The Petroleum Panel of the
Ocean Science and Technology Advisory Committee of the
National Security Industrial Association

Report on the Relationship Between the Offshore Petroleum Industries and the U. S. Government

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NATIONAL SECURITY INDUSTRIAL ASSOCIATION
Union Trust Building
15th and H Streets, N.W., Suite 700
Washington, D. C. 20005

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Petroleum Panel
of the
Ocean Science and Technology Advisory Committee

Mr. Robert W. Bybee
CHAIRMAN, PETROLEUM PANEL
Exxon Company, USA

Mr. Bill C. Anderson
Atlantic Richfield Company

Dr. F. Gilman Blake
National Science Foundation

Dr. Kenneth A. Blenkarn
Amoco Production Company

Mr. V. C. Eissler
Continental Oil Company

Mr. Ronald L. Geer
Shell Oil Company

Mr. Mike K. Horn
Cities Service Oil Company

Comdr. John H. Jorgenson USN (Ret.)
National Security Industrial Assoc.
(Executive Secretary)

Mr. Thomas H. Montgomery
Phillips Petroleum Company

Mr. Eugene A. Moores
Sun Oil Company

Mr. L. A. Rupp
Mobil Oil Corporation

Mr. John E. Sherborne
Union Research Center

Mr. J. L. Sleeper, Jr.
Texaco, Incorporated

Mr. Larry Thrasher
Chevron Oil Field Research Company

PREFACE

The attached report by the Petroleum Panel of the Ocean Science and Technology Advisory Committee of the National Security Industrial Association is in response to numerous requests from several federal offices, functions, and individuals desiring industry views on federal marine goals, programs, and activities.

The precipitous cutoff of crude and petroleum product imports to the United States from the Middle East due to the October 1973 Arab-Israeli conflict will prove to be a momentous event in our history. At the time this report was written, conditions were in such a state of flux that little could be said about the short-range energy supply situation. However, there is no question that with or without embargos the United States faces a difficult energy supply picture for the next decade. Whatever else evolves, the Arab action will do a great deal to increase the awareness of the U.S. citizen of the great significance of energy and particularly petroleum to his well being.

EXECUTIVE SUMMARY

Summary

For the next decade, perhaps the most important priority facing our nation is the provision of a reliable supply of energy. For at least this period of time, the burden of supply will fall largely on oil and gas. The greatest U. S. potential for additional petroleum reserves lie offshore. Demand for energy not met by increased domestic supplies must either be satisfied by imports or go unfulfilled. Marine transportation and associated terminaling facilities for petroleum produced either offshore or imported are vital links in our energy outlook. Even with early adoption of a sound national energy policy with means to implement it, most likely some of our energy needs will not be met.

All segments of our society must work effectively together if our country is to develop and maintain ~~even~~ an adequate energy self-sufficiency in a reasonable period of time. A closer relationship between industry and government must be developed so that the respective proper roles and strengths of each can be maximized. Government can best provide national direction including the articulation of national goals and priorities, providing legal safeguards, encouraging economic growth, and fostering an informed and unbiased political climate. Government and industry should each develop needed technical information where it is most effectively, appropriately, or economically done by them. Government should serve to collect and make available to users such information as is essential for achieving national goals.

The offshore petroleum industry feels that the government's primary emphasis should be on activities traditionally performed for the benefit

of broadly based user groups. Commensurate with this philosophy, there are ocean activities which the government performs or could perform which will greatly assist the petroleum industry in finding and producing the additional domestic petroleum so greatly needed by this country. Many of these activities are closely aligned with offshore lease sales and when appropriate, should be conducted as far in advance of pending lease sales as possible. These lease sales should be on a firm and regular schedule. The scheduling of sale areas under consideration should reflect technological, economic, social, and environmental factors.

Recommendations

The federal government activities which the Petroleum Panel feels most appropriate and important are listed below. Due to many factors, they are not listed in any particular order of priority.

1. Determine the fate and effects of oil in the marine environment. Special emphasis should be placed on the long-term sublethal effects of low level petroleum hydrocarbons and also the establishment of standards for equipment, techniques, and parameters or items for measurement.
2. Assist the states in coastal zone planning and management to assure the accommodation of offshore and onshore petroleum facilities to meet regional and national needs.
3. Improve our knowledge of the weather and marine conditions in frontier petroleum development areas.
4. Improve bathymetry and surface geologic mapping of the sea floor where needed. Make broad, basin-type mineral resource potential studies on a regional basis.

5. Measure and locate the mean low water line along the shore. Charting offshore areas with geodetic markers. Aid mariners in the establishment of precise positioning capability.
6. Intensify research and development on weather modification with particular emphasis on hurricanes.

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ENERGY OUTLOOK

For the next decade, perhaps the most important priority facing our nation is the provision of a reliable supply of energy. It is clear that for this period the burden of supply will fall on the fossil fuels and to a great extent on petroleum--oil and natural gas. For the long term we do have adequate resources to satisfy most of our fundamental needs. However, for the short-term numerous difficulties must be resolved if we are to satisfactorily meet our requirements. Certain remedies for the resolution of these difficulties are apparent and have been variously proposed by Congress, the President, energy companies, and others. Nonetheless time is definitely not on our side, and even if a sound national energy policy is adopted soon with viable means to implement it, there is great likelihood that some of our needs will not be met.

The recent petroleum embargo placed upon the United States as a result of the Arab-Israeli conflict merely catapulted forward the point in time when this nation recognized it must address itself to the question of dependence on foreign sources of energy. While severe dislocations and diseconomies will be borne by our country as a result of this embargo, the immediate severity of the problem will be less now than if the embargo had occurred at a later date.

Resources and Reserves

The fossil fuel resources and reserves of the United States are presented in Figure 1. To make comparison easy, they have been expressed in terms of

quadrillion BTU energy units. There is much confusion about the difference between resources and reserves, and these terms are often used interchangeably by individuals who do not recognize the difference between them. Resources are the total amount of a material known to exist or which are authoritatively estimated to exist. Proven reserves are that portion of the resource which can be produced by today's technology and at today's prices. Thus, the amount of reserves available is determined by technological, environmental, economic, and often political factors. On the other hand, the resource, e.g., the amount of oil and gas in place, does not change but the amount we have discovered at any one time changes.

It can be seen from the chart that by far the largest amount of fossil fuel resources enjoyed by the United States is coal. The 74,400 quadrillion BTUs are equivalent to 3.2 trillion tons. The reserves represent about one-twentieth of the resource--enough to last about 250 years at present usage rates.

Oil shale is the next most abundant fossil energy resource amounting to 10,000 quadrillion BTUs or the equivalent of 1.78 trillion barrels of oil. Although currently we have the technology to produce 54 billion barrels, i.e., 3 percent of this amount, no reserves are shown because historic domestic oil prices have not justified the necessary investment. It can be seen also that the United States has substantial resources of oil and natural gas. These will be discussed more fully later.

Availability

The fact that a given amount of reserves is known to exist does not mean that they are instantly available. There is for each type of energy resource a limiting rate of availability governed by many factors. For example,

any given petroleum field may take from 20 to 40 or more years to recover the reserves. Significant production from a new field may take from 7 to 10 years after its discovery.

Supply and Demand Balance

Until recently, most energy studies concentrated on juggling the types, origin, and percents of various primary fossil fuel energy forms necessary to meet the nation's projected energy demands. The general consensus was that total unrestrained energy demand would approximately double between 1970 and 1985, or to approximately 125 quadrillion BTUs per year. If the total demand were to be supplied by oil alone, it would require the equivalent of 62.5 million barrels per day. Current studies are now concentrating on the forcing of demand to meet available supplies.

The most comprehensive studies of both types have been conducted by the National Petroleum Council.[1,2] In the first referenced NPC report which was made prior to the recent Arab oil cutoff, 22 alternative cases were studied. These studies took into consideration various rates of population growth, per capita usage, environmental impacts, and conservation possibilities. These were condensed into high, intermediate, and low cases. The low case may be said to represent a low population growth rate, minimum adequate environmental impact, maximum feasible conservation, etc. The high case is representative of opposites of these. The intermediate case represents what is thought can be more reasonably expected. The most significant aspect of all these

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[1]U.S. Energy Outlook, National Petroleum Council, Washington, D.C., December, 1972.

