Guide to National Petroleum Council Report on United States Energy Outlook

How much energy do we need?

Where are we going to get it?

What changes in government policies or economic conditions would enhance our national energy posture?

Presentation Made to
National Petroleum Council
December 11, 1972
by
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Summary

The National Petroleum Council's studies reveal that U.S. requirements for energy will approximately double between now and 1985. During this period, we shall have to rely upon oil, gas, coal, and nuclear power to meet over 95 percent of our requirements. New domestic supplies of these four basic energy sources are not being developed fast enough to meet our needs.

The nation has three basic options:

First, we could rely on increased imports of oil and gas from overseas to meet our requirements. This would impair our national security and provoke a burdensome deficit in our balance of trade in fuels.

Second, we could reduce the growth in energy demand through imposed restrictions or more efficient use of energy. Imposed restrictions would alter life styles and adversely affect employment, economic growth, and freedom of consumer choice. Such restrictions are not recommended. More efficient use of energy is clearly desirable, and some improvement is likely as energy becomes more costly and as technology advances. There are, however, inherent limitations on the extent of the improvements that can be accomplished during the next 15 years.

Third, we can accelerate the development of our domestic energy resources. This is the option strongly recommended by the Council.

Fortunately, we have an adequate energy resource base. Action taken now would markedly improve our energy situation in future years. To attract the vast capital requirements to develop our indigenous resources, we will need higher prices and appropriate national energy policies.

Among other things, the Council urges coordination of energy policies at the national level; development of realistic, graduated approaches to environmental goals; accelerated leasing of federal lands for exploration, particularly the outer continental shelf; continuation of tax incentives to encourage the finding and development of all energy supplies; maintenance of oil and uranium import controls; greater usage of electricity generated from domestic coal and uranium; relaxation of wellhead price controls in order that natural gas prices may reach a competitive market level; expanded research in certain carefully selected areas; and reliance upon private enterprise as the best and lowest cost method of meeting energy needs.

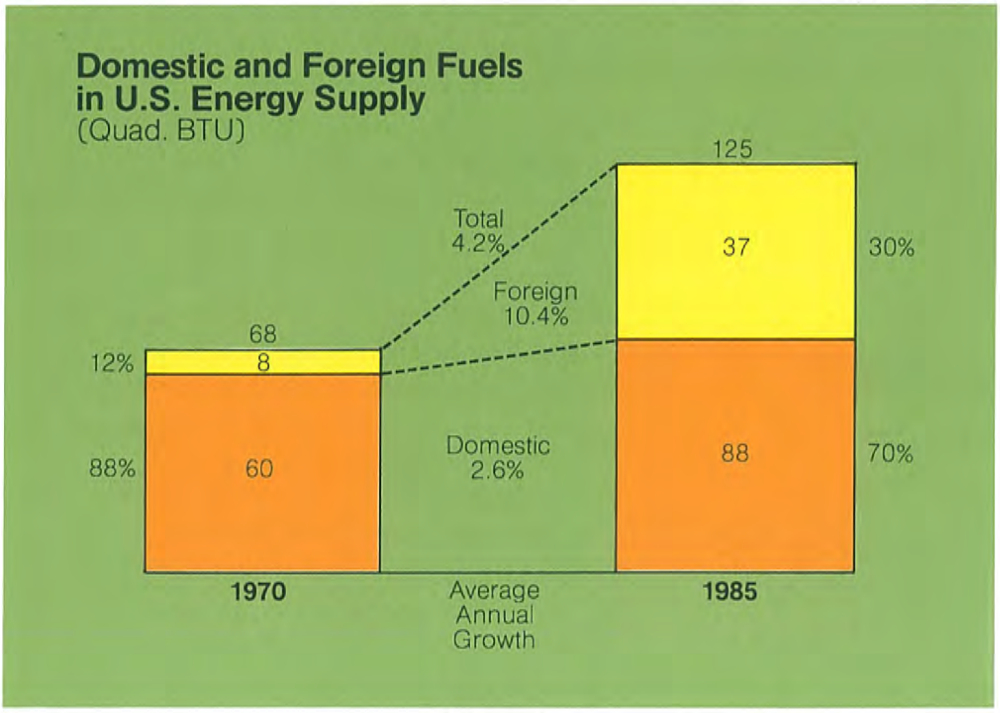


Figure 1

supply, projected through 1985. These projections represent one of the specific requests of the Department of the Interior at the time the study was undertaken.

