recognized environmental considerations which limit our ability to utilize our most abundant resource, coal, in its solid form. We have created a nuclear power industry that threatens to outgrow its domestic supply of fuel before offsetting efficiencies can be developed. We can correct these deficiencies and imbalances by timely and appropriate actions.

But the development of domestic energy resources on the scale needed will require a resolution of the issues which now divide those who would develop these resources and those who seek to assure that damage to the ecological systems affected is held to a minimum. The extreme positions that have been taken by certain individuals and groups can be dismissed as undeserving of serious consideration: the temper of the people will not permit a return to the rapacity and high-handed disregard of the public welfare practices by the extractive industries in the last Century, nor is there any sign that Americans are willing to forego the material benefits, and even more important, the basic freedoms, that would be the price of a zero-growth economy.

The real difficulty comes in composing the divergent views of serious and sensible contending interests in the absence of adequate and reliable data on the costs and benefits involved in the choices to be made. In the absence of such data, decisions are made by hunch and by guess—often under the pressure of public opinion that is either uninformed, or worse, misinformed as to the real issues at stake. In other instances the decision is simply not made at all, but postponed in the hope that data can be developed meantime that will permit a correct choice to be made. The result of both kinds of actions is to stultify and inhibit the orderly, timely development of indigenous resources essential to a secure and adequate supply of energy. Perhaps there is no more critical need for information on natural resources than that related to the impact of energy production and use upon the environment.

Meanwhile, the development of domestic energy resources must be pursued on the basis of the information that presently exists. This is obviously a tall order, and we shall have to knock on every door. While we may tend to be captivated by the prospects of bonanzas lying over the horizon that may be brought within our grasp by extended programs of research and development, we need to remember that our need is here and now. This year we must find supply sources that will provide us with 275 million barrels of oil and $1\frac{1}{2}$ trillion cubic feet of gas more than we consumed last year. Next year we face the same problem, and each succeeding year after that. We thus face problems of the short term and problems of the long term. There are actions that pay out early and others that are years away from meaningful results. The planning we do now must contemplate not only the results we expect by 1985, but what we must do to increase our supply of essential fuels by 1975. The President's message provides action programs addressed to both. The remainder of this statement is concerned with those programs for which the Department of the Interior has responsibility.

NEAR TERM OPTIONS: NORTH SLOPE DEVELOPMENT

First and foremost, we need to achieve an early solution to the problems besetting the movement of oil from Prudhoe Bay to markets in the conterminous United States. Here is nearly ten billion barrels of discovered oil, by the conservative estimate of the American Petroleum Institute, which could provide a flow of at least 2 million barrels a day by 1980 or before. We badly need it. The Department of the Interior is working diligently to solve the administrative problems related to the Native Claims issue and the protection of the Arctic environment to permit this acutely needed addition to our oil supply. If these difficulties can be overcome there is every reason to believe that vigorous exploration in the Arctic will result in further large discoveries in that region.

The fate of Prudhoe Bay oil has a direct bearing upon Prudhoe Bay gas. The 20 trillion cubic feet identified to the Prudhoe Bay field is associated gas, and its production is regulated by the production of the oil from the same reservoirs. If the oil cannot be produced, neither can the gas, so that the inability to move the oil to market hinders gas supply as well.

SANTA YNEZ FIELD DEVELOPMENT

Much closer to its market, but also beset by environmental problems is the enormous Santa Ynez field discovered in the Santa Barbara Channel in 1970. Estimates of its recoverable content run from 1 to 3 billion barrels. It is less than 300 miles from most major markets in California. It should be clearly understood

that Santa Ynez is *not* the field from which the January 1969 blowout occurred; there has been no pollution from any of the wells drilled in the Santa Ynez unit, nor is it involved in the proposal to repurchase certain of the leases in the Santa Barbara Channel. Nevertheless, the difficulties experienced in the Dos Quadros field have created a climate in which development of oil reserves in that area can proceed only with extraordinary difficulty and delay. But the simple fact is that we need the oil. We need it this year. We need it to keep the West Coast from becoming even more dependent upon imported oil than it presently is.

ACCELERATED DEVELOPMENT OF THE OUTER CONTINENTAL SHELF

The U.S. Continental shelves out to a water depth of 200 meters comprise about 800,000 square miles of prospective territory that remains virtually untouched except for the development off Louisiana and Southern California. Even off Louisiana where exploration has been proceeding for more than twenty years, there remain 9½ million acres that have never been leased. The Department of the Interior considers that accelerated development of the Outer Continental Shelf is the most promising action that can be taken to expand production of oil and gas in the Lower Forty-eight States. This is particularly true of the region off Louisiana, where an active offshore production network already exists. Here the results of a new lease sale should begin to become significant to consumers in about three years. In areas where there is little or no existing activity, the lag may be more than seven years.

The Department has prepared a tentative 5-year OCS lease sale schedule, and is strengthening all its OCS program activities to help assure timely, orderly, and prudent leasing and development of minerals which may be found on the OCS. This program involves the acquisition of geological, geophysical, and engineering data on the OCS; lease tract selection; improvement of our pre and post sale evaluation procedures; further study of alternative leasing systems and bidding methods; environmental protection; and improving the overall management of lease exploration, development, and production. The 5-year lease schedule will be published shortly as announced by the President in his message.

Outer Continental Shelf leasing has been resumed under new regulations for environmental protection that were developed as the result of the knowledge gained from lease operations, including the incidents at Santa Barbara and the Gulf of Mexico. It can be hoped that the high valuation the petroleum industry placed on the tracts leased off Western Louisiana last December will be abundantly justified by the discovery of large deposits of natural gas in that area. Both oil and gas have already been discovered in tracts leased at this sale. Nominations closed in March on acreage off Eastern Louisiana, and a sale is tentatively set for December 1971 after all the terms of the Environmental Policy Act have been satisfied. A drainage sale is planned for October this year. The Department proposed under its schedule to conduct about two general OCS lease sales annually to assure a steady flow of prime prospective leasable lands to those interested in investing in oil and gas production on the OCS.

INCREASED RECOVERY EFFICIENCY

Apart from finding new oil and gas supplies, a large area for improvement lies in increasing the recovery efficiency of the oil and gas that have already been found. On average, we are presently able to produce only about 30 percent of the oil in place that we have discovered. Since about 400 billion barrels have been discovered, each percentile by which we can raise this recovery rate adds four billion barrels of oil to our supply. There is a general belief that the recovery rate has been increasing at an average rate of one-half percent per year—due mainly but not entirely to the effect of fluid injection.

There are a number of things that can be done to increase recovery efficiency, including innovations to the tried and true, MER concept, water-flood, miscible displacement, and thermal recovery through steam injection and combustion in situ. Most of these require a considerable amount of additional research, and the prospective results are correspondingly some distance away in time. One fracturing technique developed by the Department that may have near term significance for both oil and gas is under study by the petroleum industry at the present time. The underlying concept is to induce upon the natural fracture system of the reservoir another fracture system oriented at right angles to the

natural system. A several-fold increase in gas productivity is expected from a test to be conducted this year in West Virginia. If the test is successful, this technique could provide economic access to an appreciably increased amount of gas in the Appalachian basin alone. Nationally, its potential for increasing the recovery of both oil and gas is very great. The Department will continue its current studies to explore this very attractive option as well as other stimulative techniques.

COAL RESOURCE SURVEYS

It was noted earlier that our coal problem stems mainly from the fact that we are in short supply of low-sulfur coal in the areas where the principal demand occurs. If we could find adequate and suitable supplies of coal in the right places, it would provide the quickest and probably the cheapest solution to the problem of how to make use of our largest hydrocarbon resource. There is a good chance that this can be done. Coal is so plentiful that we have not troubled ourselves greatly to look for it in many years, but where we have, the search has been highly rewarding. Geologic studies of the Appalachian coal fields have resulted in an average increase in coal reserves of 90 percent in each area studied. The Department will continue its programs to identify high-quality coal resources by geologic mapping and related studies and to inventory and classify Federal coal lands.

URANIUM RESOURCE SURVEYS

As the large amount of nuclear generating capacity begins to come on line over the next few years, demand for uranium will rise rapidly, and supply will become a severe problem unless discoveries are substantially increased above the present rate. Although prospecting for uranium has increased dramatically since 1965, there has been an equally dramatic falling-off of results obtained per unit of exploratory effort expended. This decline is due to inadequate basic geologic knowledge of many of the regions now being explored. The Department is continuing its programs to identify areas favorable for the occurrence of uranium; to provide mapping in known and potential uranium districts to aid future exploration; to increase basic knowledge of the origin and occurrence of uranium needed to find new deposits; and to support a modest drilling effort in carefully selected locations to provide subsurface geological information.

MID-TERM AND LONG-TERM OPTIONS

Beyond the efforts aimed at near-term payoffs are those which will begin to bear fruit in the latter part of this decade or early in the next. For the most part, these require not only additional research and development, but the marshalling of vast amounts of capital and manpower, and in certain instances the creation of entire new industries. Many of them are aimed at a more rational utilization of coal, either by converting it to clear forms of energy, or cleaning the coal itself before, during, or after combustion.

COAL CONVERSION PROCESSES

The gasification of coal has top priority among all Departmental programs related to coal conversion. The need for pipeline gas is considered to be so urgent that a coal gasification program has been proposed to investigate the possibilities of 7 major coal gasification processes. As the President stated, Federal funds for coal gasification will be stepped up to \$20 million a year. This program will be pursued as a team effort with private industry.

The production of liquid fuels from coal remains an important part of the coal conversion effort. In addition to the conversion of coal to gaseous and liquid fuels, the Department has a modest program aimed at converting coal directly to electricity by passing the ionized gases from its combustion through a magnetic field. This eliminates the intermediate stages of the conventional steam electric plant, and promises a conversion efficiency of as much as 60 percent—half again the best figure attained by conventional plants. This is the magnetohydrodynamic generation of electricity (MHD) about which much has been written in the past few years. The technical obstacles are formidable, and commercial availability is not expected during this decade. In the shorter range, there looms the development of the coal-fired fluidized bed for industrial and utility boilers that can burn coal in its conventional form without pollution.

DESULFURIZING FLUE GASES

Desulfurizing flue gases permits coal to be burned in its solid form, and eliminates the conversion loss that changing it to liquid or gaseous form involves. Five processes are currently being investigated by the Department of the Interior; others are being considered. The more promising of these processes may be demonstrable on commercial scale equipment within 5 years.

OIL SHALE DEVELOPMENT

Our oil shale resources are enormous, approaching the scale of our coal resources, and 80 percent of them are on Federal lands. A prototype leasing program is being readied for implementation if the requirements of the Environmental Policy Act can be satisfied. Toward this end, Departmental staff members have worked extensively with state officials of Colorado, Wyoming, and Utah to understand the nature and extent of the environmental impact of oil shale operations. As the President has indicated, a program is being prepared to overcome past problems—environmental, technical, economic—that have thwarted development. This program will permit us to pursue title clearance actions, collect and analyze resource information, further develop our knowledge of retorting oil shale *in situ* and recovering the fluids through wells, and increase our competence at solving environmental problems associated with oil shale operations. The program and its related environmental impact statement are in the final stages of preparation. Both are expected to be ready in the near future.

NUCLEAR STIMULATION OF NATURAL GAS SUPPLY

The Rocky Mountain area also holds a great potential for additional gas supply, provided the resource can be freed from the formations in which it is now so tightly bound that less than ten percent is recoverable. The Department estimates that a significant portion of 300 trillion cubic feet of natural gas might be recovered from these formations if stimulation through nuclear explosive fracturing proves to be technically feasible and economically practicable. The Department of the Interior, in cooperation with the Atomic Energy Commission and private industry, has sponsored a program aimed at increasing recovery through nuclear fracturing of the reservoir rock. The results of the two tests conducted so far, Gasbuggy and Rulison, are still being evaluated, and much additional information must be developed. The start of commercial development—assuming test results are favorable—is probably three or more years away, with gas from this source becoming significant in the latter half of the decade.

OTHER PROGRAMS

Other programs the Department of the Interior is proposing relate to the delineation of additional methods of recovering, processing, and utilizing tar sand resources in the United States; identifying and evaluating areas for geothermal energy; and the development of improved methods for the location of oil and gas deposits. These programs are modest in scope, although the geothermal effort is currently being reviewed for possibilities of expansion. Active consideration is being given to a lease sale of geothermal resources at some time in the fall of this year in accordance with the President's wishes.

ORGANIZING FOR EFFECTIVE ENERGY POLICY ADMINISTRATION

As the agency of the Executive Branch principally concerned with the Nation's natural resources, including its energy resources, the Department of the Interior has long played a leading role in resource management and development. It was recently given new responsibilities under the Mining and Minerals Policy Act of 1970 to report to Congress annually on the utilization and status of fuel minerals and to develop legislative programs to further the policies of the Act. We are presently organizing for the initial report to be made covering the year 1971.

The second vital reform is the President's reorganization plan which will centralize the responsibility for national energy policy within the proposed Department of Natural Resources. This new department would complement the energy functions now being discharged by the present Department of the Interior with additional important energy responsibilities now located elsewhere in the Executive Branch. In the President's own words, "A single agency authority which would thus be created would be better able to clarify, express, and execute Federal

energy policy than any unit in our present structure. The establishment of this new entity would provide a focal point where energy policy in the Executive Branch could be harmonized and rationalized."

The Department of the Interior has historically viewed the assurance of an adequate, secure, reasonably priced supply of energy to the Nation as one of its major responsibilities. This Department has long pursued this objective by locating, mapping and defining potential resources; assisting with the development of technology for the production, processing and use of energy; managing Federal lands on and offshore to assure orderly resource development; and endeavoring to promote an economic environment conducive to an optimum level of private investment in energy development and use.

Proper discharge of this responsibility is becoming increasingly difficult and complex. As our society has grown and matured, we have recognized other national objectives, many of which relate to the production of energy, its conversion, its distribution or its use, and frequently all of these. These other objectives increasingly have to be taken into consideration in the provision of adequate energy supplies. Often they impose constraints upon the energy industries; they also may demand additional energy supplies.

Moreover, the expanding interfaces between energy problems and other matters of concern to governments at all levels have led to widespread interest in energy to some overlapping responsibilities and in a number of instances to conflicting objectives. This proliferation of involvement with energy matters makes it essential both to maintain a communication among related interests and to provide a focal point for the clearance of energy information problems and programs.

Under the new concept of organization to meet the Federal government's responsibilities in the climate of growing concern for our energy supply certain principles can serve as useful guides to policies and programs that are addressed to energy matters:

1. There should be a clear recognition of the division of responsibilities between the public and private sectors.
2. Public policy should include incentives and regulations that stimulate the exploration for and development of, energy resources on all lands, including the Outer Continental Shelf Alaska, and the western United States coal and oil shale lands.
3. Provision should be made for establishing national and regional authorities to investigate, coordinate, and authorize the siting, construction and operating conditions for power plants and other facilities necessary for energy demands.
4. The public sector should guide and encourage by incentives or appropriate funding, research and development activities that lead to more efficient production conversion and utilization of all energy resources.
5. The provision of fuels and the protection of the environment are inter-related but the fact that costs are associated with the attainment and preservation of a quality environment must be recognized.

DEPARTMENT OF THE INTERIOR ACTIONS

In terms of the Department's presently constituted responsibilities, the following actions will be taken within the limits of resources provided to improve its performance in response to the President's call for a broadfront attack on the Nation's energy problems:

The Department will expand existing programs and institute new ones to accelerate the development of energy resources on all public lands. In this regard, the Alaskan oil issue is receiving careful attention. Regularly scheduled sales of oil and gas leases in the OCS will be held at frequent intervals to encourage the orderly development of these areas.

The Department will expand research and development efforts to: devise and improve methods and techniques to discover and assess new energy resources; develop improved recovery methods; develop synthetic and substitute fuels from natural resources; improve the efficiency of converting and utilizing fuel resources; develop new technologies for the removal of potential pollutants from fuels, either before, during, or after combustion; and develop feasible methods for utilizing energy values from garbage, waste, and other urban refuse.

Needed R & D achievements are as follows:

Development of improved radiometric, seismic, magnetic, or other geological methods for the location of hydrocarbon deposits.

Development of commercial viable processes for the removal of sulfur oxides from stack gas emissions.

Development of economical methods for the conversion of coal into gaseous and liquid fuels.

Development of fluidized bed boilers.

Completion of a national reconnaissance inventory of mineral fuel reserves and resources.

Development of low sulfur, low ash, coal products.

Development of improved oil recovery techniques such as miscible fluid or thermal methods.

Development of nuclear or other fracturing techniques for low permeability gas deposits.

Development of economic methods for oil shale and heavy oil recovery.

Development of fuel cells, MHD, and other improved conversion processes.

Development of processes for production of fuels from urban refuse.

Development of significant geothermal energy sources.

Development of methods for the reclamation of or safe storage or disposal of industrial liquid and solid wastes resulting from fuels and mineral processing.

Commercial application of nuclear breeder reactors.

Commercial development of new energy conversion systems such as thermionic, thermoelectric, or similar systems.

Development of new energy systems from tidal, nuclear fusion, or solar sources.

CONCLUSION

The United States is entering a period of increasing demand for energy, and supply problems such as declining reserves of domestic petroleum and natural gas, aggravated by restrictions placed on the burning of high sulfur coal which tend to increase demand for oil and gas. The deficiency of domestic resources can be filled by increased usage of foreign oil, which means predominantly oil from North Africa and the Middle East. It is proposed that we proceed without delay to develop our own energy resources of all types. These resources are enormous, and they are adequate to meet all our needs for the foreseeable future. The challenge is to make them available in the proper forms as they are required. The President's message articulates this objective.

To accomplish this purpose, a number of programs are being proposed by the Department of the Interior, and certain principles have been suggested to guide the Nation's general policies and programs addressed to energy.

The action of the Congress in passing the Mining and Minerals Policy Act focuses strongly upon the problem of assuring an adequate supply of energy to the Nation, and upon the department of the Interior's responsibilities in energy matters. The President has proposed a reorganization and strengthening of the Department's capabilities to carry out these responsibilities.

Under guidance of the Congress and under the organization and administrative arrangements proposed by the President, there are excellent reasons to believe that the new Department of Natural Resources can make its full contribution to the goal of assuring a secure and adequate supply of energy to the United States, won from our own soil in harmony with the environment, at costs which are reasonable in view of the value received.

TABLE 1.—CONTINGENCY FORECASTS OF DEMAND FOR ENERGY RESOURCES BY MAJOR SOURCES AND USES, YEAR 2000

	Anthracite		Bituminous coal and lignite		Natural gas, dry ¹		Petroleum ²		Total (trillion B.t.u.)	
	Million short tons	Trillion B.t.u.	Million short tons	Trillion B.t.u.	Billion cubic feet	Trillion B.t.u.	Million barrels	Trillion B.t.u.	Unadjusted	Adjusted
Household and commercial:										
Low range	(7)	2.0			13,800.0	14,242.0	318.0	1,992.0	16,236.0	21,142.0
High range	.5	13.0		8,790.0	22,227.0	22,938.0	2,440.0	13,940.0	45,681.0	40,774.0
Industrial:										
Low range	(5)	(21.0)	(88.7)	(2,399.0)	(15,930.0)	(16,440.0)	(1,445.0)	(7,367.0)	(26,227.0)	(32,982.0)
High range	.8	(72.0)	(744.6)	(20,127.0)	(21,097.0)	(21,772.0)	(4,882.0)	(24,783.0)	(66,754.0)	(59,999.0)
Food and kindred products:										
Low range			1.2	32.0	1,205.0	1,244.0	3.0	17.0	1,293.0	1,535.0
High range			24.3	653.0	1,710.0	1,765.0	58.0	331.0	2,749.0	2,506.0
Paper and allied products:										
Low range			7.6	204.0	830.0	857.0	5.0	27.0	1,088.0	1,321.0
High range			34.3	926.0	1,080.0	1,115.0	77.0	445.0	2,486.0	2,253.0
Chemicals and allied products:										
Low range			20.0	540.0	3,405.0	3,514.0	944.0	4,336.0	8,390.0	11,169.0
High range			247.3	6,675.0	3,630.0	3,746.0	3,172.0	14,638.0	25,059.0	22,281.0
Petroleum refining and related industries:										
Low range			72.6	1,952.0	1,820.0	1,878.0	394.0	5,493.0	4,271.0	5,314.0
High range					3,250.0	3,354.0	860.0	5,222.0	10,528.0	9,486.0
Stone, clay, glass, and concrete products:										
Low range			10.0	270.0	1,020.0	1,053.0	2.0	10.0	1,333.0	1,566.0
High range			36.6	987.0	1,510.0	1,558.0	32.0	184.0	2,729.0	2,496.0
Primary metal industries:										
Low range	7	17.0	29.5	802.0	1,540.0	1,589.0	23.0	138.0	2,546.0	3,588.0
High range	2.6	66.0	180.2	4,901.0	2,130.0	2,198.0	277.0	1,638.0	8,803.0	7,760.0
All mineral and other manufacturing industries: ⁷										
Low range	2	4.0	20.4	551.0	6,110.0	6,305.0	74.0	446.0	7,306.0	8,489.0
High range	.2	6.0	149.3	4,033.0	7,787.0	8,036.0	406.0	2,325.0	14,400.0	13,217.0
Transportation: ⁸										
Low range			380.0	9,956.0	1,700.0	1,754.0	5,443.0	30,464.0	32,218.0	36,359.0
High range					2,800.0	2,890.0	7,890.0	44,221.0	57,067.0	52,927.0
Electricity generation, utilities: ⁹										
Low range (low fossil; high nuclear)	1	2.0	845.0	20,282.0	3,370.0	3,478.0	137.0	861.0	24,623.0	29,505.0
High range (high fossil; low nuclear)	.3	6.0	1,520.0	36,480.0	9,576.0	9,882.0	1,200.0	7,544.0	53,912.0	49,029.0
Miscellaneous and unaccounted for:										
Low range										
High range										
Total energy inputs:										
Low range	1.0	25.0	933.7	22,681.0	34,800.0	35,914.0	7,343.0	40,684.0	99,304.0	119,988.0
High range	3.6	91.0	2,980.1	75,353.0	55,700.0	57,482.0	16,412.0	90,488.0	223,414.0	202,729.0
Total energy inputs, cumulative (1959-2000):										
Low range	111.4	2,784.7	21,933.0	545,817.5	848,338.8	875,483.5	191,463.8	1,072,316.2	2,496,401.9	2,782,972.3
High range	188.7	4,771.0	44,740.3	1,149,839.5	1,122,724.4	1,158,651.8	306,936.3	1,690,534.9	4,003,797.2	3,764,243.5

See footnotes at end of table.

TABLE 1.—CONTINGENCY FORECASTS OF DEMAND FOR ENERGY RESOURCES BY MAJOR SOURCES AND USES, YEAR 2000—Continued

	Nuclear power ³		Hydropower (plus imports) ³		Total gross energy inputs ⁴ trillion B.t.u. adjusted	Average heat rate B.t.u. kilowatt-hour	Utility electricity generated and distributed ⁵		Total ³ sector inputs ⁶ trillion B.t.u.
	Billion kilowatt-hour	Trillion B.t.u.	Billion kilowatt-hour	Trillion B.t.u.			Billion kilowatt-hour	Trillion B.t.u.	
Household and commercial:									
Low range					21,142.0		6,127.0	20,906.0	42,048.0
High range					40,774.0		6,929.0	23,643.0	64,417.0
Industrial:									
Low range									
High range									
Food and kindred products:									
Low range					(32,964.0)		(3,285.4)	(11,110.0)	(44,674.0)
High range					(59,996.0)		(3,715.4)	(12,677.0)	(72,671.0)
Paper and allied products:									
Low range					1,535.0		188.7	644.0	2,179.0
High range					2,506.0		213.7	729.0	3,235.0
Chemicals and allied products:									
Low range					1,321.0		169.7	579.0	1,900.0
High range					2,253.0		192.2	656.0	2,909.0
Petroleum refining and related industries:									
Low range					11,169.0		953.7	3,254.0	14,423.0
High range					22,281.0		1,078.2	3,679.0	25,960.0
Stone, clay, glass, and concrete products:									
Low range					5,314.0		132.2	451.0	5,765.0
High range					9,486.0		149.5	510.0	9,906.0
Primary metal industries:									
Low range					1,566.0		160.6	548.0	2,114.0
High range					2,496.0		181.4	619.0	3,115.0
Low range					3,574.0		755.2	2,577.0	6,151.0
High range					7,737.0		854.0	2,914.0	10,671.0

All mineral and other manufacturing industries:

Low range.....	8,485.0	925.3	3,157.0	11,642.0
High range.....	13,217.0	1,045.3	3,570.0	16,787.0
Transportation: ^s				
Low range.....	36,359.0	28.4	97.0	36,456.0
High range.....	52,927.0	32.2	110.0	53,037.0
Electricity generation, utilities: ⁹				
Low range (low fossil; high nuclear).....	632.0	5,056	32,213.0	
High range (high fossil; low nuclear).....	632.0	5,056	36,430.0	
Miscellaneous and unaccounted for:				
Low range.....	5,421.8	40,965.0		
High range.....	3,614.6	31,327.0		
Total energy inputs:				
Low range.....	5,421.8	40,965.0	9,441.0	122,651.0
High range.....	3,614.6	31,327.0	36,430.0	190,127.0
Total energy inputs, cumulative (1969-70):				
Low range.....	29,426.9	240,137.3	489,962.2	2,437,148.4
High range.....	22,177.3	193,190.0	529,129.9	3,291,685.0

^aThe range of forecast demand for individual end uses was subjected to a probability adjustment within 2 standard deviations about the mean. While recognizing that a totaling of the high-low ranges for competing or substitute commodities includes some further bias, this is shown to provide an order of magnitude of the probabilistic range of forecast demand by commodity groupings.

¹ Excludes natural gas liquids.

² Petroleum products including still gas, liquefied refinery gas, and natural gas liquids.

³ Represents outputs of hydropower and nuclear power converted to theoretical energy inputs at the prevailing average heat rate at central electric stations. Excludes inputs for power generated by nonutility plants which are included within the other consuming sectors.

⁴ Gross energy is that contained in all types of commercial energy at the time it is incorporated into the economy, whether energy is produced domestically or imported. Gross energy comprises inputs of primary fuels (or the derivatives) and outputs of hydropower converted to theoretical energy inputs. Gross energy includes energy used for production, processing, and transportation of energy proper.

⁵ Utility electricity, generated and imported, distributed to the other consuming sectors as energy resources inputs. Distribution to sectors is based on historical series in the Edison Electric Institute Yearbook. Conversion of electricity to energy equivalent by sectors was made at the value of contained energy corresponding to 100 percent efficiency using a theoretical rate of 3,412 Btu per kilowatt-hour.

⁶ Energy resource inputs by sector, including direct fuels and electricity distributed.

⁷ Less than $\frac{1}{2}$ unit.

⁸ Includes bunkers and military transportation.

⁹ Adjusted from 43,374 and 28,917, respectively.

Source: Bureau of Mines, Mineral Facts and Problems, 1970 edition. Revised Aug. 31, 1970.

TABLE 2.—U.S. DEMAND FOR ENERGY RESOURCES BY MAJOR SOURCES, YEAR 1970, AND ESTIMATED PROBABLE DEMAND IN 1975, 1985, AND 2000 ¹

	1970 ²	1975	1985	2000
Petroleum (includes natural gas liquids): ³				
Million barrels.....	5,367	6,500	8,600	12,000
Million barrels per day.....	14.70	17.9	23.56	32.79
Trillion B.t.u.....	29,617	36,145	47,455	66,216
Percent of gross energy inputs.....	43.0	40.8	35.6	34.6
Natural gas (includes gaseous fuels):				
Billion cubic feet.....	21,847	27,800	38,200	49,000
Trillion B.t.u.....	22,546	28,690	39,422	50,568
Percent of gross energy inputs.....	32.8	32.4	29.5	6.4
Coal (bituminous, anthracite, lignite):				
Thousand short tons.....	526,650	615,000	850,000	1,000,000
Trillion B.t.u.....	13,792	16,106	22,260	26,188
Percent of gross energy inputs.....	20.1	18.2	16.7	13.7
Hydropower, utility: ⁴				
Billion kilowatt-hours.....	246	282	363	632
Trillion B.t.u.....	2,647	2,820	3,448	5,056
Percent of gross energy inputs.....	3.8	3.2	2.6	2.6
Nuclear power: ⁵				
Billion kilowatt-hours.....	19.3	462	1,982	5,441
Trillion B.t.u.....	208	4,851	20,811	43,528
Percent of gross energy inputs.....	.3	5.4	15.6	22.7
Total gross energy inputs, trillion B.t.u.....	68,810	88,612	133,396	191,556

¹ Preliminary estimates by Bureau of Mines staff.² Latest data.³ Product demand, includes net processing gain.⁴ Includes pumped storage, internal combustion and gas turbine generation. Converted at prevailing and projected central electric stations average heat rates as follows: 10,769 B.t.u./kw.-hr. in 1970; 10,000 B.t.u. in 1975; 9,500 in 1985; and 8,000 in 2000.⁵ Converted at average heat rates of 10,769 B.t.u./kw.-hr. in 1970; 10,500 in 1975 and 1985; and 8,000 in 2000.

TABLE 3.—U.S. FUEL MINERAL REQUIREMENT AND RESOURCES 1970-85 (CUMULATIVE)

[Quintillion Btu's (10¹⁸, or 1 million trillion)]

Item	Requirement	Known reserves ¹	Resources ²	Marginal resources ³
Oil.....	0.65	0.23	3.0	2.1
Gas.....	.45	.28	2.5	.8
Coal.....	.27	3.50	7.0	25.0
Uranium.....	.20	.12	.6	475.0
Oil shale.....				81.0
Thorium.....				546.0

¹ Proved or measured reserves.² Probable or inferred resources that can reasonably be expected to be found and recovered commercially using present technologies.³ Geologic estimates of possible or speculative resources not now commercially recoverable using present technologies.

STATEMENT OF DR. EDWARD E. DAVID, JR., DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY

Mr. Chairman, Members of the Committee, I am very pleased to have this opportunity of appearing before you to discuss the President's energy message transmitted to the Congress on June 4. As you know, this was the first message dealing exclusively with energy ever sent to the Congress by a President of the United States. We believe the President's message represents an important milestone in the recognition of energy policy problems and more importantly in developing a program to supply clean energy for America's future.

The Office of Science and Technology has been deeply involved in the question of energy policy for the past 3½ years since the establishment of an energy policy staff headed by Mr. Freeman. An energy policy group was established in our Office because it was recognized at that time that there was no single group or agency within the federal government with the broad responsibility to examine the issues of fuel supply from an overall energy perspective. Many agencies were and still are, concerned with individual fuels and specific policies involving energy.

The OST Energy Policy Staff was, therefore, charged with evaluating federal policies involving energy and serving as a focal point in formulating government-wide energy policy. This effort was carried out by three professionals in OST, but called upon a much larger support in the federal agencies with statutory responsibility for the various energy programs.

Our efforts have involved leadership and participation in several interagency studies dealing with energy questions such as sulfur oxides control technology, power plant siting, magnetohydrodynamics, and several other small scale contract and panel studies. But perhaps of greater significance than any specific study has been our role in stressing the need for an overall energy approach to the problem.

In this respect we participated in the work of the Ash Council in developing the format for the proposed Department of Natural Resources which would provide a focal point for energy in the Executive Branch. And in the meantime, our Office participated in the establishment of the Domestic Council's Energy Subcommittee and has worked closely with Dr. McCracken, who chairs that subcommittee, since its formation last summer.

Dr. McCracken has outlined the process whereby the Committee went about studying the situation and making its recommendation to the President. We participated in this process and in the final preparation of the message.

I do not wish to recapitulate the message in detail, but rather to make some general observations. The message does not intend to be encyclopedic addressing every possible issue of energy policy. It concentrates on longer term actions which the federal government can take in cooperation with industry to assure clean energy supplies for the future. The problems of this summer, of this year and the next are difficult and must be resolved. They are, however, the primary responsibility of the individual firms in the energy industry, and of the government agencies which regulate them on a day-to-day basis. The message raises our sights beyond these short-term issues to set our goals for the future. Government action can affect the future and indeed the President's program is designed to give the nation a better choice than fuel shortages or pollution. We can and must have adequate supplies of clean energy to meet the needs of the economy and the environment.

The most heartening part of the message to me, a scientist and engineer, were the commitments to developing new technologies. Perhaps the most important conclusion I reached during the course of the study was that our needs for energy and our environmental protection goals will clash if we try to meet the energy demands for the 1980's and beyond with today's technology. The President's energy message is, to my knowledge, the first to propose a research and development response to a major national problem. The liquid metal fast breeder, sulfur oxide control technology, and coal gasification are all key elements in a program to provide clean energy for America's future.

Your invitation to participate in this hearing requested that we cover several important questions concerning the message, particularly how it is to be implemented. The three major research and development initiatives—the Liquid Metal Fast Breeder Reactor (LMFBR), sulfur oxide control technology, and coal gasification—are the responsibility of AEC, EPA, and Interior respectively. I am sure that Secretary Morton and Dr. Seaborg will cover the specific actions involving their own agencies so I will discuss the implementation of those actions involving OST and other agencies.

The development of technology to control the emissions of sulfur oxides from power plants and other stationary sources was assigned to the air pollution control agency several years ago. This agency was transferred to EPA and the new projects are a direct continuation of their current program. Following an inter-agency study chaired by OST, EPA began a program of stack gas cleaning demonstration projects in which the federal funds were matched by industry. This pattern will continue.

In addition to the three priorities fixed in the message, the President requested that I undertake a detailed assessment of the many other technological opportunities for clean energy supply and recommend additional projects for priority attention. Our plans for this effort are still in the formative stage but I would expect this effort to require a period of about a year to complete. We intend to look at each possible new technology which may aid in meeting our needs for clean energy and determine where it stands now, what problems must be solved prior to commercialization, what its potential benefits are, and what problems it may cause. The objective answers to these questions should provide the basis for establishing new priorities and guidance for the nation's energy R&D. We expect to work closely with other federal agencies and to obtain the advice of experts in private industry and at the universities.

The area of energy conservation and more efficient use is another one in which I am deeply interested. Consumers in America are primarily interested in the services they receive from energy use, not in the quantity of fuel they consume. If we can supply these services using less energy at reasonable cost, then we will reduce the upward pressures on energy consumption with its attendant environmental problems. We have already taken one step through the issuance of revised FHA insulation standards which will reduce the maximum permissible heat loss from new federally-insured homes. In the process, the home owner will save money. Mrs. Virginia Knauer is working with the Bureau of Standards and others to develop the consumer information called for by the message. This information will aid consumers in making better choices in purchasing energy intensive equipment.

The power plant siting legislation and government reorganization to establish the Department of Natural Resources are now in the hands of Congress and wait your action. These are key proposals to help resolve the conflict between energy and the environment and to develop more coherent energy programs and policies. We urge your prompt action to approve them. Preparation of draft legislation and the sulfur oxide emissions charge is still underway by Treasury and CEQ. This tax is a new concept in pollution control, but it offers to facilitate the early implementation of our air quality standards as well as to provide funds for the development of clean energy supplies.

As I mentioned at the outset, the message deals primarily with long-term actions to increase the domestic supplies of clean energy and not the many short-term problems confronting us this summer or in the next couple of years. Other long-range questions involving R&D priorities for fusion, solar power and the like were not settled, but the assessment which the President asked me to undertake is intended to provide information on which to base the answers.

I believe it is important to recognize that the problems of energy supply are susceptible to technical solutions. The President's message makes commitments to new technology that we have good reason to believe can be successfully developed. The nuclear breeder reactor, for example, is not just a vague hope. It is backed by a large scale, long term R&D effort and is now ready for the construction of a commercial-size demonstration plant. Coal gasification is likewise technically developed to the point where we can expect good results in a reasonable number of years. And I believe there are other promising R&D areas that will emerge as deserving a stronger effort. Research and development can provide fundamental solutions to our goal of a clean energy supply.

I hope these comments will be of use to you and I would be pleased to answer your questions.

STATEMENT OF DR. GLENN T. SEABORG, CHAIRMAN, U.S. ATOMIC ENERGY COMMISSION

It is my understanding that this Committee—in cooperation with the other Senate committees having responsibility in the energy field—is undertaking to make a complete and full investigation of energy demands and fuel resources, evaluate all possible methods of energy production and recommend policies which would insure that the Nation's need for clean low-cost energy is fulfilled. The role that this Committee is taking in assuring a coordinated effort to provide for the Nation's energy needs without adversely affecting the quality of the environment is a task to which we in the AEC also have been dedicated.

Consistent with the Committee's advice, my statement today will concentrate on the program laid out in the President's Energy Message of June 4th to the Congress. Particular emphasis will be placed on how the AEC is implementing those elements of the President's program which pertain to atomic energy. Before I discuss our specific AEC efforts, however, I would like to make a few overall comments regarding major energy policy issues and goals in response to the Committee's request.

MAJOR ENERGY ISSUES

In our view, the major energy issues facing this country were articulated very well in this Committee's recent print "A Review of Energy Issues and The 91st Congress" which was prepared by the Environmental Policy Division of the Library of Congress. This document has provided an excellent review of the energy issues and the status of the activities directed toward their solution. The

following list, derived from the Committee's print, summarizes those issues of special importance to the AEC:

1. Siting of electrical generating plants.
 2. Reliability of electric power generation.
 3. Adequacy of energy supplies to meet projected demand (for each fuel form).
 4. Environmental factors affecting fuel selection, availability and use.
 5. The role of government in nuclear energy development.
 6. Methods of encouraging exploration and development of indigenous resources.
 7. The relative roles of indigenous and imported energy supplies in maintaining "security" and "self sufficiency".
 8. Methods for encouraging competition in the energy industries.
 9. The role of the federal government in energy research and development.
 10. Energy utilization and the balance of payments.
 11. Management of the Federally owned energy resources.
 12. Energy as a means of recycling other materials—the "ultimate resource."
- A number of these issues will be touched upon in the material that follows.

GOALS OF ENERGY POLICY

The President's Message set forth the overall national goal which our energy policy should seek to advance: a sufficient supply of clean energy to sustain healthy economic growth and improve the quality of our life. We strongly believe that nuclear energy and particularly the breeder has a vital role to play in meeting this goal.

There are, of course, subsidiary goals which an energy policy should advance in our view. These include:

1. Conservation of an appropriate portion of our energy resources for future generations.
2. development of new energy sources as well as the improvement of existing sources.
3. improved efficiency of energy conversion, transmission and utilization.
4. minimum dependence on energy from foreign sources.
5. increased substitutability and flexibility among energy sources.
6. optimum use of energy resources for specific applications.
7. open and free competition among energy sources.

Government policies should prescribe the framework within which the energy industries carry out their task of enduring adequate and secure supplies at reasonable competitive costs. There has to be a continued dependence upon effective performance by sound and viable industrial firms. The Government, through a combination of incentives, regulations, and direct support, must assure that the energy sector develops in a way that meets social, environmental, and economic requirements.

Major undertakings such as those necessary to prove out a new technology may require Government sponsorship. Government will need to assist when the undertaking exceeds industry's capability and resources, when the probable benefits are widely dispersed throughout society, when the welfare of future generations is involved, or when necessary to maintain effective competition among and between energy sources.

I would now like to proceed with a summary review of the several nuclear energy programs discussed in the President's Message.

BREEDER PROGRAM

Let me begin with the fast breeder reactor program which the President described as our best hope for meeting the Nation's growing demand for economical clean energy.

First let me remind you that the nuclear power plants being installed today utilize light water cooled reactors. This class of nuclear power plants has reached commercial status and is rapidly assuming the burden of providing an increasing proportion of the Nation's electric energy requirements. The commercial introduction of the light water reactor was based initially on its ability to compete economically with fossil-fired plants. However a major factor in the continued sale of light water reactors is the recognized advantage of providing electric power without releasing products of combustion to the environment, as well as their essential independence from the geographic aspects of fuel supply.

We anticipate that 30 years from now nuclear power plants will be generating over one half of the Nation's total electric power. This growth probably would not be achieved if we were counting on doing the job exclusively with today's commercial light water reactor plants. While these plants must be the work-horses of the nuclear power industry in the years immediately ahead they must be coupled with other more advanced types to fulfill our longer-term energy needs, while at the same time satisfying environmental and social concerns about large-scale energy production.

Current light water reactors have many advantageous characteristics but they do not achieve thermal efficiencies comparable to the more advanced reactors now under development. Further they extract only between 1 and 2 percent of the energy potentially available from their uranium fuel. They are, therefore dependent on the availability of large amounts of low price uranium ores to keep their power costs economically competitive.

Fortunately nature has arranged things so that we can obtain through the breeder reactor principle a large fraction of the vast amounts of energy locked up in our uranium and thorium resources. Furthermore, breeder reactor power costs will be relatively insensitive to the cost of the uranium and thorium thus opening up the economic use of low-grade as well as high-grade ores.

The breeder reactor gets its name from the fact that it will produce more fissionable material than it consumes. Breeding can be accomplished by two different methods. One involves the thermal breeder employing slow (thermal) neutrons; it works best on the thorium-232-uranium-233 cycle—called the thorium cycle. The other is the fast breeder employing more energetic (fast) neutrons; it operates best on the uranium-238-plutonium-239 cycle—called the uranium cycle.

Since the fast breeder uses the uranium cycle it is complementary to the light water reactor which also employs this cycle. We see the transition from the light water reactors to the fast breeders as an orderly process in which the plutonium produced by the light water reactors helps supply the fast breeder reactors until they have operated long enough to provide a completely self-sufficient fuel system. In such a system, each fast breeder reactor would, in about ten years, produce enough fissionable fuel to refuel itself and one other reactor of equal size.

BENEFITS OF BREEDER

In taking full advantage of the fast breeder we can extend the use of our uranium resources from decades to centuries and, at the same time, produce economic electric power. The financial dividend associated with the introduction of the breeders will be very large. If we introduce the commercial fast breeder in the mid 1980's, the gross benefits to this Nation from electrical energy savings in the 35-year period following could be more than \$350 billion in terms of today's dollars.

In addition to the economic and resource conservation benefits associated with the breeder, significant environmental advantages will accrue from its use. As with the light water reactor, the breeder will not add products of combustion to the atmosphere. Since the breeder will operate at high thermal efficiencies, the amount of waste heat released to the environment per unit of power produced will be comparable to that from the modern fossil-fueled power plant. Further reductions will be made in the already very low releases of radioactive wastes to the environment at the nuclear plant site.

The projected operation of about 150,000 MWe of light water reactor plants by 1980 will result in the production of many thousands of kilograms of plutonium. This plutonium will be much more valuable as fuel in fast breeder reactors than it would be if it were recycled back into the light water reactors. The projected economic advantages of the fast breeder reactor, coupled with the rapidly expanding energy needs and with the additional incentive offered in the optimum utilization of perhaps a billion dollars worth of plutonium, have provided emphasis to the program of fast breeder development.

About five years ago, as a result of the many important implications of the large scale commitments to the commercial light water reactors, an intensive breeder reactor development program was undertaken aimed at making this type of reactor a commercial reality, following about 20 years of more fundamental development of the breeder principle. With the many pressing national funding needs, the effort was focused on one breeder system, the Liquid Metal Fast Breeder Reactor (LMFBR), because of its favorable performance and economics, the support of the reactor manufacturers and electric utilities, and the great body of base technology and organizational and operating experience already available here and abroad.

Liquid metal (sodium) was chosen as the coolant for several reasons, among which was the fact that over the years substantially more experience had been acquired by the laboratories and industry—both here and abroad—with liquid metal systems than with the other coolants for the breeder application. This experience included that gained from the operation of a number of experimental reactors using a liquid metal coolant. These reasons were strong enough to offset some unfavorable characteristics of sodium such as its high chemical reactivity.

Most of the other major industrial nations in the world have made the LMFBR their highest priority energy development program and have also committed significant resources to test facilities and demonstration plants. For example, the Soviet Union is well along in construction of the world's two largest LMFBRs of 350 and 600 megawatts electric (MWe) capacity, and the United Kingdom and France are scheduled to begin operation of 520 MWe plants in 1972 and 1973, respectively. Japan and West Germany have also initiated strong programs.

CURRENT STATUS

The U.S. effort on the LMFBR has been significantly strengthened over the last several years. Available resources—test facilities, technical and management personnel, and funds—have been focused. A comprehensive National LMFBR Program Plan has been prepared and implemented. New major test facilities, such as the 400 MWt Fast Flux Test Facility (FFTF) in Hanford, Washington, are being constructed, and other existing proof-test facilities, such as those at the Argonne National Laboratory complexes in Chicago and Idaho, and the Liquid Metal Engineering Center (LMEC) in California, are being upgraded.

While development of the LMFBR system is recognized to be complex, difficult and costly, its practicality has already been established in this country and abroad. Research and development over the past two decades, intensified during the last five years, has established a sound technology base and identified the remaining tasks to be completed; the transition into the design, engineering and prooftesting of commercial sized components has begun.

DEMONSTRATION PLANT PROGRAM

As indicated in the President's Message, the next step toward timely demonstration of commercial breeder capability is to promptly and effectively implement a demonstration plant program. This demonstration plant in the power range of 300–500 MWe will be a cooperative undertaking among industrial contractors, the utilities, and the Government.

A demonstration plant will bring together, in the most meaningful manner possible, the results of the many years of extensive research and development and will consolidate and confirm these results in an operational power plant in its intended utility environment. Just as the Fast Flux Test Facility Project in the State of Washington is now doing, the demonstration plant program will provide extensive and important technical and engineering feedback into the ongoing liquid metal breeder effort.

Following the demonstration plant program, and as additional technical knowledge and engineering capability accumulate, it will be possible to initiate design of larger plants in the 800 to 1000 MWe size, the size range of most of the large commercial light water reactor plants now being constructed.

During the early to the middle 1980's it is expected that significant commitments will be made for the construction of large commercial size LMFBR plants, permitting this concept to be introduced into the power economy in a significant way in the late 1980's and establishing a viable breeder industry to meet the future long-term energy needs of the nation.

We believe that, as a result of a deliberate and well-planned buildup, the fast breeder program has reached the stage where the transition from the technology phase to the demonstration and commercial phases can take place in an orderly manner. The program proposed by the President establishes a national program goal which will serve to enhance the cooperative effort of the three groups participating in the breeder program—the utilities, the reactor industry and the Government. It will provide additional funding for the Demonstration Program and for the design, manufacture and test of prototypic size hardware of the major components of the LMFBR reactor system. It will allow also additional research into the technology and safety of breeder reactors to assure the timely application of the LMFBR system to large-scale utility use.

OTHER CONCEPTS

Though priority has been given to the LMFBR, investigations are continuing on other advanced reactors which have an important potential for increased fuel utilization or breeding. These include two thermal neutron breeder concepts utilizing the thorium cycle: the Molten Salt Breeder Reactor (MSBR) under investigation at the Oak Ridge National Laboratory and the Light Water Breeder Reactor (LWBR) being investigated under Admiral Rickover's direction. In addition, considerable interest exists in the U.S. and abroad in the development of the Gas Cooled Fast Breeder Reactor (GCFBR) which employs the uranium cycle.