[2]Emergency Preparedness for Interruption of Petroleum Imports into the United States, National Petroleum Council, July, 1973, and Its Supplemental Interim Report, November, 1973.

projections is that even with the major effort to conserve usage a 1985 demand of over one and one-half times the present requirement seems inevitable.

A thorough study of Figures 2, which is based on the NPC intermediate case, will reveal the seriousness of the energy problem. Although these figures were compiled prior to the recent Middle East outbreak of hostilities, the demand projections up to 1985 have not been altered or reduced, since the duration and severity of the denial of petroleum by the Organization of Arab Petroleum and Exporting Countries (OAPEC) to Japan, Western Europe, and the United States cannot be projected. Also many other factors have a significant bearing on the U.S. demand and supply, including the demand savings due to lower speed limits, lower thermostats, less airconditioning and so on. Nonetheless, the reader is urged to appreciate the growing gap between the normal upward trending "demand" curve and the "total domestic supply" curve. As of 1973, Middle East imports amounted to approximately 3 million barrels of oil per day and had been expected to provide the necessary incremental growth amounts in the future. Nonconventional sources of energy are not included in domestic supply sources in Figure 2 due to their anticipated small singificance of contribution and their unpredictability of becoming economically available. Synthetic crude from oil shale and coal was optimistically projected to contribute a little over 1 million barrels per day by 1985. The recent oil embargo and crude oil price increases have increased interest in synthetics and nonconventional sources of energy to a high degree. Significant contributions from these new sources will probably now occur sooner than previously anticipated.

Demand

The manner in which energy has been and could be used is presented in Figure 3. It can be seen that the rate of growth of use of electrical energy is much

higher than that of other uses. However, most electrical energy has been made from primary energy sources such as coal, oil, and gas. In the process much primary energy is lost. It is estimated that by 1985, 24 percent of all primary energy used will be lost in the generation of electricity. Electrical energy usage is divided among industrial, commercial, and residential end users.

Supply

How will these demands be met? At present, petroleum hydrocarbons--oil and natural gas--supply about three-fourths of our total energy demands. It appears that this proportion will decrease only slightly sometime after 1985. Its importance can be appreciated when one recognizes that as of 1972 petroleum supplied essentially 100 percent of our transportation energy, 78 percent of industrial, 97 percent of that used in homes, and 40 percent of our electricity.

Oil Supply

Based upon the intermediate case developed by NPC, Figure 2 shows a projection of U. S. oil supply to 1985. This has been modified to allow for delays resulting from the fact that until recently very little has been done to stimulate domestic production. Expected demand by 1985 is 26 million barrels per day. However, it can be seen that domestic sources can be expected to supply only about 14 million barrels per day, leaving 12 million barrels per day to be supplied either by other sources or not met. It will be noted that both the Alaskan North Slope and offshore production are expected to play a significant and increasing role in domestic supply. The estimated 2 million barrels per day from the North Slope and 2 million barrels per day from offshore are expected to account for over 1/3 of total 1985 domestic crude supply.

Our lack of ability to supply more of our demand domestically is not through lack of resources. The present status of U. S. resources and reserves is given in Figure 4. The United States has an estimated ultimate discoverable amount of oil in place of 810 billion barrels, of which 434 billion have already been discovered. About 100 billion of these have already been produced, and a reserve of 36.3 billion presently exists at early 1973 conditions. Note that this leaves about 298 billion barrels already discovered but not classifiable as reserves. With technology already developed, reputable engineers have estimated that 35 to 40 billion barrels of these can be recovered with an adequate increase in price to offset the higher recovery costs which more sophisiticated recovery methods require. The industry has eminently demonstrated its capability to develop its needed technology and will continue to do so if it has an adequate economic incentive and political climate. Since 1942, as a result of improved recovery technology, the average recovery of oil in place from known fields has increased from 21 to 31 percent. With further development of recovery methods, both by improvement of existing procedures and pursuit of concepts currently under study in research laboratories, it has been estimated that average recovery efficiencies in excess of 50 percent of the oil in place can be achieved. This would amount to 70 to 80 billion barrels from currently producing fields.[3] Currently, about 40 percent of U. S. domestic daily production is obtained by means of secondary and tertiary recovery methods.

Probably the most promising way of increasing our near term domestic crude oil availability is to intensify offshore exploration and development activity. This is over and above oil from the Alaska North Slope which,

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[3]Clewell, D. W., An Appraisal of the Petroleum Situation in the Ocean, presented before NOAA Conference, Seattle, Washington, July 17-19, 1973.

it is hoped, will become available during the period by expeditious installation of the required pipeline. As Figure 4 shows, about 65 percent of our onshore domestic discoverable crude oil has been found. The U. S. land area, excluding Alaska, has been one of the most intensively explored regions of the world. The opportunities of finding large new fields on land are now limited and future on-land discoveries can be expected to be mostly found in smaller, deeply buried fields. In contrast, only about 14 percent of offshore discoverable oil has been found, and it can be expected that significant quantities of remaining discoverable offshore oil will be found in large and relatively shallow fields. Such fields are much more susceptible to discovery by present oil-finding techniques than are the remaining undiscovered fields onshore. This is not to imply, however, that we should ignore onshore possibilities. As indicated earlier, we shall need to take all reasonable steps to increase domestic energy availability.

Natural Gas Supply

In some respects the natural gas demand-supply outlook is even more bleak than that for crude oil. Even with an aggressive domestic exploration and development program and an intensive effort to increase our import and synthetic gas production capabilities, it would appear that we shall fall even shorter of supplying the potential demand for natural gas than we have for oil. The outlook for natural gas is presented in Figure 5. This is based on data developed by NPC.[4] It is significant that even with an accelerated effort the decline in onshore gas supply will continue through 1985. If steps are not

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[4]NPC, U. S. Energy Outlook, An Initial Appraisal, Volume II, November, 1971.

taken to intensify exploration and production and the present decline in gas productivity persists, the onshore yearly production can be expected to drop to below 10 trillion cubic feet per year in 1985 rather than the 15.2 trillion projected in the intermediate case shown.

As in the case for petroleum liquids, it is not a lack of gas resources which lies at the root of the problem. Rather, the problem stems directly from the ill advised Federal Power Commission policy of regulating gas prices at the wellhead at unrealistically low prices. The relationship between risk and return on investment has caused a poor economic climate. A table of resources and reserves is shown in Figure 6. It will be noted that of the 1857 trillion cubic feet of ultimate discoverable gas in the U. S., 699 TCF have already been found, as of the end of 1973. Of that discovered, 433 TCF have been produced. Thus, there are on hand reserves amounting to 266 TCF and another 1158 TCF remain to be discovered.

Similar to the case for oil, the most promising means of increasing domestic production rapidly would be intensification of offshore operations and for the same reasons. It should be noted that about 15 percent of future gas will be obtained from that associated with oil production. Hence, accelerating the finding and production of new oil will also make new gas available.

Causes of the Energy Shortfall

A great number of factors have combined to create the current situation. The reasons behind these factors are often numerous and complex and the reader is urged to ask himself "why?" as he reads each of the more significant of these factors:

1. Stagnation of domestic crude oil production rates
2. Decline of domestic natural gas production

3. Delays in planned completion and operation of nuclear powered electric utility plants
4. Technological difficulties with the development of sulfur control equipment for coal and oil burning equipment
5. Rapid upturn of economic activity
6. Environmental and safety-related equipment on motor vehicles
7. Lack of significant expansion and addition of new refineries
8. Concern about environmental effects of strip mining and human safety in deep mining.

CHAPTER II

PETROLEUM TRANSPORT ON THE OCEANS

It is evident that even with a very material conservation of energy, and marked increase in domestic petroleum exploration and development, a very large increase in imports of petroleum will be needed. Both crude oil and natural gas will be required. It is expected that a portion of U. S. needs can be obtained from Canada by pipeline. Nevertheless, by far the greater bulk of our imports will have to be transported by ship. Transport of natural gas by ship requires a different type of operation than that for crude oil and will be treated separately.