The objective of the LWBR program is to develop the technology necessary to significantly improve the fuel utilization in light water thermal reactors. A core is being fabricated for installation in the Shippingport reactor and the breeding demonstration will be initiated in FY 1975. Successful completion of the demonstration will show that it is feasible to install breeder cores in existing and future pressurized water reactors.

The molten salt reactor has the potential for attractive fuel cycle and power generation costs, low fuel doubling time and high thermal efficiency. While work on this concept was initiated in the late 1940's, the technology is at an early stage of development with respect to its engineering base and reactor operating experience. Further work is required on fuel reprocessing and on major reactor components and materials unique to the MSBR. Development of the technology for a potentially useful commercial reactor would require a greatly expanded government program and expanded industrial support.

The gas cooled breeder reactor shares many of the attractive potential advantages of the MSBR including low fuel-cycle costs, improved fuel utilization and increased thermal efficiency. Studies to date indicate that it has a potentially high breeding ratio and fuel doubling times of less than ten years.

I should also mention one other concept—the High Temperature Gas Cooled Reactor (HTGR)—which like the MSBR and the LWBR employs the thorium cycle. Although not a breeder, the HTGR offers substantial improvement in fuel utilization, reduced sensitivity to rising ore costs, and reduced thermal discharge because of its high thermal efficiency. A prototype plant based on this concept, Peach Bottom I, has been in operation in Pennsylvania since 1967, and a 330 MWe prototype, Ft. St. Vrain, is under construction in Colorado.

NUCLEAR FUEL AVAILABILITY

The President's Message emphasized the importance of an adequate supply of energy in the decades ahead. Since the supply of energy is dependent upon the availability of fuel, I would now like to discuss the adequacy of our nuclear fuel supplies, including the important action taken by the President to help assure sufficient capacity in our uranium enrichment plants.

Uranium can be obtained from many grades of ore and various other sources. The resource currently being exploited is uranium-bearing rock from which uranium can be recovered at prices below \$30 per pound of uranium oxide (U_3O_8). The AEC estimate of U.S. uranium resources, as of January 1, 1971, available at less than \$30 per pound U_3O_8 is 2.4 million short tons, including both reasonably assured reserves and estimated additional resources. The full extent of our uranium resources is not yet well known. Exploration has been underway for only about 25 years, and resources are increasing as exploration continues.

The uranium producing districts and ore processing mills are entirely in the western United States, primarily in four states: Wyoming, New Mexico, Colorado, and Texas. There are also less important producing areas in Utah and Washington.

Assuming the utilization of only light water reactors, the energy content in the AEC estimated U.S. uranium resources (at a price of U_3O_8 up to \$30 per pound) is about 1 Q, which is a quintillion Btu. A quintillion Btu is a very large amount of energy, a billion billion Btus. The entire total energy requirement in the U.S. from now to the year 1985 is estimated to be about 1.5 Q.

Since breeder reactors will extract over 30 times the amount of energy from a given amount of uranium than can be extracted by light water reactors, they will greatly extend the Nation's energy resources. In addition to being able to more efficiently utilize uranium, breeder reactors are much less sensitive to raw material price than light water reactors. An increase in the cost of uranium in a breeder from 10 to 100 dollars a pound of U_3O_8 would increase the cost of electricity from breeder reactors by only about 0.2 mill per kwhr. This insensitivity to raw mate-

rials price enables breeder reactors to take advantage of higher cost resources, further extending energy resources. Breeder reactors also will enable utilization of the large amounts of uranium-238 "tails" obtained as a by-product from enrichment plant operations. (see next section)

The resources of thorium, the other source of nuclear fission power, are large relative to expected requirements. Reactor systems analyses indicate that, even with installation of 500,000 megawatts of uranium-233 fueled (the thorium cycle) reactors by the end of the century, which now seems unlikely, there would be a cumulative requirement of only 67,000 tons. This is less than the presently known low-cost domestic thorium reserves.

CASCADE IMPROVEMENT PROGRAM

Uranium as mined from the ground must be enriched in the fissionable isotope U-235 in gaseous diffusion plants before it can be used in light water reactors; the residue called "tails" contains less than half of the original proportion of U-235 and is useful mainly for breeding in fast reactors. As the President pointed out in his Message, diffusion plant expansions are required so that we can meet the growing domestic and foreign demands for nuclear fuel in the late 1970's.

The most economic and timely means available for expanding uranium enrichment capacity is to modernize the existing gaseous diffusion plants at Oak Ridge, Tennessee, Paducah, Kentucky, and Portsmouth, Ohio through a Cascade Improvement Program (CIP). The CIP, by modifying the cascade equipment to incorporate the latest gaseous diffusion technology, will increase the operating capacity of our three gaseous diffusion plants from 17.1 million units of separative work per year to 21.9 million units per year. This would be an increase of approximately 28% in separative work capacity for a total capital investment of 525 million dollars (1972 dollars). The incremental 28% production can be provided with no overall increase in operating costs or electric power consumption and is estimated to cost only \$16 per unit of separative work using a ten-year amortization period and a 7½% interest rate. This may be compared with the price of \$28.70 per unit of separative work in existing plants.

Implementation of the Cascade Improvement Program will:

1. Provide assurance that the United States will have the enriching capacity required to meet the growing demands for nuclear fuel in the late 1970's, both in the U.S. and in other nations for which this country is now the principal supplier.
2. Provide the additional capacity with no overall increase in operating or power costs and thus help to minimize the future cost of uranium enrichment.
3. Provide the additional capacity without use of additional electric power, thereby reducing power requirements by approximately 1200 megawatts over that which would be required by producing the same amount of additional separative work in a new gaseous diffusion plant.

PLOWSHARE

As the President stated in his Energy Message, "additional supplies of gas will . . . be one of our most urgent needs in the next few years." Recognizing this fact, the AEC has been concentrating in its Plowshare program on developing nuclear gas stimulation technology which would permit the Nation to tap the 317 trillion cubic feet of gas estimated by the Bureau of Mines to be potentially available from the tight gas formations of the Rocky Mountain area. This is an amount greater than the current reserves.

Projects Gasbuggy and Rulison, the two nuclear gas stimulation experiments conducted to date, demonstrated that nuclear explosions can significantly stimulate the flow of natural gas not otherwise available. The 26 Kiloton Gasbuggy nuclear detonation resulted in a five- to eight-fold increase in gas production over surrounding wells in the area. While results from Rulison, the second such experiment, are still being evaluated, preliminary analyses indicate that at least a five- to ten-fold increase in gas production was realized. Thus, we know that, technically, gas stimulation works.

Recent economic analyses indicate that, if production and other assumptions hold, nuclear stimulated gas could be produced at about 30¢ per thousand cubic feet at the wellhead and return a profit after royalties and taxes. This compares favorably with other new sources of natural gas such as imported liquified natural gas (LNG).

From the time we began to consider this Plowshare application, the radioactivity which might be added to the natural gas by the explosion has been a

matter of great concern to us. Based on laboratory tests, our original conclusion was that tritium would be the radionuclide to be watched, and indeed one of the purposes of Gasbuggy and Rulison was to study the tritium in the gas. The level of the tritium in the gas freed by these detonations has been lower than predicted. Even so, we are now working on a nuclear explosive which will produce much smaller amounts of tritium. Studies indicate that using this new explosive, and assuming that the gas is used in large metropolitan areas, the radiation exposure to the public would be less than one millirem per year, or 1/100 of the average exposure due to naturally occurring radiation.

Our experience also indicates that seismic motion can be kept to acceptable levels. Both Gasbuggy and Rulison resulted in relatively few claims due to seismic damage. Those received were primarily for such things as cracks in plaster, or broken chimneys. In those areas where ground motion must be reduced, we plan to use multiple explosives of lower yields fired sequentially to reduce the total seismic effect.

Based on our experience to date, we have developed a proposed four year program to answer the remaining questions regarding practical application of this technology. The program consists essentially of four tests to develop a small-diameter, low-tritium, temperature-resistant explosive suitable for nuclear stimulation, and five to six production experiments to be carried out jointly with industry.

We are confident that the companies in the gas industry will continue to cooperate with us in carrying out additional joint government-industry experiments similar to Gasbuggy and Rulison and in this manner defray a large part of the cost of this development. In fact, project definitions—that is joint design efforts—are actively underway for two potential experiments, Rio Blanco and Wagon Wheel. Both experiments would require multiple explosives in a single emplacement hole. Rio Blanco is being sponsored by CER Geonuclear Corporation and would be located in the Piceance Basin of Colorado. Wagon Wheel is proposed for the Pinedale area of Wyoming, and is being sponsored by the El Paso Natural Gas Company, the industrial sponsor of Gasbuggy.

To summarize, we believe that within a few years, at a modest cost, Plowshare can make available significant quantities of competitively priced natural gas not otherwise available. This additional gas supply will buy time for development of other long range means of meeting the Nation's energy needs. Looking somewhat further into the future, the AEC believes that the Plowshare technology also holds considerable promise for recovering our oil shale and geothermal energy resources.

CONTROLLED THERMONUCLEAR RESEARCH (CTR)

The objective of the CTR Program is to create a major new source of energy from nuclear fusion. As the President's Message indicates, recent progress in this program suggests that the scientific feasibility of CTR may be demonstrated in the 1970's. The potential advantages of fusion power in terms of fuel reserves, compatibility with environmental quality, and technological applications are so impressive that the CTR Program should proceed as rapidly as technological progress permits. Some specific potential advantages are:

1. The fuel is inexpensive and very plentiful;
2. Such reactors should be inherently safe;
3. Effects on the environment could be minimal; and
4. High thermal efficiencies are possible, and direct conversion of nuclear energy to electrical energy also may be achieved.

Power through nuclear fusion might be obtained through several different fuel cycles and through a variety of interrelated approaches to the heating and confinement of fusion fuel. The major approaches to fusion devices which are now being pursued in the United States fall into four broad classes: magnetic mirror systems, steady state toroidal systems, pulsed high-beta pinch systems, and laser initiated fusion systems.

Four major phases are envisioned in the development of commercial fusion power. They are:

1. a basic fusion plasma research and development phase in which research experiments to produce, heat, contain and study thermonuclear plasmas are conducted in parallel with the development of associated fusion technologies.
2. a scientific feasibility phase in which experiments are constructed and operated which attempt to reach "break-even" fusion plasma conditions (minimum values of density, temperature, and plasma confinement time) in laboratory

configurations which lend themselves to development into net power producing systems. Fusion fuels need not necessarily be used in these experiments. The program is beginning to enter this phase now.

3. an experimental reactor phase in which one or more experimental reactors, designed to use fusion fuels and to produce net energy in a useful form (steam or electricity), would be constructed and operated.

4. a prototype or demonstration reactor phase in which one or more electric power producing units, including all of the elements of a commercial power plant, would be built and operated. Successful operation of a demonstration plant would be a prelude to commercial sales.

The first scientific milestone was to raise the temperature of an ionized gas (plasma) to over 40,000,000°C so that the production of energy by fusion reactions would exceed the energy loss due to escaping radiation. Several methods of heating have been applied to intermediate-sized plasma and this milestone has been passed. The second scientific milestone was to learn how to contain plasmas with magnetic fields long enough so that the plasma loss rate would be lower than that required for a fusion reactor. Numerous experiments within the past few years, in devices of intermediate size and temperature, have demonstrated confinement times which will be more than adequate for a fusion reactor provided that the same results hold in larger, hotter plasmas. Thus, the second milestone has been passed. The third scientific milestone is to reach actual plasma conditions which would be required for the release of fusion energy to exceed the energy required both to create and to sustain the plasma, i.e., to reach the "break-even" conditions. Reaching this milestone will generally be regarded as constituting the demonstration of scientific feasibility. The current research program is directed toward achieving this demonstration.

As a result of successes of the past few years, scientists are now quite confident about their ability to achieve adequate confinement in the hot dense plasmas (already accomplished) and to achieve thermonuclear temperatures in the well confined plasmas (also accomplished) and, therefore, to pass the third milestone. Plans are now being laid for experiments which, if successful, would extrapolate the presently attainable plasma conditions very significantly—possibly to "break-even" conditions. Such experiments will, of necessity, operate at a higher power level and require larger magnet, heating, and energy storage systems, and will be more sophisticated technically.

We are pleased that the President has requested additional funding in the amount of \$2 million for this important program in this fiscal year. Similarly, we sincerely hope that the Administration and the Congress will fund the necessary increases during the coming fiscal years in order that the scientific feasibility of this concept can be demonstrated in this decade.

POWER PLANT SITING

As the President's Message points out, improved institutional mechanisms are needed to assure that new power plants and their associated transmission lines are completed on time and in a manner which avoids major damage to the environment. The AEC has been deeply involved in the efforts designed to formulate such improvements—primarily through our active participation in the Interagency Power Plant Siting Group.

The results of these efforts were summarized in an Office of Science and Technology (OST) report entitled "Electric Power and the Environment," published last August. A four-point program was proposed in this report for resolving the apparent conflict between power needs and environmental protection.

1. Long-range planning and utility expansions on a regional basis at least 10 years ahead of construction,

2. Participation in the planning by the government environmental protection agencies and private organizations and notice to the public of plant site locations at least 5 years in advance of construction,

3. Pre-construction review and approval of all new large power facilities by a public agency at the state or regional level, or by the Federal Government if the states fail to act,

4. An expanded program of research and development.

The basic conclusion of the report was that, with a program of long range planning in which the environmental protection agencies and private organizations participate at an early stage, many siting problems could be resolved well in advance of construction timetables. The detailed plant review immediately prior to construction could then be expected to proceed in a timely way. And with an

accelerated research and development program, the technology could be more readily available in the future to permit greater flexibility in site selection and could reduce undesirable environmental effects at the site selected.

Hearings have been held on proposed power plant siting legislation by the Interstate and Foreign Commerce Committee of the House of Representatives. Commissioner Ramey presented the AEC's views regarding this legislation to this Committee on May 26, 1971. The AEC supports the enactment of the Administration Bill (HR 5277), since in our view it would best implement the recommendations of the interagency Power Plant Siting Group report.

GOVERNMENT REORGANIZATION

As you are aware, in his Energy Message, the President clearly reaffirmed his desire to consolidate all important energy resources development programs within the new Department of Natural Resources (DNR). The Message indicates that the single energy authority thus created would be better able to clarify, express, and execute Federal energy policy, and that greater balance would also be given to research and development in the energy field.

The President's reorganization plan proposes the transfer of several energy functions from the AEC to the new DNR. The uranium raw materials and enrichment programs would be transferred, and, in addition, the DNR would fund and establish priorities for the Plowshare program and the development of civilian nuclear power reactors. However, the AEC will continue to conduct the research, development, and demonstration (including safety) in the Plowshare and civilian reactor programs because of our expertise and facilities.

CONCLUSION

I would like to conclude by expressing AEC's strong support of the action program laid out in the President's Energy Message. The multifaceted approach should indeed help assure the achievement of our common goal of an adequate supply of clean energy in the years to come.

We are particularly pleased that the vital role of nuclear power has been recognized, and that the President has established as a national goal the commercial demonstration of the breeder reactor by 1980. We also welcome the increased support for CTR, CIP and Plowshare, as well as that for sulphur oxide control technology, coal gasification, and the several other non-nuclear programs. Personally, I have always believed that the fossil fuels and nuclear energy should not be considered as competitors. But as partners, in accomplishing the very difficult task of meeting our growing energy demands.

I am optimistic that we can achieve the clean energy goal, even though I must admit that man often has been reckless, wasteful, and even destructive in his use of energy in the past. I can't agree with those who predict only disaster ahead. Perhaps history reveals much of man's folly, but it also has repeatedly proved man's strong instinct for survival and his ability to counteract environmental problems—natural or of his own doing. What gives me great hope is our increased sensitivity today and our ability to detect, forecast, and deal with environmental changes. This sensitivity and ability are evident, and I think we have the will to use them.

STATEMENT BY JAMES T. RAMEY, COMMISSIONER, U.S. ATOMIC ENERGY COMMISSION

Mr. Chairman, members of the Committee, I am pleased to be given this opportunity to present briefly my views on the President's Energy Message as well as other current and long range energy issues and goals.

As you may know I have devoted much of my time and effort over many years attempting to bring about better long range planning in energy production. My interest began with my work for the Tennessee Valley Authority in the early 1940's and continued throughout my years on the AEC staff and as Staff Director of the Joint Committee on Atomic Energy. More recently, as an AEC Commissioner, I have served as the Commission's representative on the Interdepartmental Study on Energy R&D and National Progress and in dealing on various aspects with the Federal Power Commission and the National Association of

Regulatory Utility Commissioners. I also had a good deal to do with establishing the OST interagency group that put out the pioneer reports on electric power and the environment.¹

In my testimony today, I will try to be mindful of the suggestion made in your letter of invitation that I address, among other things, "other important policy issues not touched upon or developed at length in the President's message."

THE PRESIDENT'S ENERGY MESSAGE

I would like to begin my brief statement this morning by endorsing what Chairman Seaborg has said regarding the development program outlined by President Nixon in his Energy Message of June 4, 1971. As you might expect, I am particularly pleased with the President's endorsement of, and proposed increased funding for, the breeder reactor.

I would like to stress a couple of points in connection with the development of the breeder reactor. The first relates to its environmental aspects.

As you, Mr. Chairman have explicitly recognized for some time, the liquid metal fast breeder can be designed to even improve on the already very low releases of radioactive wastes to the environment at the nuclear plant site. Senator Jackson stated in an address last September that: "... the central thrust of the LMFBR program can truly be identified with the national objective of meeting our energy needs in a way that minimizes environmental effects. Because of certain rather unique characteristics, the LMFBR concept, directed as it is toward high temperature systems and significantly improved fuel utilization, will go even further than the light water reactors toward reducing adverse environmental effects."²

Many of us have for some time advocated moving ahead with the breeder. For example, I indicated last December in remarks in San Diego before the Executive Committee of the Western Systems Coordinating Council as follows:

"Notwithstanding for favorable developments which I have been describing, the fact is that the liquid metal fast breeder program is just not being adequately funded—either in Government or in industry—commensurate with its assignment as this Nation's highest priority energy development program. I strongly believe that dramatic and far-reaching measures must be taken both by Government and industry—and within the next year or two—to increase program funding as was done for the light water reactor development in the late 1950s and early 60s."

* * * * *

"... I concur wholeheartedly with Congressman Holifield and others that the fast breeder is a basic technological challenge of this decade and that we need to establish a national objective for its industrial development and commercial application. I also concur that there is a golden opportunity for the Executive Branch and industry to take the leadership in a program which should receive overwhelming support and cooperation from the Congress."³

The President has seized this opportunity to provide the necessary leadership, and the additional funds he has requested from the Congress—when appropriated—will be most helpful.

The President's message requests an additional \$27 million in FY 1972 for the base breeder program and related technological and safety programs. He has also requested an additional \$50 million in Federal funds toward a demonstration plant. I note, however, that responsible industry people have already expressed concern that, even with this addition, the funding may still be insufficient to do the job—and I should admit that I somewhat share their concern.

In this regard, I believe consideration should be given at the proper time to providing the Commission with additional contractual authority to share some of the risks of the project that may be encountered in the breeder demonstration plant phase. With the Government and industry together sharing some of the risk we might just have the means of bridging the difference between what the Government can provide and what industry believes the Government should provide in order for the effort to succeed.

¹ "Considerations Affecting Steam Power Plant Site Selections," a report sponsored by the Energy Policy Staff, Office of Science and Technology, January 1969, and "Electric Power and the Environment," a report sponsored by the Energy Policy Staff, Office of Science and Technology, August 1970.

² Remarks by Senator Henry M. Jackson, at Groundbreaking for High Temperature Sodium Facility, Richland, Washington, September 24, 1970.

³ "Nuclear Power: 1971", remarks by James T. Ramey, Commissioner, San Francisco Electric Club, March 15, 1971.

I should like to emphasize that the funding of the first breeder demonstration plant is only taking care of a part of the program. In my view, if our breeder program is to move on a timely and economical basis from the experimental and developmental phase to the large scale introduction of the commercial breeder it will be necessary to have at least one additional demonstration plant.

Our experience with the development of light water reactors to the point of general commercial acceptance convinces me that new concepts such as the LMFBR, which involve complex engineering features, require not only a strong base of conceptual work and advanced research, but also sufficient actual operating experience to technically and economically justify the major follow-on commitments which will have to be made by the manufacturing and utility industries to install large numbers of full scale breeder powerplants. Two demonstration plants are also essential to keep competition alive in the nuclear equipment industry.

We are close to moving ahead with one demonstration plant but I urge that we not lose sight of the need for at least a second such plant.

FINANCING R&D IN THE ENERGY FIELD

I might mention in the context of an overall energy policy that the funding problems we are encountering in our efforts to get moving with a breeder demonstration plant are by no means unique. They are instead quite symptomatic of an across-the-board problem that exists in the funding of energy research and development. This is a problem which was not covered in the Energy Message and it is a matter which should certainly be given priority attention.

In addition to the appropriation of more federal funds for energy research and development we must also be thinking of means of obtaining increased funds from the utility industry for this purpose. A number of arrangements have been under consideration recently, including the levying of federal or state taxes based on energy produced or consumed, taxes on effluent emissions, and so on.

It is worthy of note that the State of Maryland recently levied an energy tax to obtain R&D funds and the American Public Power Association last year advanced a proposal for a Federal annual assessment against each electric utility based on kilowatt hour sales with the funds to be expended on projects selected by a co-operative government-industry management group. Similar approaches have been suggested by other including Paul McCracken, Chairman of the Council of Economic Advisors.

While I personally would prefer to follow the voluntary approach to industry funding, I believe the other approaches I've mentioned may be worthy of consideration if sufficient utility contribution is not forthcoming on a voluntary basis.

INTERNATIONAL ASPECTS OF ENERGY

When considering energy in the context of a comprehensive policy, we should of course consider its international aspects. In this regard the role of the peaceful atom in the international sector should be noted. Over the years, we have worked closely with developing countries throughout the world on their plans to introduce nuclear power as a new energy source for further national economic development. The whole Atoms for Peace Program is geared to the concept of assisting developing countries in the realization of the potential of the atom. For example, we have been cooperating with the Government of India in a study of the concept of a combination power plus desalting complex based upon nuclear energy. We have also been working with the Government of Mexico in looking at possible use of very large scale nuclear power desalting plants for the arid Southwest, the output of which would be shared by the U.S. and Mexico. Follow-on studies are now under serious consideration both in Mexico and in the U.S. It is my understanding that Chairman Jackson discussed this potential project at the Parliamentary Meetings with Mexico this Spring.

From the point of view of international trade and the balance of payments, the sale of U.S. reactors abroad and the toll enriching services for foreign reactors by U.S. gaseous diffusion plants have been significant. These activities have also fostered mutual cooperation in the peaceful application of nuclear energy throughout the world.

INDUSTRIAL CONCENTRATION IN THE ENERGY FIELD

There is another aspect of our national energy policy picture which needs attention. It is one that has both short-term and long-term significance. That is the growing tendency towards industrial concentration in the energy field.

One of the early concerns (in 1964 and 1965) was that there were only two suppliers of commercial nuclear power reactors. This problem led to discussions with the Department of Justice, which resulted in an agreement to jointly study the nuclear power supply industry. The study was subsequently carried out for AEC and the Department of Justice by Arthur D. Little, Inc. The resulting report, which included a discussion of policy objectives and possible approaches, was published early in 1969.⁴ The report provides background information and economic data on each segment of the industry and analyzes its economic aspects.

Since those days, our anxiety in that particular area has been relieved. There are now four suppliers of light water power systems and one which supplies high temperature gas reactors. However, this problem of industrial concentration remains with us in other forms. Concern has been voiced regarding recent acquisitions of coal companies and coal and uranium reserves by petroleum companies. For example, Congressman Chet Holifield of the Joint Committee on Atomic Energy in a speech last year at Oak Ridge, Tennessee, said:

"There are related developments afoot which should concern us all as citizens and taxpayers. Today the electricity which lights our homes, lightens our household chores, and turns our factory wheels comes from burning coal, oil and gas. These fossil fuels are rapidly coming under common corporate control. The oil companies are buying into coal and atomic energy. They now own 60% of the large coal mine companies. These power cartels will mean privately-managed price control for private profits. If the great corporations that control the prices of coal, oil, and gas gain control of nuclear fuel through ownership of the gaseous diffusion plants, they will have made their monopolies virtually complete."⁵

The problems of concentration are currently being studied by the Federal Trade Commission and we have been cooperating with FTC and the Department of Justice in trying to develop appropriate guidelines for the developing nuclear industry.

ENERGY ORGANIZATION

I would also like to offer a brief comment or two on the question of organization of the energy development functions on a national scale. Separate and apart from the question of long term Governmental organization to meet this nation's rapidly growing energy needs, I believe there are interim steps which can—and I believe should—be taken to improve and expand upon this nation's energy development programs.

One very logical step acknowledged in the President's message would be that of broadening the Atomic Energy Commission's authority to permit AEC to conduct research and development in all energy areas.

The Commission and its contractors have broad experience in many of these areas already. For example, under the law as it now stands, our laboratories in conjunction with private industry and other governmental agencies have already done extensive research work in such areas as desalting, thermal effects, and power plant siting.

I would emphasize that the Commission, its laboratories and its contractors have unique capabilities which could be devoted to work in the development of new technologies and improvements in existing technologies for the production of energy sources and the generation, transmission and utilization of energy. These capabilities should be used. Let me mention a few examples of this sort of work:

The Argonne National Laboratory is embarked on a significant research program looking toward the development of a long-lived, lightweight battery. While EPA is currently supporting this battery development from the standpoint of pollution-free vehicle propulsion, the idea may be adaptable to bulk energy storage.

⁴A study of "Competition in the Nuclear Power Supply Industry" by the Arthur D. Little Co., sponsored by the Atomic Energy Commission and the Department of Justice.

⁵Remarks by Representative Chet Holifield, Chairman, Joint Committee on Atomic Energy, U. S. Congress, at dinner for Senator Albert Gore at Oak Ridge, Tennessee, July 13, 1970.

Our Oak Ridge Laboratory came up with the concept of large scale floating power plants for use in coastal areas. Such a concept has obvious environmental advantages, such as for cooling water. Westinghouse is seriously interested in the commercial application of this concept and Consolidated Edison and Jersey Central have been looking into it.

Oak Ridge has also studied the idea of large, multi-purpose, agro-industrial energy centers. Such a grouping might include interrelated industrial processes and large scale desalting of seawater for a highly intensified program of irrigating food crops.⁶

In terms of obtaining the much needed coordination between energy development programs, I think this can most effectively be achieved without necessarily a complete reorganization of the involved agencies such as has been proposed by the Reorganization Bills.

For example, in the field of power supply and siting, significant and mutually beneficial coordination and liaison has already been established between AEC and those other agencies of the Federal Government with responsibility for energy and energy resources through the Interagency Power Plant Siting Group which I mentioned earlier. The AEC was delegated to head up the development of this group's research and development recommendations. (See Appendix) Effective—but necessarily limited in scope—cooperation between government and industry in the area of research and development has also been achieved through the Electric Research Council—in which the Interior Department has taken the leadership but in which AEC is also a participant.

I believe that the experience gained in these groups can readily—and perhaps even more effectively—be applied to the development of a coordinated governmental energy effort. A suggestion somewhat similar to this was made by Chairman Nassikas of the FPC in his speech last June at the Edison Electric Institute annual convention in Boston and I believe such a proposal has great merit.⁷

CONCLUSION

In concluding, I would like to stress my belief that we must use all of our energy sources to meet out future needs, and we must learn to use them wisely. I am confident that, through good planning, management, and organization, this Nation's energy needs and the environmental effects associated with energy production and use can be harmonized with minimum adverse effects. We can and must have both additional energy and a healthy and desirable environment, and the public will benefit from such an achievement.

Your Committee and its study can contribute significantly towards this end. Thank you.

APPENDIX

RESEARCH AND DEVELOPMENT RECOMMENDATIONS INCLUDED IN "ELECTRIC POWER AND THE ENVIRONMENT," A REPORT SPONSORED BY THE ENERGY POLICY STAFF, OFFICE OF SCIENCE AND TECHNOLOGY, AUGUST 1970

RESEARCH AND DEVELOPMENT

1. A greatly expanded research and development effort is urgently needed if we are to make significant progress in meeting power needs with less damage to the environment. An expanded R&D program can develop the many technological concepts which promise to alleviate the pressing environmental problems inherent in using present-day generating and EHV transmission technology at any site. We also need to develop new ideas to improve our technology for the production, transmission and consumption of electric power with less impact on the environment and also gain a better understanding of the impact of power production on the physical environment.

The most important requirements are for increased research and development programs to provide:

Improved methods for utilizing or disposing of the waste heat produced by all thermal power plants.

Improved and new methods for reducing, collecting and disposing of the solid and gaseous wastes from fossil fuel plants and of radioactive wastes from nuclear

⁶ "Nuclear Energy Centers, Industrial and Agro-Industrial Complexes, Summary Report," Oak Ridge National Laboratory (ORNL-4291), July 1968.

⁷ Remarks by Chairman John N. Nassikas, Federal Power Commission, at the Annual Convention of the Edison Electric Institute, June 1, 1970.

power plants. Measures to reduce such wastes by improving the fuels are also useful in certain cases.

New and improved methods of power generation which will increase efficiencies in fuel consumption and reduce the volumes of wastes.

Undergrounding of high voltage transmission lines, ultimately permitting large blocks of power to be transmitted from generating sites to the consumer with greater flexibility in siting and routing.

Development of offshore islands, energy centers, and other techniques for improved siting.

Better understanding of the environment itself so that the intrusion of current and future technologies can be minimized.

Chapter VI of this report describes the most promising high-priority R&D ideas which must be undertaken or continued.

2. To accomplish the needed R&D, major new sources of funding will be required. For no matter what measure we use to express current R&D expenditure, as a nation we are not making the investment necessary to do the job. In addition to the investments being made in first-of-a-kind plants, the utilities should contribute much larger funding to the coordinated R&D effort needed and institutional arrangements in the industry for pooling R&D funds and joint sponsorship of research should be strengthened. These industry efforts should be coordinated with federal R&D programs.

3. We believe that uniform rate-making procedures and accounting principles should be developed promptly to authorize the recovery of R&D expenditures in the rate structure of utilities. State and federal regulatory agencies should encourage a greater R&D effort by utilities and remove any doubt that such expenditures are a legitimate expense for rate-making purposes. The requirement for additional concentration of financial and technical resources on the research and development related to power plant siting is most urgent. It is essential that the technical and financial resources of the manufacturing and utility industries be brought more heavily to bear on this problem. A coordinated industry-government program to fund R&D requirements is needed. A vital ingredient in such a program is increased funding of R&D by all segments of the electric utility industry. We believe the federal government should take appropriate action to assure that such funding is forthcoming.

STATEMENT OF GEORGE A. LINCOLN, DIRECTOR OF THE OFFICE OF EMERGENCY PREPAREDNESS

Mr. Chairman and members of the Committee, It is a pleasure to appear here today with other colleagues of mine who serve on the Energy Subcommittee of the Domestic Council. Dr. McCracken has served us well as Chairman of the Subcommittee, and I enthusiastically joined the others in support of the important and substantive recommendations contained in the President's energy message submitted to the Congress on June 4.

The Office of Emergency Preparedness has several roles in relation to fuels and energy. As Director of the agency, I am a member of the Energy Subcommittee. In addition, the Director serves as Chairman of the Oil Policy Committee created by the President in February, 1970. My third hat is that of Chairman of the Joint Board for Fuel Supply and Fuel Transport, created last fall by approval of the President. It should be noted that each of these functions involves interagency effort. In each case my responsibilities are in the nature of policy-making or coordination or both.

In the deliberations of the Energy Subcommittee the Office of Emergency Preparedness participated actively. We reviewed the various suggestions and proposals submitted to the Subcommittee and offered our views freely, and even vigorously where appropriate.

Since about three-quarters of our total energy requirements have been met from oil and gas each year of the last decade, the vital importance of these conventional fuel sources, in addition to coal, must be recognized. However, as Chairman of the Oil Policy Committee, I have become most familiar with the background and operations of the Mandatory Oil Import Program. The past fifteen months have convinced me that we can no longer rest our energy security so heavily on our indigenous crude oil resources alone. We must do whatever is necessary to provide an adequate energy security foundation from all our energy

fuel sources, conventional and unconventional alike. Therefore, one must be greatly heartened by the integrated all-fuels approach to our clean fuel problems, as outlined in the President's message.

As a result of my function as Chairman of the Joint Board for Fuel Supply and Fuel Transport, the Office of Emergency Preparedness is called upon to make frequent assessments of our seasonal and short-range energy supply problems. With the assistance of personnel of the other agencies represented on the Joint Board, the regional offices of our agency assist public and private fuel-users in solving their spot supply problems. I am enclosing for your record a copy of our latest assessment for this summer, which was released on May 17.

Last fall there were widespread reports that there would be fuel shortages and electric blackouts during the winter. These did not develop, fortunately, but the Joint Board did work diligently to overcome spot shortages, particularly in New England. Both federal agencies and private industry are to be commended for their efforts in this regard.

My experience with the Joint Board has caused me to have a clear appreciation of the impact of local, state and federal programs to clean up our environment. As new regulations are adopted limiting sulfur and other emissions, we are narrowing both sharply and rapidly the supply of fuels which will be acceptable under those regulations for the indefinite future. The demand for natural gas and low sulfur oil products has galloped ahead of the available supplies. Consequently, all should applaud the actions by the President to accelerate the development of stack control technology, gasification of coal and the breeder reactor—all designed to give us an assured supply of clean fuels.

I should also add that it is of the utmost importance that we give proper encouragement to early development of oil shale, geothermal steam, and tar sands, with ample environmental safeguards, of course. These are all clean fuel sources and must play their part in giving us a plentiful supply as our energy demands grow in the years to come.

While energy security is not the principal concern of the President's message, all of the actions outlined do in fact contribute to that security. Since the Mandatory Oil Import Program is a security program, it is appropriate for me to comment on this subject in view of my responsibility.

My office recently released a report on the crude oil and gasoline price increases announced by the industry last November. This was the first such formalized report prepared under the direct mandate of Section 6(a) of Proclamation 3279, which created the Mandatory Oil Import Program. That provision requires the Director of the Office of Emergency Preparedness to maintain continuing surveillance over the program. I am enclosing a copy of our report for your records.

From our report it seems clear that the Mandatory Oil Import Program, in effect for 12 years, is no longer alone adequate to achieve the national security we need. True energy security must be based more broadly and our security measures must take account of all our energy resources.

Proclamation 3279, under which President Eisenhower initiated the Mandatory Oil Import Program, and the controlling legislation clearly do not limit the concept of national security to current national defense requirements or to future mobilization needs. National security, in this context, relates directly to the indispensability of petroleum to our economy, our way of life and our strength as a nation. To maintain this concept of national security, there are at least four objectives for a viable oil import control program:

- (1) Maintain a satisfactory level of domestic reserves of crude oil, supplements from secure sources of foreign supply;
- (2) Maintain spare capacity to produce and deliver crude oil when international factors disrupt supplies from other sources;
- (3) Maintain refinery capacity in the United States adequate to meet both defense and essential civilian needs in periods of disruption of normal world oil trade; and
- (4) Provide a healthy petroleum industry in the United States with the capacity to meet the nation's defense and essential civilian needs at all times.

Our proved reserves of crude oil and natural gas are disappointing. The President's message announces actions to be taken by the Department of the Interior which will accelerate orderly offshore leasing. It also acknowledges the steps being taken by the Federal Power Commission to make interstate natural gas prices more competitive with other fuels.

A large sale of offshore exploration leases took place last December. That was the first substantial sale in thirty months. Experience has demonstrated that the

probabilities of large-scale success are greatest on the Outer Continental Shelf and in Alaska. Since the rate of exploration in these areas is under Federal control, it is of vital concern that obstacles to development be removed at an early date. The President's action in regard to offshore leasing is a major step forward in this direction.

Your committee fully appreciates the interrelationship of crude oil and natural gas at the exploration and production level. Through the oil import program we seek to encourage a vigorous exploration and development effort in the United States. At the same time, federal regulation of interstate natural gas sales put ceilings on gas prices which have discouraged the production of coal and residual fuel oil which would ordinarily compete with natural gas for use in electric generation and for many industrial markets. The natural gas industry itself has sold large volumes of interruptible natural gas at marginal cost prices which have encouraged profligate use of this very desirable fuel.

The Federal Power Commission undoubtedly will continue to recognize that natural gas has not been paying its way in our domestic exploration and development effort. According to Federal Power Commission data for 1969, natural gas supplied 44% of the BTU's at the well-head in the United States, but only 25% of the revenue. To some degree, then, the pricing of natural gas has been a disincentive offsetting the incentive we have sought to achieve with the Mandatory Oil Import Program.

The Annual Report of the Council of Economic Advisers, submitted to the Congress in February, recognized the natural gas pricing problem, at page 133, where the following statement appears:

"There appears to be a shortage of one major energy fuel, natural gas; that is, its production is clearly falling short of desired consumption at current prices. Current prices for interstate sales have been kept low by the Federal Power Commission, which sets these prices under law. Not only have prices been too low for desired consumption to be met, but they appear also to have retarded development of new gas supplies. The only satisfactory solution of this problem is to allow the price, at least of new gas not previously committed, to approach the market-clearing level."

In our evaluation of the long-term implications of last fall's crude oil price increases, we considered many of the same economic and resource factors which your committee will be analyzing in the months to come. The status of our crude oil reserves, cost trends, investment requirements, surplus production capacity, natural gas pricing and the role of the independent producer are all important elements in reviewing the crude oil situation in the total national energy perspective.

The point to be stressed continually is that price alone is not the answer to our crude oil problems. At page 45 of our report we suggested that a wide variety of other avenues should be considered, and that some or all of them were needed to supplement the Mandatory Oil Import Program if our national security interests in energy supply are to be achieved. The President's message moves forward immediately along the road we found to be necessary on energy security grounds.

In the course of your studies I realize the Committee will be compiling a vast amount of data from the Federal agencies concerned with energy fuels. Consequently, I have not attempted to provide that kind of information today.

Nevertheless, there are some salient data which should be kept in proper perspective. The United States has on the order of half of all the low-sulfur crude oil found in the world up to this time, even though our total crude oil reserves represent only a small fraction of the world's total. This presents a challenge to develop policies that will make the best use of these resources.

Another point to be made is that we have vast known reserves of coal—far beyond those of any other single nation in the Free World. Even using very conservative measures of technology limitations and economic feasibility, specialists in the Bureau of Mines have told us that the reserves of minable coal available today are the equivalent of three times the entire proved crude oil reserves of the Middle East. With advances in technology we have still further coal resources that could last for hundreds of years.

Using equally conservative assumptions concerning oil shale, we have high quality reserves equal to about double our present proved domestic reserves of crude oil from which commercial production could be commenced now.

In other words, a multi-fuel approach to energy security can still provide us with secure sources of supply of energy fuels.

In closing, I should also comment on the importance of conservation in the use of energy. As our people insist on clean fuels, it is apparent that energy is becoming

more expensive as we become more selective in our demands for fuel. If we are to bridge the transition in the next few years, our efforts should turn to informing our citizens of ways they can both reduce their own living costs and help everyone avoid energy supply shortages.

The recent Joint Board statement previously submitted for your record outlines the actions already under way. In addition, the President's Special Assistant for Consumer Affairs and the Director of the National Bureau of Standards are issuing a most useful brochure this week which will outline 11 ways to economize in the use of energy. These will be continuing programs to help the consumer help himself and also help his country solve its energy problems.

I hope my remarks have been helpful. Thank you for this opportunity to participate in this initial public hearing relating to your committee's energy study.

[Office of Emergency Preparedness, May 17, 1971]

GOVERNMENT TAKING ACTIONS TO MEET SUMMER POWER NEEDS

The government today called on the public, industry and government at all levels to undertake measures for general conservation of energy and to reduce power use during peak load periods this coming summer.

George A. Lincoln, Chairman of the President's Joint Board which coordinates the Federal response to potential fuel and energy crises, today released a Survey of Electric Power Problems for Summer 1971. Included was a statement outlining energy conservation measures.

"I see only five principal sources for dealing with our energy problem," Lincoln said. "The first four are the great energy fuels—oil, gas, coal, and nuclear power. The fifth and perhaps most important is the relatively unexplored source of energy conservation.

"The Joint Board action stresses the last, conservation," he said, "because it has thus far received so little attention. We could build better-insulated houses and use less fuel and electric power. We could use lower-powered and less-polluting cars and less gasoline. We could have less ostentatious and wasteful lighting in many places. Action on conservation might give us the energy equivalent by 1980 of discovering another major oil field without triggering the environmental debate we are having now. In fact, such action would help meet the environmental objectives and help reduce the ever-increasing costs we inevitably have to pay for a cleaner environment. Being lavish with conservation rather than lavish with energy helps both energy security and the family budget."

The Survey is directed at the next few months when the power situation will be tight and could result, during extended and extremely hot periods, in brownouts and selective blackouts in high energy-use areas such as New York, Chicago, and Washington.

Utility fuel supplies have improved significantly during the past year, Lincoln noted, but increased power demands coupled with utility construction delays have caused the power generation reserves in critical areas to be only slightly better than a year ago. "With no prolonged or unusually hot weather, we can get through the summer without serious problems," Lincoln said. But, the report notes, the margins are too tight to depend on this happening. Conservation of power appears to be the most reasonable course.

The conservation program is intended to elicit voluntary response by the general public, industry, and government agency power users. The Special Assistant to the President for Consumer Affairs will spearhead the drive for public conservation of power. The Department of Commerce will lead in advising industry in measures they should take to reduce power loads. The General Services Administration will head the Federal government's internal energy-saving program.

The Joint Board's eight field boards will coordinate Federal conservation measures and assist State and local authorities in instituting similar programs and, resolving problems.

The Survey and statement released today result from continuing studies begun over a year ago by the Joint Board on Fuel Supply and Fuel Transport. The Board comprises the Office of Emergency Preparedness, the Council of Economic Advisers, the Council on Environmental Quality, the Department of Commerce, the Department of the Interior, the Federal Power Commission, and the Interstate Commerce Commission. Other offices participating in the current report include the Office of Science and Technology, the Special Assistant to the President for Consumer Affairs, the Atomic Energy Commission, and the Environmental Protection Agency.

STATEMENT BY HON. GEORGE A. LINCOLN, CHAIRMAN OF THE JOINT
BOARD ON FUEL SUPPLY AND FUEL TRANSPORT

REGARDING ELECTRIC POWER PROBLEMS, SUMMER 1971

The President's Joint Board on Fuel Supply and Fuel Transport, which was created a year ago, has studied problems of electric power supply in various sections of the United States for the coming months. In addition to the Office of Emergency Preparedness, the members of the Joint Board working on the study include the Council of Economic Advisers, the Council on Environmental Quality, the Department of the Interior, the Department of Commerce, the Federal Power Commission, and the Interstate Commerce Commission. Other offices participating in the current report include the Office of Science and Technology, the Special Assistant to the President for Consumer Affairs, the Atomic Energy Commission, and the Environmental Protection Agency.

We find that electric power generating capacity to meet peak loads this summer will be in tight supply in many areas from the Midwest to the Eastern Seaboard and particularly in New York City. Fuel supply to utilities is generally improved, allowing plants to rebuild stocks. Barring unexpected reductions in coal production and imports of residual oil, no interruption of power is expected from fuel shortages. In the areas which experienced difficulties last summer, the reserve margins have improved, but are still below desired levels. Some areas have slightly less reserve capacity than last year. This tight power situation is complicated by regular maintenance deferred because of the power shortages this past winter and other delays affecting the timely completion of units planned for operation this summer.

Electricity is the lifeblood of our industrial economy and an integral part of our way of life. The power industry is shifting to the use of new fuel sources to lessen environmental problems, but this takes time. Eventually, means will be found to control stack emissions and to give us non-polluting power generation, but this must be accomplished in the face of growing power demand. In the meantime, to insure the fulfillment of our desires for the things electricity provides—lights in the home, safety and security in the street, air-conditioned comfort, and cleaner and more flexible power for industry and commercial establishments—and still meet our desires for cleaner air and water, we must eliminate wasteful practices and conserve our energy resources.

For these reasons, the Joint Board has decided to launch an extensive campaign for energy conservation. The campaign will be directed specifically at reducing the heavy energy load during the coming summer, but its effects are expected to extend far beyond this period to upcoming winters and summers.

The program of energy conservation will run in three avenues, aimed at eliciting response from the general public, the Nation's industries, and Federal, State, and local government agencies.

The Public Conservation Program will be spearheaded by the Special Assistant to the President for Consumer Affairs. It will suggest standards and provide guidance to private citizens as to how we may all conserve energy and save money as well. The Environmental Protection Agency and the National Bureau of Standards will cooperate in this effort.

The Industrial Conservation Program will be led by the Secretary of Commerce, and will elicit the aid of industrial and trade associations in informing firms what they can do to save electricity for the long run as well as reduce power during peak load periods.

The Government Conservation Program will comprise a cooperative effort of a number of Federal agencies and State and local authorities. The General Services Administration will lead the Federal program, with the Department of Defense and the individual military services, National Aeronautics and Space Administration, Postal Service, Veterans Administration, and many others participating to lower energy use in Federal buildings and facilities. Programs similar to the Federal one will be recommended to States and cities where power problems are most acute.

Field Boards, comprised of Federal representatives from various agencies, are established in the eight Office of Emergency Preparedness regions and will be local channels for advising States and localities, and businesses, on the measures suggested, and for assisting wherever problems may be encountered such as the lighting requirements for safety, security, and the prevention of crime.

Survey of Electric Power Problems

May 1971



★ ★ OFFICE OF ★ ★
EMERGENCY
PREPAREDNESS

EXECUTIVE OFFICE OF THE PRESIDENT

(125)

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF EMERGENCY PREPAREDNESS
WASHINGTON, D.C. 20504

SURVEY OF ELECTRIC POWER PROBLEMS

Prepared by the Joint Board consisting of
representatives of:

Council of Economic Advisers
Council on Environmental Quality
Department of the Interior
Department of Commerce
Federal Power Commission
Interstate Commerce Commission
Office of Emergency Preparedness, Chairman

With participation from:

Office of Science and Technology
Special Assistant to the President for
Consumer Affairs
Atomic Energy Commission
Environmental Protection Agency

May, 1971

SURVEY OF ELECTRIC POWER PROBLEMS

SUMMER 1971

A. INTRODUCTION

The electric power supply situation in parts of the United States appears to be worse than last summer. It appears that generation and transmission capacity will be the major bottleneck this summer. In some of the areas which had difficulties last year, in the form of voltage reductions, appeals to reduce use and interruption of some industrial loads, the situation has prospects of being better for this summer, although in other areas the reserve margins are lower.

This summer much of the Nation -- particularly the area from the Midwest to the Atlantic Seaboard -- is expected to face an especially tight power capacity problem unless normal summer temperatures prevail and, in general, system capacity performs as scheduled. Equipment breakdowns or unscheduled outages similar to those which have occurred so far in calendar 1971 could aggravate the situation. Because of the continuing tight electric power situation in many areas, especially New York City, normal maintenance has not been performed on some units. In addition, many units are old and unreliable and normally would have been replaced, except for the current problems of obtaining replacement capacity.

At the present time, the most feasible way to avoid an emergency power situation this summer is an extensive conservation program to be exercised by the government, industry and the public during the critical summer months. While other actions, such as bringing new plants and transmission lines on line, making more effective use of standby and emergency units or releasing power from AEC gaseous diffusion plants, are feasible solutions in some situations, electric power conservation during times of peak usage is the key to avoiding major power interruptions this summer.

B. Adequacy of Generating and Transmission Capacity for this Summer's Peak Loads

Some areas of the country may experience power supply shortages this coming summer as a result of inadequate installed capacity to meet summer peak loads.

This capacity shortage is due primarily to delays in placing new generating facilities in service. To make up for the delayed capacity, utilities are installing large blocks of gas turbine capacity, which, while well suited to carry peak loads for short periods, can not be relied on for carrying loads for an extended time.

The percentage of reserve electric power generating capacity margins is expected to be lower this summer than last summer in some areas. The situation may even be worse than the lower reserves indicate. The reserve capacity estimates are dependent on new large units whose reliability is uncertain, a large number of small units which are past retirement age, and some units which have not received adequate regular maintenance because of the continued tight supply situation this past year. In addition, peak loads could be several percent higher than utility estimates. A combination of an intense heat wave and poorer-than-expected power system performance could result in the elimination of reserve margins and a failure to meet peak loads.

The power situation is complicated by regular maintenance deferred because of the power shortages this winter, late deliveries of generating equipment, and other delays affecting the timely completion of units planned for operation this summer. Air or water pollution requirements have resulted in deratings of some existing generating capacity. In addition, ecological concerns have prevented the use of many localities as sites for planned expansion or construction of generating facilities or transmission lines.

On the other hand, there are some compensating factors. The reserve capacity has been determined by comparing estimated 1971 summer peak loads with generating capacity scheduled to be in service as of May 31, 1971. Any capacity which becomes available after May 31 to carry load dependably in advance of summer peaks would increase the indicated reserve margins.

Several nuclear power plants have achieved full power since last summer, and are available for this summer's peak load. Other nuclear plants are in the final stages of construction, and, if not delayed by public hearings, they could in some cases reach full power by late summer. In many cases, public hearings on environmental concerns are in progress, and could result in later operational dates. The total additional

Comparison of Projected Load-Supply Situation
By National Power Survey Region^{1/}
Summer 1970 - Summer 1971

National Power Survey Regions	Estimated Net Dependable Capacity as of May 31	Estimated Peak	Capacity Available for Reserves		Additional Capacity Scheduled for Service During June-July-August	
	MW	MW	MW	% of Peak	MW	% of Peak
Northeast						
1970	61,092	53,653	7,439	13.9	2,270	4.2
1971	67,675	57,196	10,479	18.3	1,125	2.0
East Central						
1970	51,122	43,824	7,298	16.7	1,358	3.1
1971	53,672	47,651	6,021	12.6	951	2.0
Southeast						
1970	59,475	53,209	6,266	11.8	822	1.5
1971	65,957	58,676	7,281	12.4	1,262	2.2
West Central						
1970	38,774	34,403	4,371	12.7	1,137	3.3
1971	42,186	36,996	5,190	14.0	100	0.3
South Central						
1970	45,476	39,016	6,460	16.6	16	0.0
1971	49,454	42,981	6,473	15.1	1,056	2.5
West						
1970	61,876	50,048	11,828	23.6	1,475	2.9
1971	63,335	53,291	10,044	18.8	682	1.3
Contiguous U.S.						
1970	317,815	274,153	43,662	15.9	7,078	2.6
1971	342,279	296,791	45,488	15.3	5,176	1.7

^{1/} Based on data from reports filed in February of each year. The 1970 information was published originally in FPC News Release No. 16755, May, 1970.

capacity estimated to become available after May 31, including both nuclear and non-nuclear plants, scheduled for service during the summer months in the U. S. involves about 5,176 MW or 1.7% of the expected peak.

A reserve margin of about 20% of expected peak loads is considered generally necessary to compensate for the many uncertainties and contingencies that may occur including maintenance, forced outages, and unanticipated increased power use. Systems that seem to have adequate reserves occasionally experience difficulty when one or more large units are forced out of service.

The situation is aggravated by limited transmission capacity. Public resistance to the lines for aesthetic reasons have contributed to keeping required lines from being built. In a number of cases, strong interconnections still do not exist to assure adequate reliability.

1. Northeast Region

Although the reported reserves are slightly better than last summer, conditions are considered to be very tight this summer in the Northeast. The projected capacity includes some 4,000 MW of capacity not yet in service but scheduled for the summer peak. It also includes some 2,500 MW of capacity out of service with extensive damage, scheduled to be back in service before the peak period. Each of the three groups of utilities comprising the region is discussed in the following paragraphs:

a. New England

The New England area peaks in the winter, and summer loads should be slightly less than those of winter. In spite of a 20.5% projected reserve, it is probable that this power pool may face difficult capacity situations this summer when loads approach or exceed the estimated peak, especially if large amounts of capacity are forced out of service.

b. New York State

On the basis of capacity and load data, the New York Pool appears to have a satisfactory reserve generating capacity of 21.2%. However, conditions may not be as satisfactory as indicated, and the pool may be required to reduce voltage and possibly use other load curtailment procedures at times during the summer, as a result of the power requirements of New York City, and the continuing environmental controversies. With the large amount of over-aged equipment still in operation, and the probability of

extensive forced outages, this summer could be one of continuing difficulty. Although power may be available from Canada or other regions of the U. S., lack of transmission capacity may limit the amount of power brought in during peak load periods.

c. Pennsylvania-New Jersey-Maryland

With a reserve of 15.4%, and much of this dependent on new equipment installed this year, it appears that the PJM Interconnection may have a difficult power-supply situation, particularly if some of the new large units are delayed and extensive repairs are not completed before the summer peaks, or if a large amount of forced outages are experienced.

2. East Central Region

This region has a reserve margin of only 12.6%, and some utilities or pools may face a tight supply situation this summer if an appreciable amount of the 2,884 MW of new capacity scheduled for service before the end of May is delayed. There are only four large utilities in the area with less than ten percent reserves, but the indicated reserves of six utilities could vanish if capacity scheduled for service before the summer peak is delayed until after the period.

3. Southeast Region

The Southeast has only 12.4% reserves for this summer, and new capacity scheduled for service before the summer peak composes over half of the indicated reserves. This region will face a tight power supply situation even if all of the new capacity is placed on line as scheduled. The following paragraphs discuss two problem areas in the Southeast:

a. Virginia-Carolinas Group

The four-company group has only 7.8% reserves. This area could experience problems this summer if the new Robinson nuclear unit No. 2 is not fully dependable or if one or two large units are forced out of service. One member of the group, the Virginia Electric and Power Company, considering its firm commitments, has 6.2% reserves for the summer, but some gas turbines are scheduled for June operation and should offer a slight increase in reserve margins. Carolina Power and Light Company has reserves of 6.0% with no more capacity scheduled for the summer. Both companies can call on the system's limited reserves as required.

b. Florida Pool

The pool reserve is only 11.3%. The Florida Power Corporation's reserve is 11.1%. The Florida Power and Light Company's reserve is only 3.6% without the Turkey Point nuclear unit No. 3 near Miami which will not be available for the summer, as had been scheduled.

4. West Central Region

This region has a reserve margin of only 14%. With the exception of 100 MW in small peaking units on three Wisconsin systems, virtually all of the possible capacity which can be available within the region during the summer is scheduled to be in service before the end of May. A number of areas in the region have low reserves and problems could develop if some large units were forced out of service. Wisconsin, Minnesota, Iowa, and Nebraska all have reserves below 15%.

a. Commonwealth Edison Company

Commonwealth Edison Company, serving Chicago, has 14.7% reserves but these are based on the availability of the new 809 MW Dresden No. 3 nuclear plant (now estimated for service in July but it is a new unit, and not fully reliable), and additional power from Dresden No. 2. Without Dresden No. 3, Commonwealth's reserves are only 7.5%, and other anticipated deratings would decrease the reserve margin to less than 6%. The new 809 MW Quad City nuclear unit No. 1 near Cordova, Illinois, will not be operating at all during the summer.

5. South Central Region

With a reserve supply of 15.1%, the reserve margin situation for the South Central region appears to be less than desirable. Estimated reserves of the Region are down from 16.6% during the previous year. An additional 1,056 MW of capacity is scheduled for June, July and August and this capacity is equal to 2.5% of the summer peak. No nuclear units are among those scheduled for completion in the region prior to summer 1971.

6. West Region

With a reserve of 18.8%, the West appears to have a satisfactory supply situation. The Pacific Northwest, with 11.5% reserves has one of the lowest reserve margins of any area in the West region, but summer is the low load period for this area. These reserves should be ample since water

conditions are better than average, and there are large interruptible loads which can be dropped when capacity is not available. The region also has idle generating capacity of 907 MW in its hydro-plants, which can be used when needed.

The 750 KV D. C. Pacific Northwest-Southwest intertie was lost during the February 9 earthquake. The D. C. terminal and converter at Sylmar will be out of service for the summer. This severely limits the transfer capability between the Northwest and Southwest Pacific areas. The two 500 KV A.C. lines are expected to provide reasonably adequate but limited transfer capacity, north and south, for the immediate future.

C. FUEL SUPPLY FOR ELECTRIC POWER GENERATION

Fuel supply for electric power generation is expected to be adequate for the summer, subject to the availability of transportation and no serious interruptions to production.

Electric Utility Industry Generation by Fuel (in percent)

	<u>Coal</u>	<u>Fuel Oil</u>	<u>Gas</u>	<u>Nuclear</u>
1970	56.7	11.1	27.2	5.0

1. Bituminous Coal and Lignite

It is anticipated that in general coal supplies will be adequate for the summer, if unexpected problems do not develop in transport and production. Air pollution standards are not expected to create unmanageable problems this summer. Coal production and stocks at electric power facilities have increased steadily since last summer.

There has been a steady increase in coal production through 1970, and to date in 1971. Coal stocks at utilities have been substantially rebuilt. As of January 31, 1971, they approximated 69.7 million tons, for an average of 70 days' supply for the Nation as a whole, as compared to 52.8 million tons and 54 days' supply on January 31, 1970. Supplies averaged from 111 days' supply in New England to 45 days' in the Rocky Mountain Region. At this time, there are no critical shortages of coal at any major electric utility plant. Consumers, including utilities, are expected to maintain their stockpiles at reasonably high levels as a safeguard against emergencies.

2. Residual Fuel Oil

Consumption of residual fuel oil by electric utilities in 1970 increased rapidly over 1969. Nearly all of this increase was supplied by imports from overseas sources. The predominant consuming area was the U. S. East Coast. In the months from April through September of 1970, the United States consumed residual fuel oil at a rate of 1,881,000 barrels a day. Oil deliveries to public utility electric power plants, principally residual fuel oil, averaged 840,000 barrels a day during that period.

In the same months of 1971, U.S. consumption of residual fuel is projected to increase by 10 percent over 1970. This increase, which will occur principally in power plants, is less than the 1970 growth rate. Numerous conversions to oil have already been accomplished last year in 1970.

The projected level of demand should be met, and normal seasonal inventory build-ups accomplished, with an increase in residual fuel imports. The worldwide oil situation appears to have stabilized except for continued closure of the Suez Canal and imports should be available without undue problems. Air pollution standards are not expected to create unmanageable problems this coming summer.

A potential problem area is New York-New Jersey where large power plants are being newly converted to oil. Other conversions and new oil-burning plants are concentrated in upstate New York, Maryland, Virginia, and Florida. However, these plants should not experience difficulties in obtaining sufficient quantities of low-sulfur residual fuel oil this summer.

3. Natural Gas

Natural gas available to electric utilities this coming summer will probably not be significantly greater than last year. No major increase in production or imports is expected.

On the other hand, several problems have arisen which may well reduce natural gas delivery during the season, including the need to comply with the requirements of the Pipeline Safety Act. Fifty percent of the work must be completed by December 31, 1971, and many sections of line must be taken out of service. This could decrease deliverability during the summer.

Several individual companies have already announced that they will seek to implement summer curtailment programs in order to build up their storage supply. This program will be subject to the approval of the Federal Power Commission. Any short fall of natural gas supplies will have to be met by replacement with coal and/or oil in order to meet fuel requirements.

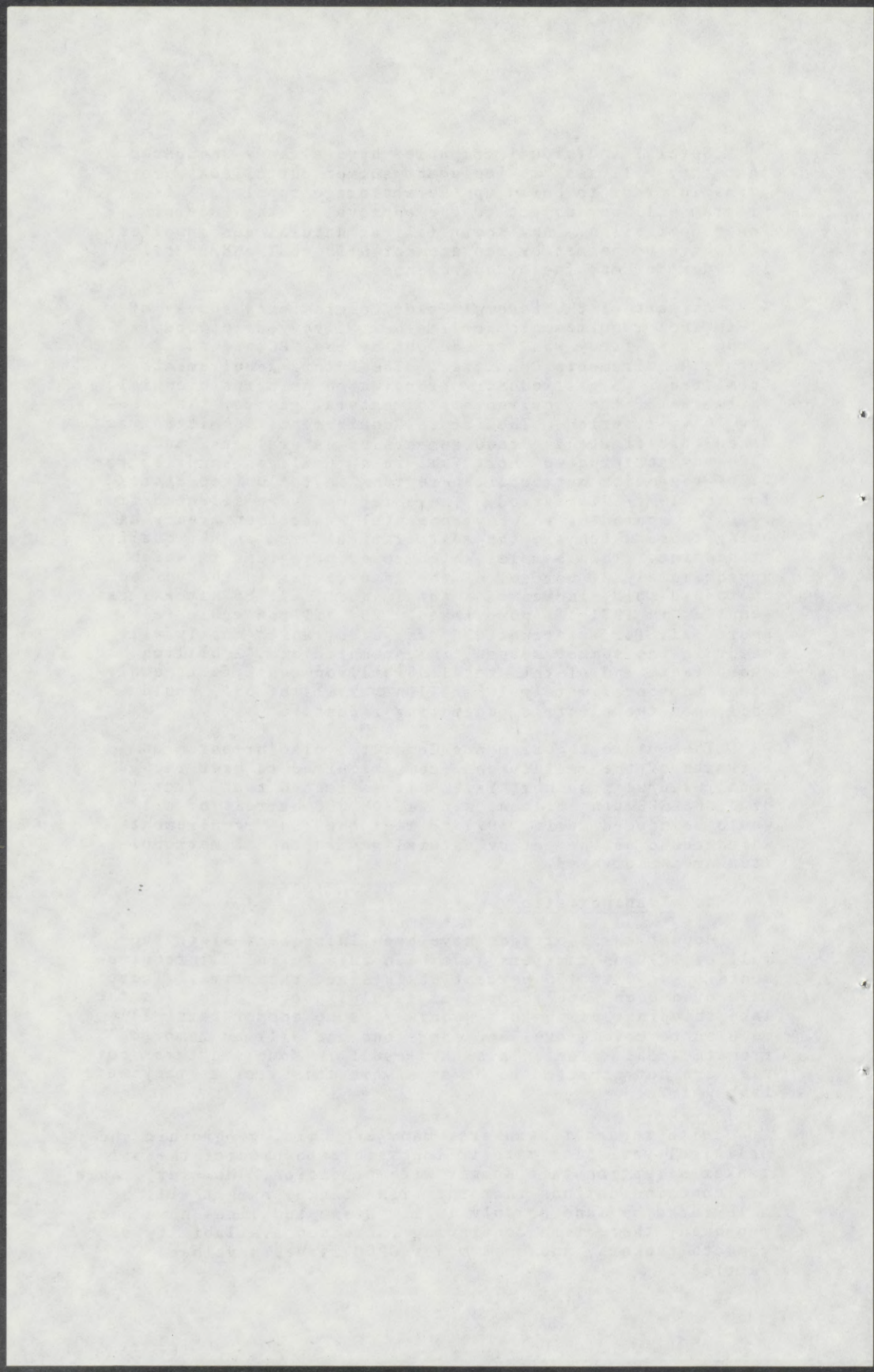
As part of the Federal Power Commission's survey of clean fuel requirements for the next five-year period, a cooperative study was carried out by the FPC and the Future Requirements Committee. The Future Requirements Committee is a gas industry group which prepares biennial estimates of the requirements of natural gas for the ensuing 20-year period. The Future Requirements Committee was asked to estimate the requirements of natural gas, and also any anticipated short fall in natural gas supplies for 38 of the major metropolitan regions in the United States for the 1971-1975 period. These regions were selected from a list prepared by the Environmental Protection Agency as being those which are the most critical from an air quality standpoint. This sample, which covered regions in which approximately 27 percent of the natural gas in the United States is sold, indicated a total short fall of natural gas supplies in 1971 of approximately 204 billion cubic feet. Short fall for interruptible gas sales, which mostly will occur in the summer season, is estimated at 141 billion cubic feet, and of this total 95 billion cubic feet, equivalent to approximately 16 million barrels of oil, would fall upon the electric generating industry.

The Future Requirements Committee also prepared an estimate of the replacement fuels required to meet the total natural gas short fall. It estimated that a total of 3,065,000 tons of coal and 21,300,000 barrels of oil would be needed during 1971 to meet the fuel requirements which could not be met by natural gas in the 38 metropolitan areas surveyed.

4. Transportation

Hopper car shortages have been infrequent since the fall of 1970 as carriers have been able to fulfill requirements on a 90 to 100 percent basis since that time. There have even been some reports of surplus hopper cars. As the lake shipping season gets underway, some hopper cars will be used to move gravel and sandstone and will be removed from the coal trade. This may result in some shortages but they are not expected to be as severe this year as they were last year.

With regard to tankers, many economic, geographic and political variables make it impossible to predict the oil tanker situation this summer with precision. However, there are some indications that the tight tanker market will be alleviated by June or July 1971. Disrupted lines have been reopened, there is a continuing increased availability of mammoth tankers, and most major OPEC issues have been settled.



REPORT
on
CRUDE OIL AND GASOLINE
PRICE INCREASES
of
NOVEMBER 1970



★★ OFFICE OF ★★

EMERGENCY

PREPAREDNESS

EXECUTIVE OFFICE OF THE PRESIDENT

(137)

April 1971

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF EMERGENCY PREPAREDNESS
WASHINGTON, D.C. 20504

OFFICE OF THE DIRECTOR

April 15, 1971

The President
The White House
Washington, D.C.

Dear Mr. President:

I enclose a study prepared in my office concerning the price increases in crude oil and gasoline initiated on November 11, 1970. Judging that the increases announced on that date by a major company did herald industrywide increases, I initiated the action required of me by Section 6(a) of Presidential Proclamation 3279, which established the Mandatory Oil Import Program, to determine whether such increases are necessary to accomplish the national security objectives of the controlling legislation and of the proclamation.

In the context of the pertinent statute and Proclamation 3279, national security is not the same as the popular conception of national defense. Direct defense requirements for petroleum products are relatively small when measured against our national consumption. We are here concerned with the essential role of petroleum in our economy and our way of life, and the measures necessary to assure an adequate and secure supply in all contingencies, whether or not of military origin.

This investigation has included consultation with the Secretaries of State, Defense, Treasury, the Interior, Commerce, and Labor as required by Section 6(a) of Presidential Proclamation 3279, as amended, in addition to the Chairman of the Council of Economic Advisers and the Attorney General. Also, I have considered comments from the industry and other interested parties (a total of 57) submitted in response to an invitation for comment published in the Federal Register. Although I have given substantial weight to the views of the agency heads mentioned above, each does not necessarily agree with all of my findings and conclusions.

As the discussion in the enclosed report indicates, there are not, in my judgment, reliable indices on which to base a determination concerning the price of gasoline, particularly over a short period. The gasoline market is highly competitive in many places as to price and subject to varying degrees of discounting, although the vigor of this competition is not sustained everywhere. The last two Inflation Alerts issued by the Council of Economic Advisers have reported substantial erosion of the attempted increase in gasoline prices. If the market does stabilize at a higher price, the increase undoubtedly can be ascribed in major part to any increases in crude oil price which the industry may succeed in sustaining over time. Hence, I do not attempt to reach a determination on the matter of the price of gasoline apart from the question whether the crude price increase is necessary.

I consider that the current 25¢ per barrel increase in the price of crude oil should be the subject of two determinations: the first in the light of short-term considerations; the second in light of the longer-term considerations of petroleum supply and overall energy security.

I conclude that the November price increases were not required to meet any national security objectives arising out of the present short-run disruptions in the international flow of oil. Supply was meeting market demand at the previous price. It does not, therefore, appear that a crude oil price rise was needed to meet short-term requirements. The ultimate conclusion, however, must rest on long-term national security effects.

The state of the art of the analysis required is such that there is unlikely to be certainty in an appraisal, within a few months of the price change, of the long-term effect on national security purposes of the comparatively small (less than 10 percent) incremental price increase being investigated. As the Task Force study indicated, professional judgments differ widely concerning the elasticity of supply, i.e. the extent to which the discovery of new reserves is responsive to price increases over time.

The study does clearly show the need for new and accelerated actions to support our petroleum security in the future in order to minimize reliance upon even higher prices to assure needed supplies. Indeed, our study does not conclusively show that the recent price increase, without other accompanying measures, would be necessarily effective. Nor do we yet know whether these other measures will be instituted on a timely basis.

The suggestion may be made that the crude oil price increases should be checked or thwarted through increasing supply by increasing import quotas. The enclosed study shows, however, that supply measured by inventories and refinery runs was meeting demand at the prices prevailing before November 11 and the supply situation has not materially changed since. Also, the unusual present international oil situation currently results in quantities of crude oil imports from overseas which are below the level of quotas already permitted. Those levels will, however, almost certainly need to be progressively increased in future years to assure adequate supply.

The defenders of the price increase have clearly established in their submissions the need for immediate actions to guard our longer-term energy security. In my judgment, it has not been established that price increases alone will achieve our national security objectives, even though they certainly will provide a measure of incentive toward that end. For example, development of the great supply potential of the North Slope of Alaska is currently insensitive to price at present levels, because the North Slope discovery is of such magnitude that the unit costs of production will be low and its unavailability to the market is not a matter of price. On the other hand, revisions and extensions of existing fields and the extent of other exploration efforts may well turn on this marginal increase in crude prices.

The enclosed study concludes that programs and policies other than price increases need to be pressed. Whether further price increases in the longer-term will be needed is an open question which will depend, in large part, on the timely adoption of programs and policies which will encourage the necessary investments to meet our fuel and energy problems. If we do not press forward on other energy supply policies, there will be an increasing tendency to rely on further price increases. This we should not encourage.

We are traditionally concerned about the price of energy fuels. We are concerned over the quality of our environment. We are also concerned about the adequacy and security of the supply of our energy fuels. The quality of life of our country, as well as much of our country's strength, turns on that adequacy and security.

The lead times in developing energy supplies are long. Time is running out for providing the energy supply assurance needed for the latter half of this decade and beginning of the next. We have recently placed greatly increased stress on our environmental programs. Along with improving the quality of life, the effects sometimes include delaying friction with essential energy programs, and also increased cost of energy to the consumer.

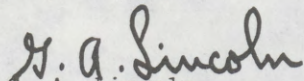
The situation argues for accepting and pressing those helpful actions which can be gotten underway promptly. If further progress had been made in the past decade on energy programs which we now see as needed, the recent price increase might be clearly unnecessary.

The courses of action are generally beyond the boundaries of the oil import program for which I have the policy responsibility. That program can no longer be relied on as the exclusive means to assure adequate secure petroleum supply. The Energy Committee of your Domestic Council is preparing recommendations for you in the energy field. I have provided, as an input to that Committee's studies, my conclusions developed in connection with this price study as to energy actions needed.

I recommend that you refer this letter and the enclosed study to the Energy Committee of the Domestic Council.

Because the assurance of adequate secure petroleum supplies in the future is an urgent matter, and there are inevitable uncertainties about the timing and effects of other programs which may be instituted, I cannot confidently conclude that the November crude oil price increase was unnecessary.

Respectfully,


G. A. Lincoln
Director

Enclosure

TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION-----	1
National Security Criteria-----	2
PUBLIC AND INDUSTRY COMMENTS-----	5
The Proponents' Argument-Gasoline Prices-----	5
The Proponents' Argument-Crude Oil Prices-----	6
Adverse Comments-----	8
FINDINGS AND CONCLUSIONS-----	9
STRUCTURE OF THE U.S. PETROLEUM INDUSTRY-----	14
Refining-----	14
Crude Oil Production-----	16
Transportation-----	17
Marketing-----	18
EVALUATION-----	19
<u>Crude Oil Price Increase</u> -----	20
--Short-Term Considerations-----	20
--Long-Term Considerations-----	24
...Proved Crude Oil Reserves-----	25
...Exploration and Development Expenditures-----	28
...Natural Gas Pricing-----	28
...Cost Trends-----	29
...Investment Requirements-----	33
...Surplus Production Capacity-----	38
...The Independents' Role-----	39
...Summary Long-Term Observations-----	40
<u>Gasoline Price Increase</u> -----	46

INTRODUCTION

On November 11, 1970, the Gulf Oil Company increased its purchase price of domestic crude oil by \$0.25 per barrel and, on the following day, increased gasoline prices to its dealers by 0.7¢ per gallon. Judging that the action of the Gulf Oil Company heralded general price increases by the industry, the Director of the Office of Emergency Preparedness announced on November 12 that he would proceed according to Section 6(a) of Presidential Proclamation 3279, as amended:^{1/}

The Director of the Office of Emergency Planning shall maintain a constant surveillance of imports of petroleum and its primary derivatives in respect of the national security and, after consultation with the Secretaries of State, Defense, Treasury, the Interior, Commerce, and Labor, he shall inform the President of any circumstances which, in the Director's opinion might indicate the need for further Presidential action under Section 2 of the Act of July 1, 1954, as amended. In the event prices of crude oil or its products or derivatives should be increased after the effective date of this proclamation, such surveillance shall include a determination as to whether such increase or increases are necessary to accomplish the national security objectives of the Act of July 1, 1954, as amended, and of this proclamation.

A notice (Annex A) inviting comment on the necessity of the price increases to national security was published in the Federal Register on November 17, 1970. In addition, letters requesting specific comment were sent to the principal companies announcing crude oil or gasoline price increases. A total of some 57 responses have been submitted from a wide spectrum of the oil industry, Congressmen, State officials, consumer associations, independent oil experts, and the general public. These have been carefully examined and analyzed.

^{1/} No similar formal action has been taken since the issuance of the Proclamation in 1959.

The Director of OEP asked each department head specified in Proclamation 3279, as well as the Attorney General and the Chairman of the Council of Economic Advisers, to designate an official for consultation as the investigation progressed.

National Security Criteria

Presidential Proclamation 3279 charges the Director, in conducting this review of crude oil and gasoline prices, to determine whether they are necessary to accomplish the national security objectives of the Mandatory Oil Import Program and Section 232 of the Trade Expansion Act of 1962 (19 USC 1351).

The most authoritative definitions of these national security objectives are to be found in the legislation and Proclamation and the most recent analysis is in the Cabinet Task Force Report of February, 1970. While, as the Cabinet Task Force Report notes, objective standards to be used in appraising the threat to national security are not stated with precision, a study of the above documents establishes the following criteria rather clearly:

- a. The need to guarantee supplies sufficient to meet the need of U.S. military forces and defense industries;
- b. The need for sufficient supply of crude oil and its derivatives to meet essential civilian demands and sustain economic growth;
- c. The need to foster exploration and development so as to ensure against a depletion of reserves to an extent which would jeopardize the capability of the petroleum industry to meet future demands, without undue reliance on foreign sources of questionable reliability.

The Trade Expansion Act of 1962 directs that the national security criteria must include consideration of industry growth requirements and the investment, exploration and development necessary to assure that growth insofar as they affect the capacity of the United States to meet national security requirements.

In announcing the institution of the Mandatory Oil Import Program on March 10, 1959, President Eisenhower stated:

The new program is designed to insure a stable, healthy industry in the United States capable of exploring for and developing new hemisphere reserves to replace those being depleted. The basis of the new program, like that for the voluntary program, is the certified requirements of our national security which make it necessary that we preserve to the greatest extent possible a vigorous, healthy petroleum industry in the United States.

In addition to serving our own direct security interests, the new program will also help prevent severe dislocations in our own country as well as in oil industries elsewhere which also have an important bearing on our own security. Petroleum, wherever it may be produced in the free world, is important to the security, not only of ourselves, but also of the free people of the world everywhere.

Proclamation 3279 also explicitly recognizes the need:

"...to avoid discouragement of and decrease in domestic oil production, exploration and development to the detriment of the national security."

The Cabinet Task Force Report of 1970 generally reaffirmed these national security objectives. The majority report added a new feature by calling for a limitation of dependence on the Eastern Hemisphere, recommending that such imports be limited to 10% of domestic demand, a figure brought into question by recent disruptions of much lesser amounts than this (p. 135). The Secretary of Defense, in his statement of supplementary views, said (p. 132):

"...it is extremely important that the program be carefully administered and security considerations be paramount. As a member of the Interdepartmental Policy Panel the Secretary of Defense would consider the following to be essential:

a. That domestic exploration be maintained at approximately current rates and that no reduction in reserves be allowed."

In the same vein, the Secretary of Treasury said (p. 131):

"Our domestic industry will be expected and encouraged to continue to expand its output and to explore for and develop new sources of crude oil and substitutes; the revised oil import control system should be so managed as to work toward this goal."

In the context of the authorizing legislation and Proclamation 3279, national security is not limited to current national defense requirements nor to future mobilization needs. Rather, it relates directly to the indispensability of petroleum to our economy and our way of life.

The essential national security objectives of the Mandatory Oil Import Program certainly include:

- (1) a satisfactory level of domestic reserves of crude oil, supplemented from other secure sources of supply;
- (2) maintaining spare capacity to produce and deliver crude oil when international factors disrupt supplies from other sources;
- (3) maintaining refinery capacity in the United States adequate to meet both defense and essential civilian needs in periods of disruption in normal patterns of world oil movement; and
- (4) providing a healthy petroleum industry in the United States with the capacity to meet the nation's national defense and essential civilian needs at all times.

In applying the above standards of national security objectives, the markets for crude oil and gasoline, while closely related in several ways, are sufficiently different in their structure and past price behavior as to necessitate separation of these two portions of this price investigation for much of the analysis and findings.

The present world supply situation is that type of situation which the oil import program is designed to protect against -- and hence is not, standing alone, an argument

for raising prices of domestic crude oil or controlled refined products. Rather, domestic crude oil and product prices have, in the past, been higher than world prices in order that this insurance would exist and additional costs resulting from a tight world supply situation could be avoided to the fullest extent possible. It should be recorded that no one gave the tight world situation as the reason for the announced higher prices in responding to our requests for comments, even though the landed cost of crude oil carried in spot tankers was almost certainly higher than the price of domestic crude oil.

PUBLIC AND INDUSTRY COMMENTS

Since the essential charge of the Presidential Proclamation 3279 is a determination whether price increases are "necessary" to national security objectives it seems reasonable that the initial burden of justifying price increases on national security grounds rests with the industry. Accordingly, the following is a summary of industry submissions which endeavor to prove the necessity of the price increases to national security.

A total of 57 submissions were received either in response to the notice in the Federal Register of November 16, 1970, inviting comments on the recent oil and gasoline price increases, or to the letters sent to those companies which raised their prices. (A list of respondents is given as Annex B).

In this summary, the emphasis has been placed upon the logic of the arguments, and the numerical data offered in support of the arguments have been omitted. These data, where vital, have been verified as within a tolerable range of acceptability.

Although some respondents presented their case in greater length and detail than others, and the statistics cited vary somewhat among the individual statements, the general rationale of those supporting the price increases is similar. These arguments will be separately summarized for the dealer tank wagon gasoline price and the crude oil price under review here.

The Proponents' Argument - Gasoline Prices

Most of the respondents in rationalizing the gasoline price increase cite the fact that gasoline service station prices

(usually less taxes) have not risen as fast as the Consumer Price Index to support their contention that gasoline prices have not been a cause of inflation.

The refiners also cite rising refinery and marketing costs in support of higher gasoline prices. Increased taxes, higher wages, higher equipment and construction costs, and costs associated with new lead-free gasoline are all cited by various respondents as components of their overall cost problems. These are often said to be increasing faster than gasoline prices, putting the refiners and marketers in a "cost-price squeeze." Many net buyers of crude oil also cite the need to raise product prices to cover the higher costs resulting from the crude oil price increase.

The gasoline price increase is said to be linked to the national security by the general argument that the higher price is necessary to maintain a healthy industry.

The Proponents' Argument - Crude Oil Prices

The principal argument for the increase in the price of crude is that it is required in order to provide the necessary capital and the incentive for exploration and production which is needed if the U.S. crude oil reserve position and producing capability are to be maintained at the level required for national security. The individual considerations used to support this line of argument include the following:

a. The reserve position and producing capacity of the domestic producing industry are not being maintained. If present trends continue, the U.S. will have become increasingly dependent on Eastern Hemisphere petroleum supplies, even with the introduction of Alaskan North Slope production, a dependence which will tend to threaten our national security.

b. Declining trends in basic activities such as geophysical crew activity, exploration, leasing, well drilling, and total well completions indicate a lack of incentives to find and develop sufficient U.S. oil reserves and production capacity.

c. Petroleum prices have been relatively stable for more than a decade. Crude oil prices, prior to the increase, have risen much less than the Wholesale Commodity Price Index.

d. The petroleum industry's aggregate costs have been rising more rapidly than its prices. Taxes have been increasing, and, especially, the Tax Reform Act of 1969 sharply increased the industry's tax bill. As "easier" prospects are being used up, exploration for oil must be conducted in more remote, more costly areas. The percent of new-field wildcats discovering significant quantities of oil and gas is decreasing. Wages are up in all sectors of the industry, and material costs are also rising. Large sums are being spent by the industry for protection of the environment. Interest costs are also higher, and this is particularly significant to the petroleum industry because of its capital intensity and its growing need to supplement internally generated funds.

e. The profitability and investment return for the petroleum industry have been declining and are said to be unfavorable compared to other industries. These trends, together with currently higher borrowing rates, make financing of large present and future capital requirements, exceedingly difficult.

Two companies reported that they had reduced their exploration expenses sharply in 1970 compared to those in 1969.

Higher prices will contribute to greater domestic petroleum supplies by: (1) prolonging the effective life of marginal wells which otherwise would be abandoned, (2) increasing the number of economically acceptable secondary recovery projects, (3) increasing incentives for exploration for new reserves, and (4) improving the industry's financial capability to undertake these expanded efforts.

A considerable number of companies that followed price increases initiated by others stated that they were obliged to do so to maintain their crude supplies in a competitive market. A number of those refiners who on balance are substantial buyers of crude oil supported the increases as necessary to maintain local crude oil production at levels required by their own refinery operations. Whether or not advantaged by the price increase, practically all industry respondents supported it as needed for national security reasons.

Although the investigation does not deal with natural gas prices, some respondents note that "unrealistically low"

natural gas prices contribute to the profit squeeze. They also relate this to incentives for exploration and development of crude oil reserves because oil and gas are so closely linked in exploration.

One respondent, a regional producers' association, took a different view in support of higher prices. On the basis of experience in their area, they concluded that the major companies no longer find it profitable to commit a substantial part of their exploration budgets to prospecting for reserves onshore in the lower forty-eight states. They claim that these major companies, as net crude oil purchasers, have incentives to hold prices down. They further state the recent price increase is insufficient to make a meaningful change in exploration programs.

Adverse Comments

There is much less uniformity in those responses that opposed the price increases.

Senator McIntyre, Congressman Conte and their associates urge a thorough and incisive investigation of price increases (including increases in price of No. 2 and No. 6 oils), with the burden of proof to rest on the major oil companies. They also urge interim action to roll back recent price increases with consideration to be given to decontrol of imports from Canada, No. 2 fuel oil to the East Coast, and residual fuel into Districts II through IV; a relaxation of imports from the Western Hemisphere; removal of crude oil production on Federal lands from state prorationing controls, and the suspension of the Connally "Hot Oil" Act. They suggest examination of seventeen specific questions, appended to their statement, relating principally to the structure of and cost price relationships within the oil industry.

The New England Council claims that a disproportionate share of the cost of import restrictions falls on the New England area; criticizes failure to implement Cabinet Task Force findings and move toward freer imports; and asks analyses of recent increases in prices of No. 2 and No. 6 oils. Senator Prouty also makes this latter request and asks consideration of a "uniform national pricing structure."

Independent marketers and refiners cite an uneven impact of price increases on various sectors of the petroleum industry, despite appearance of comparable increases in crude

oil and gasoline prices. Their arguments are based on institutional characteristics of the industry (percentage depletion, oil import allocations, integration) and upon concern that crude oil price increases will hold, but that gasoline price increases will not, thereby squeezing the profitability of nonintegrated refiners. Professor Allvine of Northwestern University, who has been involved in a study of competition in the gasoline-oil industry, also contends that the oil import program has worked to increase the vertical integration in the domestic oil industry, but he does not compare the scale of integration and competition in the United States with that in other countries.

Two oil companies indicate that they followed crude oil price increases reluctantly in order to protect their crude oil supplies. One believes that the crude price rise may have been too much and claims a more urgent need for higher natural gas prices. The other attributes the present sellers' market in crude oil to adherence to the 12.2 percent formula in setting oil import quotas; mandatory controls of imports from Canada; the postponement of Outer Continental Shelf lease sales; and delays in access to Alaskan North Slope production.

One respondent, the Air Transport Association, proposed a price freeze at November 1, 1970, levels. A.T.A.'s major thesis, however, is the financial plight of domestic airlines and their need for Federal financial support in the interest of national security.

The American Paper Institute does not articulate a position, but merely states their interest as a major user. They include a survey of their membership on "Fuel and Energy Problems in the Pulp and Paper Industry," which cites an interest not only in prices but in assured availability of fuel.

FINDINGS AND CONCLUSIONS

-FINDINGS-

1. The Mandatory Oil Import Program permits (with exceptions, e.g. residual oil in District I) a continuing price structure for crude oil and its derivatives which is insulated over time from the full effects of competition from imported oil.

2. There are four clearly identifiable national security objectives of the Mandatory Oil Import Program which can serve as criteria in determining whether price increases are justified as necessary to the achievement of national security objectives:

- (1) A satisfactory level of domestic reserves of crude oil, supplemented from secure foreign sources of supply;
- (2) Maintaining spare capacity to produce and deliver crude oil when international factors disrupt supplies from other sources;
- (3) Maintain refinery capacity in the United States adequate to meet both defense and essential civilian needs, in periods of disruption in normal patterns of world oil movement; and
- (4) Provide a healthy petroleum industry in the United States with a capacity to meet the nation's national security requirements.

3. No national security justification for gasoline price increases has been offered other than their possible relationship to the health of the petroleum industry which is also essential to evaluation of the crude oil increase. Competition in the market place may not sustain the attempted increase in gasoline prices. Under these circumstances no finding on gasoline prices has been made apart from that on crude oil prices.

4. No evidence has been offered to establish that the November price increases will lead to the maintenance of spare capacity for the production of crude oil or the maintenance of refinery capacity in the United States adequate to meet both defense and essential civilian needs in periods of disruption in normal patterns of world oil trade. Consequently, these national security objectives have not entered into this analysis.

5. From the initiation of the oil import program in 1959 until 1969, the price of crude oil remained almost constant. Although there have been two price increases since December 1968, crude oil prices have increased only 11.6% over the life of the oil import program while wholesale prices for all commodities have increased 17.8%.

6. Domestic crude oil proven reserves (excluding Alaskan North Slope oil) have declined markedly since 1968, and the average ratio of reserves to consumption has been declining for over a decade. North Slope Alaska discoveries, not being deliverable to date, are not included as proven reserves in this report.

7. When measured by indices such as drilling rigs in operation, wells drilled, wells completed, geophysical expenditures and acreage under lease, there has been a declining trend in exploration and development effort in the U.S. for more than a decade. There has not been a proportional fall in proven reserves, but in view of our rapidly increasing demand for petroleum, our proven reserve situation is unsatisfactory when measured in national security terms.

8. In the past year there has been a disruption in world oil movement which has been met in the United States by increases in the production of domestic crude oil (utilization of spare production capacity) and imports of Canadian oil. Higher prices were not necessary to bring forth this domestic production and the larger volume of Canadian imports flowing at the time of the price increase.

9. The major portion of spare production capacity has been in Texas and Louisiana. The use of this spare production has not been at an increased unit cost since it has come primarily from efficient wells for which production allowables have been increased under state procedures.

10. From 1952 through 1969 exploration and development expenditures in the U.S. have remained almost constant, if bonus payments to State and Federal governments for search rights are excluded, while our consumption of petroleum has steadily increased.

11. For various reasons leasing and development on the Outer Continental Shelf have been severely curtailed since May of 1968 and development in Alaska also has been stalled, even though these areas have been demonstrated as having the greatest promise of large-scale exploration success and hence for substantial additions to reserves.

12. Industry off-peak pricing practices and federal regulatory policies in relation to well-head pricing of natural gas have limited revenues from natural gas sales

so that incentive has been lacking for an exploration and development effort for natural gas in proportion to the percentage of the energy demand which needs to be supplied by natural gas. Natural gas has not been carrying its reasonable share of exploration and development costs and incentives therefor.

13. While the costs of exploration and development activity and income taxes on the oil industry have increased, these costs do not materially affect exploration activity where there are favorable probabilities of large-scale, giant field production and low average unit costs per barrel produced, e.g. the high probability formations in Alaska and offshore. These costs do, however, undoubtedly have some adverse effect over time on secondary development of already proven reserves and exploration in areas favorable to discoveries of lesser pools of crude oil.

14. In view of the large capital requirements of the petroleum industry, both in the United States and overseas, for production, transportation, refining and marketing purposes to meet the burgeoning worldwide demand for petroleum products, it follows that:

- (a) it is unrealistic to expect these requirements to be met from the industry's cash flow alone;
- (b) a substantial share of the industry's capital needs will have to be obtained through equity and debt measures attractive to outside capital;
- (c) the anticipated return will need to be adequate, in comparison with other investment choices, to attract equity and debt capital to the domestic oil industry; and
- (d) increased cash flow resulting from the November price increases will be reflected to some degree in increased exploration and development effort which would not occur otherwise and which is essential to our national security objectives.

15. The net earnings and cash flow position of the petroleum industry have been and are favorable when compared with other manufacturing industries, and, therefore, in the short run should provide no obstacle to exploration and development

investment. However, it is also clear that incentives must be adequate to attract substantial amounts of new equity and debt capital for the industry's investment needs over the next decade.

16. A crude oil price increase alone will not assure the independent segment of the industry a larger and more active role in the domestic exploration and development activity needed to find and develop larger crude oil reserves. Leasing policy changes and/or the utilization of innovative financing arrangements by independents will be necessary if this segment of the industry is to share largely in the future activity.

17. While it may be assumed that crude oil price increases at the present time in the long run would encourage some future expansion in exploration and development effort, there are a number of governmental programs and policies which could be instituted or modified and which would also contribute to our national security objectives.

18. To most refiners, increased crude oil prices represent a net cost inverse to the degree that they own or control their own crude oil production. Those refiners with lesser crude oil self-sufficiency therefore are pressed to maintain higher product prices to the consumer.

19. In the long run future crude oil price increases may be necessary if fuel supplies are to be developed consistent with our national security requirements. A series of governmental measures to achieve our national security objectives should be accelerated promptly in order to minimize reliance on future price increases.

-CONCLUSIONS-

1. The petroleum industry has not adequately justified crude oil and gasoline price increases at this time on short run national security grounds.

2. Reluctantly, it is concluded that because of the urgent need to encourage exploration for and development of crude oil reserves in the long run, the November price increase for crude oil of approximately eight percent may be justified because of sound national security considerations.

3. Crude oil price increases will be an inadequate instrument for the achievement of our national security objectives. Other measures should be considered and pressed to execution at this time which contribute to achieving national security objectives without further price increases. Among these would be accelerated offshore leasing and realistic pricing of natural gas more nearly approaching its market value in relation to alternative fuels.

STRUCTURE OF THE U.S. PETROLEUM INDUSTRY

A brief review of the structure of our domestic petroleum industry is believed useful before attempting to evaluate the implications of the recent price increases. Undoubtedly, the following description over-simplifies this most complex subject, but it has been reviewed by persons whose knowledge and industry association should assure reasonable accuracy.

Refining

As of January 1, 1970, the petroleum refining industry was made up of 129 companies in the United States which owned or controlled 262 refineries. The ninety-one leading companies in petroleum production and refining had a net worth of more than \$50 billion at the beginning of 1969. In terms of net worth this industry greatly exceeds that of any other, including such giants as electric generation, natural gas distribution, telephone and telegraph companies, railroads, steel, and the automobile industry. The rank of this industry in the manufacturing spectrum is not surprising since oil and gas provide three-fourths of the energy fuels used in the United States.

Refining companies have processing capacities ranging from a few hundred barrels of crude oil per day up to more than 1 million barrels per day. The largest single refinery has a daily capacity between 400,000 and 500,000 barrels per day.

Twenty-one of these companies have refinery capacities of 100,000 B/D (barrels per day) or more.^{1/} Of these, 4 exceed 900,000 B/D, 6 exceed 800,000, 8 exceed 600,000,

^{1/} Domestic refinery capacities are as reported by NPRA for January 1, 1970, excluding Puerto Rico. Since then about 6% or 700,000 B/D have been added, but information is lacking with reference to its distribution among companies or size classes.

and 16 exceed 200,000 B/D. It should be noted, however, that all of the larger companies operate some refineries with relatively small capacities. Among the operations of the eight largest refining companies there are 15 refineries out of 70 with less than 33,000 B/D capacity, 9 of which are 20,000 B/D or less.

On the other hand, there are 21 refineries with over 20,000 B/D capacity owned by corporations whose total capacity is less than 100,000 B/D but more than 30,000 and 9 more by companies with total capacities of less than 30,000 B/D. The largest company, measured by total refining capacity, has only 6 refineries. The next largest has 12.

The largest oil company in the U.S. has less than 10% of the nation's refining capacity. The 8 largest companies have about 58% of the nation's refining capacity, the 15 largest have about 78% and the top 21 have about 85% of the total.

Refining capacity is not the only criterion to apply in evaluating financial or competitive strength in the oil industry. From the refining capability perspective this industry is not as concentrated as a number of other industries. It is characterized, however, by a high degree of integration both backward into exploration and production of its raw materials - crude oil, condensates and natural gas - and forward into marketing at many levels of distribution.

Five of the 8 largest U.S. oil corporations are also major producers and refiners of oil in other nations as well. They, together with two foreign corporations (British Petroleum and Royal Dutch Shell), constitute the so-called "Seven Sisters" in the world oil picture. These seven corporations control 58% of the giant oil fields of the Free World and 79% of the ultimate reserves. (Oil & Gas Journal, February 22, 1971, p. 109). The five U.S. companies (Jersey, Gulf, Texaco, Standard of California and Mobil) produce over half of the production and almost half of the refinery runs in the Free World outside of the United States.

Eighteen other integrated U.S. corporations together control more domestic production than the five international majors mentioned above, and most of these others have some foreign production and refining capacity. However, in the aggregate, their total foreign production is 13% of that of the 5 major internationals. Their foreign refinery inputs are barely 6% of those of the 5.

At the other end of the scale, the majority of the 129 refining companies have very little or no domestic or foreign crude production capacity, and their integration, if any, is forward into transportation and marketing at the wholesale and retail levels.