Crude Oil Imports

Reference to Figure 2 will establish that the period between now and 1977 will be particularly critical with respect to domestic supply. Even with a greatly expanded domestic effort, because of the time required, domestic production rate will decrease during this period. Beyond that time with continued effort it will slowly increase but not commensurate with the increase in demand. A projection of anticipated crude oil import requirements is provided in Figure 7. It will be noted that overland imports from Canada are projected to rise from a present value of approximately 3/4 million barrels per day to 2.8 million by 1985. This, of course, will depend upon developments in Canada in the intervening period. Changes in Canadian domestic needs, supply, import availability and export policy can markedly affect the projection. Thus, the need for foreign waterborne imports could be higher than projected.

Just to handle the waterborne crude indicated in Figure 7 will require a great increase in maritime shipments into U. S. ports. In order to handle these increasing volumes of imports, the transportation system made up of very large crude carriers (VLCC's) and modern deepwater terminals is both environmentally preferable and economically superior to alternative transportation methods.

In the past, most waterborne imports have come from Latin America. This relatively short haul has been accomplished with tankers mostly within the range of 35,000 to 70,000 deadweight tons. As a consequence, only a few ports exist at present in the U. S. capable of handling ships larger than 70,000 dwt capacity. While a "tight" definition of port capability depends on more than tonnage specifications, e.g., draft and mooring equipment, the following ports have some ability to handle larger ships.

Portland, MA
New York Harbor (Stableton Anchorage)
Northville, L.I.
Norfolk, VA
Corpus Christi, TX
Estero Bay, CA
Huntington Beach, CA
El Segundo, CA
Long Beach, CA
Los Angeles, CA
Anacortes, WA
Ferndale, WA

The prospects are that oil from Latin America will decrease in the future and that the bulk of imports will come from the Middle East and Asia. Because of the economics in transportation cost it is expected that the bulk of the ships used for this purpose will average 250,000 dwt and range up to 400,000 dwt or larger. Unless port facilities are provided to handle vessels of this size, crude will have to be transferred from them at nearby foreign ports to the smaller tankers for reshipment into U. S. ports. The use of

combined large and small vessels or transshipping would require an amount over the use of large vessels between $0.05 and $0.15 per barrel.

Continued use of small tankers could increase traffic in U. S. ports threefold by 1985. This would impose a severe burden on already congested harbors with greatly increased probability of collision and spills. On the other hand, the use of large vessels could keep the number of unloadings estimated for 1985 at about present day levels. Further, these large vessels would call at separate, specially designed terminals, away from existing harbors and congested areas, further reducing the risk of accidential collision.

In view of the significant economies to be had and the marked increase in safety which would result, it appears imperative that the development of facilities to handle larger vessels should proceed as rapidly as possible.

The single point mooring techniques for unloading tankers are a proven technology, with over 100 such facilities in service around the world. It is not only possible to install such facilities in association with current port activities, thus relieving inner port congestion, but a new dimension has been provided in that such facilities can be installed close to a center of usage for which no natural port exists or for which expansion of existing ports to accommodate larger vessels is not feasible. Recently the U. S. Corps of Engineers has thoroughly studied the relative advantages of offshore facilities[5] and endorses their use.

Liquefied Natural Gas

A significant increase in imports of natural gas will also be required. As indicated earlier, even with a several fold increase in imports, it will not be possible to fully supply potential demand. It is expected that some

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[5]Brig. Gen. J. L. Kelly, "Offshore Terminals and the National Perspective." Presented before the annual meeting of the Marine Technology Society, Sept. 10-13, 1973, Washington, D.C.

of the demand can be supplied by pipeline from Canada, but the same factors which can be expected to control Canadian oil exports will affect natural gas, too. These factors revolve around such items as the amount and location of both supply and demand, energy alternatives available, economics, environmental considerations, and most importantly, Canadian, U. S., and other governments' policy considerations. A small amount of gas imported at present from Mexico is expected to become unavailable by 1975. Thus, a significant increase in waterborne liquefied natural gas imports is projected to 1985. Only a very small amount of LNG is imported at present. Because of lack of ships and handling facilities, it is expected that the amount imported by 1975 will not exceed 0.25 trillion cubic feet per year. However, the amount shipped in is expected to rise at a much faster rate after that time, reaching a level of about 4.5 TCF by 1985. This will not adequately meet demand because imports will be primarily controlled by the rate at which adequate facilities can be provided assuming that foreign supplies will be made available at an acceptable cost.

While liquefied natural gas plant technology is fairly well established, the optimum means of shipping LNG is still being actively researched. At least four different types of containment systems are being routinely used or considered at present. Again, port restrictions may prove to be a more important factor than technological development. Since virtually a new fleet will have to be developed for LNG shipment, much consideration is being given to optimum vessel characteristics. At present it appears that a ship having a capacity of about 1 million barrels and possessing about a 20 knot speed will be best suited for the anticipated conditions. If the projected imports are to be achieved, about 44 such vessels together with the necessary port facilities at each end of the voyage will be required by 1985.

Because the unloading of LNG requires a very substantial plant for the vaporization of the low temperature liquid, the relatively simple offshore unloading systems envisaged for crude oil handling will not suffice for LNG. Thus, unless substantial fixed offshore structures upon which the necessary vaporization facilities can be placed prove economically feasible, present port facilities will have to be modified or new onshore facilities built to provide for LNG imports.

By now it should be sufficiently apparent to all that we must move without delay to alleviate our energy shortage by all reasonable means. To delay action can only mean a more aggravated problem in the future.

CHAPTER III

THE RESPECTIVE ROLES OF GOVERNMENT AND INDUSTRY

If our country is to develop and maintain an adequate energy self-sufficiency in a reasonable time, all segments of our society will have to work effectively together. Every reasonable effort to conserve energy must be pursued. All avenues of communication must assume greater responsibility for informing the public as to the facts, the nature of the problem, and the alternative solutions available to us. A closer relationship between industry and government must be developed--one in which the respective parts which each can best play are fully recognized and in which the necessary cooperation and encouragement are provided.

Of overriding importance is the necessity for the government to provide national direction, articulating national priorities and goals, providing legal safeguards, encouraging economic growth, maintaining and enhancing this country's appropriate conservative use of its natural resources and its optimum environmental and social amenities. It should foster an informed and unbiased political climate. The government should develop needed technical information where it is best suited to do it, and to encourage its development by others whenever development can be done more effectively, appropriately, or economically by them. The government should serve to collect and make available to users such information as is essential for achieving national goals.

Development of Required Technical Information

In general, the country's interests will be best served if members of industry are encouraged to undertake that research and development essential

to the maintenance of an economically viable and competitive industry. The petroleum industry has amply demonstrated its willingness and capacity to conduct the necessary R and D effort given a favorable economic and political climate. It can be counted upon to continue its efforts if favorable conditions prevail. Indeed, its research staffs and facilities for this purpose are unexcelled in the world. On the other hand, the industry has relied heavily upon R and D and technical information developed by others both in academic and government circles where such has been available. Closer cooperation between those responsible for government, industry, and academic research activities will enhance greater understanding of the part each can best play and, under optimum conditions, should result in each performing that portion of the task which the most efficient and expeditious course of action dictates. Unnecessary and costly duplication of effort could thereby be eliminated while still allowing for that freedom to pursue new ideas regardless of source so essential to scientific progress.

In the past, much of offshore operations were evolutionary extensions of onshore efforts and the technology developed over many years has sufficed with only nominal change to provide for near-land operations in shallow water. In the future, the number of operations conducted in frontier areas will increase. Much of the necessary knowledge and technology for successful resource recovery for these frontier conditions awaits development. Moreover, these resources will be more difficult and costly to find and produce. Thus, more precise and abundant knowledge will be required and will have greater relative value than heretofore. Specific suggestions as to needed information will be presented and discussed in more detail in Chapter IV.