Crude Oil Production

Estimates have indicated that there are 10-12,000 oil producers in the United States. This number includes all persons or corporations having an operating interest in oil producing properties. A large proportion of the total production from these lands is committed by lease or contract to refining corporations. Nevertheless, about 30% of total domestic production is sold by independent producers. Consequently, there is an active market for crude oil in the United States and market prices are generally known and published.

It should be noted that oil is where you find it, and other business considerations than oil location have often dictated the location of refineries. Consequently, many of the largest integrated companies are sellers of their own crude oil production from some areas and buyers for their refineries located in other areas. Crude oil exchange agreements are not at all unusual in this industry. These sales and exchanges have also contributed to make an active domestic market for crude petroleum.

Open pricing of crude petroleum is not a characteristic of the world oil trade. Published quotations of posted or tax reference prices for foreign crude oil are not measures of actual transactions. Most producers of foreign crudes are integrated companies which ship and use their own production. One major international company recently stated that it refined 2/3 of its foreign production and the rest was sold under a long-term contract. Transaction prices are not often published when they do occur, and the only open pricing is that demonstrated by published bids for relatively atypical small amounts sold to government-owned companies in a very few locations.

Very few refining companies in the United States are net sellers of domestic crude oil. Of 23 integrated U.S. corporations analyzed in 1969, only 4 were in that position. These were Getty, Tenneco, Skelly (affiliate of Getty) and Pennzoil, of which only Getty ranks among the 21 companies having a refinery capacity above 100,000 B/D.

While industry-wide data are not available on the domestic crude self-sufficiency of refiners, sufficient data are available to conclude that only 2 of the 8 largest refiners exceed 80% net crude oil sufficiency in the United States, 2 approximate 50% and 4 between 60 and 80% self-sufficiency. On the other hand, it appears that at least 2 of the 21 largest refiners have a net domestic crude oil sufficiency of less than 20%.

Posted crude oil prices for various fields are bid prices offered by buyers to potential sellers. This is vastly different from posted product prices which are sellers' published offering prices to potential buyers.

It is also clear that an increase in crude prices, even after taking into account the resulting larger tax allowances for depletion on their own production, reflects an increased net cost to nearly all refiners, even the largest integrated refiners.^{1/} The cost impact on each refiner will vary inversely to its relative self-sufficiency in the production of crude oil. On the other hand, the independent producers who produce about 30 percent of domestic crude oil, do gross the complete extent of a price increase for crude oil.

Transportation

The movement of crude oil and products overland within the United States is primarily by pipeline. Most pipelines are owned by a single oil company or a group of such companies. Generally, these pipelines are owned by corporations falling within the 21 largest refining corporations. Most are common carriers, however, under either state or Federal law.

Substantial amounts of domestic crude oil and products also move by barge and tanker. The largest water movement is between the Gulf Coast and the Atlantic Coast, nearly all of it in tankers owned or chartered by refining companies situated in the Gulf Coast area. As a general practice, buyers of crude oil or products do not own or charter tankers for movement of the crude oil or products they purchase.

Smaller volumes of crude oil are shipped by tanker from Alaska to the West Coast. The tankers moving crude oil from Alaska to the West Coast are owned or chartered, in nearly all cases, by the very few companies controlling production

^{1/} Study of Petroleum Industry Research Foundation, December, 1970.

in Alaska. There is very little movement overland either into or out of the states west of the Rockies.

Those companies having substantial crude oil positions overseas own or charter nearly all the tankers moving crude oil or products into the United States.

Marketing

Nearly all refining companies have integrated forward at least to the wholesale level. Some, including the eight largest, are engaging in the retail sale of some products in some areas, particularly fuel oils. Some, including only one of the eight largest, operate service stations in some areas. In the case of this one major, it has ten dealer-operated stations for each company-operated station. There is no uniform pattern, and the degree of forward integration tends to vary widely from area to area even for a single refiner.

No more than 8 refiners approach nationwide marketing activity, of which 7 are among the 8 largest.^{1/} However, regional as well as local marketing is quite common among refining companies, at least those above 10,000 B/D capacity. In fact, because of refinery-to-market transportation advantages, regional marketers are often in a very favorable competitive position.

Branded products generally sell at higher wholesale prices than unbranded products. Independent jobbers, wholesalers and retailers often sell at lower prices than those marketing branded products. When the spread between branded and unbranded products tends to cause marked shifts in market positions, discounts are often offered off posted prices for branded products. In the case of gasoline marketing, these are generally termed temporary dealer allowances. The common practice of allowing discounts adds to the difficulty of determining a representative wholesale price for gasoline and to the development of dependable price series.

By no means all unbranded products are sold by "independent" or smaller refiners. Major refiners at times and in varying degrees manufacture products in excess of their own marketing requirements in some areas and sell the excess as unbranded products on the basis of covering their incremental costs. In addition, refiners find it advantageous to buy products from other refiners in some areas for sale under

^{1/} Humble, Texaco, Shell, Mobil, ARCO, Gulf, Indiana, Phillips.

their own brands, and in many instances product exchange agreements are utilized. Processing agreements may be used under which one refiner manufactures products for another. Consequently, when the consumer purchases branded gasoline, it is by no means to be concluded that the gasoline he purchases was refined in a refinery of the company owning the brand name. Those companies maintaining or approaching a nationwide marketing effort often must either purchase or exchange products in order to market in some of the areas in which they are active.

In most of the important marketing areas of the United States there are integrated companies engaging in competition with jobbers and retailers to whom they supply one or more products.

EVALUATION

To determine whether these announced price increases are "necessary" to national security, there are two time frames to be considered, short-term considerations and long-term considerations. A negative conclusion as to one time frame would be overcome by an affirmative conclusion as to the other.

From the initiation of the oil import program in 1959 until 1969, crude oil prices remained almost constant, and Platt's Oilgram price index (using 1957-1959 as a base) for crude oil was at 99.7 in December 1968. The combined effect of the 1969 increase and the one under review here has been to move this index up to 111.6, or about 11.9%, in December 1970. Using the same base period, the BLS wholesale price index for all commodities moved from 109.8 in December 1968 to 117.8 in December 1970, or about 7.3%.

A table of average crude oil prices by year is set forth in Annex C. While these petroleum prices have not reached the index price of all commodities, it is obvious that their recent rate of increase has been faster. Consequently, their movement has been one of the factors in our current inflation problems, as indicated in the recent inflation alerts issued by the Council of Economic Advisers. Based on 1970 crude oil production, the price effect would aggregate almost \$800 million per year if fully passed through to the consumer.

-CRUDE OIL PRICE INCREASE-

-Short-Term Considerations-

The Suez Canal has been closed since the Israeli-Arab War of 1967. In May of 1970, the flow of Saudi Arabian oil to the Mediterranean through the Tapline across Syria to Lebanon was interrupted. In addition, production in Libya was substantially reduced by governmental edict. All these factors combined to reduce sharply the amount of short haul oil available to meet European demand. Replacement of this oil had to come from the Persian Gulf by tanker around the Cape of Good Hope. To accomplish this movement, at least four times as much tanker capacity is needed (Petroleum Press Service, January 1971, p.2). Spot tanker rates more than doubled in a year's time, and the London Tanker Brokers' Average Freight Rate Assessments Index, which more nearly reflects term charter costs, indicated an average increase of 40% in ocean freight rates for crude oil between May of 1970 and January 15, 1971. All these factors were accentuated by a growth rate in the demand for fuel oils in Japan and Europe over double that in the United States.

The shortage of tankers and rapid growth in demand elsewhere have had a direct impact on the United States. Actual imports of crude oil from all sources dropped 7.5% or 106,000 barrels per day in 1970 from the 1969 level. In supply and demand terms this reduction is perhaps more significantly measured by the fact that actual imports of overseas oil in 1970 were approximately 185,000 barrels per day less than the refinery allocations under the Mandatory Oil Import Program. This shortfall was offset in part by an increase in imports from Canada of 100,000 B/D over 1969.

While crude oil imports declined during 1970, residual fuel oil imports increased over 330,000 B/D. Practically all of these imports were used in the Atlantic Coast states which are over 90% dependent on imported residual fuel oil.

As previously discussed, there is not an open world market system for crude oil. The situation at the time of the price increase, and previously, does suggest, however, a conclusion that the marginal delivered cost to the U.S. importer of much foreign crude oil was above the price of domestic crude oil. For instance, 16% of the overseas quota allocation for 1970 was not used by importers; it does seem that if enough tankerage had been available at a cost

making imports economic, these quota allocations would have been used. As other facts pertinent to the world price situation, the East Coast of the United States, where residual fuel oil imports have not been limited by the import program and which is therefore exposed to the world price for this product, experienced an increase of 50% or more in that price. Also, the price of No. 2 oil landed from Venezuela was generally close to that of domestic oil.

In the absence of controls on imports, the international dislocation might well have caused an increase in the price of domestic oil to the price at the margin of foreign oil delivered to the U.S. East Coast. The recent dramatic increase in residual fuel oil prices (along the Atlantic Coast) underlines this point.

At the present time, then, the U.S. oil industry has been faced with a tight world transportation supply. It is noteworthy that the effect of the oil import program can be judged to have served the country well in the recent world oil transportation shortage, since petroleum supply in the U.S. has continued to be adequate. Furthermore, the estimate is that, even with a further disruption of the Eastern Hemisphere supply situation, the U.S. petroleum situation should be manageable.

It is clear that price increases were not necessary in order to bring out alternative sources of supply to meet the demand during the present disruptions in normal supply movements of imported oil. Consequently, this short run situation did not necessitate crude oil price increases and further long run analysis is required.

During 1970 domestic production of crude increased 420,000 B/D over the year, or 4.8%, to meet the gap. This increased production came primarily from Texas and Louisiana, with smaller increases in production from Wyoming and Alaska. Except for marginal wells (stripper and secondary recovery wells), Texas and Louisiana apply market demand prorationing to oil fields in those states under which production from the more efficient reservoirs is restricted to meet estimated demand. Between October of 1969 and November 1970, Texas increased permissible production from these fields from 53.7% of maximum allowables to 87.3%. In the same period Louisiana went from 44% to 75%.

After a preliminary analysis, the Director of OEP concluded that any systematic analysis of the relationship between increased prices and their national security need was complicated by State control over oil production from Federal offshore lands over which the U.S. has exclusive jurisdiction by law. These controls could withhold from the market a portion of domestic oil production for which the Federal government had the overriding responsibility for national security and ultimate management responsibility. Hence, the Director concluded that the Federal government should assume regulatory responsibility over the production from Federal offshore lands in order to assure that this Federal area would make its maximum efficient contribution to meet longer range national security objectives and any claim of short-term supply deficits. As a corollary to this action, it was concluded that price increase pressures would be restrained by this action.

As part of his preliminary analysis, the Director of OEP noted further that existing overseas allocations for oil imports were not fully used due to the disruption in the world oil situation. On the other hand, production and pipeline capacity was available to switch, if the market forces so determined, some of these unfilled overseas allocations to imports from Canada.

After the consultation required by Section 6(a) of Presidential Proclamation 3279, the Director advised the President of the above situation. On December 4, 1970, the President placed oil and gas production on Federal offshore lands under Federal regulatory control. He also made users of imported Canadian oil who hold offshore allocations eligible to exchange those allocations for additional Canadian crude oil.

One measure of the supply/demand balance at any given time is the size of the inventory. At the end of 1970 total stocks of crude oil in storage were 33 million barrels above those at the end of 1969 or about 3.4% higher. During the four weeks ending October 30, 1970 - just prior to the initial price increase announcements - crude oil stocks increased each week. However, it should be noted that state market demand prorationing tends to counteract the downward pressure of high inventories on crude prices.

It should also be noted that gasoline stocks were higher at the end of 1970 than 1969 and were also higher at the end of

October 1970 than for the comparable week in 1969. Total crude runs to stills from all products were only about 2.3% above the previous year. Therefore, one cannot infer that refinery runs were increasing rapidly which might call for a price increase to obtain a higher level of supporting stocks if crude oil production was not keeping pace with refinery operations.

Some of the written submissions suggest that a higher price for crude oil will extend the production life of stripper wells, thus increasing the short-term supply. It is undoubtedly true that some of these wells which shut down when the revenue from their production no longer covers out-of-pocket costs would continue to produce for a time. (See Annex D for stripper well trends). Taking only short-term considerations into account, it seems clear that a higher price for crude oil would not bring forth significant production from this type of well.

It is quite true that secondary recovery projects, in which reservoir production is stimulated by such methods as water flooding or the injection of steam or gas, lead to greater production than natural or primary production alone. Additional investments are required for secondary recovery, and they will not be undertaken unless the additional production will provide an adequate return on this investment. Current nationwide information is not available on secondary production, but Annex E points up the fact that secondary production is expected to become a larger part of total production in the years to come.

However, it should be noted that the Department of the Interior has informally advised that it requires about 12 months lead time for additional production to be obtained even in the case of relatively shallow and uncomplicated secondary recovery projects. Therefore, it is most doubtful whether the additional revenue from the announced price increases will stimulate additional production to assist in meeting our short-term requirements arising from the current disruptions in world oil patterns.

Many responses cited the need for higher earnings in terms of the current health of the industry. This aspect of the analysis will be undertaken as part of the long-term considerations discussed subsequently in this paper.

-Long-Term Considerations-

The price of crude oil varies by the characteristics and location of the production from a particular field. Refinery design, refinery location and refinery markets are among the factors affecting the crude oil market. Hence, there is no single existing quotation which can be taken as the price of crude oil and the most valid single figure has to be derived from a weighted average - a considerable statistical task. The most widely accepted average is that provided by the Bureau of Mines for each year, as set forth in Annex C for the years 1955-1970.

There is no direct proportional relationship between the price of crude oil and the price of any product to the consumer. Residual oil has in the past, for instance, sold at a lower unit price than the price of crude oil. One factor in this price has been the interfuel competition with natural gas and coal, a type of competition which affects gasoline prices very little. Hence, refineries have pressed to maximize production of gasoline and distillates, with consequent frequent inventory surpluses, and to minimize production of residual oil. The alternative fuel costs resulting from increased interruptions in natural gas supply and of changing environmental standards now adds to the complexity of any price analysis. There may be under way, over the mid-term and longer term future, a transition in the relationship of the pricing of the various products from a barrel of crude oil, and also a transition in the optimum economic mix of refinery production from a barrel of crude oil. Such transitions make reliable economic analysis difficult at this time.

A purpose may be served in having a look at the measure of what the United States might be willing to pay for energy security -- if the need were proven by a sobering experience. Practically all our energy supply is now secure except oil. Oil provides about 43% of total U.S. energy. The production (and import) cost of oil is about 16-18 billion dollars a year at current prices at the well head and port -- or less than 2% of our trillion dollar economy. This cost is less than a quarter of the annual budget of the Department of Defense. The total portion of the petroleum industry in the Gross National Product is on the order of \$30 billion a year, with the major part of the costs being downstream from the provision of the raw material. The cost of crude oil at the well head represents an average of only 8.13¢ per gallon of gasoline.

Viewing this basic raw material cost of energy fuel of less than 2% of our GNP in the perspective of its essentiality to our way of life and also to our security, a moderate increase in cost could certainly be sustained if that increase were needed to preserve that security. On the other hand, there should be no need to sustain an increase in cost, if that security can be attained at a lower cost. To the extent available, alternative courses should be adopted which will achieve these security objectives without greater cost to the consumer.

Recent world events have demonstrated a substantial upward shift in the cost of foreign oil. However, the recent revisions in payments to foreign governments have increased the cost of foreign oil 40¢/80¢ per barrel, thus narrowing the spread between domestic and foreign crude oil costs. Historically, the long-range trend in the cost of foreign oil has been downward, but there is no present evidence upon which to assume this trend will re-occur.

The submissions in support of crude oil and gasoline price increases are directed primarily to the national security objectives of maintaining adequate crude oil reserves and a healthy petroleum industry. Even though considerations of providing excess production capacity and adequate refinery capability also must enter into long-term analysis to some degree, the submissions did not offer any substantial comment with respect to these factors.

On the other hand, submissions in opposition tended to discount heavily, if not reject, the national security findings accepted by four national administrations. Some, however, did contend that the price increases under study were not necessary to achieve the national security objectives stated above. Others limited their objections to a statement of their views concerning the adverse competitive effects within the industry which could flow from these price increases.

Proved Crude Oil Reserves

The trend in proved crude oil reserves is basic to considering the national security implications of these price increases. In terms of assured future supplies and financial net worth, the oil industry relies only on proved reserves in which enough drilling and testing have been done to define a measure of recoverable resources from each reservoir. These proved reserves are to be distinguished from

those inferred from discovery wells alone or estimated to be available in favorable geological formations. A recent National Petroleum Council report estimated that 55% of the oil and 60% of the natural gas in the United States remain to be found. These estimates constitute inferred and ultimate resources which are not included in proved reserve calculations.

From 1952 to 1957 the U.S. proved reserves steadily increased (with only one annual exception) from 27.5 billion barrels to nearly 32 billion. After 1957 these reserves varied within a narrow range which did not fall below 31 billion barrels until 1969. However, in each of the last three years (1968, 1969 and 1970) the nation's total crude oil proved reserves have declined. The extent of the decline is from 31.4 billion barrels to 29.4 billion barrels, excluding the North Slope of Alaska. (See Annex F). In other words, gross additions to these reserves from exploration and development have not been sufficient to meet our domestic production withdrawals. However, these reserves make no allowance for discoveries on the North Slope of Alaska which are not included for the purposes of this study because they are not presently deliverable. The American Petroleum Institute now reports the proved reserves of the Alaskan North Slope to be 9.6 billion barrels, but in view of the present uncertainty whether or when these resources will be marketable, they certainly are not available to meet our national security objectives.

Proponents of the recent crude oil price increase have expressed alarm that the ratio of proved reserves to current consumption has fallen drastically since 1955. In that year our domestic proved reserves of 29-1/2 billion barrels were 9-1/2 times our current consumption at the time. In 1969 that ratio was slightly under 6 to 1. (See Annex G). Under normal economic conditions it is not to be expected that crude oil reserves will reach a life index equal to that of the early 1950's in the face of our increasing demand for energy in all forms.

Optimistic estimates have put the reserves found thus far on the Alaskan North Slope at 20 billion barrels. Other estimates are 10-15 billion barrels. If these potential proven reserves in Alaska could now be included in the calculations the result would be a heartening leap in the current total. In fact, inclusion of 9.6 billion barrels of

North Slope oil by the American Petroleum Institute lifted its reserve calculations from 29.6 billion for 1969 to 39.0 billion for 1970. But, by the time that deliverability of this large increment is arranged (1974 or 1975 at the earliest) there will be a large drawdown of current reserves and an increase in the rate of annual consumption. Significant action will be required promptly if the decline in reserves is to be reversed before the Alaskan oil becomes available, and a continuing input of reserves is needed after that time since even 20 billion barrels is only the current rate of production of U.S. refineries for about five years. It may be noted for comparison that the total reserves ever proven in Texas have been about 31 billion barrels and 11 billion in Louisiana, including offshore.

The foregoing analysis is admittedly somewhat discouraging and leads to the obvious question as to what else, in addition to proven reserves of oil, can be done to provide energy security. Should these be the only areas of security emphasis and the oil import program the only program recognizing our national security energy needs?

There are other recognized courses of action. Policies which increase gas production (related to oil production) will tend to decrease demand for oil. Assurance of foreign oil from more secure sources will contribute to alleviating the problem - but there is not that much secure foreign oil in sight. Development of shale oil and acceptable utilization of coal (stack technology and gasification) will help. But these resources are available only for the latter part of the decade and, only then, if technology and development are pressed immediately. At best they initially will only supplement production from proven petroleum reserves. Research and development effort will be required now from government, producers and industrial consumers such as utilities if these potential sources are to be effectively utilized under sound economic principles.

It does seem necessary from the national security standpoint to maintain and strive to increase our proven crude oil reserves. However, any significant long run improvement in their life index almost certainly turns on developing a capability to produce synthetic equivalents for oil and natural gas from our vast reserves of oil shale and coal.

For the longer term, the principal issue is whether the recently increased price, or a higher price, or even a lower

price, is necessary to maintain an adequate level of proven reserves and the needed accompanying production industry. The incentive factors involved include the cost/price relationship. But those incentive factors also include other government programs such as the leasing of government-owned land, environmental protection requirements, and realistic regulatory pricing of natural gas, which have not been systematically introduced into the equation of an adequate and secure petroleum supply.

Exploration and Development Expenditures

The available data confirm a declining trend in domestic exploration and development effort when measured by all the usual indices, such as geophysical expenditures, acreage under lease, rotary rigs in operation, wells drilled and wells completed.

With respect to total investments in exploration and development (excluding lease acquisition costs) the average annual investment since 1952 through 1969 has been \$3.7 billion, and the annual investment has never varied more than 5.3% below or 8% above that average. (See Annexes H and I). Including lease acquisition costs distorts any such comparison since they include the sporadic wide swings occurring when bonus lease sales occur on the Outer Continental Shelf or in Alaska. Bonus payments also distort these investment data as a measure of effort since they do not cover any of the labor or capital equipment costs of exploration and development.

Undoubtedly, the rate of exploration and development expenditures has been affected to some degree by uncertainties in government policy trends in relation to such matters as environmental regulations, import controls and tax treatment at Federal and state levels.

As we note subsequently, the relaxation and liberalization of market demand prorationing in the past year have brought forth substantial amounts of lower unit cost oil. The probability that this trend will continue in prorationing should provide an incentive for greater investment in exploration and development.

Natural Gas Pricing

Prior to World War II natural gas was viewed in most oil-producing areas in the United States as a waste product and

large quantities were typically flared. After 1945 major pipelines moved natural gas to populous areas where this desirable and clean fuel found a ready market. Large quantities have been sold on an off-peak interruptible basis for industrial and boiler fuel purposes at prices which have discouraged the use of coal and residual fuel oil. In addition, well head prices for natural gas shipped in interstate commerce have been regulated on a cost-of-service basis by the Federal Power Commission since 1954.

Since about 1/4 of our natural gas supply is produced in association with oil and exploration for oil often leads to discoveries of natural gas, potential revenues from natural gas are important in exploration and development investment decisions. The average addition of gas reserves found with the addition of each barrel of added oil reserves has ranged from 1,074 cubic feet in 1967 down to 717 cubic feet in 1969. Intrastate prices for natural gas, which are not regulated by the Federal Power Commission, are higher than the regulated interstate prices. The Council of Economic Advisers has reported:

Not only have prices been too low for desired consumption to be met, but they appear also to have retarded development of new gas supplies. The only satisfactory solution of this problem is to allow the price, at least of new gas not previously committed, to approach the market-clearing level.

As the Council observed, the competition of new supplies of natural gas would tend to reduce prices for consumers of other fuels. In our view, a revised pricing policy for interstate sales of natural gas also would provide a basis for more realistic sharing of the costs of exploration and development between the consumers of oil products and natural gas and restrain upward pressures on crude oil prices.

Cost Trends

The industry submissions in defense of their price increases have highlighted the increase in their costs and the decline in their profits and have stated that the industry is caught in a cost-price squeeze. But these claims need to be evaluated against the background of general economic events and a more complete picture of cost-price relationships than the submissions generally included.

Wage rates, drilling costs, and other elements of fixed and variable production costs have indeed been rising as claimed. But the part each of these costs plays in unit costs of production and refining is not discussed. Production costs cannot be totally disaggregated from refining industry costs since 70% of the crude oil produced is owned or controlled by refiners. According to the 1967 Census of Manufacturers, total payroll for all employees in petroleum refining (SIC 291) amounted to only 4.8 percent of total value of shipments. According to the Department of Labor, average hourly earnings in the oil refining industry advanced by 6.8 percent from September 1969 to September 1970, but output per man hour went up by 7.4 percent from 1968 to 1969 which would appear to more than offset the labor cost increase in calculating the unit cost. True, there was an industry-wide increase in labor costs in December 1970, but there is no evidence available to indicate any change in productivity trends.

Equivalent productivity data is not available for the production segment of the industry, but the wage bill is also only a small segment of costs in this part of the industry which is also capital intensive. And since State prorationing allowables have increased over the period, tending to increase the proportion of total output which comes from the more efficient, lower unit cost wells, it is entirely possible that these increases also have been offset. As noted previously, Texas and Louisiana allowables were increased substantially in 1970. In one year's time the actual lower cost production from Texas was increased almost 500,000 barrels per day, while in Louisiana it increased over 400,000 barrels per day. Even under normal world oil transportation conditions, it seems generally accepted that, given current trends in import levels, market demand prorationing will no longer be applied by 1973 or 1974 so as to have any significant effect on supply. The producers in those states will then have the full benefit of lower unit cost production. However, whether we have excess production capacity in future years will be affected primarily by the level of imports permitted under government policy and not by state prorationing in Louisiana and Texas.

Two additional cost elements, however, are not as easy to discount. These are the so-called "tax cost" of the reduction in the depletion allowance to producers and the added

costs of pollution control measures to producers and refiners. Both of these are new cost elements. They almost certainly have contributed to the fact that oil profits did not go up generally with the increase in demand which occurred even though this has been a period of economic slowdown.

The American Petroleum Institute did not provide a submission for this investigation. Their annual report does estimate that the 1969 Federal tax law added \$700 million a year to the industry's tax bills and that the industry's annual rate of expenditures in 1970 for environmental protection was \$559 million.

The Petroleum Industry Research Foundation estimates the cost of the revision in the depletion allowance to producers as around 24¢ per barrel -- almost exactly the crude price increase under investigation. If this is correct, it should be recognized that the crude oil price increases did restore the netback to the independent oil producer which he had prior to the Tax Reform Act of 1969. The Foundation also reports that, in the case of Gulf and the few other integrated companies with crude self-sufficiency of more than 82%, their depletion allowance benefit could be used to offset any additional cost in their refining operations for the oil they purchase from others. As to these few highly integrated companies, the crude price increase imposes no net cost on them even if competition erodes their efforts to increase the prices of gasoline and other products.

In evaluating the effects of cost trends it is necessary to consider productivity improvements arising from technological changes and greater efficiencies in exploration and development. According to a National Petroleum Council study prepared in 1967, the producing industry effected sizable cost reductions between 1950 and 1965, as follows: (1) improved drilling technology, 35¢ per barrel; (2) crude oil production methods, 32¢ per barrel; (3) better corrosion control, 9¢ per barrel; and (4) optimized well spacing, between 17-1/2¢ and 35¢ per barrel.

While the Department of the Interior is of the opinion that increases in costs together with the increased difficulty of finding oil have more than offset any cost savings from greater efficiencies, the Department has recognized the difficulty in providing objective data to support such a conclusion. The Department has advised us that:

Many variables affect the cost of oil; the technology of oil exploration and production is only one of these. The exact interplay between rising costs, increased efficiencies, technological and operating prices, the increasing difficulties of finding oil and randomness of new discoveries is difficult to assess and quantify for any short-term period.

Annex J sets forth the ratio of annual exploration and development costs per barrel of new reserves added for ten years, 1960-1969. Inasmuch as current reserve additions arise largely from past expenditures, and current expenditures are made in part to provide future reserves, this ratio must be used with considerable reservation. However, these data do tend to establish that annual variations cannot be relied upon as a firm basis for concluding that industry-wide exploration and development cost trends would warrant a crude oil price increase at this time.

There is considerable room for doubt whether cost trends in drilling are nearly as important as the industry's judgment of the probabilities of successful discoveries. When opportunities have been made available to obtain wild-cat drilling rights on the Outer Continental Shelf and in the Alaskan North Slope areas, exploration expenses have bulged materially because of large bonus bids. These payments, of course, did not pay for one foot of drilling costs. Thus, in 1967, 19.7% of the industry's total exploration expense was in lease acquisition costs; in 1968, 31% and in 1969, 23.8%. In contrast, from 1952 to 1960, these costs never exceeded 13% of total exploration costs.

Another indicator that success probability weighs heavily in industry exploration activity was demonstrated in the recent Louisiana offshore sale in December 1970. The high bids accepted by the Federal government amounted to almost \$846 million. The total of the unsuccessful bids was over \$2 billion. In other words, after the sale there remained over \$2 billion, most of which presumably was available for exploration in favorable areas. In 1969 the State of Alaska sold leases in the North Slope area for which cash bonuses aggregating some \$900 million were paid.

The 1969 Alaska sale is particularly significant. Operations on the North Slope were known to be extremely costly and

transportation expense largely an unknown element. Nevertheless, the industry paid out over 1/6 of its total exploration and development expense that year just for the right to drill and produce in that area. It seems apparent that the probabilities of large-scale production and low average unit costs per barrel produced are an incentive more than offsetting the obvious cost disadvantages of operations in that area. An official of one of the companies with a major interest in the North Slope has stated that the oil industry's total investment may well reach \$10 billion and, even at that cost, North Slope oil will be economically attractive. The average flow rate per well is expected to be 10,000 B/D.

From May 21, 1968, until December 15, 1970, there were no exploration leases on the Outer Continental Shelf offered for sale by the Federal government. This was a period of almost 30 months in which the only leases available in these favorable areas were in small drainage pockets for which \$125 million were paid. During the same period and continuing even now, Federal leases are not available in Alaska pending settlement of certain native claims.

Less than 5% of the world's producing fields account for more than 85% of the world's oil. When both oil and gas are considered, giant fields with over 500 million barrels of oil or gas equivalent account for over 80% of the world's hydrocarbons. Within the United States the two areas with known prospects for giant field discoveries are off the coast of the Gulf of Mexico and California, and in Alaska. Quite naturally these areas attract large amounts of capital for exploration and development, yet these are the very areas in which there have been major obstacles to Federal leasing and development for several years. It may then be questioned whether the decline in proved crude oil reserves would have been as steep in 1969 and 1970 if the Federal government had followed a different leasing policy after May of 1968.

Investment Requirements

The recent boost in crude oil prices has been consistently defended as necessary to provide funds for exploration and development, thus to assist in reversing the decline in proved crude oil reserves. As noted previously, some of the submissions supporting the increase have said it was not enough to assure the desired result, but that it is an important step in that direction.

There are three sources of funds for investment in the petroleum industry. They are (1) retained net earnings; (2) return of capital, which includes the proceeds obtained by the industry as a result of depreciation and percentage depletion allowances on crude oil production; and (3) capital raised through equity participation or through debt transactions.

A series of charts are attached which establish quite clearly that the petroleum refining industry over time has had a favorable profit experience compared to other industries. Profit rates after taxes for the refining industry exceeded the average for all other manufacturing industry in four of the seven years from 1963 to 1969, inclusive. While the total cash flow of the petroleum refining industry in relation to stockholders' equity exceeded that of the average for all other manufacturing industries in only two of these seven years, the available data indicate clearly that the oil refining industry has not been disadvantaged on balance. See Annex M.

The analysis that follows is based on data contained in the Federal Trade Commission--Securities and Exchange Commission, Quarterly Financial Report for Manufacturing Corporations. In order to sharpen the comparison, the petroleum refining data as published has been subtracted from the published data for all manufacturing to create a series for all manufacturing except petroleum refining.

Since the availability of financing for investment is affected by capital recovery as well as retained earnings, cash flow series have been calculated by adding the published data for retained profits to that for depreciation and depletion. The final adjustment to the published data was necessitated by a lack of the most recent data. Since only three quarters of data were available for 1970, annual rates are calculated by multiplying the three quarter totals by four-thirds, i.e. assuming that the fourth quarter results would be the average of the first three quarters.

Annex M gives the resulting time series for profits after taxes and cash flow for both petroleum refining and all other manufacturing. These are listed both in millions of dollars and in percentages of stockholders equity.

Annex N shows graphically the relative growth patterns in terms of the actual dollar values. Because of the differences

in scale, however, the relative heights of the lines for the two sets of curves should be disregarded - only the patterns of growth and the spreads between profits and cash flow within each set of curves are comparable.

Annex O displays cash flow and profits for these industries in terms of percentages of stockholders equity. The data are all strictly comparable on this graph, but the truncated scale may tend to exaggerate the size of the changes.

Petroleum, both in terms of profits and cash flow, appears to be much more stable than manufacturing industries in general. The data and graphs do indicate a drop in the petroleum refining profits, as claimed, but not a worsening of the position vis-a-vis all other manufacturing industries.

Of course the fact that petroleum refining profits and cash flow have not suffered as large a decline today as other industries is not necessarily proof that they are adequate to meet the needs of sustaining the level of domestic reserves.

One factor that bears heavily on this question is the extent to which these resources are indeed applied to domestic investment in production capability and exploration. While the data are not strictly comparable to that of the FTC-SEC, the Chase Manhattan Bank reports on Capital Investments of the World Petroleum Industry can help to throw some light on the question.

According to the Chase data, American companies have allocated their capital expenditures in recent years as follows:

	<u>1968</u>	<u>1969</u>
United States	\$7,745 million - 64.6%	\$7,495 million - 62.4%
Production ¹	(4,625 million - 38.6%)	(4,415 million - 36.8%)
Other ²	(3,120 million - 26.0%)	(3,080 million - 25.6%)
Free Foreign	4,240 million - 35.4%	4,510 million - 37.6%
TOTAL	\$11,985 million - 100%	\$12,005 million - 100%

1. Both crude oil and natural gas, including natural gasoline plants.
2. Pipelines, marine (tankers), refineries, chemical plants, marketing, etc.

The Chase Manhattan 1969 survey of petroleum capital investments also reveals that 81% of the worldwide spending in the search for new petroleum reserves came from American companies. In this connection, it should be noted that the same rate for depletion is allowed under U.S. income tax laws for foreign production as for domestic production. Consequently, it can be said that our income tax laws, including credits for foreign tax payments and equal depletion allowances, are essentially neutral and provide no differential incentive favoring exploration for domestic reserves. In effect, this means that the Mandatory Oil Import Program is not reinforced by our tax policy in achieving national security objectives.

While 4th quarter and year-end data are not yet available on the same basis as the first three quarters of 1970, the Wall Street Journal for February 5, 1971, surveys 4th quarter profits for 422 business concerns from more than 21 different industries. Nineteen petroleum companies were included. This summary indicated a 10% improvement over the 4th quarter in 1969 for the oil companies included. Only five of the other 20 industries were reported as having improved profits for that quarter over the previous year. Our own review of published earnings results for 23 of the companies included in the Chase Manhattan financial analysis for 1969 indicates that 11 reported increased net profits for the year and 12 reported declines, but none reported losses. Of 17 of these companies for which 4th quarter results have appeared in the press, only 3 reported a decline for 1970 over 1969. These data indicate that the industry's performance for the year actually was more favorable than that reflected in the annexes attached.

A similar survey by Business Week (February 13, 1971) for 250 corporations in 25 different categories of industry confirmed this conclusion. The oil industry, represented by 26 corporations, was one of 13 categories of corporations reporting improved 4th quarter earnings over 1969. The profit margin of oil for the quarter ranked exactly in the middle of the 13 categories showing improvement.

On February 8, 1971, the Oil and Gas Journal reported on oil industry profits for 23 corporations, including all five of the major internationals. For the 23 as a group, 1970 annual profits were only a shade less than 1969, with 10 reporting increases and 13 decreases. For the 4th quarter,

only 6 of the 23 reported declines. Of perhaps even greater significance is the fact that only one of the 5 major internationals reported lower earnings for the year 1970 than for 1969, and their 4th quarter results were much more favorable than the other companies as a group. The one exception emphasized an unfavorable tanker position. Since these five major internationals received over 63% of the total profits of the 23 corporations included in the survey and there have been widespread reports of favorable foreign results in 1970, it can be questioned whether additional profits from price increases in the U.S. will in fact lead to more domestic exploration and development in the face of attractive opportunities for overseas investments by the industry.

The point is made in several submissions that the industry historically has relied heavily on cash flow (retained earnings and return of capital) to finance its investment requirements, but in recent years it has had to rely more heavily on borrowed money and equity issues. This trend is confirmed by the 1969 Chase Manhattan financial study of 27 corporations. In 1959, they met 91.3% of their capital needs from cash flow, whereas in 1969, 76.4% was obtained from these sources.

Nevertheless, one should not assume that this trend is precisely related to exploration and development trends in the United States. From these same capital sources must come the funds invested by American companies overseas as well as home. Furthermore, the capital requirements of the industry also include funds for transportation, refining and marketing facilities, as well as exploration and development. Merely adding to the industry's cash flow by a domestic crude price increase does not assure, in itself, that more would be invested in domestic exploration and development.

In view of the readily apparent need of the industry for vast sums of money for investment in the years to come, in order to meet world demand growth, more and more reliance on new equity and debt capital must be expected. One major company has recognized this and in the last year has raised about \$1 billion in new money.

For the Chase Manhattan group, the proportion of its total investment in the United States has declined from 79% in 1959 to 72.8% in 1969. This reflects in part the phenomenal industry growth elsewhere, particularly in Europe. Almost half of the Chase Group's capital investment

worldwide in 1969 were for purposes other than production of raw materials. A recent Oil and Gas Journal (February 22, 1971) projected that refining capacity in Europe will be expanded at the rate of 1.4 million B/D for each of the next 5 years. The U.S. Department of Commerce has estimated that U.S. overseas oil investment will jump 13% in 1971.

Insofar as interest costs on borrowed money may be concerned, the petroleum industry certainly is not disadvantaged in relation to other industries. Nor are the recent high levels of interest costs to be considered as immutable. Interest rates for substantial borrowers have been dropping rapidly in the past six months.

Surplus Production Capacity

While provision for surplus production capacity is an essential consideration in analyzing any oil program for national security purposes, the submissions made no substantive contribution that would connect the price increases to this objective. The Department of the Interior has estimated that there remains today a surplus capacity of one million barrels per day, deliverable within a reasonably short time. Of this amount, 225,000 B/D are attributed to Elk Hills Naval Petroleum Reserve No. 1 and the remainder to Texas and Louisiana. The latter capacity is surplus in the sense that state prorationing has limited production below the Maximum Efficient Rate for many fields in those states. It has been held in surplus for reasons other than national security, and it is generally agreed that our burgeoning demand for petroleum will cause effective removal of prorationing limits by as early as 1973. However, substantially higher import levels could be expected to result in excess domestic production capacity. The national security benefits from this surplus capacity in previous crises have been merely by-products of other restraints such as import policies and state market demand prorationing.

Merely providing more funds to the industry through higher crude oil and product prices will not assure a desirable level of surplus capacity for national security protection. Even if the funds so raised are expended in exploration and development, that would not guarantee excess producing capacity available on short notice. Unless market demand conditions warrant development drilling, there will be a

tendency to restrict such development to that necessary to define a newly discovered reservoir and thus prove its crude oil reserves. Further development would then be staged as the market for the oil would justify.

If the Federal government is to carry out its national security responsibility properly, it would seem that incentives must be tailored to fit the desired level of excess production capacity. An increase in crude oil and product prices as the sole incentive is obviously poorly suited to that purpose.

The Independents' Role

In the past independent producers have participated substantially in expenditures for exploration and development of oil and gas resources. From 1946 through 1955 the Chase Manhattan group (which includes some large independent producers and all the major refiners) averaged \$1.4 billion per year while all others, including literally thousands of independents, averaged \$1.3 billion.

After 1955, however, this relative situation changed materially. By 1969 the Chase Manhattan group had increased its annual expenditures for exploration and development by 50%, but the other elements of the industry were expending 45% less than their 1956 level of investment.

There is little evidence that crude oil prices were a substantial factor in this change. As noted previously, exploration emphasis has shifted materially to the Outer Continental Shelf and to Alaska where there were favorable prospects for giant fields and where leases are issued on the basis of competitive cash bonus bidding. As noted previously, these lease acquisition costs have become a major portion of exploration investment and no doubt have hindered participation by many independents. It is heartening, however, to note that in the December 1970 Outer Continental Shelf sale, independent producers were major participants in two of the three tracts for which the highest per acre bids were made. In addition, the use of drilling funds has provided a means to raise money for expensive exploration efforts. As a tool, these funds certainly provide an avenue for participation and management by skilled independents.

In the long run it appears that it may be necessary to rely significantly on the independent to take the wildcat

risks necessary to explore those areas which are favorable prospects but are not likely to yield giant fields. In addition, leasing policy which did not turn so heavily on large advance bonuses would provide him more opportunity to participate in highly desirable areas such as the Outer Continental Shelf.

Integrated companies have become progressively more self-sufficient in crude production. See Oil and Gas Journal, January 18, 1971, pp. 22-24. An increase in crude oil prices generally will tend to accentuate that trend. It is apparent that the more costly purchased crude becomes, the greater the incentive for integrated companies to expand their own exploration effort (in competition with the independent) and thus reduce their purchases of crude oil in the open market.

Here again it seems that a desirable objective - significant participation by independent producers - may require tailored incentives and will not necessarily be achieved by a crude oil price increase alone.

Summary Long-Term Observations

Exploration and development for oil are assumed in the submissions, sometimes explicitly, sometimes implicitly, to be directly related to the price of crude oil. There is, however, a very wide difference in professional judgment on the long-range relationship of crude oil prices to production levels. (See Annex P on the elasticity of supply). The submissions from the producers, however, generally show an attitude that the recent price rise, while welcomed, is not enough in their opinion.

As stated earlier, the prices for domestic crude oil vary widely. Gravity, sulfur and metallic content and location all materially affect the pricing of crude oil. This is well illustrated by the average prices of the 5 types of crude oil used by the Bureau of Labor statistics in its monthly wholesale price index. For the month of January, these prices varied from \$2.97 per barrel for Wyoming sour crude to \$3.765 for upper Texas Coast sweet crude. Some specialized crudes command even higher prices in the marketplace.

Adequacy of exploration, by implication in most of the submissions, is measured in terms of geophysical operations,

leasing, active drilling rigs, and feet of drilling. These physical indicators of exploration activity have all been declining over the past decade. Another measure of adequacy mentioned is the dollar investment in exploration and development. That rate of investment, excluding bonus payments, has remained fairly steady for at least ten years at about 3.7 billion dollars.

The only available estimates of oil industry investment needs in the future are from private sources. The Chase Manhattan Bank estimates that approximately \$7.25 billion (including lease acquisition) per year is required over the decade of the seventies. This estimate seems to assume a continuing and increasing reliance on petroleum as an energy source. Such a level of investment, or for that matter even the recent level, turns on a combination of anticipated success in exploration, anticipated price of oil, availability of capital for this purpose, and the rate of development of alternative energy sources.

Generally, emphasis has been placed on the price of crude oil, both as an incentive to explore and as a provider of capital. But it does seem unlikely that price alone will bring about almost double the rate of capital investment from earnings of the oil industry--when that investment has remained about constant for at least ten years, even in those few instances in which there have been changes in crude oil prices. See Annexes C and I. Hence, attention in this analysis needs to be paid to the general problem of provision of capital and to probability of success in drilling. For, referring to the last point, the real test of adequacy in exploration is in the addition to reserves, and not in dollars spent, feet drilled, or any other measures.

Capital tends to move where investment is judged to be most remunerative. This principle applies to oil company earnings, which may move to coal, refineries, pipelines, motels, or some other investment, either here or abroad, rather than to domestic exploration and development. The same principle applies to bank investments or any other sources of capital for exploration. Hence, to maintain exploration and development, we have to premise an anticipated longer-run earnings situation for the oil industry comparable to anticipated earnings for other major capital investment. Whether some additional increment is needed because of the risk element is arguable, and difficult to analyze because of such compensating aspects as tax treatment. But certainly

the maintenance of a healthy industry, assuring adequate exploration and development, requires an assurance of earnings in equilibrium with that for other major industry. Otherwise, capital will not be provided to do the needed long-run job.

Parenthetically, critics of the oil industry have pointed to its earnings. That earnings rate is substantially the same as that for all other manufacturing and we should not premise that it be less. See Annexes N and O. Otherwise, we may be creating a situation unattractive to capital and inhibiting a development essential to national security.

Furthermore, if an increased rate of investment is needed, it may be argued that some incentive beyond that for other industry is warranted. The choice among incentives is not limited to oil prices alone. Incentives could be governmental assistance of some type (such as pilot plants for synthetic fuel), a more favorable leasing policy, more return for natural gas, or some other provision or combination of provisions. For instance, as noted above, the U.S. depletion allowance tax policy applies equally whether the oil produced is domestic or produced in an insecure foreign source. About half of the exploration capital of major U.S. companies is invested abroad. Since the U.S. crude price is higher than overseas crude costs and imports into the United States are limited by quotas, the reasons for this export of available capital must lie outside the domestic crude oil price structure.

As mentioned above, the future level of investment turns primarily on anticipated success in exploration, anticipated price and availability of capital--and the objective is addition to reserves. Oil companies often stress need for assurances as to long-term policy as much as they stress price. The flow of exploration capital abroad must be primarily due to anticipated success in exploration in relation-ship to costs and profit margins realizable in foreign markets.

We have mentioned above the demonstrated willingness of U.S. capital to make large bonus payments for leases believed favorable to the discovery of large fields. With that commitment to leases goes an implicit commitment to invest in exploration in order to recover the initial lease acquisition costs. But recent leasing and other government policies have not encouraged exploration and development of the more promising areas (offshore and Alaska).

Certainly, there are conflicts among public policy objectives, e.g. maximum income from bonuses, maximum environmental protection and perhaps others. But the tradeoff for each increment in achieving adequate reserves may, in the long run, have to be increased prices. But the incentive of price alone is unlikely to provide those reserves. For instance, as noted before, Alaska is a striking example of a situation where development of reserves is currently not price sensitive because of the temporary overriding effect of other factors. A coordinated family of actions is needed.

As noted before, several respondents have indicated that the November price increase is not adequate. None attempted to estimate the increase considered adequate. Such an estimate is obviously difficult, involving as it does, estimates of U.S. demand and domestic supply at different price levels and a judgment as to the amount of dependency which threatens to impair the national security. The Cabinet Task Force study (completed in late 1969) did make such an estimate concluding that a dependency on the Eastern Hemisphere for more than 10 percent of consumption should be avoided, and further concluding that such dependency could be avoided with a U.S. crude price of no more than \$3 a barrel and perhaps less than \$2.50 a barrel.

While not a submission for this investigation, there is a recent study taking sharp exception with the Cabinet Task Force study estimates.^{1/} This recent study estimates that, at the price level prior to the recent price increase, the 10 percent dependence on Eastern Hemisphere oil will be exceeded by 1973, the dependence will reach 16.5 percent by 1975, and 22.8 percent by 1980. This recent study further estimates an immediate need for an increase of 73¢ a barrel above 1969 prices, or about \$3.80 a barrel, to limit future dependence to 10 percent. The impact of possible program and policy options without price increases was not considered in this study, however.

Thus far, the discussion has not dealt directly with synthetics (oil shale, coal gasification and liquefaction, and perhaps tar sands). The available forecasts are that within ten years or so the United States may need these sources for any semblance of supply security unless there is a large input from the current unproven but promising locations.

^{1/} Oil Imports and the National Interest, Petroleum Industry Research Foundation, Inc., March 1971.

The United States cannot safely wait too long to move on the synthetics. The incentives could be a combination of leasing policy and price. For the latter, it has been argued that national security purposes call for a price increase sometime in the future to generate production of synthetics. The usual price mentioned by oil company executives is around \$3.75-\$4.00 a barrel. As noted previously, the best grades of crude oil currently attract prices approaching that level already. But members of the industry often add that if the government would permit a prototype operation, the necessary incentive price might be less.

Again, government as of now but not for too long, has a choice in the matter of synthetics. The options include: (1) inaction which will result in an undesirable degree of dependency on foreign oil sources; (2) complete reliance on the market in response to price increases; (3) governmental actions favorable to exploration and development, or (4) direct government assistance as it chose to do in the case of atomic energy (which will not provide more than 7-10% of energy by 1980, whereas oil and gas will probably be providing ten times that amount); or some combination of the foregoing.

On the matter of price, it has been customary to cite the lower price of foreign oil when criticizing the domestic price of crude oil as being too high. It is a fact that the cost of foreign oil did fall fairly steadily from 1960, when the landed cost in OECD countries was about \$2.65 a barrel, to 1969 when the landed cost was about \$2.20 a barrel. Recent OPEC negotiations have, however, resulted in a 42¢ per barrel average increase as of June 1 for 1971 and a contract provision for escalation over the next five years. Hence, it appears that the price of foreign oil in the longer term may well continue to increase, contrary to past history and the views of some authorities who believe that producer countries will not act together in the long term. While the cost of foreign oil at the well-head is unlikely to increase to the level of U.S. domestic crude prices, this foreign trend is a factor affecting the U.S. oil situation, including the allocation of U.S. exploration capital.

The possible avenues in the longer term, in addition to, or in lieu of, an increase in price of crude oil, include:

a. Acceleration of offshore leasing in all promising locations, including even previously unexplored areas such as offshore New England.

b. Resolution of the problems inhibiting exploration and production in Alaska.

c. Some shift to royalty leasing on a selective basis to generate exploration in previously untested areas.

d. Consideration of the tax treatment of oil to determine whether a difference should be established between exploration and development in secure areas as compared to insecure areas.

e. Systematic and timely balancing of environmental security and energy security objectives.

f. Updating of our traditional Naval Petroleum Reserve policies.

g. Steps to adjust natural gas regulation to avoid governmental underpricing of one fuel to the detriment of others.

h. Timely action on synthetics from coal, oil shale and tar sands.

i. Measures to reduce wasteful consumption.

As a concluding summary statement, referring back to the comment on cost of petroleum as compared to our total Gross National Product, the increase in the price of crude oil, in the longer term, may become necessary to achieve our critical national objectives. On the other hand, it does seem clear that price alone is most unlikely to do the job, and further increases may not be necessary if supporting programs are wisely pressed on a timely basis. In fact, it may well be hypothesized that even the increase reviewed here would be clearly unnecessary if these actions had been examined thoroughly and those most feasible had been vigorously implemented over the past decade.

-GASOLINE PRICE INCREASE-

To obtain greater realization of profits through increasing the wholesale price of gasoline is difficult because of the competitive, volatile, and complex structure of the gasoline market. Earlier attempts -- February 1969 and May 1970 -- to raise dealer tank wagon prices were substantially negated by competition within the industry itself. See Annex K.

The 1969 price increase effort began on February 25 when Texaco increased domestic crude prices by 20¢ per barrel and dealer tank wagon prices by 0.6¢ per gallon. Industry reaction was mixed. That time the higher gasoline prices received a greater immediate industry response while the crude increase picked up support more slowly. An erratic pattern of price changes continued over an extended time. By the end of 1969, the structure of the gasoline marketing system had itself essentially eliminated the sought-after gasoline price increase, even though average crude oil prices for 1969 were 12¢ per barrel higher than for 1968.

The 0.7¢ per gallon dealer tank wagon price increase started by Mobil in March 1970 did not hold either, except that the increase was dissipated in a much shorter period of time.

It is not yet clear whether the industry's previous inability to maintain higher gasoline prices will be repeated in the current gasoline price increase cycle. Gulf Oil Company triggered the current attempted increase by increasing its gasoline dealer tank wagon price by 0.7¢ a gallon concurrently with its increase in the price offered for domestic crude. Also announced was a 0.55¢ increase per gallon to jobbers, suggesting a 1.0¢ retail increase at the pump.

According to the trade publications, there also followed a widespread effort on the part of the majors to withdraw outstanding dealer competitive allowances. Such a withdrawal could have resulted in a net increase at the pump of 2¢ to 9¢ depending on local market situations, and in one week the Council of Economic Advisers reported that gasoline prices went up 16%. In other words the effort was to increase gasoline pump prices substantially more than 1¢ above the previously prevailing retail prices.

It is difficult to establish a single definitive measure of national gasoline price levels at given points in time because of the differences in competitive conditions among

local markets and the lack of comprehensive statistical measures of gasoline prices. Several measures of price changes in the period November 1, 1970 to February 1, 1971 are available. These measures should be viewed in the light of both their statistical adequacy and the markets which they describe.

According to Platt's Oilgram of February 2, 1971, the retail market consists essentially of four categories, each of which seeks a different level of profit per gallon according to their sources of supply, services rendered, and method of operation. These several categories enhance competition and tend to dampen or overcome attempts to increase the price of gasoline at the pump.

- a. Unbranded, self-serve operators who seem to be satisfied with a profit margin of 5¢ per gallon.
- b. The private brand operators -- the so-called SIGMA group, or Society of Independent Gasoline Marketers of America -- who aim for a profit margin of 7¢ to 8¢ a gallon.
- c. The branded independent operators who normally price at 1¢ above the SIGMA group.
- d. Major brand operators who tend to seek a price level 2¢ above the branded independent operators.

Both Platt's Oilgram and the Oil and Gas Journal depend primarily on company-supplied information for their price surveys. For a given market area, there may be a range of prices prevailing for the same brand of gasoline. In addition, none of the existing measures of prices are scientifically weighted by volume of sales; consequently, the reported national price levels are simple arithmetic averages of data from all cities sampled. In the Oilgram report, for example, Los Angeles is given the same weight as Portland, Maine, even though Los Angeles obviously consumes a far greater volume of gasoline. Finally, the geographic distribution of selected cities is probably not a representative sample of the United States as a whole. The Oil and Gas Journal, for example, lists only eight cities on the East Coast between Maryland and Maine, while showing nine in the state of Texas.

Recognizing the above shortcomings in popular statistical measures, there follows a summary of national "average" prices for the period November 1, 1970 to January 1, 1971. The prices are in cents and do not include local sales taxes.

Platt's Oilgram--55 Selected Cities
(Major brand, regular)

	<u>Nov 1, '70</u>	<u>Dec 1, '70</u>	<u>Jan 1, '71</u>	<u>Net Change Nov-Jan</u>
Dealer Tankwagon (ex tax)	17.40	19.03	18.38	+0.98
Service Station (ex tax)	23.71	26.50	25.61	+1.90
Tax (Incl 4¢ Federal)	11.14	11.14	11.14	0.0
Service Station (incl tax)	34.85	37.64	36.75	+1.90

Oil and Gas Journal--52 Selected Cities
(Major brand, regular)

	<u>1970</u>		<u>1971</u>		<u>Net Change Nov-Feb</u>
	<u>Nov 3</u>	<u>Dec 1</u>	<u>Jan 5</u>	<u>Feb 23</u>	
Service Station (ex tax)	23.35	25.85	24.67	22.54	-0.81
Pump Price	34.26	36.76	35.56	33.43	-0.83

A comparison between the service station (ex tax) prices of these two indices illustrates the difficulty in determining what the price of gasoline actually is. However, the Bureau of Labor Statistics survey of retail gasoline prices in 10 major cities, which reports a high-low range, reveals that the January low prices in those cities were above November lows in only 3 of the 10 cities.

As a cross-check against the above reported averages, we have also examined price levels for jobber unbranded regular gasoline in 10 markets on a day-to-day basis from October 1, 1970

through February 26, 1971, as reported in The Oil Daily. These prices have a marked effect on competitive prices as indicated in the earlier discussion of the petroleum industry. These wholesale data are summarized in Annex L for the Williams Brothers Pipeline Terminal, Oklahoma Northern Movement, and five of eight cities examined (the three cities excluded--Bay City, Evansville, and Detroit--have patterns almost identical to that shown for Indianapolis).

Although the sample of jobber prices reported by The Oil Daily is admittedly small and is somewhat regional in nature, the relative stability of these jobber prices in the face of the attempted price increases and volatile swings in other parts of the market is significant.

Of the eight cities surveyed, there were no changes in jobber prices until December 1, 1970 when increases in two cities in the amounts of 0.50 and 0.25¢ were posted. Milwaukee remained constant throughout the period while the remaining five cities showed the first increase on February 2, 1971. The patterns in Williams Brothers Pipeline Terminal and Oklahoma Northern Movement were somewhat more active, with each showing a decrease of 0.25¢ on October 13 followed by a return to the starting price of 12.25¢, a series of adjustments, and a net change from the starting price of -0.50¢. Over the total period the net change ranged from -0.50¢ to +0.75¢ and the average change for the ten markets was +0.31¢.

The resistance of unbranded jobber prices to upward price announcements is a source of pressure on branded suppliers to grant larger dealer competitive allowances in order to meet the unbranded competition and avert a significant market shift. Evidence to date indicates that the competitive pressure within the market--and particularly that caused by unbranded gasoline prices--may have created a market atmosphere in which the gasoline price increase sought by the industry in November cannot survive in the short term.

The temporary dealer allowance is a discount or price support offered to the dealer or jobber in order to support a particular pump price and thereby meet the competition. Such allowances have played a significant role ever since the mid-fifties.

The January 1971 National Petroleum News indicates that refiners report a major growth in allowances with 1970 totals about double those for 1969. In any event, temporary competitive allowances are not only a major factor in meeting

competition but also represent a significant drain from refinery profits. National Petroleum News also cites a major company which estimates its total competitive dealer allowances in 1970 as approximately \$100 million at an average cost per gallon of 2¢.

Confidential data have also been made available to us by one integrated company with a high degree of crude sufficiency. These data, although not necessarily typical of the industry as a whole, tend to confirm both the magnitude of competitive allowances and the widespread reports in trade publications of continued discounting from posted dealer tankwagon prices since November 11 when the current round of price increases was announced.

- (a) For the first eleven months of 1970 this company granted over \$8 million in allowances at an average rate of approximately 1.3¢ per gallon. Individual allowances in local areas have ranged as high as 12¢ per gallon for short periods of time.
- (b) Total temporary allowances per year have multiplied by 4-1/2 times what they were in 1965 and the allowance cost per gallon by 3-1/2 times.
- (c) The netback to the company per gallon of gasoline increased approximately 0.3¢ from November to December 1970. However, its average netback was less than one mill per gallon higher for the year 1970 than 1969.

There is support for a judgment that dealer allowances are an important factor in any effort to determine the price of gasoline and its trends. A survey of quoted prices is not alone sufficient. But dealer allowances are not readily susceptible to incorporation in the data base of a price index or even of a price survey such as those undertaken by the trade press.

At least two companies have recently announced new pricing policies apparently intended to eliminate temporary competitive allowances. Phillips announced that it was discontinuing temporary competitive allowances indefinitely for jobbers and dealers in southern Idaho, western Wyoming, eastern Nevada and all of Utah. This was followed in December by termination of minimum margin assurances to jobbers and

dealers in Arkansas, Louisiana, and Texas. National Petroleum News, January 1971, reports the Phillips rationale for these actions as an effort to "lessen the impact of destructive price wars on Phillips' dealers, jobbers, and Phillips itself." With respect to the discontinuance of the assured margins, a Phillips spokesman is reported as saying, "We believe price supports at downstops during gasoline-price wars have outlived their usefulness, and indeed oftentimes contribute to depressing prices to unrealistic levels."

According to Platt's Oilgram, the Continental Oil Company, on January 21, 1971, discontinued the granting of temporary competitive allowances and concurrently announced a reduction of 1.2¢ per gallon for its normal dealer tank wagon price and 0.6¢ per gallon for its normal jobber price. The CONOCO philosophy, as cited in Platt's Oilgram, is: "The pricing of petroleum products inevitably must undergo drastic change in the 1970's. This change will be either evolutionary or revolutionary -- i.e., it will be change which is intelligently, deliberately 'managed' by oil suppliers themselves, or it will be revolutionary change imposed on the industry by the government."

Recent reports have indicated that neither Phillips nor Continental succeeded in its effort to reduce the practice of discounting.

It is apparent that for the majority of refining companies, including some major companies such as Mobil and Standard Oil of Indiana, the November increase in crude prices represents an additional cost, unless they are able to pass this higher cost through to the consumer in the form of higher product prices, including those of gasoline. The level of this additional cost, of course, varies inversely with respect to the degree of crude self-sufficiency of the refiner in question. Those refiners having little or no crude production are therefore under pressure to maintain higher product prices, including the price of gasoline, as a result of crude oil price increases. In the longer term this pressure may well suffice, in conjunction with other market conditions, to establish gasoline prices at levels higher than those in effect prior to the price increase initiated by Gulf Oil Company on November 11, 1970, particularly since these less crude-sufficient refiners are often very competitive in their pricing practices and contribute to the volatility of gasoline prices.

OFFICE OF EMERGENCY PREPAREDNESS

Notice of Investigation of Recently Announced
Increases in Prices of Crude Oil and Gasoline

Section 6 of Proclamation No. 3279, as amended, requires the Director of the Office of Emergency Preparedness to maintain constant surveillance of imports of petroleum and its primary derivatives in respect to the national security and to inform the President of any circumstances which, in the opinion of the Director, might indicate the need for further Presidential action under Section 232 of the Trade Expansion Act of 1962. That section also provides that in the event prices of crude oil or its products or derivatives should be increased after the effective date of that Proclamation "...such surveillance shall include a determination as to whether such increase or increases are necessary to accomplish national security objectives...."

Notice is hereby given that the Office of Emergency Preparedness, with the assistance of the Department of Justice and the several Departments referred to in Section 6 of Proclamation No. 3279, as amended, will conduct an investigation of increases in prices of crude oil and gasoline

ANNEX A

recently announced by certain producers and refiners of petroleum. Interested parties may file information or comments concerning the subject matter of this investigation until December 1, 1970. All such information and comments should be submitted in writing, and 25 copies of each such submission should be provided. All such submissions should be addressed to:

Director
Office of Emergency Preparedness
Washington, D. C. 20504

Information which would disclose confidential business data or operations within the meaning of section 1905 of Title 18 of the United States Code or section 552(b)(4) of Title 5 of the United States Code, will be accorded confidential treatment if submitted in confidence. All information submitted in confidence must be on separate pages marked "Business Confidential." All information and comments submitted pursuant to this Notice, except "Business Confidential" information submitted in accordance with the preceding sentence, will be available for inspection or copying. A list of persons submitting information pursuant to this Notice will be maintained and will be available for inspection and copying.

SIGNED

G. A. Lincoln
Director

Dated: November 16, 1970.

LIST OF RESPONDENTS (57)

Respondents Favoring Petroleum Price Increases (42)Major Integrated Oil Companies (15)

Atlantic Richfield Company
Cities Service Company
Continental Oil Company
Getty Oil Company
Gulf Oil Company
Humble Oil and Refining Company (Standard Oil Co., N.J.)
Mobil Oil Corporation
Phillips Petroleum Company
Shell Oil Company
Skelly Oil Company
Standard Oil Company (California)
Standard Oil Company (Indiana)
Standard Oil Company (Ohio)
Sun Oil Company
Texaco, Incorporated

Independent Producers (4)

Alvin C. Hope
Herman G. Kaiser
L.V.O. Corporation
Waverly Oil Works Company

Independent Refiners (6)

American Petrofina, Inc.
Champlin Petroleum Company
Clark Oil and Refining Company
Diamond Shamrock Oil and Gas Company
Kerr-McGee Corporation
Marathon Oil Company

Independent Marketers (2)

Oskey Gasoline and Oil Company, Inc.
Rock Island Oil Company

Producers and Professional Associations (13)

American Association of Petroleum Geologists (AAPG)
American Association of Oilwell Drilling Contractors
California Independent Producers and Royalty Owners Association

ANNEX B

- 2 -
- 3 -

Producers and Professional Associations (13) (con't)

Independent Petroleum Association of America (IPAA)
Kansas Independent Oil and Gas Association
North Texas Oil and Gas Association
Ohio Oil and Gas Association
Panhandle Producers and Royalty Owners Association
Permian Basin Petroleum Association
Petroleum Industry Research Foundation, Inc. (PIRINC)
Rocky Mountain Oil and Gas Association
Texas Independent Producers and Royalty Owners Association
West Central Texas Oil and Gas Association

Congressional (2)

Senator John G. Tower
Senator Bob Dole

Other (1)

W. L. Pennington, Consulting Geologist

Respondents Opposed to Petroleum Price Increase (11)

Oil Refiners/Marketers (2)

Ashland Oil, Inc.
Martin Oil Service, Inc.

Associations (4)

Air Transport Association
Independent Terminal Operators Association
New England Council for Economic Development
Society of Independent Gasoline Marketers of America (SIGMA)*

Congressional (3)

Representative Silvio Conte and 43 others.
Senator Thomas McIntyre
Senator Winston Prouty

Others (2)

Fred C. Allvine, Assistant Professor of Marketing,
Northwestern University
Theodore R. Brooks, Oil Editor

Respondents Expressing Reservations About Price Increases (3)

Oil Companies (2)

Union Oil Company
Murphy Oil Company

Associations (1)

American Paper Institute

* Letter submitted by Hogan & Hartson.

AVERAGE CRUDE OIL PRICES AT WELL
(Per Barrel)

	Current \$
1955	2.77
1956	2.79
1957	3.09
1958	3.01
1959	2.90
1960	2.88
1961	2.89
1962	2.90
1963	2.89
1964	2.88
1965	2.86
1966	2.88
1967	2.91
1968	2.94
1969	3.06
1970	3.16

Source: U.S. Bureau of Mines.

U. S. CRUDE OIL PRODUCTION

(Thousand Barrels Daily)

	<u>From Stripper Wells</u>	<u>Total U. S. Production</u>	<u>Percent from Stripper Wells</u>
1959	1,462	6,828	21.4%
1960	1,577	6,720	23.5%
1961	1,622	7,035	23.1%
1962	1,587	7,158	22.2%
1963	1,521	7,324	20.6%
1964	1,461	7,420	19.7%
1965	1,614	7,559	21.3%
1966	1,329	8,072	16.5%
1967	1,369	8,513	16.1%
1968	1,326	8,757	15.1%
1969	1,246	8,882	14.0%
1970*	1,225	9,179	13.3%

* Estimated (Oil and Gas Journal, January 25, 1971, p. 132)

Source: National Stripper Well Surveys (1959-1969)

ESTIMATED GROWTH IN SECONDARY VS. PRIMARY PRODUCTION
(Based on Continuation of Present Import Program)

Year	Primary	Secondary	Total Crude	Lease Condensate	Total Crude & Condensate
Thousand Barrels Daily					
1950	4442	898	5340	111	5451
1953	5242	1113	6355	156	6511
1955	5294	1359	6653	172	6825
1957	5550	1468	7018	210	7228
1959	5267	1563	6831	266	7097
1961	4867	2009	6876	323	7199
1962	4830	2192	7022	341	7363
1963	4764	2357	7121	310	7431
1965	4854	2534	7388	433	7821
1970	5093	3160	8253	579	8832
1975	5407	3908	9315	716	10031
1980	5790	4608	10398	892	11290

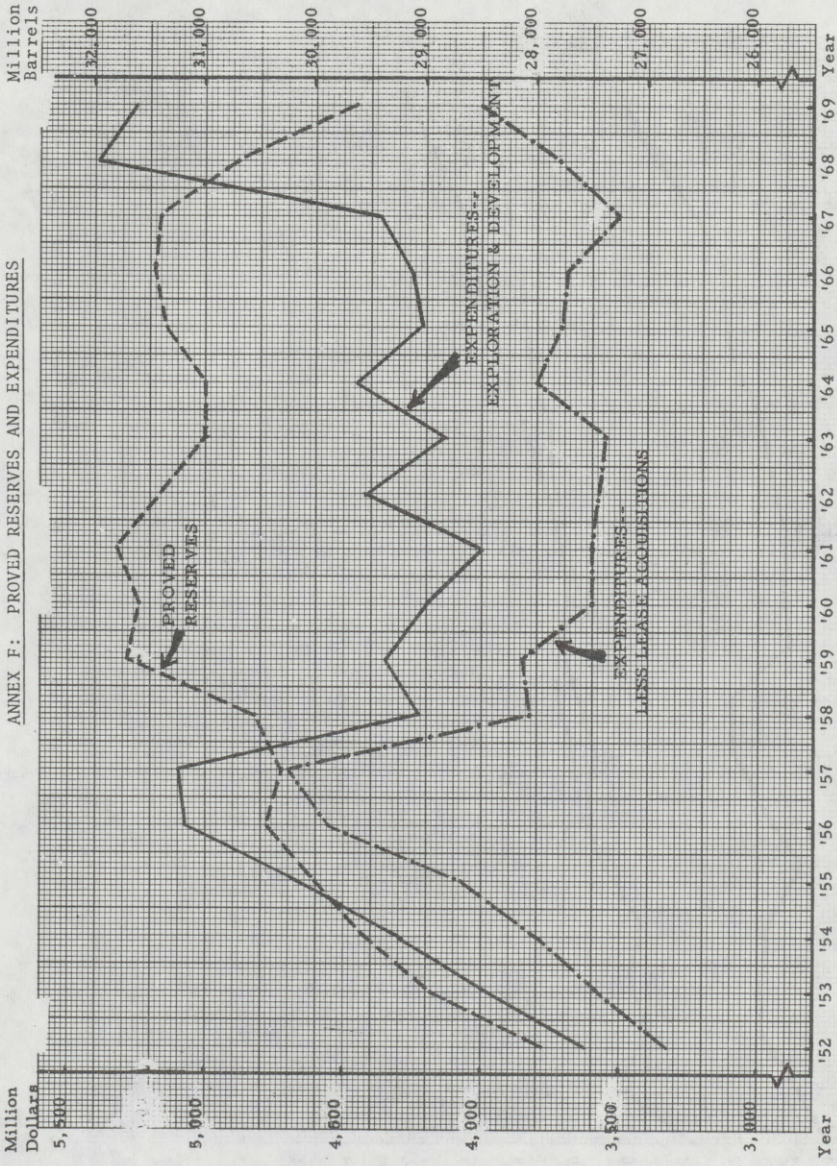
Percent of Total					
1950	81.5	16.5	98.0	2.0	100.0
1953	76.5	17.1	97.6	2.4	100.0
1955	77.6	19.9	97.5	2.5	100.0
1957	76.8	20.3	97.1	2.9	100.0
1959	74.2	22.0	97.2	3.8	100.0
1961	67.6	27.9	95.5	4.5	100.0
1962	65.6	29.8	95.4	4.6	100.0
1963	64.1	31.7	95.8	4.2	100.0
1965	62.1	32.4	94.5	5.5	100.0
1970	57.7	35.8	93.5	6.5	100.0
1975	53.9	39.0	92.9	7.1	100.0
1980	51.3	40.8	92.1	7.9	100.0

Source: 1950-1963 derived from state totals by Bureau of Mines (Dallas) November 1964; figures for national totals differ slightly from those reported in Bureau of Mines annual yearbooks.

1964-80 projected by Bureau of Mines (Dallas)

"An Appraisal of the Petroleum Industry of the United States", January 1965, U.S. Department of the Interior.

ANNEX F: PROVED RESERVES AND EXPENDITURES

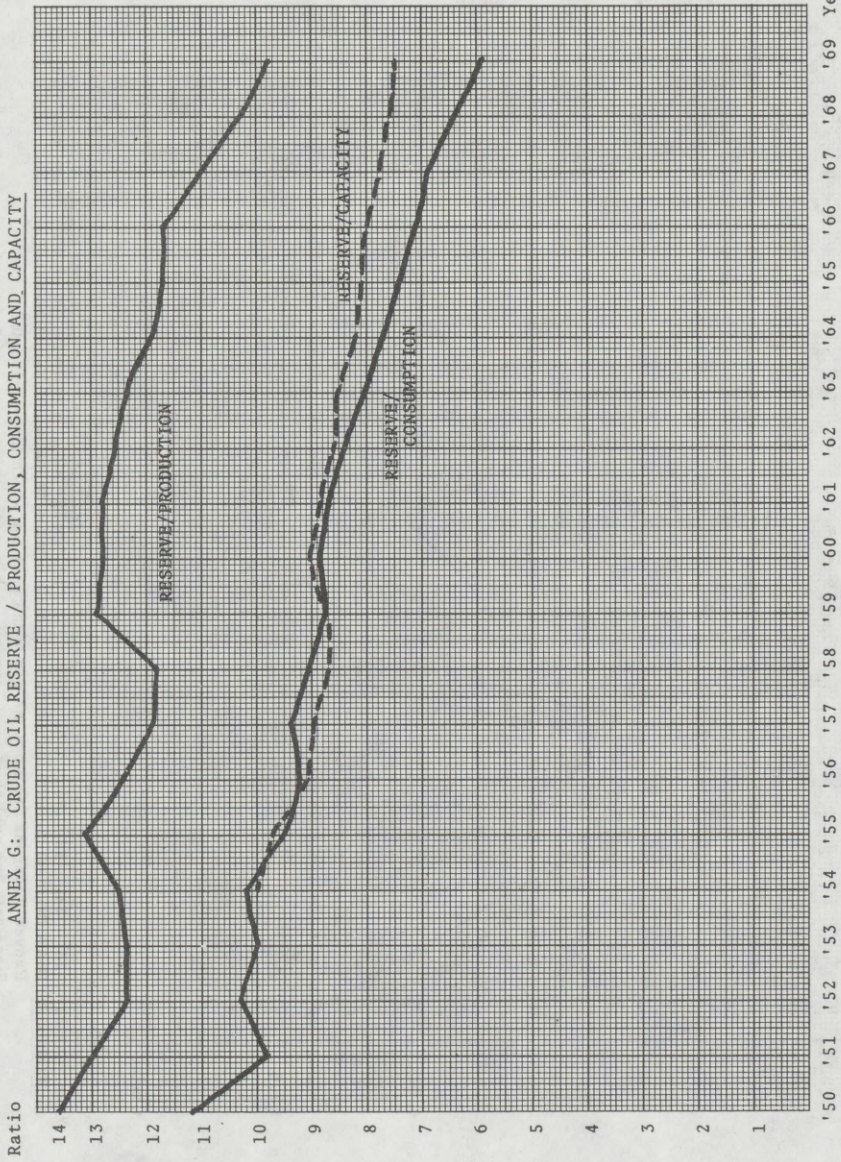


SOURCE: IPAA (Natural Gas Plants Excluded) (Alaska North Slope reserves not included.)

Proved Reserves are as of the end of the year for which they are posted.

Since data are published as of January 1, this means the data are posted for the year before that indicated by their published year.

ANNEX G: CRUDE OIL RESERVE / PRODUCTION, CONSUMPTION AND CAPACITY



EXPLORATION AND DEVELOPMENT EXPENSE
UNITED STATES

(1) <u>Year</u>	(2) <u>Lease Acquisi- tions</u>	(3) <u>Producing Wells</u>	(4) <u>Dry Holes</u> (Million Dollars)	(5) <u>Geological & Geophysical Expense</u>	(6) <u>Lease Rentals</u>	(7) <u>Total</u>	(8) <u>Total Less Col. 2</u>	(9) <u>Lease Acqui- sition as % of total cost</u>
1952	300	1,950	875	350	150	3,625	3,325	8.3%
1953	400	2,100	900	400	175	3,975	3,575	10.0%
1954	500	2,250	950	425	175	4,300	3,800	11.6%
1955	600	2,450	1,000	450	175	4,675	4,075	12.8%
1956	525	2,650	1,200	500	200	5,075	4,550	10.2%
1957	400	2,625	1,375	500	200	5,100	4,700	7.8%
1958	400	2,275	900	475	175	4,225	3,825	9.5%
1959	500 (1)	2,250	950	475	175	4,350	3,850	11.5%
1960	600 (1)	2,125	850	460	165	4,200	3,600	16.7%
196	400	2,175	825	450	150	4,000	3,600	10.0%
1962	850 (1)	2,200	800	425	150	4,425	3,575	20.1%
1963	575	2,125	825	440	160	4,125	3,550	13.9%
1964	650 (1)	2,225	925	490	160	4,450	3,800	14.6%
1965	500 (1)	2,200	900	450	160	4,210	3,710	11.9%
1966	560 (1)	2,115	925	500	150	4,250	3,690	13.2%
1967	860 (1)	2,040	850	475	140	4,365	3,505	19.7%
1968	1,675 (1)	2,150	850	575	140	5,390	3,715	31.0%
1969	1,250 (2)	2,325	950	575	150	5,250	4,000	23.8%

(1) Includes acquisition of offshore leases:

1959 - \$135 million	1964 - \$175 million	1967 - \$560 million
1960 - \$285 million	1965 - \$100 million	1968 - \$1,375 million
1962 - \$550 million	1966 - \$260 million	1969 - \$125 million

(2) Includes Alaska - North Slope - \$900 million

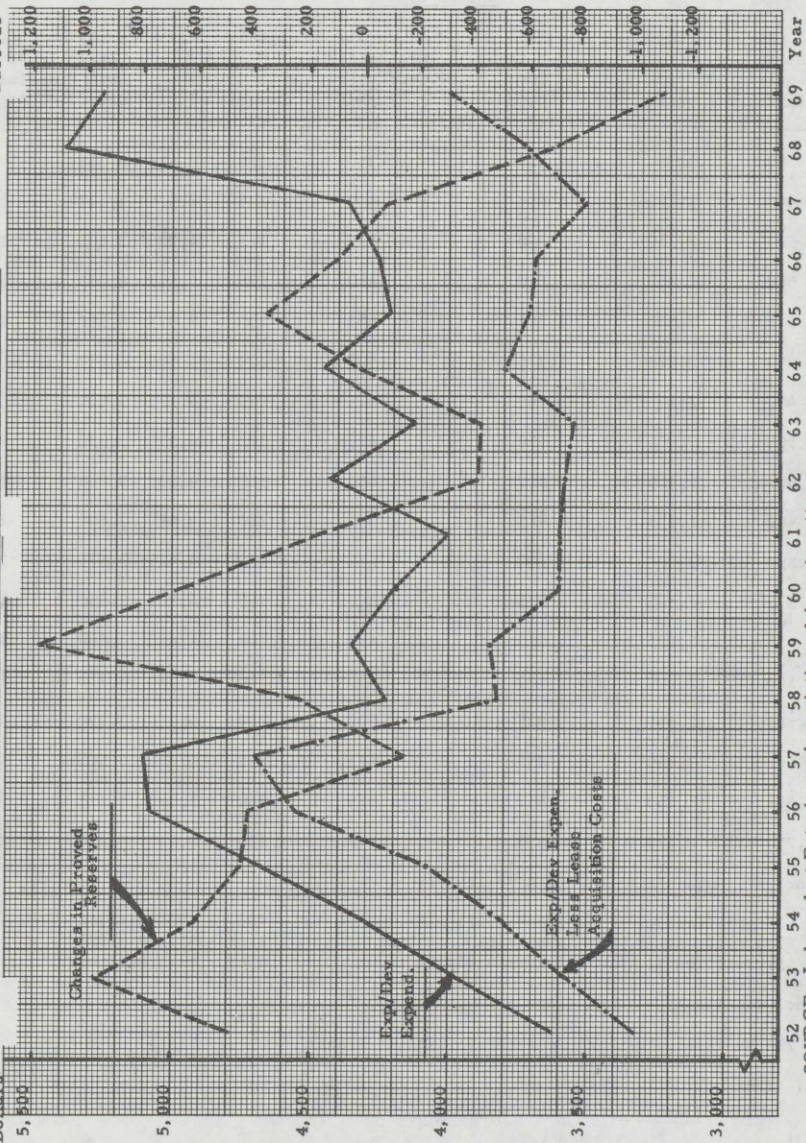
NOTE: The above figures exclude natural gasoline plants

SOURCE: IPAA

ANNEX H

Millions of
Barrels

ANNEX I: EXPLORATION & DEVELOPMENT VS. CHANGES IN RESERVES

Millions of
Dollars

SOURCE: Independent Petroleum Association of America (Alaska North Slope reserves not included.)

Changes are from end of previous year to end of year posted.

Since data are published as of January 1, this means the changes are calculated by subtracting the posted years figure from that for the next year.

ANNEX J
GROSS ADDITIONS TO RESERVES AND EXPLORATION AND DEVELOPMENT COSTS

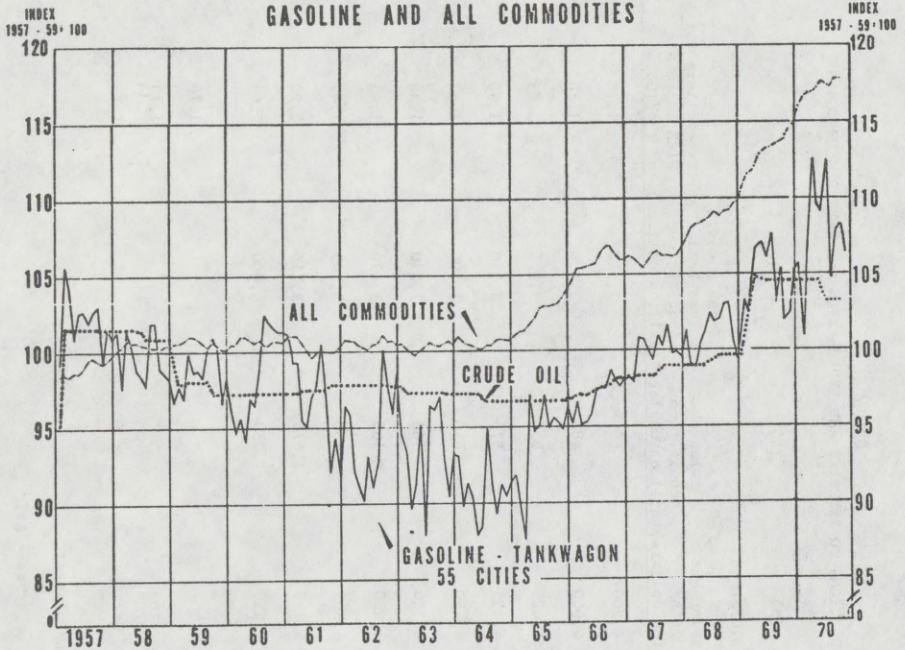
(1)	(2)	(3)	(4)	(5)	
	Gross Additions to Reserves	Exploration and Development Costs*	Lease Acquisitions (million dollars)	E and D Cost Less Lease Acquisitions (million dollars)	Expenditure Per Barrel (dollars) With Lease Acq. Without Lease Acq. (3)/(2) (5)/(2)
Year (million barrels)		(million dollars)			
1960	2,365	4,200	600	3,600	1.78 1.52
1961	2,658	4,000	400	3,600	1.50 1.35
1962	2,181	4,425	850	3,575	2.03 1.64
1963	2,174	4,125	575	3,550	1.90 1.63
1964	2,665	4,450	650	3,800	1.67 1.43
1965	3,048	4,210	500	3,710	1.38 1.22
1966	2,964	4,250	560	3,690	1.43 1.24
1967	2,962	4,365	860	3,505	1.47 1.18
1968	2,455	5,390	1,675	3,715	2.20 1.51
1969	2,120	5,250	1,250	4,000	2.48 1.89
1960-64 Avg.		-	-	-	1.76 1.51
1965-69 Avg.		-	-	-	1.73 1.37
1960-69 Avg.		-	-	-	1.75 1.44

* Excluding natural gasoline plants.

Source: Gross additions to reserves - API
Other - IPAA

ANNEX K

WHOLESALE PRICE INDEXES OF CRUDE OIL GASOLINE AND ALL COMMODITIES



Source: Gasoline-Platt's Oilgram Price Service
 All Commodities-Department of Labor

Prepared and submitted by Texaco.

ANNEX L

JOBBER, UNBRANDED, REGULAR GASOLINE PRICES^{1/}

Date	^{2/} Williams Bros. PL Terminal		Chicago		St. Louis		Minneapolis/ St. Paul		Milwaukee		^{3/} India- napolis		Oklahoma, Northern Movement	
Oct 1, 1970	12.25		12.50		12.75		14.00		13.35		13.00		12.25	
Dec 1, 1970	13.00		13.00		13.00		14.00		13.35		13.00		12.50	
Jan 6, 1971	13.00		13.00		13.00		14.00		13.35		13.00		13.00	
Jan 27, 1971	12.50		13.00		13.00		14.00		13.35		13.00		12.50	
Feb 2, 1971	12.00		13.00		13.50		14.50		13.35		13.75		12.00	
Feb 10, 1971	12.50		13.00		13.50		14.05		13.35		13.75		12.50	
Feb 22, 1971	12.25		13.00		13.50		14.05		13.35		13.75		12.25	
Feb 26, 1971	11.75		13.00		13.50		14.05		13.35		13.75		11.75	
Net Change	-0.50		+0.50		+0.75		+0.05		0.00		+0.75		-0.50	

^{1/} Prices shown are the lower ends of a 0.25¢ price range which applies in each case. The dates selected after October 1 are dates on which changes in cities are recorded.

^{2/} Midwest prices for delivery from Williams Brothers' Pipeline terminal points plus pipeline tariffs from origin.

^{3/} Evansville, Detroit, and Bay City are not shown since their patterns are almost identical to that shown for Indianapolis.

ANNEX M:
Profits and Cash Flow--Millions of Dollars and (% of Stockholders Equity)

Year	All Manufacturing Except Petroleum Profits 1/ Cash Flow 2/	Petroleum Refining Profits 1/ Cash Flow 2/
1963	15,652 (9.92)	3,831 (11.08)
1964	19,116 (11.40)	4,094 (11.23)
1965	23,079 (12.84)	4,442 (11.42)
1966	25,982 (13.32)	5,055 (12.11)
1967	23,511 (11.24)	5,497 (12.18)
1968	26,275 (11.67)	5,794 (12.05)
1969	27,364 (11.14)	5,884 (11.45)
1970 3/	23,430 (9.17)	5,680 (10.53)

1/ Profits after taxes.

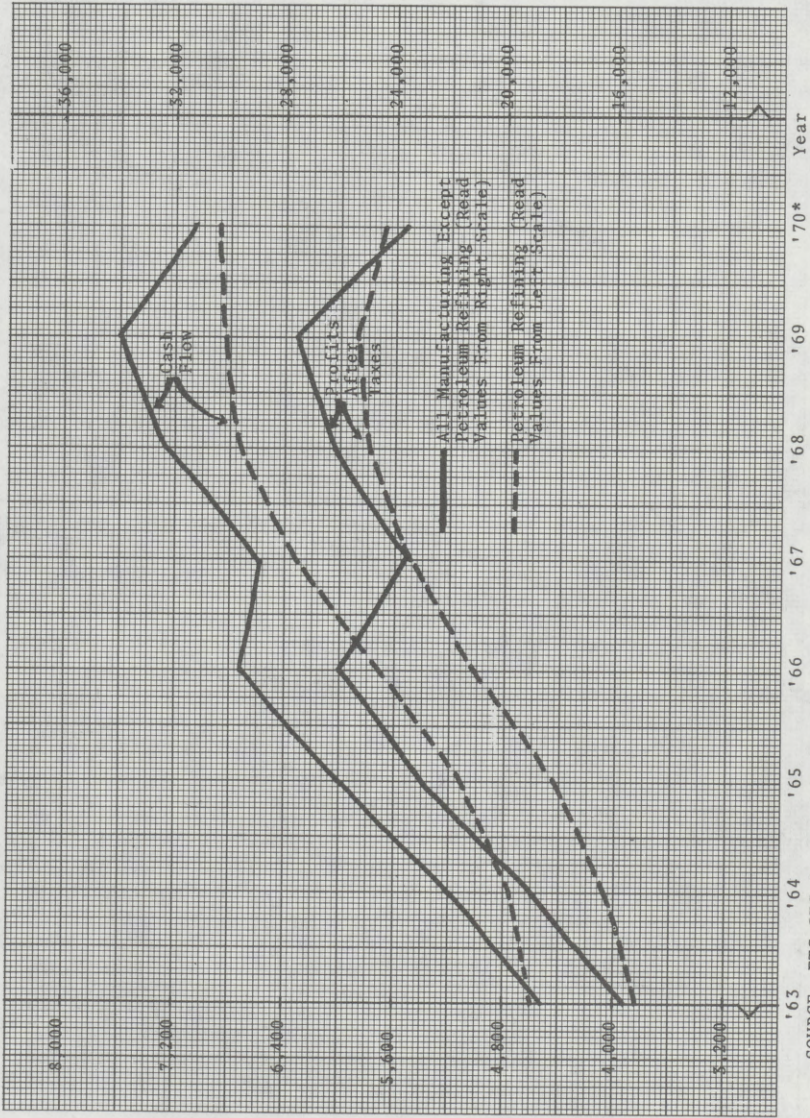
2/ Retained earnings plus depreciation and depletion.

3/ First three quarters raised to reflect annual rate.

Source: FTC-SEC, Quarterly Financial Report for Manufacturing Corporations.

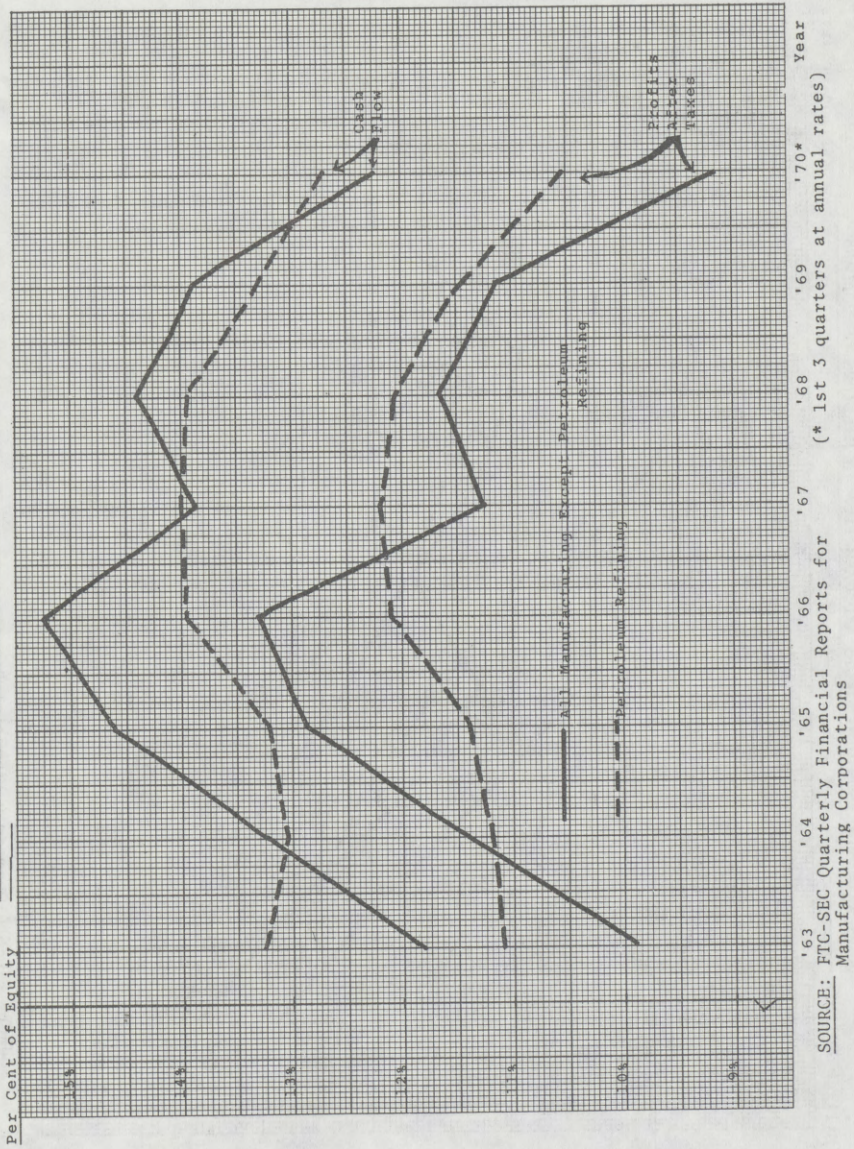
ANNEX N: COMPARISON OF PROFITS AND CASH FLOW IN MILLIONS OF DOLLARS

Million Dollars



SOURCE: FTC-SEC Quarterly Financial Reports for Manufacturing Corporations
(* 1st 3 quarters at annual rates)

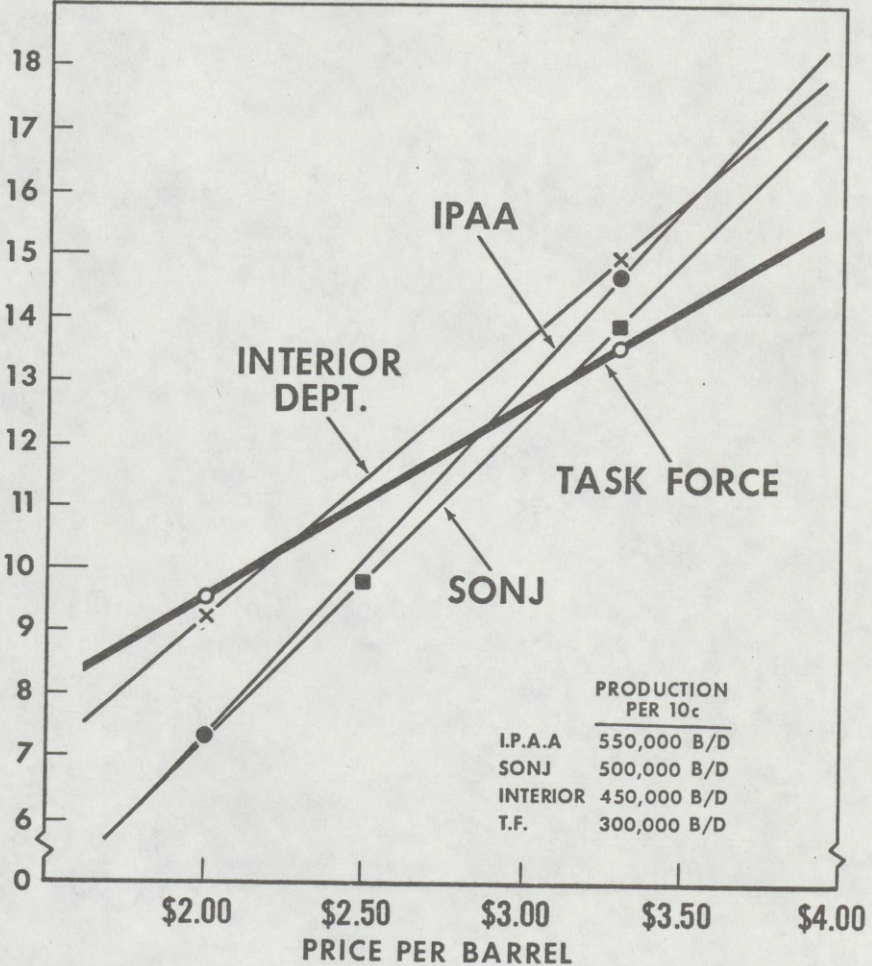
ANNEX O: COMPARISON OF PROFITS AND CASH FLOW AS % OF EQUITY



ANNEX P

ESTIMATES OF U.S. PRODUCTION OF PETROLEUM LIQUIDS IN 1980 AT VARIOUS PRICES

PRODUCTION
MILLION BBLs DAILY



NOTE: All estimates made prior to, and not taking into consideration, 1969 changes in tax laws.