Scheduling of Lease Sales

A great and immediate aid the government can provide is a firm and orderly scheduling of lease sales of greatly expanded acreage. The industry

is encouraged by the recent releases by the Department of the Interior of its five-year lease schedule for certain offshore areas. Greatest efficiencies can be achieved if all proposed sales up to two years in the future are firm with sales two to five years in the future on a semi-firm basis. Both government and industry can achieve mutual benefits by working closely together in a cooperative annual updating of the schedule. Industry can certainly best conduct its operations if it has at least a two-year notice of a sale, and this time lead will also probably allow all interested government offices sufficient time to properly plan. The offshore areas that are of greatest immediate interest to the offshore industry are the Gulf of Mexico, Baltimore Canyon, Gulf of Alaska, Bristol Bay, Offshore North Slope, Chukchi Sea, Southern California, Blake Plateau, and Georges Bank. Industry, environmentalists, and government are working together in selecting provinces for future nominations both by point in time and sequence. This will allow industry to utilize to the fullest extent its imminent or current technological capabilities. This cooperation will also encourage a logical development of the total resources within general geographic areas rather than providing what appears to be a less efficient procedure as in the present approach. It seems quite likely that future events resulting from the latest Arab-Israeli conflict may warrant the nation to adopt as a matter of policy the exploration and development of its most promising offshore areas at the earliest feasible time.

Consolidation of Federal Energy Activities

Another step which would appear to enhance the direct communication and cooperation required to develop and carry out national goals is the incorporation of those parts of the many government agency activities that pertain to energy into one or a very few highly coordinated focal points. A difficulty which harasses all those in government concerned with establishment and implementation of federal policy is lack of an integrated source of

necessary information. This arises not so much from lack of provision of the needed information by industry as it does from the fact that portions of the information are collected by many agencies. Each agency or office collects that data needed for its own special purposes or needs but nowhere in government is a timely composite accumulation made. Consolidation of federal energy activities should greatly aid representatives of industry and government to consult effectively relative to offshore matters, thus enhancing expeditious accomplishment of necessary goals.

Priorities

The Petroleum Panel suggests that the benefits to this nation of steady and orderly recovery of the petroleum resources of its outer continental shelf are too great to allow for any unnecessary impediments. While properly recognizing the legitimate rights and desires of individuals, and of local and state governments, the federal government also has the obligation to recognize the equally legitimate regional and national rights and needs. The delicate balancing of these sometimes apparently opposing interests should be accomplished by the democratic processes and the federal government is the proper focal point for the resolution of these conflicts. Coastal zone planning and management implemented at the state level but with federal involvement is a natural and desired consequence of these democratic processes.

Finally, it is realized that the National Energy Policy must stand in legitimate competition with and be reconciled among other equally valid national policies, programs, and goals dealing with such subjects as tax reform, national defense, environmental protection, marine and estuarine sanctuaries, clean air and water, coastal zone management, land use, and optimization of federal revenues and expenditures. The fact that only the government can make the final decision on the priorities of these and

other national goals is fully appreciated and concurred with by industry. Industry is most willing to fully cooperate with government in any and every legitimate way and will accommodate all other interests in every reasonable manner.

CHAPTER IV

RECOMMENDATIONS CONCERNING INDUSTRY AND GOVERNMENT ACTIVITIES IN THE MARINE ENVIRONMENT

Commensurate with the general observations made in the preceding chapter, the Petroleum Panel has listed in this chapter those areas of ocean activity which the government now performs or which we feel the government could perform, the undertaking of which would greatly assist the offshore industry to find and produce the additional domestic petroleum so greatly needed by this country. As an example, industry has benefited from continued improvement in navigation and oceanographic data. Continued improvement of such information in frontier areas would be of great technical assistance. It is recognized that certain government activities naturally are closely aligned with lease sales and that, in general, should continue wherever possible. Other data could be more useful to industry if provided as far in advance of pending lease sales as possible. Certain oceanographic data fall into this classificaiton. Not only would early provision of such data allow industry to better preplan exploration, production, and transportation activities and programs, it should allow government offices involved with offshore activities to better preplan also.

The Petroleum Panel recognizes that federal agencies serve the needs of many segments of society as well as industry and that data of only marginal value to the offshore petroleum industry may have great value for other purposes and users. The report only addresses the interests of the offshore petroleum industry. The Petroleum Panel is also cognizant of the fact that the setting of priorities of government agency activities is a matter solely to be

decided by government. Nevertheless, it hopes that a lack of provision by government of information which would be of use to the industry will not result in the postponement or impedance of planned offshore petroleum efforts. This is to say that industry is not solely dependent upon government data or assistance for successful offshore activities but that the additional information may make for safer and more economical operations. The petroleum industry feels that the government's primary emphasis should be on activities traditionally performed for the benefit of broadly based user groups.

The following list of government marine activities is divided into two categories. These are activities considered by the industry to be: 1) both appropriate and important to the offshore petroleum industry; and 2) activities considered to be less important to marginal as far as use to the offshore industry is concerned. It will be noted that some items represent data which have been made available in some form in the past. Others represent information which may be new, improved or extended in scope. In this connection it should be observed that industry has many offshore structures which offer in a number of instances the opportunity to improve the gathering of data or to make possible the obtaining of new information heretofore inaccessible or not feasible to acquire. Many companies have a standing policy of permitting and encouraging use of these platforms by qualified government and academic representatives for selective scientific and research purposes. The primary conditions upon their use are that the additional activity will not endanger lives or property and that it not unduly interfere with the principal purpose of the structure.

Activities Considered Appropriate and Important

Following are those activities considered by the Petroleum Panel of OSTAC to be both appropriate and important to the offshore petroleum industry.

1. Fate and effects of oil in the marine environment.

The fate and effects of oil discharged into the world's oceans is one of the most pervasive environmental concerns facing the petroleum industry and the U. S. government. It is an inter-regional matter and one that affects many segments of government, industry, and society. Even though we have learned a lot about the effects of oil in the marine environment, there is much more to know.

It is essential to determine as rapidly as possible the facts with regard to the fate and effects of oil in the ocean so that all concerned can make decisions which truly represent what is in the best national interest. Based on inadequate information and sheer speculation, a number of individuals have predicted very dire consequences of oil entering into the sea. These conclusions which we believe to be largely premature or unfounded, coupled with adverse publicity given to major spills, have greatly exaggerated the proportions of the problem and have unduly aroused the concern of the public, industry, and government. In response, government and industry have adopted new regulations and expensive procedures in the conduct of marine oil operations without adequate knowledge that they are either necessary or justifiable. These regulations, plus those currently being formulated, will have far reaching effects on the petroleum industry's marine operations. Not only do they deprive the country of much needed petroleum but they greatly increase its cost.

Government and industry should cooperate in determining the total overall needs and the extent to which they are currently being met. A possible effective way to do this might be to compile a list of needs as seen by both government and industry. It would be possible then to determine whether these needs were being satisfied on the basis of currently available knowledge and ongoing research. If not, programs and optimum means of implementing them could be recommended to fill in the gaps or extend the range of knowledge.

Two big question marks here that need to be answered are what parameters or items to measure and then what techniques, standards, and equipment should be employed for those measurements. Investigations should be conducted and compared for coastal areas with and without various types of petroleum activity and with the open oceans. Determination of petroleum inputs by source and activity should be developed including the location of natural seeps. Inexpensive and accurate techniques for distinguishing man-associated petroleum hydrocarbons versus naturally occurring petroleum hydrocarbons and biologically produced hydrocarbons must be developed.

It would be valuable if government were to increase its research emphasis on the long-term sublethal effects of low level petroleum hydrocarbons rather than concentrating predominately on the well-known, short-term consequences of oil spills. Specific emphasis should be placed on determining whether or not and to what extent and for what duration of time oil pollution poses a hazard. Needed projects under category of fate of oil include studies dealing with natural bacterial degradation, weathering, solubilization, and mass balance investigations of oil in the oceans.

The scope and importance of the subject of fate and effect of oil in the marine environment require the utmost of cooperation, coordination, and planning among and between the various segments of industry and government. Each aspect of the problem should be considered in light of how it can best be handled and every effort should be made to enlist the services of those best able to carry out the various specific parts of the undertaking.

2. Coastal Zone Planning and Management

Regardless of the degree to which it actually impacts its surroundings, the effect of any activity in the coastal zone is greater than it would be

in the open sea simply because it is within the scope of the concentrated number of people who live in the coastal zone. Thus, state and local coastal zone legislation and regulation against onshore and nearshore petroleum-related endeavors can dramatically affect federal and industry offshore plans and operations. While the states in cooperation with their local communities are the logical entities to research, plan and manage their valuable and limited resources of the coastal zone, it is in the interest of all segments of our country that the regional and national interests not be ignored. Thus, the federal government has here a significant role to play. The time has long since passed when an isolated community can satisfy the needs of its citizens without recourse to supplies and services beyond its pale. Thus, all must cooperate, each making some sacrifice, so that everyone will be better served. In ascertaining the regional and national interests that must be incorporated into the state planning and management programs, the various federal agencies must work together to assure a balanced input of social, environmental, technical, economic, defense, etc., considerations. The federal government should also cooperate fully with the states in the collecting, sharing and interpreting of the oceanographic and environmental data collected in the coastal and offshore areas.

A specific effort that logically falls within the scope of federal government activity that could be very useful in high use offshore areas is the compilation of all principal uses and intensities by month or season. Potential conflicts between users of the sea might thus be avoided if patterns of use could be established. For instance, the petroleum industry could schedule geophysical surveys to avoid overlap as to area and season for specific fishing activities. Likewise, activities undertaken by others might reasonably be rescheduled by them with little or no loss to permit optimization of petroleum industry activity.

3. Measuring and forecasting marine conditions in frontier areas.

Oceanographic data currently used by or of greatest potential use to industry for design and planning are as follows:

a. Sea states. Sea state, including swell and waves, giving significant heights, significant periods, and energy spectra.

b. Winds. Sustained winds at 10-meter height including speed and direction.

c. Currents. Surface and vertical profiles of speed and direction of tidal, wind driven, and general circulation currents.

d. Tides. Sea surface elevation changes caused by astronomical and storm tides.

e. Other meteorological data. Air temperature, precipitation, visibility, humidity, icing tendency.

f. Water temperatures. Surface and bottom temperatures (recording frequency to be daily or weekly, as appropriate).

g. Reliability of communication. Data on ionospheric conditions and guidance in selecting radio communication frequencies.

h. Sea ice. Occurrence, motion, strengths, salinities, and dimensions. This should cover bergs, pack ice, large ice ridges, and shore-fast ice.

i. Ice scour and bottom sediment scour. Occurrence and intensity on sea floor in applicable places such as the offshore North Coast of Alaska.

j. Seismic activity. Occurrence and magnitude of earthquakes; associated geologic information in seismic active regions.

k. Data atlas. Assemble for specific areas historical and new information covering all items above and make available in summary form, either by computer filing and recall or by frequently updated "encyclopedias."

The frequency of obtaining the readings above on a three-or six-hour basis would be most useful unless rates of change are slow. The extremes of storms should be based on 1, 2, 5, 10, 25, 50, 75, and 100 year occurrences.

Such data as those listed above are essential to baseline studies if valid results are to be obtained. Future efforts should primarily be directed towards filling gaps and in extending knowledge rather than duplicating prior data, unless there is reason to believe that such data are significantly in error. This data will not only aid industry in their planning and daily operations but it is essential to understanding biological relationships and the development of environmental baseline studies.

Forecasts and warnings of hurricanes and severe storms and or critical values of other parameters mentioned above are required to support safe day to day operations of all ocean users.

4. Bathymetry, surface geologic mapping of the sea floor using grab samples, shallow core data, reconnaissance gravity, magnetic, seismic surveys, regional geologic mapping, and broad basin type mineral resource potential studies.

The government can be of great assistance if it collects and assimilates accurate bathymetric data. Where these data do not now exist, or could be justifiably improved, they should be obtained and compiled. The scale mapping of bathymetry should be correlated to diversity and intensity of map usage. Normally, areas around population centers and other areas of high use should receive priority attention and greater detail. Primary use by the petroleum industry of this data would be associated with seismic line layout, gravity corrections, pipeline laying, and determination of unstable conditions. Specific areas of interest are dictated by offshore fields and deep water terminals and onshore facilities. Detailed surveys of bathymetry for specific projects and single users such as deep water oil terminals and offshore pipelines should be the responsibility of the user.

Specific geophysical and geological assessments by government would be of greatest use if it provided general regional information with respect to the following: location, general outline, and configuration of sedimentary basins; determination of age and thickness of stratigraphic sections; location of major intrabasin structural features such as rift zones and arches; surface faults; subsea soils characteristics and location of geologically unstable sea floor conditions. Determination of these various features can be provided by regional reconnaissance gravity, magnetic, and seismic surveys, bathymetric mapping, and ocean bottom sampling. Such programs will provide government with the information necessary to outline potentially productive areas and to determine the problems associated with the exploitation of those areas. Government-conducted and government-supported regional geologic mapping and broad basin-type mineral resource potential studies are of interest and use to many scientific, governmental, and commercial interests.

The exact point of demarcation between regional reconnaissance surveys and detailed prospective surveys is irrelevant as long as the terms are conceptually compatible among interested parties. Petroleum industry companies generally agree that geophysical grid surveys of 20 miles by 20 miles or greater are reconnaissance and everything as dense as 5 by 5 miles is prospective. Industry recognizes and encourages the efficiencies that may be obtained by government conducting several scientific and oceanographic shipboard investigations concurrently. The net values derived, however, are dependent upon associated needs, benefits, and costs. For example, the required density of line spacing for bathymetry, gravity and magnetics, and deep seismic data surveys differ considerably. Industry needs detailed geophysical data for prospective evaluations while government

uses geophysical data for outlining regional geology including the definition of large sedimentary basins, general management decisions, and for filing environmental impact statements. The different needs by different users require varying degrees of data accuracy and completeness and do not signify inherent incompatabilities.

Because of the inherent risks and uncertainty in determining the potential of exploration ventures, even with extensive geological and geophysical work, individual members of the offshore industry interested in acquiring leases must of necessity conduct their own detailed surveys. One need only consider the wide range in bidding at lease sales now to recognize the great latitude for differences in interpretation that exists within the framework of the best obtainable data. The necessity to acquire reserves to continue to stay in business and the high degree of competition existing among oil and gas producers will assure that bonus bids on sales tracts will provide the government more than adequate remuneration for the value of the federal leases. Thus, it would appear that the optimum use of the limited available funds, both federal and private, would be made if the effort continues to be divided. Accordingly, it appears the national interests would be best served if the government programs were directed primarily to reconnaissance of the vast reach of the U. S. continental margins, leaving the detailed prospecting to the individual companies. There is little if any chance that the government will lose by this policy and by minimizing the duplication of effort more funds should be available for the needed reconnaissance and other needed oceanographic data.

Much offshore geologic and geophysical data collected by the petroleum companies is also valuable for achieving national goals. While

some of this data is exceptionally confidential to individual companies, other data fall into categories of lesser confidentiality and nonconfidentiality. Efforts by industry are being increased to transfer data of these latter categories to government archives such as NOAA's Environmental Data Services.

5. Measuring and locating the mean low-water line along the shore, charting of offshore areas tied into geodetic markers, and establishment of precise positioning capability.

Geodetic markers placed offshore are a logical extension of government responsibility traditionally performed onshore. It is highly desirable that the government take whatever steps it can at the earliest date to establish or bring about settlements of all boundaries between private citizens, local, state, and federal, and/or international governments. Under present procedures this will require measuring and locating of the mean low-water line along this shore and the charting of offshore areas. It would be highly desirable if a more permanent base system for boundary lines and offshore charting could be adopted.

In 1963, the former U. S. Coast and Geodetic Survey established some horizontal control off the Louisiana coastline. The financing of this effort was done jointly by the government and the petroleum industry. Since 1963, the system has been extended by industry to include virtually all platforms. This supplemental control, while not as accurate as the USC&GS work, is adequate for drilling operations.