Prepared by the Independent Petroleum Association of America June 1970

THE EFFECT OF THE PRODUCTION OF FERTILISERS ON THE FERTILITY OF THE SOIL



It is evident from the graph that the production of fertilisers has a direct and positive effect on the fertility of the soil. As the production of fertilisers increases, the fertility of the soil also increases. This relationship is shown by the upward-sloping lines on the graph.

A large, bold, black graphic of the number '11' dominates the upper half of the page. The '1's are thick and blocky, with a slight slant at the top. To the left of the first '1', there are three small black dots arranged vertically.

Ways to Reduce Energy Consumption and Increase Comfort in Household Cooling

(213)

The nation today faces increasing demands for fuel and power, and increasing prices which these demands tend to foster. The counter-measures for cold weather offered in **7 Ways to Reduce Fuel Consumption in Household Heating . . . through Energy Conservation**, which we previously published, promised personal gains to you, the household consumer, and national benefits to you, the citizen.

The same is true with **11 Ways to Reduce Energy Consumption and Increase Comfort in Household Cooling**. In air conditioning, as in heating, care in the use of energy can benefit the household consumer through economic savings, increased comfort, and reduction in environmental pollution.

The Federal Government's concern for energy conservation has resulted in a number of steps to reduce consumption in Federal buildings. Industry has been encouraged to take similar steps. In the second brochure prepared by the National Bureau of Standards in collaboration with the Office of the Special Assistant to the President for Consumer Affairs, you, the consumer, are furnished ways in which you also can help in the conservation of national energy resources and the resultant abatement of environmental pollution.

You will note that many of the measures suggested for air conditioning serve also to reduce energy consumption during the heating season. Also, many of these suggestions benefit families who do not use air conditioning.

Since in **11 Ways**, as in **7 Ways**, the conservation measures offered can increase your personal comfort, reduce your ultimate costs for energy and serve the nation's interest, we trust you will give them the careful attention they deserve.

Thank you.

Mrs. Virginia Knauer
Special Assistant to the
President for Consumer Affairs

Dr. Lewis M. Branscomb
Director, National Bureau
of Standards, U. S.
Department of Commerce



A Word in General . . .

Appreciate the Benefits of Energy Conservation

Whether or not your home is air-conditioned, there are methods of improving its summertime livability. These "11 Ways" will help to reduce the cost of cooling and to conserve national fuel and power (and environmental) resources.

Several of the suggestions offered in this brochure are more easily carried out in some dwellings than in others, but all lead to lower cost or greater comfort, or both. In any event, it is important to have a "feel" for the concepts involved, regardless of whether you live in a house or an apartment.

The overall cost of air-conditioning depends on a complex array of factors—climate, type of building, the degree to which your house is thermally insulated, length of cooling season, local prices of power or fuel, cost of air-conditioning equipment and labor, and method of operation. It is not necessary to have precise overall cost information to consider the adoption of the steps suggested in this brochure. Since individual circumstances vary, estimates are given when possible of the time needed to pay back an investment for a suggested improvement (assuming reasonable costs for materials and installation and a 6% interest cost on the money invested) with the yearly savings realized in the average case. After the

investment is repaid the householder will continue to profit by the annual cost savings.

A cooling effect of 1000 Btu per hour costs about $\frac{1}{4}$ cent per hour if the price of electrical energy is 2c per kilowatt-hour and that of gas or oil is equivalent to \$1.30 per million Btu. (A Btu—or British thermal unit—is a unit of heat measurement; 1000 Btu are equivalent to approximately 0.3 kilowatt-hour). For different local prices for energy, the cost of cooling varies with the ratio of the local price to that given above. In conservation terms, this cooling effect also requires the combustion—either at the electricity-generating plant or at your building—of 1700 to 2000 Btu of fuel per hour. So if you are using 40,000 Btu per hour to cool your home and you effect a 10% saving in your energy consumption you benefit by 1c per hour or 24 cents per day—or \$24 savings if you have 100 cooling days. And the nation saves through the conservation of fuel.

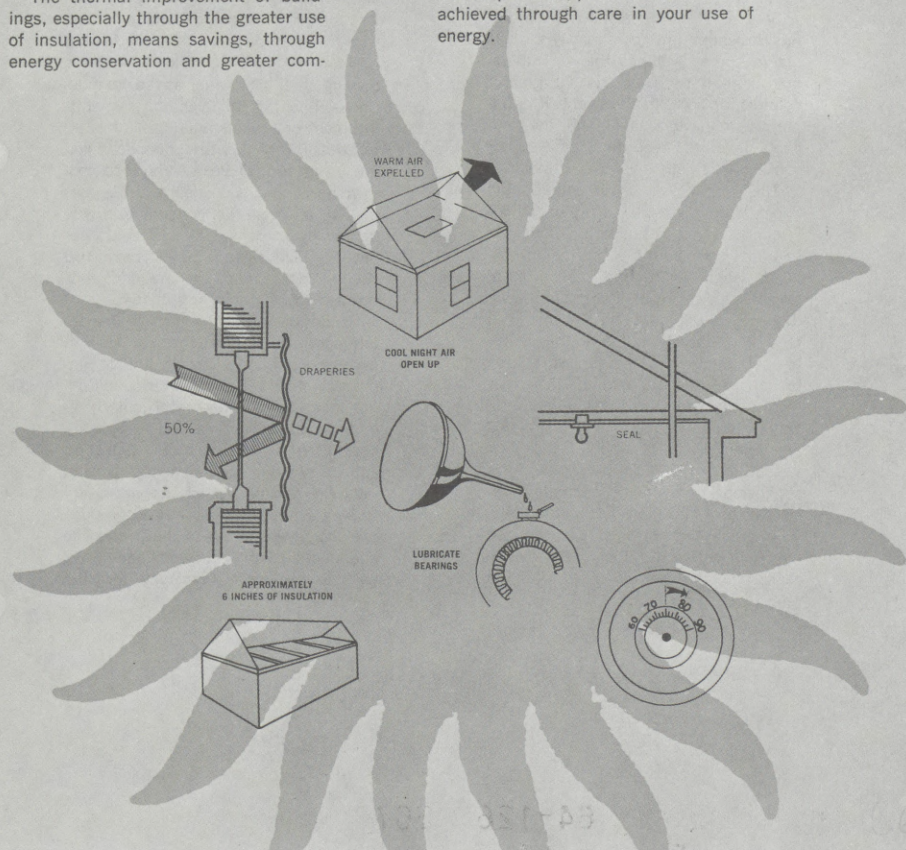
In houses which are already air-conditioned, our suggestions can lead to savings in operating costs and to improved comfort. But when air conditioning is to be installed—particularly in a house yet to be constructed—it is important to realize that better insulation and sun shading can reduce the size and thus the initial cost of the necessary cooling equipment, as well as reduce operating expenses over the years. The equipment savings may be enough to pay for, or more than pay for, the

thermal improvements at the outset; certainly the annual operating cost savings will pay back the investment within a reasonable number of years.

The thermal improvement of buildings, especially through the greater use of insulation, means savings, through energy conservation and greater com-

fort for you and your family in **winter** as well as in summer.

Moreover, since the consumption of energy results in some environmental pollution, pollution abatement is achieved through care in your use of energy.



2

Air Infiltration and Leakage

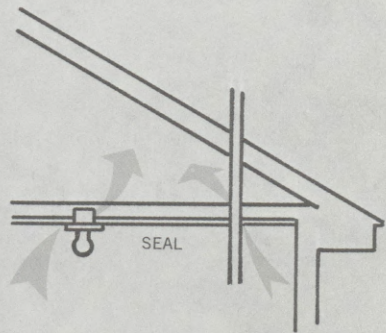
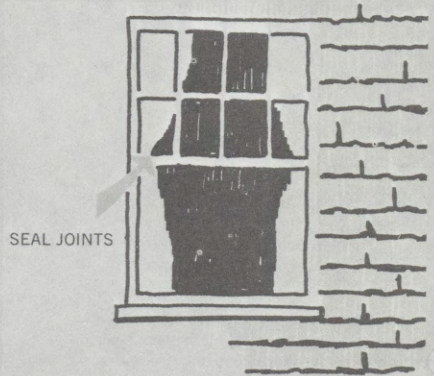
Prevent Excessive Entry of Outdoor Air

In an air-conditioned house you need outdoor air for ventilation at the rate of about 5 cubic feet per minute (cfm) for each member of your family. Ordinarily, this is enough to maintain freshness and to provide the combustion air for a gas-burning range and hot water heater. When outdoor air enters your house at a rate greater than this, energy is wasted and your cooling costs are needlessly high.

Assuming four persons in a household, the cost of cooling 20 cfm of ventilating air would be about $\frac{1}{4}$ cent per hour with outdoor conditions of 90 degrees and 50% relative humidity (RH) and indoor conditions of 75 degrees and 50% RH. But even in a tightly-built house the infiltration rate of outdoor air probably would be on the order of 50 cfm, and in houses with poorly-sealed windows, doors and joints the rate could easily exceed 100 cfm. The latter rate would cost about 1.2 cents per hour for cooling, or nearly 30c per day, and the increase in humidity such infiltration causes would tend to make your home less comfortable.

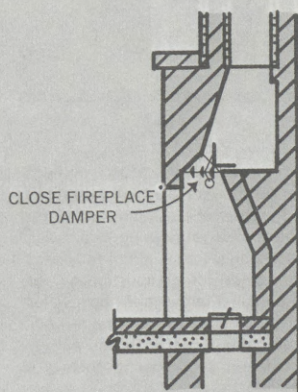
Several things can be done to reduce air infiltration:

- Weatherstrip windows and doors at movable joints, and caulk cracks and openings at their frames; seal all cracks and openings in exterior walls.
- Keep windows and doors shut, and



keep storm windows and doors in place during the air-conditioning season.

- If there is a fireplace, tightly close its damper.
- Close and seal all passages or openings between the air-conditioned space and the attic, including cracks around attic doors.
- If there is a large generation of water vapor or heat due to cooking, bathing, or washing, operate kitchen or bathroom exhaust fans, but only for as long as needed. In cooking, use covered pots and low fires when possible, especially when boiling.



3

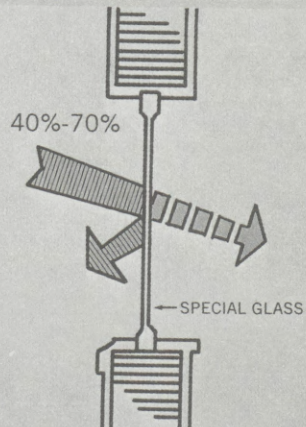
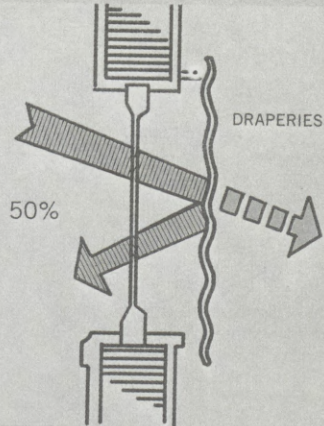
Windows

Shade Windows, Especially from Direct Sun

The daytime heat gain through windows, which typically comprise 15 to 30% of the exterior wall area of a house, puts a heavy load on air-conditioning equipment. Windows having ordinary glass transmit most of the radiant solar energy to which they are subjected and much of the heat from warmer outdoor air.

All windows, especially those exposed to the sun, should be shaded by one or more of the following means (percentage reductions in heat gain are compared with untreated ordinary glass windows):

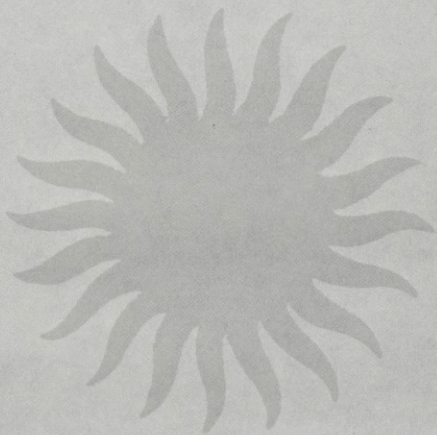
- Blinds, draperies, etc.—Such devices can reduce heat gain through windows by as much as 50%. Their effectiveness depends on how well they reflect solar radiation back through the window. They should be light in color and opaque. And they should be drawn when sunlight enters your rooms—particularly in rooms not being used for the moment.
- Special glasses—Heat-absorbing and reflecting glasses can reduce solar heat through windows by 40 to 70%. These glasses have the advantage of doing the job while not interfering appreciably with the view.
- Awnings, overhangs, etc.—By far the most effective way to reduce solar heat gain is through the use of external



shading devices such as awnings, overhangs, side fins, louvered sun screens and—yes—trees. These can reduce solar heat gain by as much as 80% if properly designed. A word of caution: awnings and overhangs should be designed so as not to trap hot air in the window area.

The costs of these means of coping with heat gain vary, and your decision to adopt certain improvements would probably depend on an array of factors going beyond considerations of thermal comfort alone. You might, for example, decide to plant a tree not only for increased thermal comfort but to attract songbirds and to view its spring blossoms, autumn foliage and winter tracery.

Keep storm windows in place during the air-conditioning season on all windows except those to be used for ventilating. Storm windows—and insulating glass windows as well—may not stop the penetration of solar radiation but they form significant barriers to the transfer of outdoor air heat to the indoors.



4

Insulation

Insulate Ceilings, Walls and Ducts

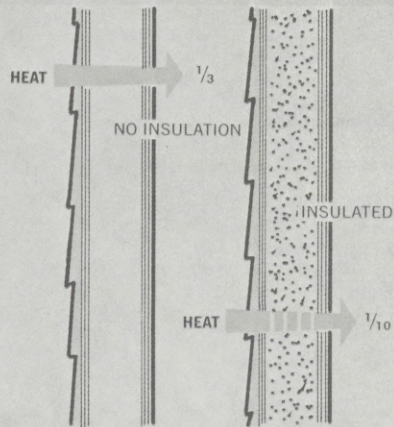
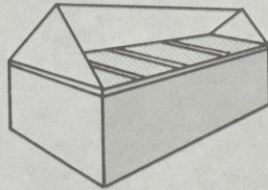
- **Ceilings**—the top-floor ceiling requires ample insulation to reduce the heat flow downward from the sun-heated attic. This ceiling barrier improves your comfort, returns you substantial savings in air-conditioning costs and avoids needless consumption of energy resources.

An installation of 6 inches of ceiling insulation will be paid back by savings in cooling costs in several years, and from then on will return a substantial annual dividend. Since the same insulation will greatly reduce heat loss in winter, the combined savings for air conditioning and heating will make the investment even more valuable—so much so that it may be returned in a year or two.

If your ceiling now has 3 or 4 inches of insulation, it is to your advantage to increase the thickness to the equivalent of 6 inches of good thermal insulation, since the additional investment will be returned in 3 or 4 years by the combined summer-winter savings.

- **Walls**—The walls of your house should be insulated with the equivalent of 3 or 4 inches of good thermal insulation. This will pay for itself in a reasonable number of years on the basis of savings in air-conditioning costs alone, but again, when savings for cooling and heating are combined, repayment of the investment is quicker. Well-

APPROXIMATELY
6 INCHES OF INSULATION

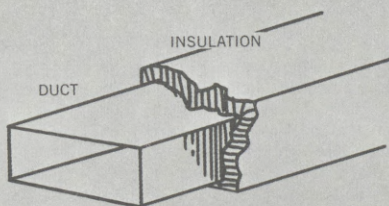


insulated exterior walls—besides saving you money—contribute much to your thermal comfort and make room space near exterior walls more habitable in both summer and winter.

It is easy to insulate walls properly when a house is under construction. While walls can be properly insulated at moderate cost in many existing houses, expert technical advice should be sought to avoid problems that might arise due to moisture condensation within the walls.

- Ducts—In many central air-conditioning systems the cooled air is circulated to rooms through ducts which pass through the attic or through other non-cooled spaces. These ducts, especially those in hot attic spaces, should be insulated with an installed thickness of at least $1\frac{1}{2}$ inches of typical, good fibrous insulation or its thermal equivalent. This is essential to conserve the cooled air for delivery to the space where it is needed and to avoid excessive operating costs because of heat gain in the ducts.

Your investment for adequate duct insulation will be quickly repaid, and once again, especially so if the same ducts are used to circulate warmed air in winter.





Attic Ventilation

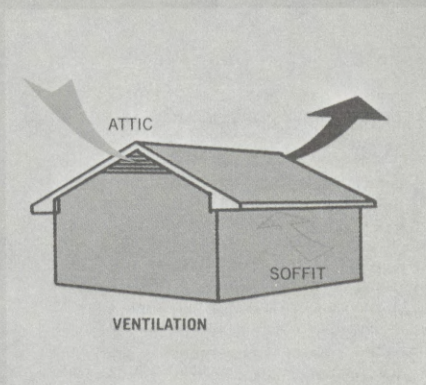
Reduce Heat Gain from the Attic

When your roof is heated by the sun, your attic will be as much as 40 degrees hotter than the temperature of outside air. Insulation is the best means of shielding your living quarters from this oven, but if insulation is impossible to install in your under-roof space, consider the use of an attic fan.

The attic temperature can be greatly reduced—and the heat flow downward into your home reduced by more than half—by drawing outdoor air through the attic space.

Your decision of whether to use an attic fan will depend on the ease of installing insulation below the attic space. If the ceiling is well insulated (with 4 to 6 inches of insulation) the heat flow is small and any further reduction by attic ventilation would be insignificant. But if your ceiling is not well insulated and cannot be improved because of inaccessibility, fan ventilation can be an effective and economically justified means of reducing downward heat flow.

The fan, which needs to move air at a rate of only about 1 cubic foot per minute per square foot of ceiling area, should be mounted so as to exhaust air from high in the attic where temperatures are the hottest. It can be governed by a thermostat located so as to turn the fan on when the air temperature near the fan reaches 110 degrees or so.



In some cases, it is possible to reduce the number of hours of air conditioner operation by drawing outdoor air—when it is cool enough—through the house by use of an attic ventilating fan (as discussed in Way No. 11). This would entail opening the normally tightly-closed attic door or pull-down stairway to allow the air to be drawn into the attic.



Internal Heat Generation

Limit the Use of Electricity, Gas, and other Fuels

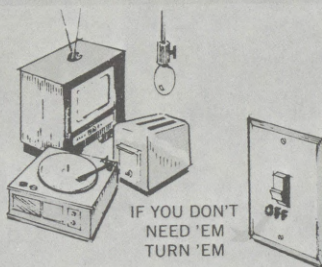
You and members of your family give off heat (about 400 Btu per hour per person). While there is nothing you can do about this, you can be careful in your use of electricity and fuel and in other activities which generate heat and moisture.

Each kilowatt of electrical energy used for illumination and appliances is converted to heat at the rate of 3412 Btu per hour. Cooking, showers and washing are estimated to cause an average heat input of 1000 Btu per hour. Overall, an average heat generation (excluding heat given off by occupants) in a moderately-sized household might be on the order of 60,000 Btu per day (over a 100-day cooling season, this load represents a \$15 expense).

You can benefit by reducing energy consumption to the minimum compatible with household needs. This will effect double-edged savings, since the energy itself costs money on top of the additional cooling load cost its use imposes. It will also reduce loads on electrical utility systems.

Several relatively easy steps can be taken:

- Turn off lights, especially high-wattage lights used for sewing, study, hobbies, etc., when they are not being used.



- Turn off television sets, radios and phonographs when they are not being used. Use electric irons, hair dryers and other electric appliances only as much as needed.
- Make sure that refrigerator or freezer door seals are airtight and that their condensing coils are clean for good air flow. Avoid unnecessary or prolonged door openings.
- Avoid using the cleaning feature of self-cleaning ovens at times when air-conditioning loads are heavy. You will be more comfortable if this operation is done late at night or in the early part of the day.
- Try to schedule electrical energy-using activities such as washing, drying and ironing, for early morning or late evening when heavy demands are not being made upon electrical distribution systems.
- Try to confine heavy use of cooking ranges and shower facilities to the cooler morning or evening hours. These activities set up a chain reaction of energy consumption for hot water heating and space cooling . . . You can defer them to times when energy availability is greater.

7

Cooling Units

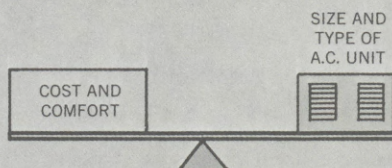
Select the Type and Size That Meets Your needs

Home air-conditioning equipment ranges from manually-controlled window units to complex central systems designed to provide independent temperature and humidity control in each room of the house. The simpler units emphasize economy; the complex systems emphasize comfort.

- The cooling equipment you select should be sized to hold the inside temperature at 75 degrees during all but the very peaks of hot weather. Experienced air-conditioning people can tell you what size equipment you need. Calculation procedures are available from responsible air-conditioning dealers, contractors and related industry associations and professions.

Do not buy oversized equipment. When seasonal peak temperatures are reached a properly sized unit will operate continuously and the interior temperature will "swing" up a few degrees above the normal thermostat setting. Proper sizing and continuous fan operation work to counter two adverse conditions:

—Humidity—Most residential cooling systems produce a steady relative humidity (RH) — typically 50% — only when operation of the unit is nearly continuous. Oversized units operate with shorter "on" periods and may provide less uniform humidity conditions.



—Stratification—Continuous fan operation along with proper design of the air distribution system, including proper placement of air supply devices

avoids having layers or pockets of air that are either too warm or too cool.

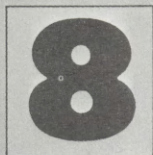
Properly sized equipment and adequate distribution provides the best combination for economy and comfort. But what kind of equipment?

- Central cooling systems generally provide the most effective and economical means of total-house cooling, especially when the duct work of forced air heating systems can be used as the distribution system. In many cases, all you need to add is a cooling coil and condensing unit, and probably a combination heating-cooling thermostat. If your heating system is other than forced air you have to install a duct system for central cooling—or consider the use of window or through-the-wall units.

In fact, if your home has a number of rooms which are used infrequently and therefore do not require continual cooling, individual units for these rooms may be the most economical from the standpoint of both investment and operating cost. In other words, you need buy only as many units as you definitely need, and you need run those units only when the seldom-used rooms require their operation.

Window units are frequently undersized when used to cool large living rooms; in bedroom installations they are frequently oversized. All individual units which are left unattended should have thermostats to avoid excessive cooling; this is especially true of units used in bedrooms.





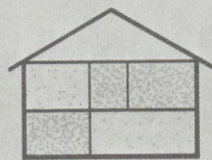
Operating Practices

Operate Your System or Unit to Increase Comfort and Economy

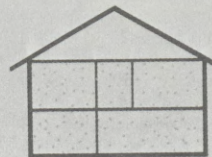
How you operate the temperature humidity and fan controls of air-conditioning equipment will have a significant effect on the comfort you attain and your cost of operation, whether you use individual units or a central system.

- Individual, or window units—These units provide cooling and indirect control of humidity; when properly sized and operated continuously they can keep down mugginess.

With any window unit the position of the adjustable louvers in the discharge air stream and the location of the unit itself should be chosen to mix the chilled air and the room air in a way that will not cause drafts on members of your family. If the circulating fan has more than one speed you can, in mild weather, lower the cooling effect, obtain more continuous operation and reduce noise by running the fan at lower speeds. Because most houses have enough natural air leakage for ventilation purposes the outdoor air damper should be closed to obtain greater economy and effectiveness. It can be opened to speed up the removal of cooking or tobacco odors. The greatest economy of window unit operation is realized when it is turned on only when needed and turned off when the space it cools is to be unoccupied for several hours.



UNBALANCED



BALANCED

- Central air-conditioning systems—Central systems employ a thermostat to start and stop the compressor, and sometimes the circulating fan as well, although greater comfort and uniformity of temperature within each room can usually be had by running the fan continuously (which for the cooling season might mean an additional \$5 in electric energy cost over cyclic operation). In more sophisticated systems, a humidistat may be used to control the house humidity and would require some type of reheat system to simultaneously control room air temperature and humidity. Simultaneous control of temperature and humidity entails a greater outlay for equipment and usually greater operating costs, but does provide improved comfort in high humidity climates.

The thermostat should be located on an inside wall of the room where comfort is of greatest significance or in a hallway where it will sense the return air temperature from all rooms. It should not be located near electrical appliances or warm pipes, in direct sunshine or behind draperies or in any location where it is appreciably shielded from air circulation in your house.

Your house will be most effectively cooled if the distribution system is balanced so as to deliver exactly the right amount of chilled air to each room, and if the total air circulation is kept at the maximum. If your distribution system gets out of balance it can easily be corrected by the following procedure:

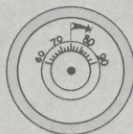
After the system has been operating for an hour or two on a hot day fully **open** all outlet grilles, or registers. If certain rooms get too cool, gradually close their registers until all rooms are at about the same temperature. This approach will produce balanced distribution with maximum air circulation. Under no circumstances should you close any register more than necessary.

In houses with central air conditioning you can save some electric energy by closing the door to an unused room. Unless the room is to be unused for an extended period of time, do not close the register in the room since the entire system would have to be rebalanced when use of the room is resumed. You may want to close kitchen and laundry-room doors during times of heat-generating activities in these rooms and use

natural or mechanical ventilation at these locations. This practice will save electricity and maintain comfort.

If you live in an area where the electric utility system becomes over-loaded in extremely hot weather you can help prevent a brownout by doing the following:

- Start your air conditioner earlier in the day or run it on the thermostat so you will not be placing the highest load on the system at the most critical time of the day.
- At times when a brownout may occur, it is better to leave the air conditioner operating on thermostat when leaving the house for periods of only several hours, rather than to attempt to cool the house on your return—unless expressly directed to do otherwise by your local officials.
- Raise your thermostat setting to the upper limit of the comfort range, say 80 degrees, during the period of highest load. For example, changing your thermostat setting from 75° to 80° will reduce the air-conditioning load by 15% or more.
- As much as possible, reduce internal heat generation.



**INCREASE DURING
PEAK DEMAND**



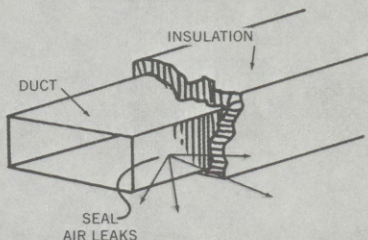
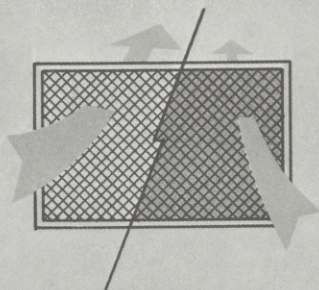
Maintenance

Keep the System Clean and in Good Functioning Condition

If air that is conditioned is not distributed to where you need it the most, you are paying for something you are not getting and wasting valuable energy besides. Here are some of the things you can do to keep your system operating efficiently:

- **Change or clean air filters**—Air filters are universally used on central cooling systems to keep dust and lint from depositing on the air blower and the cooling surfaces, as well as to deliver cleaner air to living spaces. Do not remove these filters to get more air; you will reduce the effectiveness of cooling elements by allowing dirt to build up on them. Instead, periodically look at the filter—if it looks dirty, change or clean it. Your system is designed to operate efficiently with relatively clean filters if you follow the printed instructions on the filter. For the average household a filter check may be necessary only every 30 to 60 days. It is also in your best interest to have the cooling surfaces checked, and if necessary, cleaned by service professionals every year or two.

Window-type air-conditioners contain filters that can easily be inspected by removing the room-side cover. It is especially important to check those units that are made with the air filter in immediate contact with the cooling coil. If the filter is dirty, a buildup of



frost and ice can occur that will further impede the flow of air. Operating a window unit when the weather is mild can also cause frosting of the cooling coil, and when the frost melts it can cause water damage to window frames, walls or furnishings beneath the air-conditioning unit. To prevent frosting and save energy, the best procedure is to keep the filter clean, and avoid using your air conditioner in mild weather.

- **Seal air leaks**—The objective of a central air-conditioning system is to deliver cooled air that is low in moisture

content to your living space and to return warm, moist air to the cooling coil for cooling, dehumidification and recirculation using a blower to circulate air through the duct system and living space. If cooled air is allowed to leak from the ducts, duct joints, or from the living spaces into non-air-conditioned spaces, or if the return air duct draws warm moist air from non-cooled spaces, the cooling efficiency of the system is greatly reduced. Simple inspection can often reveal such leaks. Look for and seal by taping or caulking all cracks; a crack is much too large if you can feel cool air coming from it. Carefully seal around window air-conditioning units.

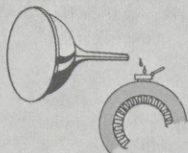
In general, building spaces should not be used as part of a duct system because of the possibility of excessive air leakage. For example, if your air conditioner is in a closet, the return duct system should be connected directly to the air conditioner, not just to the closet space. Also, if hollow spaces in floors and walls (between joists and studs) are used as return ducts they should be tightly sealed.

- Keep the condenser clean—the condenser in an air-conditioning system is located outdoors (both in window units and central systems). The finned surfaces of the condenser should always be kept clean and free of leaves, mud, etc. Also, the air flow through the condenser should not be impeded by shrubbery, placement too close to walls, etc. If the air flow becomes impeded

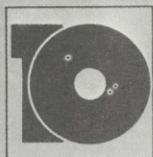
the process of transferring heat from your equipment to the outdoors is greatly reduced in efficiency—and power will be wasted.

- Lubricate bearings and tension the fan belt—The bearings on the blower and electric motor unit should be lubricated to maintain maximum efficiency. Lubrication instructions can usually be found on the nameplates or in the manufacturer's manual for the equipment, and these should be followed at least once a year, preferably at the start of the cooling season.

Pulleys on a motor and blower are usually connected by a belt to transmit the rotative power of the motor to the blower. Power is transmitted at maximum efficiency when this belt is at the proper tension. A simple check of belt tension is to shut off the electric power to the motor and press down on the belt midway between the pulleys. The distance the belt depresses with a few pounds of force applied to it should be between $\frac{1}{4}$ and $\frac{1}{2}$ inch. The tension of the belt usually can be controlled by adjusting screws on the mounting frame that fasten the motor to the blower housing.



**LUBRICATE
BEARINGS**



House Exteriors

Shade Surfaces from Sun; Use Light-colored Paints and Roofing Materials

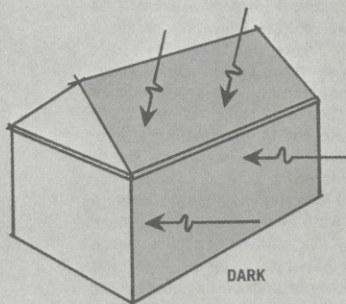
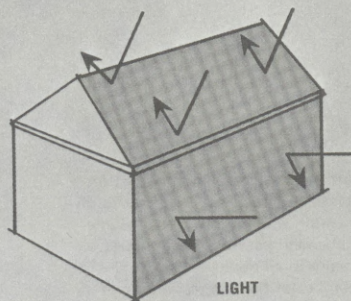
The best way to protect your home from the sun's rays is to shade it; the next best way is to cause at least some of those rays to reflect off your house, and you can do the latter with color.

- **Shading**—It is often possible to use trees (deciduous trees if you want the sun to penetrate in winter) or other foliage for shielding large areas of a house. When used to keep some solar radiation off the roof, trees prove especially useful. They are also highly effective when used to intercept radiation from a morning or evening sun, thus preventing a heat build-up on the east or west walls of the house.

Other methods of shading include the use of such architectural devices as wide overhangs, porches, balconies or other horizontal projections, and sun screens positioned according to solar angles. These devices can greatly reduce solar heat gain and can be most profitably used in shielding doors and windows.

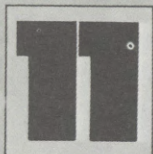
- **Color**—Light colors reflect more solar radiation than dark colors; the whiter and smoother a surface is the less solar radiation energy it absorbs.

A dark-colored surface can get as much as 60 degrees hotter than the air temperature. That same surface, if painted white, would heat up to only



about 20 degrees above the air temperature.

It is especially desirable to have your roof color as light as possible. If you are planning either to build a house or to re-roof the one you have, select the lightest-colored roofing materials available.



Houses Without Air Conditioning

Insulate, Ventilate—and Take Advantage of Nature

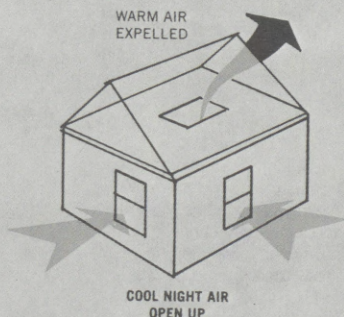
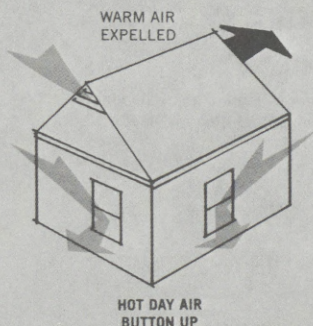
It is possible to maintain a comfortable home in summer in many parts of this country without relying on a mechanical cooling system. As a matter of fact, many families do.

A number of the suggestions offered in this brochure, while aimed at reducing air-conditioning loads, are perhaps more critically useful to families who do not use air conditioning.

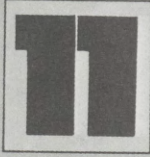
It is practical in many areas to take advantage of the daily temperature cycle—to invite night's cool air into your home and to button up the house come the morning. The daily range of outdoor temperature is between 15 to 35 degrees and the lowest air temperatures usually occur from midnight to just before dawn.

In dry climates evaporative cooling can provide comfortable conditions both day and night at low cost. These devices evaporate water to lower the temperature of a stream of outdoor air circulated through the house. Evaporative coolers are of limited effectiveness east of the Mississippi River because of high summer humidity levels.

Many design and construction features for maintaining comfort are readily incorporated in a new house but difficult to apply on an add-on basis to an existing house. A new house can be oriented to take advantage of solar



and climatic conditions. Rooms can be oriented accordingly—bedrooms, for example, might be located in the east so they will not receive the rays of the late afternoon sun. Building elements of large mass might be used to even out the daily indoor temperature cycle. In any event, professional advice might



Houses Without Air Conditioning (continued)

well be sought if you are planning to build. Meantime, here are some suggestions:

- When ventilating, draw in air from the coolest side of the house. Expel warm air from the upper parts of the house, either into the attic or through windows near their tops. A ventilator fan can be effectively installed into the upper ceiling to pull air through the house and push it into the attic. Or it can be situated in the attic to ventilate that space while pulling air through an opening into the attic.
- Take advantage of all possible ways of reducing solar heat gain; remember to draw the blinds and draperies of windows exposed to direct sunlight.
- Keep doors and windows closed during the day for as long as practical.
- Reduce indoor heat generation as much as possible; use exhaust fans in kitchen and bathroom, but only for as long as is necessary.
- Use small, quiet fans to provide the most satisfactory local air movement for the comfort of your family.
- Check Ways Nos. 2 through 6 and Way No. 10 of this brochure; these represent highly valuable suggestions to families who do not use air conditioning.

OFFICE OF CONSUMER AFFAIRS
WASHINGTON, D.C. 20506

OFFICIAL BUSINESS



POSTAGE AND FEES PAID
OFFICE OF CONSUMER AFFAIRS

11

A Word in General . . .
Air Infiltration and Leakage
Windows
Insulation
Attic Ventilation
Internal Heat Generation
Cooling Units
Operating Practices
Maintenance
House Exteriors
Houses Without Air Conditioning

APPENDIX

(Under authority previously granted, the following communications were ordered printed:)

SUMMARY CLEAN ENERGY

MESSAGE FROM THE PRESIDENT OF THE UNITED STATES TRANSMITTING A PROGRAM TO INSURE AN ADEQUATE SUPPLY OF CLEAN ENERGY IN THE FUTURE

This summary of the President's Energy Message of June 4, 1971 (H. Doc. No. 92-118) was prepared by the Science Policy Division of the Congressional Research Service of the Library of Congress for the use of the Senate Committee on Interior and Insular Affairs in connection with its study of National Fuel and Energy Policies pursuant to S. Res. 45.

On June 4, 1971, the President sent to Congress a message on energy announcing "a broad range of actions to ensure an adequate supply of clean energy for the years ahead." Private industry is expected to play the major role with government helping.

The message addressed research and development, access to energy resources on Federal lands, the supply of enriched uranium, more efficient use of energy, planning for power plant sites and transmission line routes, economic incentive to reduce sulfur oxide emissions, and establishment of an Energy Administration. Of these the President said, in part:

Research and development for clean energy

"Our past research in this critical field has produced many promising leads. Now we must move quickly to demonstrate the best of these new concepts on a commercial scale. Industry should play the major role in this area, but government can help by providing technical leadership and by sharing a portion of the risk for costly demonstration plants. . . .

Sulfur oxide control: ". . . the new air quality standards promulgated under the Clean Air Amendments of 1970 require an even more rapid development of a suitable range of stack gas cleaning techniques for removing sulfur oxides.

"I have therefore requested funds in my 1972 budget to permit the Environmental Protection Agency to devote an additional \$15 million to this area, more than doubling the level of our previous efforts. This expansion means that a total of six different techniques can be demonstrated . . . during the next three or four years."

The nuclear breeder reactor: "The liquid metal fast breeder is ready to move out of the laboratory and into the demonstration phase with a commercial size plant . . . I am therefore requesting an additional \$27 million in Fiscal Year 1972 for the Atomic Energy Commission's liquid metal fast breeder reactor program—and for related technological and safety programs . . ."

". . . we will make every effort to see that these new breeder plants be designed in a way which inherently prevents discharge to the environment from the plant's radioactive effluent systems.

"We have very high hopes that the breeder reactor will soon become a key element in the national fight against air and water pollution.

". . . I have requested the early preparation and review . . . of a draft environmental impact statement for the breeder demonstration plant in accordance with Section 102 of the National Environmental Policy Act.

"I believe it is important to the Nation that the commercial demonstration of a breeder reactor be completed by 1980. To help achieve that goal, I am requesting an additional \$50 million in Federal funds for the demonstration plant."

Coal gasification: ". . . it is technically feasible to convert coal into a clean gas which can be transported through pipelines.

"We have . . . initiated a cooperative program with industry to expand the number of pilot plants, making it possible to test new methods . . . so that the appropriate technology can soon be selected for a large-scale demonstration plant.

"The Federal expenditure for this cooperative program will be expanded to \$20 million a year. Industry has agreed to provide \$10 million a year . . . the Government will continue to finance the larger share of pilot plants and the industry will finance the larger share of the demonstration plants."

Other research and development

Coal mine health and safety research: ". . . the Bureau of Mines research effort has been increased from a level of \$2 million in Fiscal Year 1969 to \$30 million in Fiscal Year 1972."

Controlled thermonuclear fusion research: ". . . we have requested an additional \$2 million . . . for Fiscal Year 1972."

Coal liquification: ". . . the Department of the Interior has underway a major pilot plant program directed toward converting coal into cleaner liquid fuels."

Magnetohydrodynamic power: "In partnership with the electric power industry, we have been working to develop this new system of electric power generation."

Underground electric transmission: ". . . In cooperation with industry, the Government is funding a research program to develop new and less expensive techniques for burying high voltage electric transmission lines."

Nuclear safety: ". . . we must continue to fund safety-related efforts in order to ensure the continuance of the excellent safety record. . . . An additional \$3 million has recently been requested . . . in Fiscal Year 1972."

Advanced reactor concepts: ". . . the Atomic Energy Commission is also supporting limited alternate reactor programs involving gas cooled reactors, molten salt reactors and light water reactors."

Solar energy: NASA and the NSF are ". . . currently re-examining their efforts in this area and we expect to give greater attention to solar energy in the future."

Access to energy resources on Federal lands

The Outer Continental Shelf "I am . . . directing the Secretary of the Interior to increase the offerings of oil and gas leases and to publish a schedule for lease offerings on the Outer Continental Shelf during the next five years. . . ."

Oil shale: "I am . . . requesting the Secretary of the Interior to expedite the development of all oil shale leasing program including the preparation of an environmental impact statement."

Geothermal energy: "I am requesting the Secretary of the Interior to expedite a final decision on whether the first competitive lease sale should be scheduled for this fall . . ."

Natural gas supply: "Additional supplies of gas will . . . be one of our most urgent energy needs in the next few years . . ."

Federal efforts to augment the natural gas supply include:

- accelerated leasing on Federal lands.
- demonstration of coal gasification.
- FPC actions to provide greater incentives for the natural gas industry to search for new sources.
- Facilitating imports of natural and liquified gas from Canada and other nations.
- "progress in nuclear stimulation experiments . . ." to free natural gas from tight geologic formations.

Fuel imports from Canada

"The United States is . . . prepared to move promptly to permit Canadian crude oil to enter this country, free of any quantitative restraints, upon agreement as to measures needed to prevent citizens of both our countries from being subjected to oil shortages, or threats of shortages."

Supply of enriched uranium for nuclear fuel

"I expect that private enterprise will eventually assume the responsibility for uranium enrichment . . . but in the meantime the Government must carry out its responsibility to ensure that our enrichment capacity expands at a rate consistent with expected demands.

". . . I am releasing \$16 million to start the Cascade Improvement Program in Fiscal Year 1972." The pace of the improvement program will be tailored to fit the demands for enriched uranium in the United States and in other countries.

Wiser use of energy

". . . I am directing the Secretary of Housing and Urban Development to issue revised standards for insulation applied in new federally insured homes."

"... I am ... asking my Special Assistant for Consumer Affairs ... to gather and publish ... information ... to help consumers focus on the operating costs as well as the initial cost of energy intensive equipment.

"... the Joint Board on Fuel Supply and Fuel Transport ... is developing energy conservation measures for industry, government, and the general public to help reduce energy use in times of particular shortage and during pollution crises.

Powerplant siting

Urges Congress to take "... prompt and favorable action" on his Special Message on the Environment of last February that proposed legislation to provide for longer range planning by the utilities and establishment of State or regional agencies to license new bulk power facilities prior to their construction.

A sulfur oxides emissions charge

Calls attention to the proposed sulfur oxides emissions charge in his environmental message.

Government reorganization: an Energy administration

"... I have proposed that all of our important Federal energy resource development programs be consolidated within the new Department of Natural Resources."

"The single energy authority ... would be better able to clarify, express, and executive Federal energy policy than any unit in our present structure."

"We believe that the planning and funding of civilian nuclear energy activities should now be consolidated with other energy efforts in an agency charged with the mission of insuring that the total energy resources of the nation are effectively utilized. The Atomic Energy Commission would still remain intact, in order to execute nuclear programs and any related energy research ..."

(NOTES.—There follows a short explanation of two items mentioned by the President: breeder reactors and enriched uranium.)

Breeder reactors: Nuclear power plants now being built can use only 0.7 percent of the uranium found in nature as fuel and none of the thorium. The breeder reactor as it generates electricity with nuclear fuel can also convert some of the non-usable uranium and thorium into nuclear fuels, thus multiplying the energy potentially recoverable from deposits of uranium and thorium. AEC chairman Seaborg has estimated that the type breeder to which the President would give priority would multiply the utility of our uranium reserves as much as fiftyfold.

Enriched uranium. The fuel for nuclear power plants is uranium. Some plants have been designed to use uranium as it is obtained from the ores. Other designs, of the kind used now in this country, require that part of the non-useful uranium be removed so that the fuel material in essence is "enriched" in the useful species of uranium. At present the only source for this enriched uranium, for commercial nuclear power in the United States are the three government owned enrichment plants mentioned by the President.

EDISON ELECTRIC INSTITUTE,
New York, N.Y., June 15, 1971.

HON. HENRY M. JACKSON,
Chairman, Interior and Insular Affairs Committee, U.S. Senate, New Senate Office Building, Washington, D.C.

DEAR SENATOR JACKSON: While only government agencies concerned with energy matters were invited to testify at the June 15 hearings on the President's Message on Energy, on behalf of the Edison Electric Institute we would like to submit comments concerning this important Presidential statement.

The Institute is the principle trade association of the investor-owned electric utility industry. Its 186 operating member companies serve over 98 percent of all customers of the investor-owned segment of the electric power industry in the United States. These customers comprise more than three-quarters of our nation's users of electricity.

Fuel is the basic raw material of our business. Last year the electric power industry in the United States consumed slightly more than 320 million tons of coal, almost 325 million barrels of oil, 3.9 trillion cubic feet of gas and 570 short tons of uranium ore to produce 83.8 percent of the 1.53 trillion kwhr of electric energy consumed by our nation. Hydraulic energy produced the other 16.2 percent of our electric needs.

We believe that the President should be commended for the timely initiative he has taken in the broad field of energy supply, as evidenced by his proposed

long-range program to assure an adequate supply of clean energy in the years ahead. Of particular importance is the emphasis on developing the fast breeder nuclear reactor and sulfur oxide control systems. The Institute agrees with the President that these development projects should be afforded the highest priority.

The breeder reactor has significant potential advantages for producing electric energy more economically, with greater environmental compatibility, and with increased efficiency in the use of natural resources. For several months, committees of the electric utility industry and the U.S. Atomic Energy Commission have been meeting to work out methods for bringing the fast breeder to fruition. Presently, the Institute is developing a program to raise an equitable share of the research and development funds required for a breeder demonstration plant.

Vitally important, too, are steps proposed in the President's program to assure the ready availability of coal, oil, gas and enriched uranium. EEI recently formed a Policy Committee on Energy Resources to consider the many factors involved in fuel supply, including environmental considerations. Through this committee, a comprehensive study of energy requirements and supply is now under way. As the study progresses, we would like to share its results with your committee.

The Institute also agrees with the President on the desirability of the nation's using its energy resources wisely. Last year, we cooperated with Mrs. Virginia H. Knauer, the President's Special Assistant for Consumer Affairs, in providing information for a widely distributed booklet on methods of avoiding the wasteful use of energy.

We do not believe the establishment of a sulfur oxides emission charge in the form recommended by the President is necessary or equitable. Attached is a copy of a comprehensive memorandum on this subject which was recently submitted to the Treasury Department by several member companies of the Institute. In addition, the Institute believes the Administration's plant siting legislative proposal has certain serious defects. In this connection I have attached a copy of testimony presented by Mr. D. Bruce Mansfield, Chairman, Edison Electric Institute, at recent hearings on plant siting legislation held by the Subcommittee on Communications and Power of the House Committee on Interstate and Foreign Commerce.

EEI feels that the President's program offers much that will be helpful as our industry continues its efforts to assure an abundance of electricity to serve the nation's needs in an environmentally compatible manner. We wish to offer our most thoughtful and constructive cooperation in working with the Administration and the appropriate committees of Congress in realizing our common objectives.

Respectfully yours,

W. DONHAM CRAWFORD, *President.*

MEMORANDUM ON THE PROPOSED SULFUR TAX¹

The electric power industry shares President Nixon's concern about the effects of sulfur oxide on our environment, and has worked hard and is continuing to work vigorously to reduce emissions and concentrations, but it must register its opposition to the sulfur tax. The tax would be levied on the sulfur content of fuels.² By penalizing the use of sulfur bearing fuels, proponents hope that sulfur oxide emissions and, correspondingly, ground level urban concentration levels would be reduced.