Although the industry system is available to most users, additional surveys and placement of markers by government would be of great value. The East Main Pass, South Extension of West Cameron, East Cameron, Vermilion, South Marsh Island, and Eugene Island areas of Louisiana are areas of great

need at present. Other areas of prime importance would be the Texas, Mississippi, Alabama, and Florida offshore areas, as well as other areas previously mentioned and under consideration for tract sales. Ideally, the sequence of plotting the frontier areas should generally coincide with but adequately precede in time the tract sales. Geodetic control along the continental shelf of all prospective areas will be a necessity in order to properly operate beyond the shelf in deeper water and long distances from shore.

In all probability, there will be many significant differences in future petroleum operations in frontier areas than in those of the Gulf of Mexico in the past. The Gulf of Mexico petroleum development was an evolutionary stepping stone occurrence starting from the shore utilizing onshore techniques and equipment. Frontier areas will probably begin development 50-100 miles or more offshore employing specialized equipment.

Geodetic control of platforms in the Gulf of Mexico went seaward from known onshore positions. Each fix is believed to be at least $\pm$ 50' in accuracy. While the compounded error of several fixes may be potentially large, the significance of the error can be easily minimized. To avoid any possible illegal drainage of hydrocarbons from adjacent tracts, platforms are placed within the boundaries of the tracts to compensate for possible errors of positioning. Most tracts are either 5,000 or 5,760 square acres. Navigation hazards due to errors in plotting are minimized by establishing shipping fairways as well as platform warning devices such as lights and horns. The Geneva Convention on the Continental Shelf stipulates that ships in transit allow at least 500 meters clearance from the periphery of artificial islands.

The ability to determine precise locations with low-cost, on-board equipment will be of substantial benefit to petroleum exploration efforts

as well as to sports and commercial fishing vessels, aircraft, pleasure craft, and commercial transport vessels. Such an ability could add greatly to rescue and safety-at-sea efforts, too. Ultimately, a traffic control computer system would greatly enhance safety and operations by providing detailed information at the time of need relative to all vessels and fixed structures in a particular area.

Industry is most interested in the positioning test project now being undertaken by NOAA's Satellite and Marine Applications Section of the National Geodetic Survey. Hopefully, the test will result in the ability to locate platforms or other objects anywhere offshore to at least six feet of true position. Further, this accuracy may be obtainable at less costs then current methods of surveying. Markers of this accuracy in frontier petroleum areas would be of tremendous assistance and benefit.

6. Intensify efforts on the possibilities and consequences of weather modification.

Prediction, alteration, and modification of the physical elements are of considerable interest to the offshore industries. Better prediction of path and intensity of hurricanes could significantly reduce operational costs where these are prevalent, particularly on the East and Gulf Coasts. The Petroleum Panel strongly supports NOAA's hurricane research programs and especially Project STORMFURY which was developed to explore the structure and dynamics of hurricanes, potential for modification, and verification of results after seeding with silver iodide. Due to the potential benefits to our industry as well as to all society accruing from hurricane modification, we would encourage substantial amplification and intensification of this project.

Another project to be considered would be the fixing or control of the location of the ice sheer zone offshore the Alaskan North Slope.

The development of a means for predicting and modifying the direction of movement of large ice islands and ridge formations in the same area would also be of benefit. Likewise, rerouting or destruction of icebergs in any higher latitude area would aid in the design and operation of any platform expected to be exposed to icebergs.

Activities Considered to be of Less Importance, of Marginal Value, or More Appropriately Performed by Others

It has been recognized earlier in this report that the Petroleum Panel is not in a position to assess the relative value of all government activities to all users. Hence, it must consider the value of government-provided services within the framework of its own expertise and experience. From this viewpoint and with a sincere desire to put forth recommendations which it believes to be in the best national interest it makes the following observations:

1. Individual tract evaluation

The opinion has already been expressed above that the detailed surveys necessary for individual tract evaluation are best left up to industry. The only method of accurately ascertaining the presence of petroleum hydrocarbons in an underground formation is by exploratory drilling. Preliminary efforts utilizing geophysical interpretations, while they give some idea of structure, provide at best only educated guesses as to the real worth of a tract. For the government to gather the detailed information to duplicate that obtained by the industry would not only be expensive and drain away funds from more useful government enterprise, it would not really satisfy the purpose for which it is claimed that it is needed. The principal justification advanced for its collection is that it would permit government to independently assess the value of the tract and thus keep industry from getting a parcel for less than its worth. The thought being here that if bids did not equal or exceed the value placed

on the tract by government it would be withheld. There is very little chance, if any, that this will increase the government's revenue over that which it now gets. Indeed, this practice has a good chance of being contrary to the national interest. There are several reasons for this. First, in view of the limitations of the data, the government's evaluation is as likely to be as erroneous as that of any of the individual bidders. If the government appraisal places a higher value on the tract than that of even the most optimistic bidder, as has often been the case, the individual tract will not be sold. While this tract might subsequently be sold in some future sale, the odds are good that it will not unless government places a lower value on it in a future sale. In either case, the government loses or postpones receipt of money it could have received and, more important, the opportunity for early development of much needed petroleum reserves. Second, since the fair market value of any item being sold is what the market will bear, the government's appraisal, being unknown to the bidders, does not protect the nation's citizens from any "loss of heritage." The prevention of this theoretical loss of value is the rationale for the tract evaluation.

2. Production and drilling technology

Experienced research personnel know that the closer the research and development problems approach operations the more they require actual experience with operations for their optimum solution. Thus, as a matter of policy and experience, it has been found advantageous in the development of such things as new and improved exploration, drilling, and production equipment to encourage the suppliers to perform the research and development. In those instances when for one or another reason it has seemed appropriate to pursue such research within the petroleum industry laboratories, the knowledge and experience of those intimately acquainted with the operation

have been heavily drawn upon. In fact, the required research and development have been of such a magnitude that many companies, both operators and suppliers, have jointly sponsored the R & D projects.

Often suggested projects require major auxiliary research requiring intimate knowledge of the significance of the many variables involved. As an example may be cited the development of a system for use of continuous drill pipe. Variables to be satisfied range all the way from space limitations which must be met to development of new metallurgy. Ultimately such developments must be tested under actual operating conditions usually with a prolonged, extensive and costly pilot stage.

For these reasons, the Petroleum Panel would recommend against government undertaking of this type of work. Both industry as well as government experience gained in defense, NASA and Atomic Energy agencies as well as others indicate it is better to arrange for experienced people and firms to perform such research. It should also be mentioned that industry itself has always been willing to provide the necessary technology as its potential need has become apparent. Were it not for technology developed by the U. S. petroleum industry many of the 70 countries around the world now enjoying the fruits of petroleum developments in their offshore waters would not even know they had such a resource. Almost every country has benefited from the petroleum produced from these foreign areas including the United States. It is unfortunate to say the least that the technology the petroleum industry has exported has not been as effectively used to develop domestic offshore resources because of inhibitions imposed upon the industry at home.

The industry supports the need of government to confirm the fact that new techniques and equipment employed on OCS platforms are in the

nation's best interests. Since various government agencies must inspect OCS drilling and production operations for safety, reliability, pollution, and other factors, they must be aware of new industry developments prior to adoption for proper evaluation. For this reason, the appropriate federal bodies are generally consulted by industry during the research and development stages.

3. Performance of studies and acquisition of data, the purposes for which and/or the manner in which the results can be effectively used are not known or poorly delineated.

It is very easy under pressure from poorly conceived legislation or public emotionalism to mount studies which appear to have potential value if successfully pursued but which in fact, even if successful, have little value or little chance to provide the answer to the problem that needs be answered. While many instances can be cited, a number of current ones fall into a class which might be called ecological or environmental. Some of these fall into a subcategory which might loosely be called baseline studies. The importance of establishing unequivocably the impact of petroleum in the ecosphere has been covered earlier. Unless a project for this purpose considers all of the significant variables and provides for their quantitative accountability in the system under study, the results of the study are almost certain to be inconclusive. Thus, studies of only a limited portion of such a system are doomed to be of little value unless they have been carefully planned to provide conclusive, useful results or are designed to usefully fit into a comprehensive framework of similar useful researches. In future research on ecological matters it is hoped that all sources of existing valid knowledge and ongoing research will be used as a base upon which to build projects which augment

the base and extend the frontier of useful knowledge as opposed to replication. Such studies would be of greatest help if they were conceived and executed in anticipation of lease sales and preceded them sufficiently as to not interfere with their timely availability.

The petroleum industry supports the purposes of the National Environmental Act of 1969 which are in part: "To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation ..." Conversely, we are opposed to those endeavors that do not support this balanced viewpoint of which there are an unfortunately significant and growing number.

For many reasons, the Petroleum Panel feels it is imperative that the government soon develop guidelines concerning baseline studies. This effort is needed to help eliminate the current confusion which now surrounds this subject. These guidelines should insure the satisfaction of NEPA's concern for the balance between man, nature, and the Nation.

FIGURE 1

UNITED STATES FOSSIL ENERGY RESOURCES (1973)

	QUADRILLION BTU			
	RESOURCE IN PLACE	RECOVERABLE BY TODAY'S TECHNOLOGY	RESERVES	TOTAL* YEARLY PRODUCTION
COAL	74,400	3,600	3,600	14.56
OIL SHALE	10,440	313	-	-
CRUDE OIL	4,100	415	226	20.12
NATURAL GAS	1,510	295	295	22.66
TAR SANDS	162	29*	-	-

* ESTIMATED

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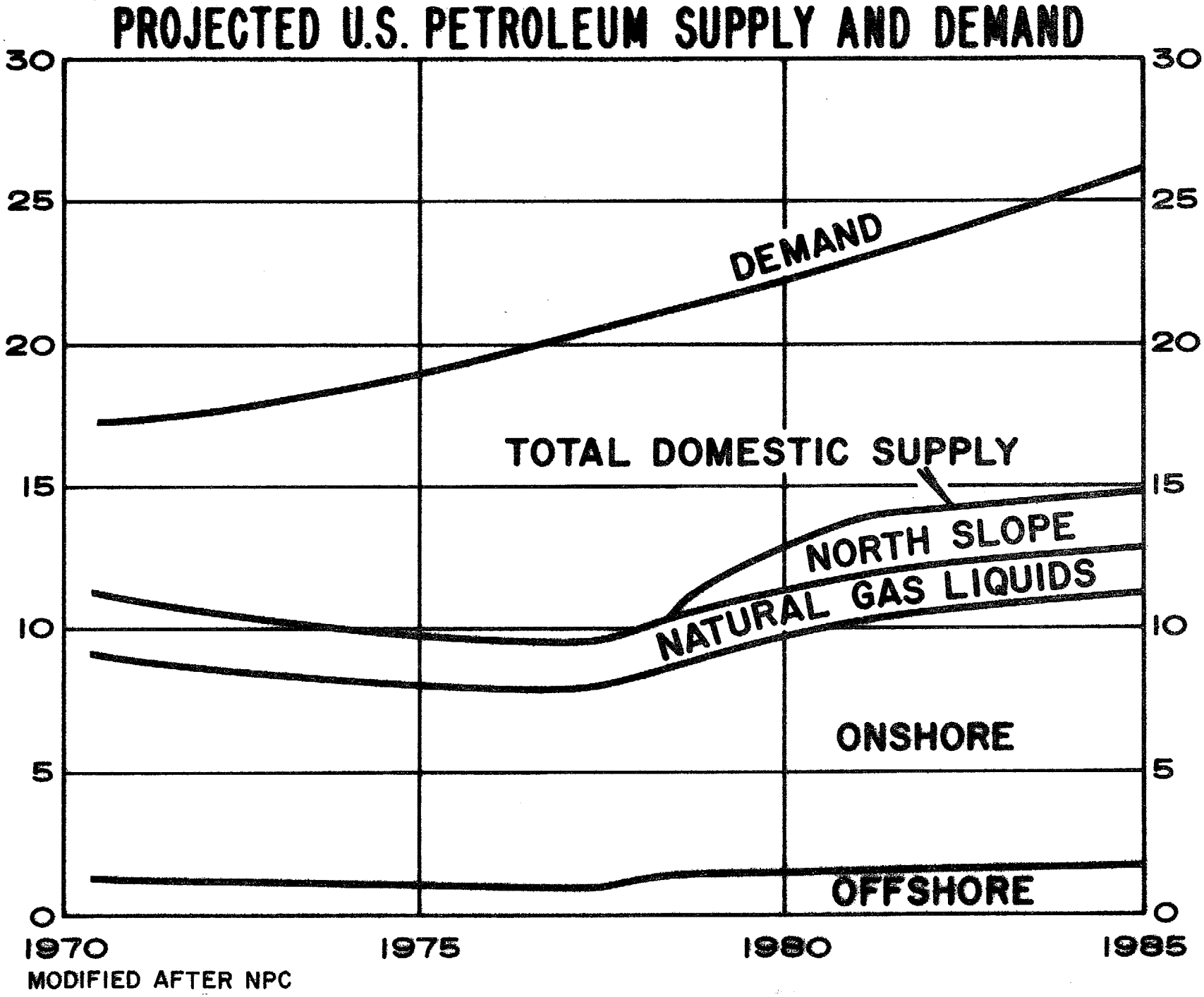
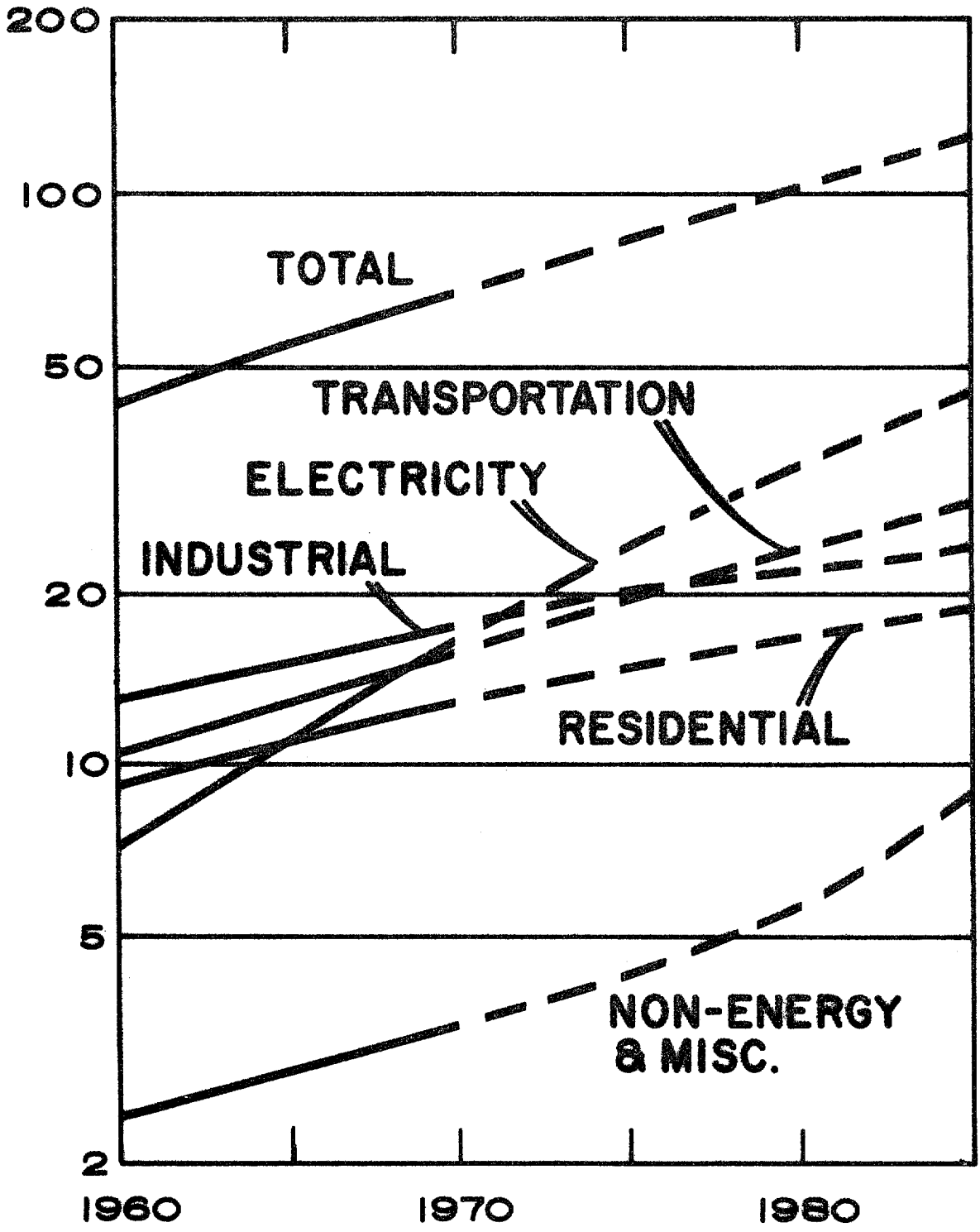