While it may sometimes be desirable to establish economic disincentives as a technique for achieving socially desirable ends, the proposed sulfur tax, in the form and with the time schedule suggested, has a number of serious shortcomings and the continued use of local standards rigorously enforced is preferable to its imposition. The proposed sulfur tax would in fact present many electric power

¹ The views expressed herein are those of the following listed companies, all of which were represented at a March 16, 1971 meeting with Treasury Department officials:

American Electric Power Company, Inc.
Commonwealth Edison Company.
Detroit Edison Company.
Duke Power Company.
Kansas City Power & Light Company.
Potomac Electric Power Company.
Public Service Company of New Hampshire.
Southern California Edison Company.

² The suggested rate of tax is 1¢ a pound in 1972, 2¢ a pound in 1973, 3¢ a pound in 1974, 5¢ a pound in 1975, and 10¢ a pound in 1976 and thereafter.

companies, already hard pressed to meet both expanding capacity demands and environmental needs, with the dilemma of not having enough suitable fuel to meet their customers' requirements or having to pay so much sulfur tax as to impair their credit to the point where they could not proceed with work on behalf of clean air and water already undertaken.

A detailed statement of the reasons for opposition to the proposed tax follows.

* * * * *

1. *The sulfur tax would not accelerate the reduction of sulfur oxide emissions from steam electric power plants in urban areas since the electric power industry now is taking all practical and economically feasible steps to clean up the air in metropolitan areas faced with air pollution problems.*

Industry efforts in urban areas to reduce sulfur oxide emissions are being conducted with maximum practicable diligence, and the proposed sulfur tax is unlikely to enhance such efforts. A brief review of recent environmental programs indicates the scope of the present effort to reduce sulfur oxide emissions. In 1968, the industry made capital expenditures of more than \$200 million on air quality control, and the level of expenditures is increasing rapidly.³ As summarized in Exhibit I, the Department of Health, Education and Welfare projects expenditures for sulfur oxide emission control on steam electric power plants of up to \$630 million annually by 1975, exclusive of new investments and nuclear power costs.

In the time available, it was not possible to obtain industry-wide figures on actual or anticipated expenditures to improve air quality, but as a guide, the following comments are made with respect to a few major electric power companies:

a. *Southern California Edison Company.*—Utilities in the Los Angeles basin area of Southern California have operated under most stringent air pollution control regulations since the late 1950's. The rules have become progressively more restrictive. Whereas they originally prohibited the voluntary use of liquid fuels containing more than 0.5% sulfur during the warmer months of the year, they now prohibit its use entirely. Such rules, and others dealing with specific stack effluents, are now in force in essentially all major counties in Southern California. Such regulations have had the effect of forcing the use of all gas fuel available to the utilities. Electric utilities in Southern California receive their principal gas supplies on an interruptible basis from local gas distribution utilities under lowest priority rate schedules. The amounts of such gas available to the electric utilities is unpredictable and subject to wide variations dependent upon the requirements of higher priority consumers, whose requirements vary as a function of weather conditions, and dependent upon the supply acquisitions of the gas distribution utilities. The electric utilities use fuel oil only as required to supplement such gas fuel supplies.

Because of the developing tight gas supply situation nationwide, gas fuel supplies available to the electric utilities are projected to deteriorate drastically at least through the mid-1970's. Such deterioration coupled with increasing gross requirements for such fuel will require Southern California utilities to increase their use of foreign source low sulfur fuel oils by up to fourfold over the levels of 1970.

Efforts of the electric utilities in Southern California to increase their supply of low sulfur fuels to reduce their contributions to environmental pollution date back as far as the mid-1950's. Several of the larger Southern California utilities have made several attempts to supplement their interruptible gas supplies by procuring major independent gas supplies from out-of-state sources. Such efforts were unsuccessful. In 1967 the electric utilities were successful, however, in efforts to persuade the Federal Government to revise oil import regulations applicable to the West Coast (District V) to allow the importation, without quota restrictions, of foreign source low sulfur oil as required to satisfy oil burning requirements of consumers required to use such oil for air pollution control purposes.

Fuel costs have increased sharply, and are projected to continue increasing, for the most part because of the conversion the electric utilities have made to the use of only low ash, low sulfur oils for air pollution control purposes due to the rising unit costs of and requirements for such fuel. The cost of low sulfur oil has risen in response to the rapidly escalating world-wide demand for such oil for air pollution control purposes.

³ This is in addition to the much larger annual fuel costs associated with low sulfur fuels, much of them accounted for by the need to open new coal mines, extend rail hauls and to purchase equipment. See Exhibit VII for description of factors involved in opening of a coal mine.

b. *Commonwealth Edison Company.*

Projected expenditures by Commonwealth Edison Company for air pollution abatement projects over the next four years are as follows:

1971-----	\$41, 400, 000
1972-----	15, 900, 000
1973-----	19, 000, 000
1974-----	14, 300, 000
Total-----	⁴ 90, 600, 000

⁴ Includes expenditures for reduction of sulfur oxide emissions of about \$37,800,000.

In addition, in 1971, Commonwealth Edison Company expects to spend about \$40 million more to use low sulfur fuel than it would have spent to use local coal with a higher sulfur content. Because of the present shortage of railroad cars, that Company arranged for the purchase of 575 one-hundred-ton coal cars for over \$9 million to carry the coal from the far west to Illinois. Beyond that, Commonwealth converted an entire generating station to burning low sulfur oil rather than coal at a cost of over \$8 million. At current fuel consumption levels, that conversion replaced over one million tons of coal annually and, further, released for use at other stations natural gas equivalent to about 550,000 tons of coal annually. It is experiencing substantial additional costs and capacity losses in burning low sulfur coal from the Western states because existing boilers are not designed to handle fuel with the characteristics of the new coals. (See Exhibit III.)

* * * * *

Presently, one of the best available long-range solutions to the sulfur emission problem appears to be nuclear power generation. To date, about \$1 billion has been spent by the industry on nuclear generating stations in operation now and from \$5 to \$10 billion for stations still under construction. The continuation of the industry's nuclear plant construction program will result in its having expended at least \$20 billion more by 1975 or so.

The industry is also spending considerable amounts on numerous sulfur removal research activities. Today over sixty processes for desulfurization of fuel or of fuel combustion products are in various stages of development with over sixty companies and institutions plus the federal government engaged in research and development. (See Exhibit IV.) Many processes are now moving into full-scale trials. For example, one major electric power company will spend about \$12 million in 1971-72 to install experimental desulfurization facilities at two of its generating stations.

It is unclear where else the industry's resources could be applied. Present efforts encompass nearly every aspect of the sulfur oxide problem—from research of ways to desulfurize fuels and combustion products, to conversion of existing facilities to burn low or non-sulfur bearing fuels, and to increased reliance on nuclear power for future fuel needs. In any case, the desirability—from the overall point of view of pollution abatement—of imposing a major new cost on the electric utility industry is highly questionable.

2. The electric power company industry is already hard-pressed financially and the proposed sulfur tax would compound its burden and threaten its financial ability to meet its obligations.

During the past ten years a number of forces have combined to weaken the industry financially, in particular the big-city companies which have been affected the most by environmental concerns. Construction cost inflation greater than has been seen in generations plus all-time high money costs have made it difficult for electric power companies to raise the billions of dollars needed to finance needed expansion and at the same time take the environmental steps which the public demands.⁵ Last year, 1970, electric power companies raised over \$8 billion—more than 20% of all the new money raised by corporations in the United States—up over \$3 billion from 1969.

⁵ Reliable routine application of sulfur removal processes cannot be attempted before sufficient experimental experience has been obtained and even then such facilities cannot be installed immediately in any one system or in all systems. It would take over ten years to install such facilities throughout a single major electric power system. (See Exhibit VI for full discussion of time required to install a sulfur removal system.)

⁶ The electric power industry is the most capital intensive in the country, investing approximately \$5 in plant facilities for every dollar of annual revenues—over twice as much as the steel industry and ten times as much as the automotive industry.

One consequence of new money borrowings is the deterioration of interest coverages for the industry's securities. After-tax interest coverages on the senior debt offerings of a number of industry members have recently deteriorated sharply. As appears from Exhibit II a representative group of electric and combination utilities which in 1965 recorded average after-tax interest coverage of 3.59, in 1970 recorded coverages of only 2.21. On a before-tax basis, indications are that earnings available for fixed charges were sufficient to cover interest charges five to six times in 1965; today, this coverage has declined to about three times interest requirements, with many electric utilities close to two times coverage. It is apparent, therefore, that the total financial resources available for environmental improvement are not unlimited. Further tax inroads on such resources could well impede the total effort to clean up the air and water by making impossible the already difficult job of raising money to fund projects.

3. *The sulfur tax would be inflationary.*

Of great concern is the inflationary character of the proposed tax. The tax would add a very substantial cost, unrelated to new pollution abatement facilities or added efficiency, to those already being experienced for environmental cleanup.

a. *Cost Pyramiding.*—As can be seen, the industry is already expending very large sums to clean up the air and to meet air quality standards set by local and state environmental agencies. And it is unlikely that the sulfur tax would be an incentive to do more. On top of the very heavy costs now being experienced to meet local emission standards, many millions annually would be extracted ostensibly to provide an incentive for the industry to do what it is now doing. This pyramiding of cost upon cost would be inflationary. It would increase costs without adding to the effort of pollution abatement and indeed would hamper the total pollution control effort by depriving the industry of a significant portion of the funds needed to finance this effort.

b. *Application to minimal emissions.*—It will be many years, if ever, before it becomes possible to attain a level of zero emissions. (See section 5 below.) The proposed tax would, thus, be a long-term burden since it would apply even in cases of the most minimal emissions. No benefit would rebound to the public for a charge on irreducible emissions.⁷ On the contrary, since the increased operating costs of a public utility are necessarily reflected in its rates, only increased costs for electricity would result for the same service and emission levels that would be present without the tax. Since it is a basic industry, any cost increases for the electric power industry are felt throughout the entire economy.

4. *A flat rate sulfur tax would be discriminatory and ineffective at reducing sulfur oxide concentrations because of the failure to take into account important differences among fuel users.*

A flat rate tax would treat all sulfur oxide emissions as having an equal impact on the environment. But in fact urban concentrations of sulfur oxide result largely from emissions by numerous small combustion units, and emissions from industrial, utility or other users in rural areas are unlikely to produce high concentrations of sulfur oxide in the atmosphere. Furthermore, a uniform nationwide sulfur tax would ignore the substantial effect of variations in climate, topography and meteorology on sulfur oxides and other pollutants.⁸

a. *Small combustion units are the source of most sulfur oxide concentrations in urban ambient air.*—Emissions discharged at low altitudes and at a low velocity and temperature have a tendency to remain in the immediate area and account for the bulk of urban sulfur oxide concentrations at ground level. Most small users' furnaces and emission facilities have these characteristics. On the other hand, electric utilities and some other industrial users release their emissions from tall stacks at a high temperature and velocity, which minimizes harmful concentrations. The existence of this phenomenon has been established both theoretically and in actual practice.

⁷ The Federal Environmental Protection Agency recognizes that small concentrations of pollutants pose little, if any, threat to health. In fact, the agency has established concentration levels for all major pollutants which must be reached to safeguard health and another lower level which will eliminate the adverse aesthetic effects of pollution. For a sister agency to announce that any emissions of a single pollutant are so harmful that they must be taxed is at best incongruous. If the emissions pose no threat to people's health they should not be subject to a penalty tax.

For another thing, sound economic theory recognizes that emissions should be reduced only to the level at which the cost to eliminate those emissions does not exceed the benefits received from their elimination. In several years, the ground level concentrations of sulfur oxides from burning even 4% sulfur content coal will be hardly measurable. This will result from combining high stack dispersal techniques with sulfur oxide removal systems, which, once available, are expected to be about 70 to 89 percent effective.

⁸ On the other hand, the Clean Air Act of 1967 expressly mentions these three factors as ones to be considered in establishing air quality control regions. 42 U.S.C. § 1857c-2(a)(1).

For example, Argonne National Laboratory prepared a mathematical model to aid prediction of pollutant concentrations in the Chicago area. The model pointed to the low temperature-altitude-velocity emissions as the primary source of sulfur oxide concentrations at ground level. Actual field measurements validated conclusions drawn from the model. The Mitre Corporation, on commission of the Federal Environmental Protection Agency, also modeled sulfur oxide concentrations in the Chicago metropolitan area. The study showed that complete elimination of sulfur oxide emissions from electric power plants would reduce ground level concentrations by but 11% in the most polluted area of Chicago even though the plants account for two-thirds of sulfur oxide emissions in the metropolitan area. At the outset of their report accompanying the study, the writers stated:

Sulfur dioxide is one of the major air pollutants in industrial cities in the eastern United States. Since 30% to 80% of the sulfur dioxide emissions in these cities may come from electric power plants that burn fossil fuels, it has been said that curbing emissions from power plants would considerably alleviate the sulfur dioxide pollution problem. We report a modeling study of atmospheric diffusion which indicates that emissions from power plants contributed only a modest percentage of the yearly average concentrations of sulfur dioxide at ground level in the most polluted areas of Cook County, Illinois, during 1968.

As a second example, the dramatic improvement in recent years in the air quality in England is well-known. This success resulted primarily from eliminating use of high sulfur fuels by home and other small users and encouraging high velocity-altitude discharges by large industrial users. Mr. F. F. Ross of the British Central Electricity Generating Board recently noted that annual emissions within fifty to sixty miles of Buxton in the English Midlands are significantly greater than those reported for comparable areas around Chicago and New York. On the other hand, the levels of sulfur oxide in the ground-level atmosphere at Buxton averaged around .03 parts per million with a high of .12 parts per million, reached only on one day,⁹ while the same or higher levels obtained in Chicago and New York where 1970 ground-level ambient air levels averaged .03 and .08 parts per million, respectively.¹⁰

It is clear that in order to reduce the sulfur oxide concentrations in city air, special emphasis must be directed to the small combustion furnaces that emit at low altitude, low temperature and low velocity. Thus, it would be clearly discriminatory to tax all sulfur emissions as though they were identical. The anomalous consequence of such discrimination would be that the small users, who have the most serious effect on the urban environment, would have relatively small incentive to clean up and no incentive at all to handle their emissions in ways which minimize their harm.¹¹

The tax would also represent a disincentive to utilities to spend many millions on high stacks which have proved to be the most effective means of reducing ground level concentrations.

b. *Rural v. Urban.*—The sulfur tax treats emissions in sparsely populated regions as having the same environmental impact as urban emissions. However, the latter clearly contribute the great bulk of sulfur oxides which result in unwanted ground level urban concentrations. It is unfair to fuel users in the non-concentrated parts of the nation to pay at the same rate for their emissions as do their urban counterparts. Moreover, it would be a mistake to establish a sulfur incentive tax which would give no incentive at all to move coal-burning plants out of urban areas. Perhaps most important for society is the fact that the flat rate puts urban and rural fuel users in competition for the limited low sulfur fuel supplies which should be directed to the urban fuel user.

c. *A sulfur tax would unduly discriminate against those regions of the country utilizing high sulfur coals but having low sulfur ambient air quality levels.*

It is a fact that in some portions of the central region¹² of the United States

⁹ Communication to Mr. G. E. Watkins of the Electric Research Council, dated December 18, 1970.

¹⁰ The recently established air quality standards of the Federal Environmental Protection Agency set 80 micrograms per cubic meter (approximately .03 parts per million) as an optimum level for primary health welfare.

¹¹ For the small user, even a 10¢ per pound sulfur tax would only amount to a few dollars a year. For the electric power industry, even after complete conversion to 1% sulfur fuels, the proposed tax would still amount to an estimated 1% to 2% of electric revenues, in addition to the cost of conversion to the low sulfur fuels themselves.

¹² Subsection (c) was prepared by Kansas City Power and Light Company and relates primarily to the Kansas-Missouri region.

local bituminous coals of high sulfur content are used in electric power plants (approximately 6% in remote rural areas and approximately 3% in and about some urban areas). However, because natural gas has historically been available in abundant quantities and at low cost for residential, domestic and industrial uses, there are extremely few small sources of sulfur emissions. Through use of tall stacks, and because of climatic conditions, including relatively high average annual wind velocities and hours of sunshine and low incidence of temperature inversions, the ambient air levels of sulfur oxides throughout the region are nevertheless extremely low. In fact, presently existing ambient air levels of sulfur oxides in this region are already below the Secondary Air Quality Standards recently established by the Federal Environmental Protection Agency as the optimum level for the protection not only of the public health, but also to avoid property damage and to protect public welfare.

The proposed sulfur tax would unduly discriminate against this and comparable regions because:

(i) The flat rate tax would be extremely and disproportionately burdensome on the electric systems in the region because of the use of local high sulfur coals.

(ii) The electric rate payers in that region would pay proportionately greater electric rates and receive no concomitant benefits because sulfur levels in the ambient air are already well below accepted levels.

(iii) The tax revenues generated from the public in such regions would presumably be used to subsidize research in the control of (a) pollutants, from competing forms of energy, and (b) sulfur oxide emissions in other regions of the country where sulfur levels are not within acceptable ambient air quality levels.

d. *The present shortage of low sulfur fuel would make the sulfur tax discriminatory among regions.*

Another discriminatory effect of the tax would result from the present fuel shortage which is plaguing the industry as a whole and causing particularly severe fuel dislocations in some areas. In 1968 and 1969 the electric power industry was first confronted with what has become a steadily worsening fuel supply shortage. The efforts to reduce sulfur oxide emissions aggravated the problem by putting a premium on the use of natural gas and residual fuel oil to replace coal. Natural gas is the most desirable fuel because it emits almost no sulfur oxides. Similarly attractive is low sulfur residual fuel oil. Finally, low sulfur coal is used, and it is available in large, undeveloped fields in the western parts of the United States.

To reduce sulfur oxide emissions, a segment of the electric utility industry turned first to natural gas, but it was available in large quantities only in the south and the southwest. Uncommitted domestic low sulfur residual fuel oil supplies are so small that they present no feasible alternative to coal. Next, foreign residual fuel oil was looked to, but at present it, too, is relatively scarce. The only fuel available to the north central section of the country is the low sulfur coal of Montana and Wyoming far distant from its midwestern users. Consequently, high transportation costs have already pushed up the price of electricity in the Midwest.

Of the available fuels, coal produces the most sulfur oxide per unit of heat. As shown above, for reasons totally unrelated to efforts at pollution abatement only low sulfur coal is available to significantly reduce sulfur emissions in the Midwest. Thus, the sulfur tax would hit hardest those in the Midwest who are forced to use coal and pay the costs of transporting it 1,000 miles or more. In fact, the sulfur tax would add gravely to the costs of those who have experienced the highest cost as a result of their past and current efforts to obtain low sulfur fuels and reduce sulfur emissions.

5. *Imposition of a sulfur tax will result in permanent economic damage to Appalachia and other regions.*

Imposition of a sulfur tax prior to development of economic and reliable sulfur removal equipment will force more conversions to low sulfur oil or natural gas and more new installations with these fuels or nuclear fuel than would be the case when satisfactory removal equipment is available. This would result in permanent economic damage to Appalachia for example where coal mining is a major industry and where the coal produced is relatively high in sulfur content. Other regions such as the Illinois-Indiana-Kentucky coal fields will also be seriously affected. The federal government is allocating millions of dollars of public funds to Appalachia in an attempt to improve economic conditions there and imposition of a sulfur tax now would work directly against this objective.

6. *The proposed time schedule is too short because emissions cannot be reduced to zero (or 0.1%) by 1976.*

No sulfur removal system is now commercially available.¹³ Although a 90 to 95 percent effective sulfur oxide removal system is the goal, no process now in any stage of research and development is realistically expected to reduce sulfur oxide emissions beyond approximately 80 percent. (See Exhibit VIII for discussion of costs and problems being encountered with major processes now under development.) Yet, if a 100% effective system were discovered today it could not be made available for commercial use and installed throughout a single electric power system before the late 1980's. As fully explained in Exhibit V, at least five years are needed to make a process ready for commercial use. Then at least twice that period would be needed for complete installation throughout an electric generating system, as explained in Exhibit VI.

Accordingly, reduction of emissions to near zero by 1976 is an unattainable goal which no electric utility could meet under the best of conditions.

7. *Attributing \$8 billion annually to damage from sulfur oxides is unsupportable and unjustifiable.*

The sulfur tax is designed to recoup a major portion of the annual \$8 billion in damages supposedly done by sulfur oxides. The basis for the \$8 billion figure is at best unclear. A review of the available materials referred to in the bibliography provided by the Council on Environmental Quality indicates that no reasonable accurate estimates are available.¹⁴ The bulk of the writing dealt with proposed methods of measuring pollution damage. Beyond this is the more difficult problem of attributing a dollar figure to the effects of a single pollutant. There appears to be no study which attempts this task. The effect of a single pollutant in laboratory tests cannot be used as a reliable guide since the toxicity of a single pollutant has been shown to vary depending upon the mix of other emissions.

It may be that within the ambient levels now being discussed as national standards, there would be little or no damage. In any event, the relationship between sulfur oxide emissions and public health, which is surely the most significant form of damage sulfur oxide is alleged to cause, is open to considerable speculation.¹⁵ Certainly at this stage evidence does not justify attaching an \$8 billion figure to the effects of sulfur oxide on the urban environment.

Even after a reasonable cost estimate of sulfur oxide damage becomes available, a determination must be made of the level at which the costs of pollution are less than the social benefits arising from the activity which causes the emissions. While it is difficult, however, to quantify the exceedingly complex relationship between electric energy consumption and life improvement and prolongation, it is submitted its existence must be acknowledged and taken into account. As economist Edwin S. Mills has stated, "the level of pollution should be achieved at which the cost of a further reduction would exceed the benefits."¹⁶

8. *The sulfur tax would unduly discourage use of electricity to meet the low pollution energy needs of urban America.*

Meteorological modeling demonstrates that substituting electric energy for on-site combustion improves urban ambient air quality, even when that electricity is produced in fossil-fueled plants.¹⁷ With the expectation of continuing reduction of sulfur oxide emissions over the next several years, electricity offers great potential for meeting urban space heating needs at low pollution levels. Of considerable importance, too, in the pollution fight, is the now accelerating application of electric arc and induction furnaces to the steelmaking and foundry processes as a means of curtailing particulate and gaseous emissions. Moreover, electrified mass transit provides an alternative to the pollution creating automobile for urban transportation needs.

However, people will not turn to electricity as a power source if it is inordinately expensive. The market for electricity is significantly price elastic. In narrow ranges and at low average usages the elasticity is probably at a minimum. How-

¹³ Report by Committee on Air Quality Management Ad Hoc Panel on Control of Sulfur Oxide from Stationary Combustion Sources for the National Academy of Engineering, 3 (Washington, D.C. 1970).

¹⁴ Irving Michelson and Boris Tourin commented: [E]stimates of the economic effects of air pollution are vague and uncertain. Such estimates can hardly be convincing to the public or to legislators who must approve laws and funds for the establishment and operation of control agencies. It is therefore imperative that guessing be replaced by more firmly established cost figures. *Public Health Reports*, "Comparative Method for Studying Costs of Air Pollution" Vol. 81, No. 6, June, 1966.

¹⁵ While a substantial number of studies indicate that there is either no relationship or at best a very insignificant one between sulfur dioxide levels and bed disability among bronchitic persons, asthmatics, persons with heart disease, or persons with acute respiratory illness, other studies indicate a relationship does exist.

¹⁶ The Economics of Air Pollution, "Economic Incentives in Air-Pollution Control," 42 (1966).

¹⁷ See discussion of Argonne National Laboratory and Mitre Corporation studies on page 9.

ever, over rather broad price ranges residential power usages shown an elasticity of one¹⁸ while usages for electric heating¹⁹ and commercial power needs appear to have greater price elasticity. In fact, the elasticity for commercial power is probably quite high as is reflected by the high electric energy consumption in areas, like those served by the Tennessee Valley Authority and Bonneville Power Authority, where costs compare favorably with those for other fuels. Consequently, burdensome taxes on electricity, like the sulfur tax, will discourage the use of electricity as an alternative to more polluting energy sources.

9. *The sulfur tax will duplicate already existing local regulation of sulfur dioxide emissions.*

It has been suggested that the sulfur tax might become the sole means of controlling sulfur oxide emissions, thus freeing fuel users from duplicative and conflicting local regulations. Since the Clean Air Act of 1967 provides that the primary responsibility "for the prevention and control of air pollution at its source" rests with local governments (42 U.S.C. § 1857(a)(3) (1967)), Congress would have to act to exempt sulfur dioxide from local regulation. But this is unlikely because usurping local responsibility by the adoption of a uniform nationwide tax would be at odds with the present approach and would not eliminate the genuine and widespread concern for maintaining diligent local policing procedures.

Recognizing the incontrovertible fact that local air quality is affected by prevailing topographical, climatological and meteorological conditions, Congress provided for the establishment of air quality control regions. 42 U.S.C. § 1857c-2(a)(1) (1967). Today there are over 100 such regions. Recently, the Federal Environmental Protection Agency promulgated minimum air quality standards and local agencies are expected to establish plans to meet them in their respective regions.²⁰ Obviously, Congress wanted local programs for pollution control to be designed to meet local needs and states and municipalities all over the country have responded vigorously.

Now, even if Congress were to modify its policies, to expect the multitude of local agencies voluntarily to leave the field of regulating sulfur oxide emissions merely because of the enactment of a federal sulfur tax is unrealistic. The level of sulfur oxide in urban areas has become an emotion-charged issue, and the likely effect of a federal sulfur tax will be increased rather than lessened efforts on the local level to demonstrate that it is not only the federal government that is concerned about sulfur oxides.²¹

10. *Local standards, rigorously enforced, are to be preferred to a sulfur tax.*

Measurements in major urban areas indicate that in recent years sulfur oxide levels have been decreasing. This is surely the result of regulation. If the government felt, however, that local authorities would grant undue variances from standards, it could with considerably less economic dislocation than would result from the proposed tax, provide for tightening up the various procedures, or even provide that the price of a variance would be the payment of a penalty tax of some kind.

In summary, the proposed tax would provide no incentive to take the most effective steps for reducing ground-level concentrations of sulfur oxide in urban areas, namely, emphasizing the effect of the small users' emissions and encouraging tall stacks, high velocity emissions and dispersal of power plants.

* * * * *

The proposed sulfur tax should not be imposed. Instead, to meet the problem of sulfur oxide concentrations, the government should consider the following:

1. Continued reliance on establishment and enforcement of local standards.
2. Encouragement and support of research and development efforts to improve techniques for both the removal of sulfur from fuel and the abatement or dispersal of sulfur oxide emissions.
3. Taking measures to increase the available supplies of low sulfur fuels—natural gas, residual fuel oil and low sulfur coal.

¹⁸ In 1970 the average residential electric bill in the Tennessee Valley Authority area was \$150.39 for 14,560 kilowatthours (or \$.01 per kilowatthour) while the average bill for a residential customer of an investor-owned utility was \$149.18 for 6,720 kilowatthours (or \$.02 per kilowatthour).

¹⁹ Based on studies (conducted in a number of cities to determine the propensity of persons to consider electric heating) which revealed a price elasticity as low as one in cities where electricity was priced significantly higher than other fuels but a price elasticity significantly higher in cities where electricity was a competitively priced fuel source.

²⁰ In 1961 only 17 states operated air pollution control programs and ten years later the number is 49. Moreover, the number of local agencies has grown from 85 in 1961 to over 140 today. Secretary of Health, Education and Welfare, *Cost of Clean Air*, 1970 Report to Congress, 8 (S. Doc. 91-65, 1970).

²¹ Under the Clean Air Act local agencies are free to adopt standards and plans more stringent than those established by the federal government. 42 U.S.C. § 1857 d-1 (1967).

4. Encouragement and support of research to establish and quantify the effects of sulfur oxide emissions on the environment.

For the reasons indicated, we vigorously oppose the concept of a tax, but if the government should decide to impose a sulfur tax, it is imperative that the tax not be imposed on emission levels which are consistent with federal air quality standards, that recognition be given to regional differences and the effect of tall stacks and other dispersal techniques, that appropriate credits be given for bona fide compliance efforts and that any monies collected be used only for sulfur removal research.

NOTE: At about the time this memorandum was being completed, Professor Charles Upton, Ph.D., of the Graduate School of Business, University of Chicago, delivered a speech entitled "Bad Smells, But Fine Policy: Some Comments on the Proposed Sulfur Emission Tax" to the Conference on Public Utility Valuation and the Rate Making Process at Iowa State University.

In his statement on behalf of the proposed sulfur tax, Dr. Upton presented some thought-provoking ideas. However, it is our belief that the bulk of his arguments are adequately refuted in the body of the memorandum, subject to the following additional comments:

(i) Dr. Upton argues that direct regulation of sulfur oxide emissions may not work since firms may find it cheaper to continue polluting while pursuing administrative and judicial appeals than to meet an emissions standard. Yet, he finds nothing reprehensible in a company's decision to pay the sulfur tax for years and years while it continues to pollute. In this respect, both direct regulation and a sulfur tax incentive system both suffer the same defect—namely, that individuals may choose to pay rather than reduce emissions. Given these comparable flaws, direct regulation is the preferable method of emission control. (This subject is also discussed in Section 10 of the memorandum.)

(ii) Failure to adopt a sulfur tax will, according to Dr. Upton, result in the creation of a new federal bureaucracy. This statement appears to be without basis in fact, unless Congress should opt for fragmented regulatory control of air pollutants.

EXHIBIT I.—ANNUAL EXPENDITURES—AIR POLLUTION ABATEMENT
TABLE 3-3.—STEAM-ELECTRIC POWERPLANTS—ESTIMATES OF REDUCED EMISSION LEVELS AND ASSOCIATED COSTS (100 METROPOLITAN AREAS)

Year	Expected emission level (thousand tons per year) ²				Associated emission control level (percent) ²				Control costs (million dollars per year)					
	Particu- lates		SO ₂		HC		CO		Investment cost			Annual cost		
	Particu- lates	SO ₂	HC	CO	Particu- lates	SO ₂	HC	CO	Lower limit	Expected	Upper limit	Lower limit	Expected	Upper limit
967.....	2,190	6,860	-----	-----	86.0	0	-----	-----	-----	-----	-----	-----	-----	-----
Fiscal year 1971.....	2,050	6,577	-----	-----	86.8	4.1	-----	-----	5.4	6.7	8.0	32.8	41	49.2
Fiscal year 1972.....	1,500	5,361	-----	-----	90.4	21.9	-----	-----	31.8	39.7	47.6	174.0	217	260.0
Fiscal year 1973.....	719	3,640	-----	-----	95.4	47.0	-----	-----	51.9	64.9	77.9	371.0	466	559.0
Fiscal year 1974.....	292	2,707	-----	-----	98.1	60.6	-----	-----	31.4	39.2	47.0	481.0	601	721.0
Fiscal year 1975.....	198	2,500	-----	-----	98.7	63.6	-----	-----	8.6	10.8	13.0	505.0	631	757.0
Total.....	-----	-----	-----	-----	-----	-----	-----	-----	129.1	161.3	193.5	1,563.8	1,956	2,346.2

¹ Cost estimates are for the control of only those facilities in operation in calendar year 1967.

The areas are defined in app. I.

² For levels of particulates, sulfur oxides (SO₂), hydrocarbons (HC), carbon monoxide (CO), Blanks in the table indicate the emission levels meet the applicable regulations (app. III) without additional control.

Source: Secretary of Health, Education, and Welfare, "Cost of Clean Air," 1970 report to Congress, 15 (S. Doc. 91-65, 1970).

As shown on the foregoing table, the Department of Health, Education and Welfare estimated that sulfur oxide control costs in 100 urban areas for 1975 would be over \$630 million for steam-electric power plants. From 1971 through 1974 the range of annual costs is expected to be from \$217 million in 1971 upwards to \$600 million in 1974. Added to these annual expenditures would be investment costs totaling some \$160 million for the five year period (1971-1975). The foregoing annual cost figures are based on use of desulfurized residual fuel oil as the basic means of control of sulfur oxide and particulate emissions with the projected investment costs those thought to be required for conversions to burn oil. The Department said that its "estimates are thought to approximate the costs of other alternatives or a combination of other alternatives" of control of sulfur oxide and particulate emissions. HEW set its annual costs of control for changing from high sulfur content coal to desulfurized residual fuel oil by estimating the average metropolitan area fuel price differences between the fuels and adding a charge of forty cents per barrel for desulfurizing the oil to an average of 1.14% sulfur content. According to the Department: "This will enable steam-electric plants to meet the selected sulfur oxides regulation for fuel combustion sources."

However, the HEW estimates may prove to be modest. A review of the air quality control commitments for the eight companies present at the March 16, 1971 meeting disclosed plans to expend at least \$350 million through 1975. These companies represent about 20% of the total kilowatt hour sales by investor-owned utilities for 1970. Consequently, even the upper limit of \$757 million in annual costs projected for 1975 by HEW may prove to be too low.

EXHIBIT II
1965-70, COMPARATIVE INTEREST COVERAGE CHARGES

Company	Operating revenues 1970 (millions)	Operating income ¹ 1970 (millions)	Interest charges 1970 (millions)	Interest charge coverage		Payout ratio (percent)		Price/earnings ratio	
				1970	1965	1970	1965	Recent	1965
Duke Power.....	\$386.1	\$68.3	\$51.6	1.32	3.49	89	60	16	26
General Public Utilities.....	416.8	110.1	72.2	1.52	3.12	87	70	13	19
El Paso Natural Gas.....	926.6	116.0	74.4	1.56	3.12	87	66	12	13
Transcontinental Gas Pipe Line.....	399.6	84.7	54.1	1.57	2.21	61	66	11	15
American Electric Power.....	685.7	176.6	107.2	1.63	3.40	72	71	13	25
Texas Eastern Transmission.....	652.5	119.6	70.6	1.69	2.16	53	59	16	14
General Telephone & Electric.....	3,439.2	450.9	265.4	1.70	3.29	75	55	18	25
Northeast Utilities.....	3,327.1	427.1	252.1	1.71	3.68	81	50	13	36
Tenneco.....	2,524.7	243.7	136.9	1.78	2.21	63	60	13	14
American Natural Gas.....	565.1	50.4	53.0	1.83	2.64	61	60	12	16
Philadelphia Electric.....	504.4	107.0	58.0	1.86	3.45	89	75	13	19
New England Electric.....	323.8	107.6	32.1	1.88	2.72	75	75	12	18
Western Union.....	362.9	90.8	32.1	1.90	2.65	61	61	21	21
Panhandle Eastern Pipe Line.....	130.2	72.6	37.5	1.94	3.01	54	57	12	16
Public Service Electric & Gas.....	741.2	144.1	73.5	1.96	2.98	62	62	11	18
United Utilities.....	496.2	81.2	41.0	1.98	4.72	80	68	12	26
Detroit Edison.....	553.3	91.0	45.8	1.99	2.09	56	37	18	19
Continental Telephone.....	372.7	82.3	41.4	1.99	2.56	53	56	13	33
Texas Gas Transmission.....	426.5	43.2	22.7	1.99	4.66	75	69	14	20
Commonwealth Edison.....	887.0	169.3	84.9	1.99	2.57	78	74	12	17
Consolidated Edison.....	1,128.5	210.6	105.5	2.00	3.19	74	68	12	14
Niagara Mohawk Power.....	522.2	82.4	39.8	2.07	3.55	62	61	13	25
Virginia Electric Power.....	374.9	95.2	44.1	2.16	2.77	63	64	14	24
Southern Natural Gas.....	738.1	171.8	79.4	2.21	2.87	61	66	13	18
Northern Natural Gas.....	516.2	94.8	42.8	2.21	2.77	61	66	14	24
Northern States Power.....	352.4	68.6	30.9	2.22	3.69	68	77	12	19
Columbia Gas System.....	822.8	128.8	57.5	2.24	2.89	60	62	14	20
Consumers Power.....	610.0	103.4	44.8	2.31	4.18	68	63	11	20
Middle South Utilities.....	450.5	100.2	43.1	2.32	3.12	60	56	16	16
Coastal States Gas.....	322.9	40.6	17.2	2.36	2.40	(?)	(?)	33	48
Southern California Edison.....	720.7	184.8	77.6	2.38	3.33	55	58	12	15
Pacific Gas and Electric.....	1,103.3	231.3	96.2	2.40	3.39	61	56	14	13
Peoples Gas.....	533.8	90.4	37.0	2.44	4.00	56	62	11	16
Consolidated Natural Gas.....	588.1	72.8	29.5	2.47	3.84	69	45	12	14
Florida Power and Light.....	416.1	97.5	38.4	2.54	3.89	51	50	18	28
Baltimore Gas and Electric.....	328.1	67.4	24.7	2.73	3.76	65	68	12	20
American Telephone and Telegraph.....	2,821.7	1,003.3	281.7	2.81	5.39	79	59	12	18
Pacific Lighting.....	683.5	59.8	20.8	2.88	4.07	62	62	14	13
Central and South West.....	358.4	85.0	35.4	3.33	4.47	67	67	16	27
Texas Utilities.....	453.0	120.5	35.4	3.40	4.60	53	58	18	24

¹ Operating income is calculated after all taxes.

² No dividends paid.

EXHIBIT III.—COAL-FIRED GENERATING UNITS

MODIFICATIONS REQUIRED TO BURN DIFFERENT COAL TYPES

Mr. Hubert E. Risser has presented the following brief description of the problems facing companies when a new coal type is introduced in a generating unit:*

Despite the wide variations in content and heat value, coals of all ranks can be used effectively for heat and power, if used in combustion units specifically designed for them. But, as in the case of internal combustion engines designed for specific liquid fuels, coal-fired units may operate poorly or not at all, when fired with coals they were not originally designed to burn.

Comparison of the characteristics of a typical medium-volatile bituminous coal from West Virginia with a high volatile C coal from Illinois and a subbituminous C coal from Montana gives some indication of the problems encountered in substituting other coals in a plant designed to burn one specific type. Typical heat contents for the three coals named above, on the as received basis, would be about 14,500, 11,000 and 8,500 Btu per pound, respectively.

A moderate sized plant designed for 200 tons per hour of 14,000 Btu coal would have to burn approximately 30 per cent more of the Illinois coal and 70 per cent more Montana Coal to obtain the same heat output. A plant with crusher, pulverizer, injection equipment, and ash handling facilities designed for 200 tons per hour, would be incapable of effectively handling so great an overland.

Ash fusion temperatures for the West Virginia, Illinois and Montana coals would, on the average, be about 2800°F., 2100°F. and 2200°F. respectively. A "dry bottom" furnace designed to normally handle high fusion temperature ash would encounter difficulty with an ash that melts at a temperature 600°F. to 700°F. lower. Likewise, a "wet bottom" furnace designed to remove the ash in molten form, will encounter difficulty in shifting to a coal with ash that melts at too high a temperature.

The three coals discussed above represent a rather extreme range of combustion characteristics. Much less variation can cause problems, and difficulties may be encountered when a shift is made to a new source of coal even when the coal comes from the same seam but in a different location or different mine.

Ash which leaves the combustion unit as fly ash, normally is captured by electrostatic precipitators. The use of a lower sulfur coal usually will result in reduced efficiency of the precipitating equipment and allow a greater escape of fly ash. To increase the recovery of fly ash from stack gas, in plants using low-sulfur coal, one public utility has experimented with injecting sulfur trioxide into the stack gas.

EXHIBIT IV.—A LIST OF SOME COMPANIES ENGAGED IN RESEARCH AND DEVELOPMENT OF DESULFURIZATION PROCESSES**

COMPANY, PROJECTS, AND PROCESSES

Abcor, Inc., Aqueous absorption systems for SO₂.

Air Products and Chemicals, Inc., Dry process for SO₂ removal.

American Iron and Steel Institute, Studies of sulfur pollution control from various iron and steel manufacturing steps.

Argonne National Laboratory, Reduction of atmospheric pollution by the application of fluidized bed combustion.

Babcock & Wilcox, Magnesium oxide scrubbing system and other SO₂ removal processes.

Basic Chemicals, Magnesium slurry scrubbing (in conjunction with Chemico).

Bechtel Corp.-Babcock & Wilcox, Limestone slurry scrubbing process.

(Commonwealth Edison Company), Demonstration of Bechtel Corp.-Babcock & Wilcox limestone scrubbing process.

Bituminous Coal Research, Inc., Use of limestone or dolomite for SO₂ removal from coal-burning boiler flue gases.

*Assistant Chief and Principal Mineral Economist of the Illinois State Geological Survey, testimony before The Illinois Pollution Control Board, March 10, 1971.

**The primary source for this information is the Report by Committee on Air Quality Management Ad Hoc Panel on Control of Sulfur Dioxide from Stationary Combustion Sources for the National Academy of Engineering, Appendix C, 65-68 (Washington, D.C. 1970).

Bituminous Coal Research, Inc., Removal of pyritic sulfur from coal.
Black, Sivalls, & Bryson, Inc., Coal gasification in molten iron; sulfur removal in slag.

The Carborundum Company, Limestone injection with wet scrubbing or bag filtration.

Chemical Construction Corporation, Various projects for SO_2 control from sulfuric acid plants and power plants.

(Boston Edison Company and other electric utilities), Demonstration of Chemical Construction Corporation process.

Combustion Engineering, Inc., Limestone injection-wet scrubbing process.
(Kansas Power and Light Company), Demonstration of Combustion Engineering limestone injection-scrubbing process.

(Union Electric Company), Demonstration of Combustion Engineering limestone injection-scrubbing process.

Consolidation Coal Company, Inc., Flue gas scrubbing, fluidized combustion in a lime bed, and pyrite removal from coal.

The Detroit Edison Company, Limestone scrubbing, ammonia injection.

The Dow Chemical Company, Gas-phase removal of SO_2 with solid alkaline materials.

Edison Electric Institute, Dispersion characteristics of stack effluents, development of a formula for stack design.

Esso Research and Engineering Company, B&W-Esso proprietary process for SO_2 removal.

General American Transportation Corporation, Catalytic reduction of SO_2 to sulfur.

Hydrocarbon Research, Incorporated, Catalytic hydrogenation of fossil fuels.
Illinois Institute of Technology Research Institute, Oxidation and reduction catalysts.

Institute of Gas Technology, Coal gasification.

Ionics Incorporated/Stone & Webster, Regenerable aqueous scrubbing system for SO_2 removal and recovery (Stone & Webster-Ionics process).

Kaiser Chemicals, Improved dry sorbent for SO_2 removal.

The M. W. Kellogg Company, Undisclosed process for power plant SO_2 removal.

Monsanto Company, Catalytic oxidation of SO_2 with recovery of sulfuric acid.

(Pennsylvania Electric Company), (Air preheater Company), (Research-Cottrell), (Illinois Power Company), Development of Monsanto catalytic oxidation process.

Nalco Chemical Company, Dry sorbent for SO_2 .

Petroleum Industry (Source: API), Industry-wide R&D for sulfur oxides control.

Pope, Evans & Robbins, Control of gaseous emissions from coal-fired fluidized-bed boilers.

Precipitair Pollution Control, Inc., Gas-phase removal of SO_2 with solid alkaline materials, and collection with fabric filters (cooperative work with Southern California Edison).

Pulp and Paper Industry (Source: NCASI), Sulfur oxides control from sulfite and kraft pulping processes.

Research-Cottrell, Inc., Scrubbing equipment development.

Reynolds Metals Company, Dry sorbents for SO_2 removal.

Reynolds, Smith and Hills, Scrubbing process for flue gas SO_2 removal.

Slick Industrial Company, Dry SO_2 sorbent development.

Southern California Edison Company, Gas-phase removal of SO_2 with solid alkaline materials, and collection with fabric filters.

Stone & Webster, Regenerable aqueous scrubbing system for SO_2 removal and recovery (S&W-Ionics process)

United International Research, Incorporated, Regenerable scrubbing process removal; SO_2 converted to H_2SO_4 .

U.S. Bureau of Mines-Morgantown, Study of corrosion/erosion and of coal type during fluidized bed combustion.

U.S. Stoneware Company, Process for SO_2 control from sulfuric acid plants.

Universal Oil Products, Dolomite slurry scrubbing; catalytic hydrogenation of fuels; sulfoxel scrubbing process

(Commonwealth Edison Company), Pilot stage development of Universal Oil Products Sulfoxel scrubbing process.

Wellman-Lord, Incorporated, R&D of regenerable wet scrubbing process at

Lakeland, Florida, and Tampa Electric, plus direct reduction of SO_2 to sulfur. Tampa Electric Company, Pilot study of Wellman-Lord process, contributed to Stone & Webster.

(Bechtel Corporation), Demonstration plant of Wellman-Lord process at Baltimore Gas and Electric power station.

(Baltimore Gas and Electric Company), Demonstration plant of Wellman-Lord process at BG&E power station in Baltimore.

(Delmarva Power and Light Company).

(Potomac Edison Company).

(Potomac Electric Power Company).

Western Precipitation Group (Joy Manufacturing Company), Scrubbing equipment development.

Westinghouse R&D Center. Evaluation of the fluidized bed combustion process.

Westvaco, Absorption of SO_2 by activated carbon.

The Wheelabrator Company, Scrubbing equipment development.

Wisconsin Electric Power, Line scrubbing, other aqueous scrubbing systems.

EXHIBIT V.—DEVELOPMENT OF A SULFUR REMOVAL PROCESS—TIME REQUIRED

In the perfection of a sulfur removal device, there are three basic stages of development. The first is referred to as the "bench" trial in which a very small scale simulation of the process is set up. At this stage the time required may vary from a few weeks to one or two years, depending upon the complexity of the process and the type and number of problems identified. Once past the bench trial, the process is installed in a pilot plant. For a stack-gas sulfur removal system this generally involves applying the process to a scale which is 10 or 15 percent of the anticipated full-size installation. Often this is done by experiment with flue gas diverted from a power station boiler. Here again, one to two years is required for testing. The long running time is necessary to detect, before committing significant sums for installation on full scale plants, the kinds of problems which may result from continuous use over an extended period. The last stage of development is the complete installation of the process on a demonstration or proto-type plant. One to two more years may elapse before the process proves workable for general full scale use. Sometimes it is still necessary to make further installations beyond the proto-type to achieve significant scale. For example, Combustion Engineering Company's dolomite injection process was applied on two 125-megawatt units before Kansas City Power and Light Company agreed to installation on a 430-megawatt unit, a size more representative of contemporary power generation facilities—and even yet there is no assurance that the process will be commercially feasible.

Of course, at any stage the process may prove either unworkable or so costly that future efforts are not indicated. In fact, one of the most favored methods now being tested, the Limestone-injection process, has suffered from continuing difficulties and presently is experiencing a lack of continuity of operation on its prototype plant.

In any event, a process proposed today optimistically would not be ready for commercial application before the late 1970's—if it is applicable and economical for new or existing plants, and if no unforeseen problems are found. The later is infrequently the case. Of the sixty or seventy processes which have been researched in recent years for sulfur oxide removal, at least half a dozen (including the alkalized alumina and Reinholt processes in which much hope had been placed) either have been scrapped or have encountered such great problems that their expected availability dates have been pushed back several years. As recently as January, 1969 the Federal Government, in a publication entitled "Control Techniques for Sulfur Oxide Pollutants," issued by the National Air Pollution Control Agency, identified the alkalized alumina sorption process as one of three most promising control techniques available at that time. Today, all indications are that an alkalized alumina sorption plant would be a complete failure because of deterioration of the sorbent material.