PROJECTED U.S. PETROLEUM SUPPLY AND DEMAND
30
25
20
15
10
5
0
DEMAND
TOTAL DOMESTIC SUPPLY
NORTH SLOPE
NATURAL GAS LIQUIDS
ONSHORE
OFFSHORE
1970
1975
1980
1985
MODIFIED AFTER NPC

FIGURE 2

FIGURE 3

PRIMARY ENERGY CONSUMPTION BY SECTORS



SOURCE: NPC

FIGURE 4

COMPARISON OF UNITED STATES CRUDE OIL RESOURCES, RESERVES, AND PRODUCTION

BILLIONS OF BARRELS OF OIL IN PLACE

	ULTIMATE DISCOVERABLE	DISCOVERED TO 1-1-73	PRODUCED TO 1-1-73	RESERVES AT 1-1-73
UNITED STATES	810.4	434.0	99.9	36.3
ONSHORE	633.9	409.1	94.6	32.3
OFFSHORE	176.5	24.9	5.3	4.0
OFFSHORE				
ALASKA	73.9	2.7	0.5	0.6
ATLANTIC COAST	14.4	0	0	0
GULF COAST	38.6	12.6	3.4	2.6
PACIFIC COAST	49.6	9.7	1.4	0.9

SOURCE: NPC, API, CALIFORNIA CONSERVATION COMMITTEE.

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FIGURE 5

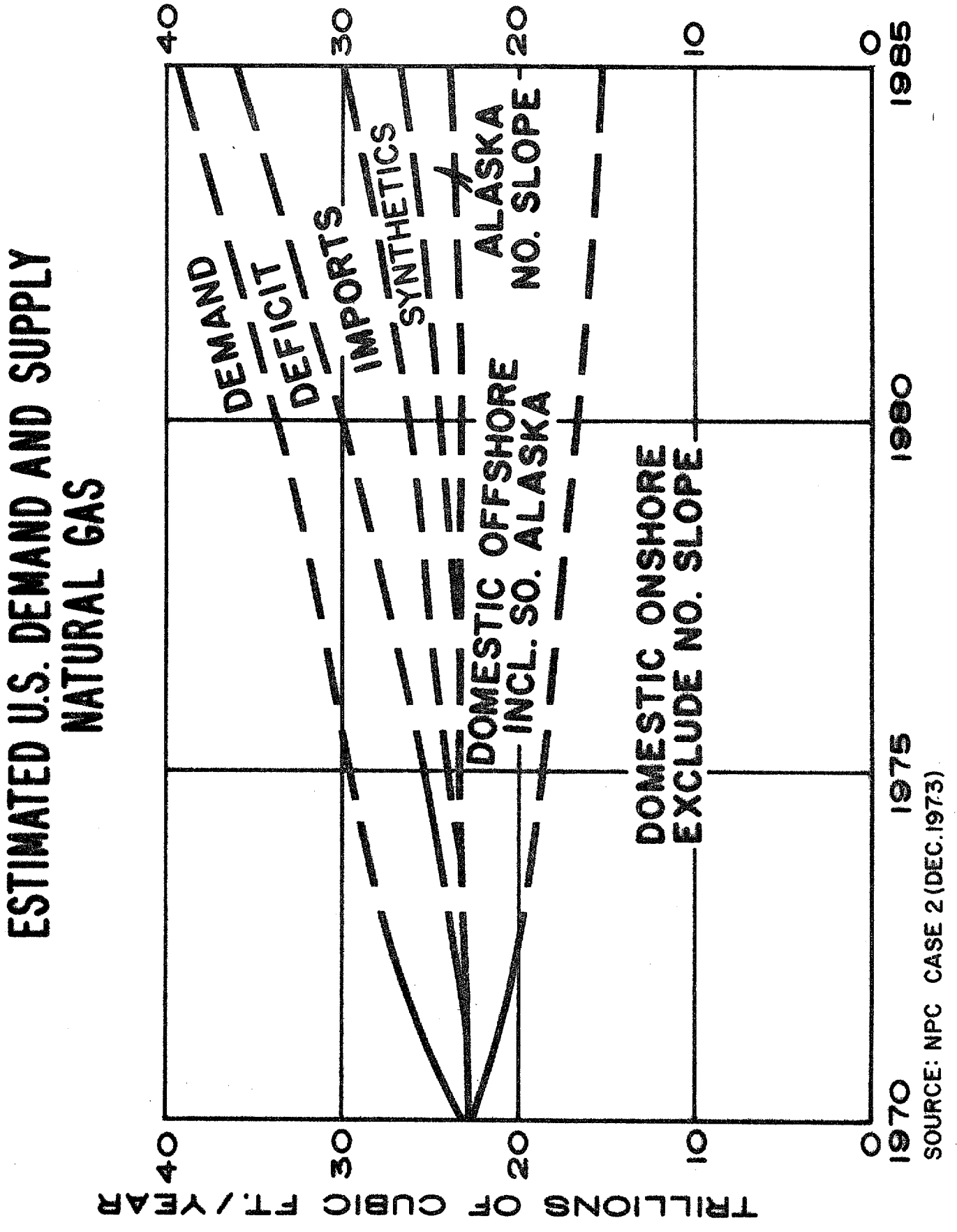
ESTIMATED U.S. DEMAND AND SUPPLY
NATURAL GAS
TRILLIONS OF CUBIC FT./YEAR
40
30
20
10
0
1970
1975
1980
1985
DEMAND
DEFICIT
IMPORTS
SYNTHETICS
ALASKA NO. SLOPE
DOMESTIC OFFSHORE INCL. SO. ALASKA
DOMESTIC ONSHORE EXCLUDE NO. SLOPE
SOURCE: NPC CASE 2 (DEC. 1973)

FIGURE 6

COMPARISON OF UNITED STATES NATURAL GAS RESOURCES, RESERVES, AND PRODUCTION

TRILLIONS OF CUBIC FEET

	ULTIMATE DISCOVERABLE	DISCOVERED TO 1-1-73	PRODUCED TO 1-1-73	RESERVES TO 1-1-73
UNITED STATES	1857.3	698.8	432.7	266.1
LOWER 48 ONSHORE	963.1	603.6	408.1	195.5
LOWER 48 OFFSHORE	260.1	63.1	24.0	39.1
LOWER 48 OFFSHORE:				
ATLANTIC COAST	54.5	0	0	0
GULF COAST	201.8	62.6	23.8	38.8
PACIFIC COAST	3.8	0.5	0.2	0.3
ALASKA	277.4	32.1	0.6	31.5
ASSOCIATED AND DISSOLVED	356.7	217.7	*	75.5

* NO SEPARATE RECORD PRIOR TO 1966.

SOURCE: AMERICAN GAS ASSOCIATION

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FIGURE 7

PROJECTED CRUDE OIL IMPORT REQUIREMENTS

MILLIONS OF BARRELS PER DAY

	1975	1980	1985
TOTAL IMPORT REQUIREMENT	8.5	9.5	11.7
POTENTIAL SOURCE OF IMPORTS			
CANADIAN OVERLAND	1.3	1.9	2.8
FOREIGN WATERBORNE	7.2	7.6	8.9

JES 11/26/73