Another very important factor to keep in mind is that discovery of an effective sulfur dioxide removal process will not necessarily lead to industry-wide reduction of sulfur oxide emissions because it may be applicable to only a small percentage of existing plants. Throughout the country, electric generating stations vary widely in structure, configuration and furnace type, thus a single process may not be applicable to all (or even most) plants. In fact, a recent study by the M. W. Kellogg Company for the Air Pollution Control Office of EPA concluded that space limitations alone would preclude the installation of *any* sulfur re-

moval process at as many as 40% of the existing fossil-fueled stations, which represent one-fourth of the total generating capacity. At many other stations, the choice of workable systems would be severely limited.

EXHIBIT VI.—TIME REQUIRED TO INSTALL A SULFUR REMOVAL PROCESS ON A MAJOR ELECTRIC SYSTEM'S FOSSIL-FUELED PLANTS

Once a process is found and made available, at least ten years will be required to install it throughout a major electrical generating system. This results from the demand for constant energy production made on electric companies. The industry cannot shut down for a month or two months to install equipment because the electrical needs of its service area would have to be met during that period. Consequently, installation would have to come during normal shut-down periods which are scheduled on a year-by-year basis. With present day energy demands at all-time highs, shut-downs must be minimized since barely adequate energy reserves exist even with all facilities available. A typical power company would be able to install sulfur removal devices on only one or two major generating units per year, depending upon the reserves it had available. The hypothetical schedule for such a company with 26 major generating units and a number of other smaller units, as set forth below, indicates that twelve years would be required to install a sulfur removal system on all such units.*

	Unit rebuilt in spring	Unit rebuilt in fall
Year—		
1973		Station A, unit 1.
1974	Station B, unit 1.	Station B, unit 2.
1975	Station C, unit 1.	Station D, unit 1.
1976	Station E, unit 1.	Station F, units 1 and 2.
1977	Station F, units 3 and 4.	Station A, unit 3.
1978	Station A, unit 2.	Station B, unit 3.
1979	Station G, unit 1.	Station D, unit 2.
1980	Station C, unit 2.	Station E, unit 2.
1981	Station G, unit 2.	Station B, unit 4.
1982	Station D, unit 3.	Station A, unit 4.
1983	Station E, unit 3.	Station E, unit 4.
1984	Station H, unit 1.	Station H, unit 2.
1985	Station I, unit 1.	

Application of any presently considered process to all of the 1,275 steam-electric generating stations in the nation could not conceivably be accomplished before the middle or late 1980's—or even the early 1990's.

EXHIBIT VII.—TIME REQUIRED TO DEVELOP A COAL MINE

Assuming that engineering studies and land acquisition have been completed, the time required for a mine to reach full scale operation is two and one-half to three years. In addition, finding coal deposits and acquiring sufficient land or mineral rights to make a mining operation economically feasible may itself require one to two years. For large scale (3,000,000 tons per year) underground mines at least a year is required to dig out and prepare a shaft for removal of the coal. Then a main entrance at the depth of the deposit must be constructed and digging equipment installed. Off of this main room several smaller ones are prepared and equipment installed there. This stage requires upwards of a year to complete. At this point coal can be mined at full capacity. However, more time can be required at any stage if difficulties are encountered.

For strip mining, the land acquisition stage can be longer. Here time is required to build larger stripper machines once an area looks as though it is worth mining. These machines are not shelf items and their delivery is often upwards of a year from order date. Once the machine is available, a few months are required to make the initial large cuts and begin actual removal of coal. Environmental concerns with the effects of strip mining have been raised and future restrictions on its use can be expected.

Finally, then, the best coal industry estimates of the average time to establish a mining operation fall within a range of two to five years.

*Assumes that the smaller fossil-fueled units would be retired during the 1970's.

EXHIBIT VIII.—DESULFURIZATION PROCESSES NOW BEING RESEARCHED—
EXPECTED AVAILABILITY DATES AND PROJECTED COSTS TO INSTALL AND
OPERATE DESULFURIZATION OF COMBUSTION PRODUCTS

DESULFURIZATION OF COMBUSTION PRODUCTS

Prospects for currently investigated systems are unclear. After suitable development the most promising process of this type may be capable of removing 80% of the sulfur oxides and 99% of the flyash from flue gas.

Time scales for commercial availability appear to be no closer than four to five years, and more likely five to ten years away. In November 1969, Dr. John Middleton, Commissioner of APCO, testified before the Joint Committee on Atomic Energy that the limestone injection, wet scrubbing process "could be fully tested and proved ready for wide application within the next four years." Continuing difficulties and lack of continuity of operation at the two pilot plants now in operation make this estimate appear optimistic. A year ago, dry limestone injection without scrubbing appeared to have a great deal of promise, but it no longer appears attractive because of the large amounts of limestone required. All hope is gone for the alkalized alumina sorption process.

The catalytic oxidation process presently faces substantial economic problems, as well as problems in technology and in disposal of sulfuric acid. The process, promoted by Monsanto, is said to be capable of converting about 90 percent of the sulfur oxides in flue gas into sulfuric acid. Monsanto, the Illinois Power Company, and APCO are installing a full-size demonstration system on an existing 100-megawatt unit, at a cost of about \$68 a kilowatt. On a new plant the cost might be in the range of \$20-\$40 a kilowatt. Of course, a major problem with the catalytic oxidation process is finding markets for the sulfuric acid which would be produced. It is estimated that upwards of 100,000 tons of acid a year would be produced at a 800,000 kilowatt powerplant burning 2.5 percent sulfur coal.

Chemical scrubbers using an alkaline medium, as in a pilot demonstration plant being built by Chemico, Boston Edison Company, and APCO, appear poorly suited for power plants except where low-cost transport is available to remove the scrubbing material from the power plant to a processing plant and back to the power plant. The minimum size of a feasible processing plant has yet to be determined, and the developers of the system freely state that the process is unsuitable for application to a single power plant. They envision, should the process become technically practical, that a number of utilities would arrange to ship the scrubbing material to a central processing plant.

Once available, presently studied processes will be costly to install and operate. While cost estimates are available from sellers and developers of processes, naturally they tend to be optimistic. A more realistic picture can be drawn from the cost experiences of existing prototype or demonstration installations. Consider the following:

1. The furnace-injection wet limestone process installed at Union Electric's Meramec Station in late 1968 cost \$1.4 million, or about \$10 per kilowatt. No operating cost record has been kept; the system has operated, on average, only one day in nine.

2. As previously noted, the Monsanto catalytic oxidation process being installed by Illinois Power Company is to cost \$68 per kilowatt. Operating costs are not certain; Monsanto is to accept the by-product acid for the first few years of operation.

3. A limestone-slurry scrubbing system, being installed at the Will County Station of Commonwealth Edison, has an estimated investment cost of about \$45 per kilowatt, with an operating cost around \$1 million annually.

4. A regenerative scrubbing system pilot plant, being installed at the State Line Station of Commonwealth Edison, has an estimated investment cost approaching \$300 per equivalent kilowatt. The electrical auxiliary power required for this unit, which is the equivalent of a 22-megawatt plant, totals nearly 10 megawatts—a ratio it is hoped will improve on full-scale versions. Natural gas, steam and air are also required. Operating costs are as yet undetermined.

In view of this experience, the following estimates of the U.S. Bureau of Mines appear on the optimistic side:

	Capital cost		Operating costs		
	Total (millions)	Cost per kw.	Total per year (millions)	Dollar mills per kw.-hr.	Dollars ton of coal
Limestone with wet scrubbing.....	\$9.44	11.80	3.93	0.620	1.77
Catalytic oxidation.....	16.99	21.25	3.88	.613	1.75

Accordingly, assertions that limestone systems will operate for around \$5.00 per kilowatt invested and \$3.50 per ton of coal, or that catalytic systems will cost \$25 per kilowatt and will break even on operating costs when by-products are sold are, at least, premature.

DESULFURIZATION OF FUELS

The petroleum industry has been experimenting with methods to desulfurize fuel oil that raise the price of oil 50¢ to 80¢ a barrel while reducing sulfur content from about 2.6 percent to less than 1.0 percent. For the utility, this results in an increased fuel cost of from 20-35 percent. It should be noted that a 50¢ increase in the cost of a barrel of oil is equivalent to about 0.7 mills per kilowatt-hour.

Research is currently underway to evolve an economical means for desulfurizing coal, but no methods short of full gasification are presently available. Using present washing and grinding processes, about half the sulfur can be removed from a pound of coal, but it is estimated that only about 25 percent of the coal used by the electric utility industry can be cleaned to produce coal with less than one percent sulfur. One estimate suggests that about 40 percent of the sulfur could be removed from the remainder of the coal used by the industry. Overall, it is estimated that washing would cost from 25¢-75¢ a ton of cleaned coal.

The Lurgi Gesellschaft, a German corporation, has developed the Lurgi gasifier, a commercial device overseas. It has not been tried on the wide variety of coals found in the United States and the adaptation of the gasifier to power production is under preliminary analysis. The Lurgi gasifier is considered a forerunner to the development of future generations of combined cycle, gasification plants. The incremental cost of such a system is estimated to be at least 35¢ a million Btu and possibly more. The Lurgi people are also developing a combined cycle plant at Lunen, Germany for a generating unit of 165 MW, utilizing gas and steam turbines and Lurgi pressure gasifiers. If successful, it may provide a method for desulfurizing fuel and producing power with capital and operating costs in an eventual range that will prove feasible.

EXHIBIT IX.—EFFECT OF SULFUR TAX ON TAX BURDEN OF MAJOR ELECTRIC POWER COMPANIES ¹

Below is set forth the percentage of 1969 revenues major electric power companies paid in taxes and a projection of what that percentage would have been with imposition of the sulfur tax of 10¢ per pound of sulfur for fuel consumed for 1969.²

[In percent]

Company—	[In percent]			[In percent]	
	Excluding sulfur tax	Including sulfur tax		Excluding sulfur tax	Including sulfur tax
A.....	27.4	34.8	K.....	19.8	22.9
B.....	25.8	33.1	L.....	17.5	21.7
C.....	14.2	25.4	M.....	17.5	20.8
D.....	20.5	26.3	N.....	17.2	20.2
E.....	27.6	27.0	O.....	21.3	21.3
F.....	25.0	27.6	P.....	18.7	20.3
G.....	23.7	26.2	Q.....	19.1	19.2
H.....	18.1	24.3	R.....	17.8	18.0
I.....	22.6	25.1	S.....	12.6	15.6
J.....	24.4	25.1	T.....	5.9	12.7

¹ Some statistics are for year 1970.

ENVIRONMENTAL COALITION ON NUCLEAR POWER, Philadelphia, Pa., June 16, 1971.

Senator HENRY JACKSON,
Chairman, Senate Interior Committee,
Senate Office Building, Washington, D.C.

DEAR SENATOR JACKSON: Allow me to introduce the Environmental Coalition on Nuclear Power. We are a coalition of 29 citizens organizations in the Pennsylvania and western New Jersey area who are concerned about the proliferation of nuclear power plants in this country without adequate assurance of the safety, insurability, reliability, economic and environmental hazards of these plants and their supporting facilities. Consequently, the Coalition is pressing for a moratorium on all nuclear power plant construction until the safety and environmental problems are much more thoroughly assessed.

In addition, the member organizations are also very concerned about the inefficiency of energy usage and the extremely disproportionate share of energy resources we consume in this country in relationship to the other peoples of the planet. Thus, we are very interested in the statement made a few weeks ago by President Nixon on national energy policy and development. We would like to respectfully submit our views on this matter.

This review is based upon newspaper and scientific journal abstracts of President Nixon's energy message and will then deal necessarily with the highlights of that message. The following points outline the Environmental Coalition's areas of agreement and disagreement with the President's message.

Areas of agreement:

(1) *Increased funds for sulfur oxide control and coal gasification technologies.*—We feel however that these funds should be increased significantly over the levels proposed by President Nixon.

(2) *Use of federal lands for geothermal energy.*—This should only be done under comprehensive environmental safeguards.

(3) *Funding in the areas of fusion, MHD, underground electric transmission, coal mine safety and health, and solar energy.*—Although here again we think that increased funding over the proposed levels is warranted.

(4) *New standards to increase the amount of insulation required in FHA homes.*

Areas of disagreement:

(1) *Increased development funds for the liquid metal fast breeder reactor.*—We are totally opposed to increased funding for this type of reactor since the great preponderance of R & D funds have been previously spent to develop nuclear fission

¹ Includes 20 of the 25 largest electric utilities, measured by operating revenues.

² Of course, by 1976 when the 10¢ per pound rate would become effective, substantial reductions in use of sulfur bearing fuels will have occurred. Even then, however, the added burden of the sulfur tax would be significant.

at the expense of thorough investigation of other more attractive means of generating electric power. Developmental funds for this reactor should be cut drastically and any testing of fast breeders should occur with reactors embedded deeply underground. We believe these reactors, especially in their present state of development, are inherently unsafe and are unfit for deployment on the surface of the earth.

(2) *Sulfur oxide control technology and coal gasification (e.g. fluidized bed coal combustion, coalplex systems).*—The funding in these two areas should be increased significantly over the proposed levels. It should also include funds for development of effective strip mine repair procedures.

(3) *Research and development of alternate power generation methods other than fission.*—Not enough funds have been allocated to investigate other technologies such as fusion, MHD, geothermal, solar power, fuel cells, combined cycles, and methane generation of electricity.

(4) *Leasing energy resources on Federal lands.*—Widespread leasing of federal lands should be heavily qualified with well defined environmental safeguards. Guaranteed access to these lands for the fuel companies could easily continue the rape promulgated by these same companies in the past and present. Since geothermal has been demonstrated to be a relatively nonpolluting source of power, we are in favor of geothermal usage on these lands as long as other uses of these lands such as recreation are not seriously compromised.

(5) *Items not mentioned by the President.*—There were many items directly related to energy policy and usage of large importance which were not even discussed by President Nixon. These major items include:

(a) Recycling of basic materials which would require significantly less quantities of electricity.

(b) Very little emphasis was placed on decentralized power sources such as solar cells for home use, small scale fuel cells, methane generation of electricity, etc. Development of these sources could ease significantly the demand for large scale power plants.

(c) Development of an effective national power grid system would enable us to use our electricity capacity much more efficiently.

(d) Studies which would evaluate costs (including social and environmental costs) and benefits for each of the present and future methods of generating electricity.

(e) Studies of social mechanisms (taxes, reversing utility rate structures, etc.) which could be effectively used to develop a more efficient use of energy in this country.

(f) Evaluation of this country's level of energy usage in light of the fact that the U.S. with approximately 6% of the world's population uses around 40 to 50% of the planet's non-renewable resources. We believe that the resources of the planet must be distributed on a much more equitable basis than exists now.

(g) Repeal of oil import quotas and depletion allowances.

(h) No mention of oil company efforts to monopolize the energy fuel field.

We would like this statement to be entered into the written testimony of the hearings of the Senate Interior Committee on President Nixon's energy statement. Also, we would greatly appreciate being notified of subsequent Committee hearings on this subject. At those hearings the Coalition would like to present a further analysis of President Nixon's energy program when the full text of his message becomes available to us. At further committee hearings, we would want to give public testimony concerning our views on a national energy policy for this country.

Sincerely,

DOUGLAS E. BAKER,
Executive Committee Member,
Environmental Coalition on Nuclear Power.

CITIZENS RIGHTS COMMITTEE,
New York, N.Y., July 20, 1971.

Hon. HARRY JACKSON,
Chairman, Senate Interior Committee,
U.S. Senate, Washington, D.C.

DEAR SENATOR JACKSON: As Chairman of the Independent Phi Beta Kappa Environmental Study Group, a research society of members of Phi Beta Kappa including scholars, scientists, and physicians; and as Chairman of the Citizens Rights Committee with membership in numerous states, I request that this letter be included in the record of your committee's hearings on energy which will treat, we trust, the requisites of a suitably balanced program for the nation.

We believe it is extremely important that informed representatives of the public be heard and participate in the decisions which crucially affect them. As you know there is a widespread sense of cynicism and dissatisfaction shading to despair because too many programs have been launched without the participation or consent of the governed, sometimes behind closed doors with the special interest prevailing over the general human interest.

We have been following energy problems for some time.

Propaganda about the scarcity of coal is, of course, indefensible and prospects for improvement in the area are great. Inside the energy industry there are moves which hold promise. Such is the recent preliminary agreement between Westmoreland Resources and Colorado Interstate Gas Company which would grant CIG a 10 year option to acquire 300 million tons and 10,000 acres of water which would provide natural resources for the production of pipeline quality gas from coal. In addition, the Westmoreland company is investigating mine-mouth electricity generation which could be a highly desirable development.

Coal gasification is expected to become a significant source of energy supply in the latter part of this decade. Technical literature and coal experts appraisals suggest that this innovation has potential.

Clean-burning coal should obviously be considered a reasonable solution to our power needs. The Interior Department's appropriation bill, as the one passed by the House and sent to the Senate, provides for assistance to 2 coal research plants without requiring industry to pick up one-third of the tab. This could hasten coal gasification, as well as development of low-ash and low-sulphur coal.

Carl Bagge, former FPC Commissioner and now president of NCA, has observed that abolition of strip mining would threaten the nation's chances for an adequate coal supply. Our organizations are not extremists as in fact few intelligent citizens organizations are. What we favor is firmly enforced laws to (1) prevent injustice to the people of such areas and (2) to require concomitant restoration of land which strip mining procedures severely damage. This includes (3) reclamation of the quality of the soil and its supply of natural earth organisms as well as planting of grass and trees and (4) total elimination of the gullies which can do harm.

MAGNETOHYDRODYNAMICS

The failure to fund this promising source of energy in this country is no less than a scandal. The recommendation to do so by the Office of Science and Technology has been ignored. Senator Mansfield apparently felt unable to steer the modest program to a successful end. MHD is operating in other countries. The obvious advantage in pursuing this development is the probable production of electric power, without intervention of steam. Heating of our waterways, in which nuclear power has been the worst offender, with the additional drawback of discharge of plant chemicals and the insidious release of radio nuclides which can be stepped up in aquatic life and in the human food cycle.

The apparent diminution of pollution problems by MHD, as well as the decreased cost, have made the neglect of research and development along these lines one more example of the fact that the welfare of the people, who are also the taxpayers, has not been a primary motive in the energy program—if there can be said to have been anything like a coherent program.

Secretary of the Interior Morton has announced plans for proposed leasing of oil shale resources on federal lands in three states, with the intention of supplementing the national ore supply, and has invited application for core-drilling permits. We want to take the occasion to state that since the oil shale on national lands is the property of the American people, leases should not be relative "give-aways"; the public should benefit financially. We ask that if such a development occurs that representatives of organizations of citizens, chosen by the citizens, be enabled to inspect the leases and determine whether the public is adequately benefitting.

GEOTHERMAL POWER

In the south, Mexico is profiting by pollution free thermal production of power. Nor is Mexico the only country to exploit this natural resource. Professor Rex of California and a number of geologists, including some governmental scientists, believe that two-thirds of the electric power of California could be supplied by this method. Moreover, there are indications that deepboring in parts of the country, not supplied with obvious geothermal sources, might make the method feasible there. We have been studying some papers on brine removal heat of rocks and other facets of the process.

Again, the discouragement of this method, with apparently a certain amount of tax harassment, is far from being to this nation's credit. Recently the President has given some encouragement to work along these lines of certain federal lands.

There are other sources of power which have been not only neglected but dismissed by those promoting another method. Included are tidal power which is proving useful elsewhere under certain circumstances and the possible use of hydroelectric power from Canada.

NUCLEAR POWER

The cause of this neglect and the distortion of our energy problem, in our carefully informed opinion, is the indefensibility of the fantastically costly promotion of a single means of power generation: nuclear fission, which has involved delays, an improbable number of breakdowns, defects, shutdowns and multiple pollution and is accordingly the least desirable method of producing electricity.

The ramifications and complexities of this process make adequate control difficult if not impossible. The AEC has already indicated that more than once in its requests for authorizing legislation and in its testimony that even before proposed proliferation of nuclear power recruitment of skilled manpower was a problem. The testimony of Milton Shom, AEC director of reactor development, has on occasion revealed a dismaying confusion with contractors changing specifications, inferior materials being substituted and failure of experimental fast breeder work because of astounding errors.

Nonetheless, a fortune in taxpayers money has been spent on this program and another vast expenditure for development of a fast breeder program which experts of the stature of Teller, Gofman, and Tamplin and other consider too dangerous to build. Our organization are totally opposed to a "plutonium economy". So explosive a device as the fast breeder and so poisonous an element as plutonium with a half life of 24,000 years, has no place whatsoever in an energy program. There is evidence indicating that inhalation of a single hot plutonium particle can induce lung cancer. Plutonium is the stuff of bombs. It is madness to ignore the implication of an abundance of this material getting out of hand.

In considering nuclear power and its pollutions we cannot limit ourselves to power stations. The pollutions by processing plants are several. The problem of storage of high-level wastes should give us long pause, since it has not been solved; and at best—what heritage is this we are to leave to our descendants?

IN CONCLUSION

We are aware of the psychology of trade-offs. For this committee we who speak in this instance for 65 organizations with whom we are backed, wish to go on record as favoring the far safer and less complex means of power generation and of opposing nuclear power proliferation. The monstrous distortion of our policy by the oversell of this method affects us. Now that it is known that no full scale tests of emergency systems (cooling) for water reactors have ever been performed and that six scaled down tests failed; and now that it has become obvious, among other important problems, that waste storage tanks have leaked their lethal contents and that no method of proposed storage has been proved safe, we see no reason for a nuclear future. And indeed, plenty of reasons why Congress must belatedly back a rational policy including a much needed national power network assisted if need be by the federal government.

Respectfully submitted.

ELISE JERARD,
Chairman,
Phi Beta Kappa Environmental Study Group.

The above statement is endorsed by Herbert Lippman, member N.Y. Chapter Committee on Natural Environment.

CLEAN ENERGY

MESSAGE

FROM

THE PRESIDENT OF THE UNITED STATES

TRANSMITTING

A PROGRAM TO INSURE AN ADEQUATE SUPPLY OF CLEAN ENERGY
IN THE FUTURE

JUNE 4, 1971.—Message referred to the Committee on Government Operations
and ordered to be printed

To the Congress of the United States:

For most of our history, a plentiful supply of energy is something the American people have taken very much for granted. In the past twenty years alone, we have been able to double our consumption of energy without exhausting the supply. But the assumption that sufficient energy will always be readily available has been brought sharply into question within the last year. The brownouts that have affected some areas of our country, the possible shortages of fuel that were threatened last fall, the sharp increases in certain fuel prices and our growing awareness of the environmental consequences of energy production have all demonstrated that we cannot take our energy supply for granted any longer.

A sufficient supply of clean energy is essential if we are to sustain healthy economic growth and improve the quality of our national life. I am therefore announcing today a broad range of actions to ensure an adequate supply of clean energy for the years ahead. Private industry, of course, will still play the major role in providing our energy, but Government can do a great deal to help in meeting this challenge.

My program includes the following elements:

To Facilitate Research and Development for Clean Energy:

—A commitment to complete the successful demonstration of the liquid metal fast breeder reactor by 1980.

- More than twice as much Federal support for sulfur oxide control demonstration projects in Fiscal Year 1972.
- An expanded program to convert coal into a clean gaseous fuel.
- Support for a variety of other energy research projects in fields such as fusion power, magnetohydrodynamic power cycles, and underground electric transmission.

To Make Available the Energy Resources on Federal Lands:

- Acceleration of oil and gas lease sales on the Outer Continental Shelf, along with stringent controls to protect the environment.
- A leasing program to develop our vast oil shale resources, provided that environmental questions can be satisfactorily resolved.
- Development of a geothermal leasing program beginning this fall.

To Assure a Timely Supply of Nuclear Fuels:

- Begin work to modernize and expand our uranium enrichment capacity.

To Use Our Energy More Wisely:

- A New Federal Housing Administration standard requiring additional insulation in new federally insured homes.
- Development and publication of additional information on how consumers can use energy more efficiently.
- Other efforts to encourage energy conservation.

To Balance Environmental and Energy Needs:

- A system of long-range open planning of electric power plant sites and transmission line routes with approval by a State or regional agency before construction.
- An incentive charge to reduce sulfur oxide emissions and to support further research.

To Organize Federal Efforts More Effectively:

- A single structure within the Department of Natural Resources uniting all important energy resource development programs.

THE NATURE OF THE CURRENT PROBLEM

A major cause of our recent energy problems has been the sharp increase in demand that began about 1967. For decades, energy consumption had generally grown at a slower rate than the national output of goods and services. But in the last four years it has been growing at a faster pace and forecasts of energy demand a decade from now have been undergoing significant upward revisions.

This accelerated growth in demand results partly from the fact that energy has been relatively inexpensive in this country. During the last decade, the prices of oil, coal, natural gas and electricity have increased at a much slower rate than consumer prices as a whole. Energy has been an attractive bargain in this country—and demand has responded accordingly.

In the years ahead, the needs of a growing economy will further stimulate this demand. And the new emphasis on environmental protection means that the demand for cleaner fuels will be especially acute. The primary cause of air pollution, for example, is the burning of fos-

sil fuels in homes, in cars, in factories and in power plants. If we are to meet our new national air quality standards, it will be essential for us to use stack gas cleaning systems in our large power and other industrial plants and to use cleaner fuels in virtually all of our new residential, commercial and industrial facilities, and in some of our older facilities as well.

Together, these two factors—growing demand for energy and growing emphasis on cleaner fuels—will create an extraordinary pressure on our fuel supplies.

The task of providing sufficient clean energy is made especially difficult by the long lead times required to increase energy supply. To move from geological exploration to oil and gas well production now takes from 3 to 7 years. New coal mines typically require 3 to 5 years to reach the production stage and it takes 5 to 7 years to complete a large steam power plant. The development of the new technology required to minimize environmental damage can further delay the provision of additional energy. If we are to take full advantage of our enormous coal resources, for example, we will need mining systems that do not impair the health and safety of miners or degrade the landscape and combustion systems that do not emit harmful quantities of sulfur oxides, other noxious gases, and particulates into the atmosphere. But such systems may take several years to reach satisfactory performance. That is why our efforts to expand the supply of clean energy in America must immediately be stepped up.

1. RESEARCH AND DEVELOPMENT GOALS FOR CLEAN ENERGY

Our past research in this critical field has produced many promising leads. Now we must move quickly to demonstrate the best of these new concepts on a commercial scale. Industry should play the major role in this area, but government can help by providing technical leadership and by sharing a portion of the risk for costly demonstration plants. The time has now come for government and industry to commit themselves to a joint effort to achieve commercial scale demonstrations in the most crucial and most promising clean energy development areas—the fast breeder reactor, sulfur oxide control technology and coal gasification.

a. Sulfur Oxide Control Technology

A major bottleneck in our clean energy program is the fact that we cannot now burn coal or oil without discharging its sulfur content into the air. We need new technology which will make it possible to remove the sulfur before it is emitted to the air.

Working together, industry and government have developed a variety of approaches to this problem. However, the new air quality standards promulgated under the Clean Air Amendments of 1970 require an even more rapid development of a suitable range of stack gas cleaning techniques for removing sulfur oxides. I have therefore requested funds in my 1972 budget to permit the Environmental Protection Agency to devote an additional \$15 million to this area, more than doubling the level of our previous efforts. This expansion means that a total of six different techniques can be demonstrated in partnership with industry during the next three or four years.

b. Nuclear Breeder Reactor

Our best hope today for meeting the Nation's growing demand for economical clean energy lies with the fast breeder reactor. Because of its highly efficient use of nuclear fuel, the breeder reactor could extend the life of our natural uranium fuel supply from decades to centuries, with far less impact on the environment than the power plants which are operating today.

For several years, the Atomic Energy Commission has placed the highest priority on developing the liquid metal fast breeder. Now this project is ready to move out of the laboratory and into the demonstration phase with a commercial size plant. But there still are major technical and financial obstacles to the construction of a demonstration plant of some 300 to 500 megawatts. I am therefore requesting an additional \$27 million in Fiscal Year 1972 for the Atomic Energy Commission's liquid metal fast breeder reactor program—and for related technological and safety programs—so that the necessary engineering groundwork for demonstration plants can soon be laid.

What about the environmental impact of such plants? It is reassuring to know that the releases of radioactivity from current nuclear reactors are well within the national safety standards. Nevertheless, we will make every effort to see that these new breeder reactors emit even less radioactivity to the environment than the commercial light water reactors which are now in use.

I am therefore directing the Atomic Energy Commission to ensure that the new breeder plants be designed in a way which inherently prevents discharge to the environment from the plant's radioactive effluent systems. The Atomic Energy Commission should also take advantage of the increased efficiency of these breeder plants, designing them to minimize waste heat discharges. Thermal pollution from nuclear power plants can be materially reduced in the more efficient breeder reactors.

We have very high hopes that the breeder reactor will soon become a key element in the national fight against air and water pollution. In order further to inform the interested agencies and the public about the opportunities in this area, I have requested the early preparation and review by all appropriate agencies of a draft environmental impact statement for the breeder demonstration plant in accordance with Section 102 of the National Environmental Policy Act. This procedure will ensure compliance with all environmental quality standards before plant construction begins.

In a related area, it is also pertinent to observe that the safety record of civilian power reactors in this country is extraordinary in the history of technological advances. For more than a quarter century—since the first nuclear chain reaction took place—no member of the public has been injured by the failure of a reactor or by an accidental release of radioactivity. I am confident that this record can be maintained. The Atomic Energy Commission is giving top priority to safety considerations in the basic design of the breeder reactor and this design will also be subject to a thorough review by the independent Advisory Committee on Reactor Safeguards, which will publish the results of its investigation.

I believe it important to the Nation that the commercial demonstration of a breeder reactor be completed by 1980. To help achieve that goal, I am requesting an additional \$50 million in Federal funds for the demonstration plant. We expect industry—the utilities and manufacturers—to contribute the major share of the plant's total cost, since they have a large and obvious stake in this new technology. But we also recognize that only if government and industry work closely together can we maximize our progress in this vital field and thus introduce a new era in the production of energy for the people of our land.

c. Coal Gasification

As we carry on our search for cleaner fuels, we think immediately of the cleanest fossil fuel—natural gas. But our reserves of natural gas are quite limited in comparison with our reserves of coal.

Fortunately, however, it is technically feasible to convert coal into a clean gas which can be transported through pipelines. The Department of the Interior has been working with the natural gas and coal industries on research to advance our coal gasification efforts and a number of possible methods for accomplishing this conversion are under development. A few, in fact, are now in the pilot plant stage.

We are determined to bring greater focus and urgency to this effort. We have therefore initiated a cooperative program with industry to expand the number of pilot plants, making it possible to test new methods more expeditiously so that the appropriate technology can soon be selected for a large-scale demonstration plant.

The Federal expenditure for this cooperative program will be expanded to \$20 million a year. Industry has agreed to provide \$10 million a year for this effort. In general, we expect that the Government will continue to finance the larger share of pilot plants and that industry will finance the larger share of the demonstration plants. But again, the important point is that both the Government and industry are now strongly committed to move ahead together as promptly as possible to make coal gasification a commercial reality.

d. Other Research and Development Efforts

The fast breeder reactor, sulfur oxide controls and coal gasification represent our highest priority research and development projects in the clean energy field. But they are not our only efforts. Other ongoing projects include:

Coal Mine Health and Safety Research.—In response to a growing concern for the health and safety of the men who mine the Nation's coal and in accordance with the Federal Coal Mine Health and Safety Act of 1969, the Bureau of Mines research effort has been increased from a level of \$2 million in Fiscal Year 1969 to \$30 million in Fiscal Year 1972.

Controlled Thermonuclear Fusion Research.—For nearly two decades the Government has been funding a sizeable research effort designed to harness the almost limitless energy of nuclear fusion for peaceful purposes. Recent progress suggests that the scientific feasibility of such projects may be demonstrated in the 1970s and we have therefore requested an additional \$2 million to supplement the budget in this field for Fiscal Year 1972. We hope that work in this promising

area will continue to be expanded as scientific progress justifies larger scale programs.

Coal Liquefaction.—In addition to its coal gasification work, the Department of the Interior has underway a major pilot plant program directed toward converting coal into cleaner liquid fuels.

Magnetohydrodynamic Power Cycles.—MHD is a new and more efficient method of converting coal and other fossil fuels into electric energy by burning the fuel and passing the combustion products through a magnetic field at very high temperatures. In partnership with the electric power industry, we have been working to develop this new system of electric power generation.

Underground Electric Transmission.—Objections have been growing to the overhead placement of high voltage power lines, especially in areas of scenic beauty or near centers of population. Again in cooperation with industry, the Government is funding a research program to develop new and less expensive techniques for burying high voltage electric transmission lines.

Nuclear Reactor Safety and Supporting Technology.—The general research and development work for today's commercial nuclear reactors was completed several years ago, but we must continue to fund safety-related efforts in order to ensure the continuance of the excellent safety record in this field. An additional \$3 million has recently been requested for this purpose to supplement the budget in Fiscal Year 1972.

Advanced Reactor Concepts.—The liquid metal fast breeder is the priority breeder reactor concept under development, but the Atomic Energy Commission is also supporting limited alternate reactor programs involving gas cooled reactors, molten salt reactors and light water breeders.

Solar Energy.—The sun offers an almost unlimited supply of energy if we can learn to use it economically. The National Aeronautics and Space Administration and the National Science Foundation are currently re-examining their efforts in this area and we expect to give greater attention to solar energy in the future.

The key to meeting our twin goals of supplying adequate energy and protecting the environment in the decades ahead will be a balanced and imaginative research and development program. I have therefore asked my Science Adviser, with the cooperation of the Council on Environmental Quality and the interested agencies, to make a detailed assessment of all of the technological opportunities in this area and to recommend additional projects which should receive priority attention.

2. MAKING AVAILABLE THE ENERGY RESOURCES OF FEDERAL LANDS

Over half of our Nation's remaining oil and gas resources, about 40 percent of our coal and uranium, 80 percent of our oil shale, and some 60 percent of our geothermal energy sources are now located on Federal lands. Programs to make these resources available to meet the growing energy requirements of the Nation are therefore essential if shortages are to be averted. Through appropriate leasing programs, the Government should be able to recover the fair market value of

these resources, while requiring developers to comply with requirements that will adequately protect the environment.

To supplement the efforts already underway to develop the fuel resources of the lower 48 States and Alaska, I am announcing today the following new programs:

a. Leasing on the Outer Continental Shelf—An Accelerated Program

The Outer Continental Shelf has proved to be a prolific source of oil and gas, but it has also been the source of troublesome oil spills in recent years. Our ability to tap the great potential of offshore areas has been seriously hampered by these environmental problems.

The Department of the Interior has significantly strengthened the environmental protection requirements controlling offshore drilling and we will continue to enforce these requirements very strictly. As a prerequisite to Federal lease sales, environmental assessments will be made in accordance with Section 102 of the National Environmental Policy Act of 1969.

Within these clear limits, we will accelerate our efforts to utilize this rich source of fuel. In order to expand productive possibilities as rapidly as possible, the accelerated program should include the sale of new leases not only in the highly productive Gulf of Mexico, but also some other promising areas. I am therefore directing the Secretary of the Interior to increase the offerings of oil and gas leases and to publish a schedule for lease offerings on the Outer Continental Shelf during the next five years, beginning with a general lease sale and a drainage sale this year.

b. Oil Shale—A Program for Orderly Development

At a time when we are facing possible energy shortages, it is reassuring to know that there exists in the United States an untapped shale oil resource containing some 600 billion barrels in high grade deposits. At current consumption rates, this resource represents 150 years supply. About 80 billion barrels of this shale oil are particularly rich and well situated for early development. This huge resource of very low sulfur oil is located in the Rocky Mountain area, primarily on Federal land.

At present there is no commercial production of shale oil. A mixture of problems—environmental, technical and economic—have combined to thwart past efforts at development.

I believe the time has come to begin the orderly formulation of a shale oil policy—not by any head-long rush toward development but rather by a well considered program in which both environmental protection and the recovery of a fair return to the Government are cardinal principles under which any leasing takes place. I am therefore requesting the Secretary of the Interior to expedite the development of an oil shale leasing program including the preparation of an environmental impact statement. If after reviewing this statement and comments he finds that environmental concerns can be satisfied, he shall then proceed with the detailed planning. This work would also involve the States of Wyoming, Colorado and Utah and the first test lease would be scheduled for next year.

c. Geothermal Energy

There is a vast quantity of heat stored in the earth itself. Where this energy source is close to the surface, as it is in the Western States, it can readily be tapped to generate electricity, to heat homes, and to meet other energy requirements. Again, this resource is located primarily on Federal lands.

Legislation enacted in recent months permits the Federal government, for the first time, to prepare for a leasing program in the field of geothermal energy. Classification of the lands involved is already underway in the Department of the Interior. I am requesting the Secretary of the Interior to expedite a final decision on whether the first competitive lease sale should be scheduled for this fall—taking into account, of course, his evaluation of the environmental impact statement.

3. NATURAL GAS SUPPLY

For the past 25 years, natural gas has supplied much of the increase in the energy supply of the United States. Now this relatively clean form of energy is in even greater demand to help satisfy air quality standards. Our present supply of natural gas is limited, however, and we are beginning to face shortages which could intensify as we move to implement the air quality standards. Additional supplies of gas will therefore be one of our most urgent energy needs in the next few years.

Federal efforts to augment the available supplies of natural gas include:

- Accelerated leasing on Federal lands to speed discovery and development of new natural gas fields.
- Moving ahead with a demonstration project to gasify coal.
- Recent actions by the Federal Power Commission providing greater incentives for industry to increase its search for new sources of natural gas and to commit its discoveries to the interstate market.
- Facilitating imports of both natural and liquefied gas from Canada and from other nations.
- Progress in nuclear stimulation experiments which seek to produce natural gas from tight geologic formations which cannot presently be utilized in ways which are economically and environmentally acceptable.

This administration is keenly aware of the need to take every reasonable action to enlarge the supply of clean gaseous fuels. We intend to take such action and we expect to get good results.

4. IMPORTS FROM CANADA

Over the years, the United States and Canada have steadily increased their trade in energy. The United States exports some coal to Canada, but the major items of trade are oil and gas which are surplus to Canadian needs but which find a ready market in the United States.

The time has come to develop further this mutually advantageous trading relationship. The United States is therefore prepared to move promptly to permit Canadian crude oil to enter this country, free of any quantitative restraints, upon agreement as to measures needed to prevent citizens of both our countries from being subjected to oil

shortages, or threats of shortages. We are ready to proceed with negotiations and we look to an early conclusion.

5. TIMELY SUPPLIES OF NUCLEAR FUELS

The Nation's nuclear fuel supply is in a state of transition. Military needs are now relatively small but civilian needs are growing rapidly and will be our dominant need for nuclear fuel in the future. With the exception of uranium enrichment, the nuclear energy industry is now in private hands.

I expect that private enterprise will eventually assume the responsibility for uranium enrichment as well, but in the meantime the Government must carry out its responsibility to ensure that our enriching capacity expands at a rate consistent with expected demands.

There is currently no shortage of enriched uranium or enriching capacity. In fact, the Atomic Energy Commission has substantial stocks of enriched uranium which have already been produced for later use. However, plant expansions are required so that we can meet the growing demands for nuclear fuel in the late 1970s—both in the United States and in other nations for which this country is now the principal supplier.

The most economical means presently available for expanding our capacity in this field appears to be the modernization of existing gaseous diffusion plants at Oak Ridge, Tennessee; Portsmouth, Ohio; and Paducah, Kentucky—through a Cascade Improvement Program. This program will take a number of years to complete and we therefore believe that it is prudent to initiate the program at this time rather than run the risk of shortages at a later date. I am therefore releasing \$16 million to start the Cascade Improvement Program in Fiscal Year 1972. The pace of the improvement program will be tailored to fit the demands for enriched uranium in the United States and in other countries.

6. USING OUR ENERGY MORE WISELY

We need new sources of energy in this country, but we also need to use existing energy as efficiently as possible. I believe we can achieve the ends we desire—homes warm in winter and cool in summer, rapid transportation, plentiful energy for industrial production and home appliances—and still place less of a strain on our overtaxed resources.

Historically, we have converted fuels into electricity and have used other sources of energy with ever increasing efficiency. Recent data suggest, however, that this trend may be reversing—thus adding to the drain on available resources. We must get back on the road of increasing efficiency—both at the point of production and at the point of consumption, where the consumer himself can do a great deal to achieve considerable savings in his energy bills.

We believe that part of the answer lies in pricing energy on the basis of its full costs to society. One reason we use energy so lavishly today is that the price of energy does not include all of the social costs of producing it. The costs incurred in protecting the environment and the health and safety of workers, for example, are part of the real cost of producing energy—but they are not now all included in the

price of the product. If they were added to that price, we could expect that some of the waste in the use of energy would be eliminated. At the same time, by expanding clean fuel supplies, we will be working to keep the overall cost of energy as low as possible.

It is also important that the individual consumer be fully aware of what his energy will cost if he buys a particular home or appliance. The efficiency of home heating or cooling systems and of other energy intensive equipment are determined by builders and manufacturers who may be concerned more with the initial cost of the equipment than with the operating costs which will come afterward. For example, better thermal insulation in a home or office building may save the consumer large sums in the long run—and conserve energy as well—but for the builder it merely represents an added expense.

To help meet one manifestation of this problem, I am directing the Secretary of Housing and Urban Development to issue revised standards for insulation applied in new federally insured homes. The new Federal Housing Administration standards will require sufficient insulation to reduce the maximum permissible heat loss by about one-third for a typical 1200 square foot home—and by even more for larger homes. It is estimated that the fuel savings which will result each year from the application of these new standards will, in an average climate, equal the cost of the additional insulation required.

While the Federal Government can take some actions to conserve energy through such regulations, the consumer who seeks the most for his energy dollar in the marketplace is the one who can have the most profound influence. I am therefore asking my Special Assistant for Consumer Affairs—in cooperation with industry and appropriate Government agencies—to gather and publish additional information in this field to help consumers focus on the operating costs as well as the initial cost of energy intensive equipment.

In addition, I would note that the Joint Board on Fuel Supply and Fuel Transport chaired by the Director of the Office of Emergency Preparedness is developing energy conservation measures for industry, government, and the general public to help reduce energy use in times of particular shortage and during pollution crises.

7. POWER PLANT SITING

If we are to meet growing demands for electricity in the years ahead, we cannot ignore the need for many new power plants. These plants and their associated transmission lines must be located and built so as to avoid major damage to the environment, but they must also be completed on time so as to avoid power shortages. These demands are difficult to reconcile—and often they are not reconciled well. In my judgment the lesson of the recent power shortages and of the continuing disputes over power plant siting and transmission line routes is that the existing institutions for making decisions in this area are not adequate for the job. In my Special Message to the Congress on the Environment last February, I proposed legislation which would help to alleviate these problems through longer range planning by the utilities and through the establishment of State or regional agencies to license new bulk power facilities prior to their construction.

Hearings are now being held by the Interstate and Foreign Commerce Committee of the House of Representatives concerning these

proposals and other measures which would provide an open planning and decision-making capacity for dealing with these matters. Under the administration bill, long-range expansion plans would be presented by the utilities ten years before construction was scheduled to begin, individual alternative power plant sites would be identified five years ahead, and detailed design and location of specific plants and transmission lines would be considered two years in advance of construction. Public hearings would be held far enough ahead of construction so that they could influence the siting decision, helping to avoid environmental problems without causing undue construction delays. I urge the Congress to take prompt and favorable action on this important legislative proposal. At the same time steps will be taken to ensure that Federal licenses and permits are handled as expeditiously as possible.

8. THE ROLE OF THE SULFUR OXIDES EMISSIONS CHARGE

In my environmental message last February I also proposed the establishment of a sulfur oxides emissions charge. The emissions charge would have the effect of building the cost of sulfur oxide pollution into the price of energy. It would also provide a strong economic incentive for achieving the necessary performance to meet sulfur oxide standards.

The funds generated by the emissions charge would be used by the Federal Government to expand its programs to improve environmental quality, with special emphasis on the development of adequate supplies of clean energy.

9. GOVERNMENT REORGANIZATION—AN ENERGY ADMINISTRATION

But new programs alone will not be enough. We must also consider how we can make these programs do what we intend them to do. One important way of fostering effective performance is to place responsibility for energy questions in a single agency which can execute and modify policies in a comprehensive and unified manner.

The Nation has been without an integrated energy policy in the past. One reason for this situation is that energy responsibilities are fragmented among several agencies. Often authority is divided according to types and uses of energy. Coal, for example, is handled in one place, nuclear energy in another—but responsibility for considering the impact of one on the other is not assigned to any single authority. Nor is there any single agency responsible for developing new energy sources such as solar energy or new conversion systems such as the fuel cell. New concerns—such as conserving our fossil fuels for non-fuel uses—cannot receive the thorough and thoughtful attention they deserve under present arrangements.

The reason for all these deficiencies is that each existing program was set up to meet a specific problem of the past. As a result, our present structure is not equipped to handle the relationships between these problems and the emergence of new concerns.

The need to remedy these problems becomes more pressing every day. For example, the energy industries presently account for some 20 percent of our investment in new plant and equipment. This means that inefficiencies resulting from uncoordinated government programs

can be very costly to our economy. It is also true that energy sources are becoming increasingly interchangeable. Coal can be converted to gas, for example, and even to synthetic crude oil. If the Government is to perform adequately in the energy field, then it must act through an agency which has sufficient strength and breadth of responsibility.

Accordingly, I have proposed that all of our important Federal energy resource development programs be consolidated within the new Department of Natural Resources.

The single energy authority which would thus be created would be better able to clarify, express, and execute Federal energy policy than any unit in our present structure. The establishment of this new entity would provide a focal point where energy policy in the executive branch could be harmonized and rationalized.

One of the major advantages of consolidating energy responsibilities would be the broader scope and greater balance this would give to research and development work in the energy field. The Atomic Energy Commission, for instance, has been successful in its mission of advancing civilian nuclear power, but this field is now intimately interrelated with coal, oil and gas, and Federal electric power programs with which the Atomic Energy Commission now has very little to do. We believe that the planning and funding of civilian nuclear energy activities should now be consolidated with other energy efforts in an agency charged with the mission of insuring that the total energy resources of the nation are effectively utilized. The Atomic Energy Commission would still remain intact, in order to execute the nuclear programs and any related energy research which may be appropriate as part of the overall energy program of the Department of Natural Resources.

Until such time as this new Department comes into being, I will continue to look to the Energy Subcommittee of the Domestic Council for leadership in analyzing and coordinating overall energy policy questions for the executive branch.

CONCLUSION

The program I have set forth today provides the basic ingredients for a new effort to meet our clean energy needs in the years ahead.

The success of this effort will require the cooperation of the Congress and of the State and local governments. It will also depend on the willingness of industry to meet its responsibilities in serving customers and in making necessary capital investments to meet anticipated growth. Consumers, too, will have a key role to play as they learn to conserve energy and as they come to understand that the cost of environmental protection must, to a major extent, be reflected in consumer prices.

I am confident that the various elements of our society will be able to work together to meet our clean energy needs. And I am confident that we can therefore continue to know the blessings of both a high-energy civilization and a beautiful and healthy environment.

RICHARD NIXON.

THE WHITE HOUSE, *June 4, 1971.*