It did not suffice to make independent projections of supply for each fuel, total these projections, and then compare this total with energy demand to obtain the overall energy outlook. Instead, a more involved procedure was required to develop overall energy balances and, thereby, determine the amounts of imported oil that would be required under various conditions.

The Committee assessed (a) the financial requirements implicit in its domestic supply projections, and (b) the balance of trade implications of the import projections.

The Committee further identified economic and government policy options which will influence the nation's long-term energy posture—from 1985 to the end of the century. This involved analyzing broad trends affecting energy demand and supply and the technological advances likely to occur in the next 30 years. This longer term outlook is important because of the long lead times and difficult problems involved in developing new energy sources, such as solar energy and thermonuclear fusion.

Lastly, and at the Department of the Interior's request, the specific changes in government policies which would improve the nation's energy posture were identified.

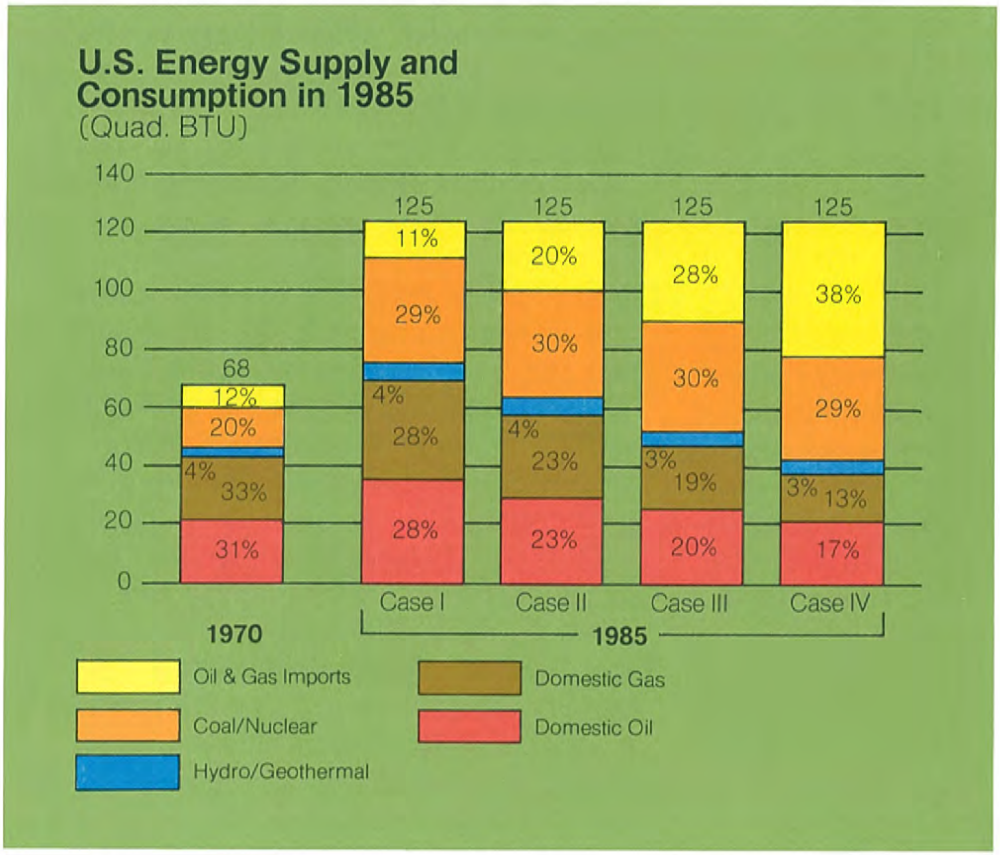
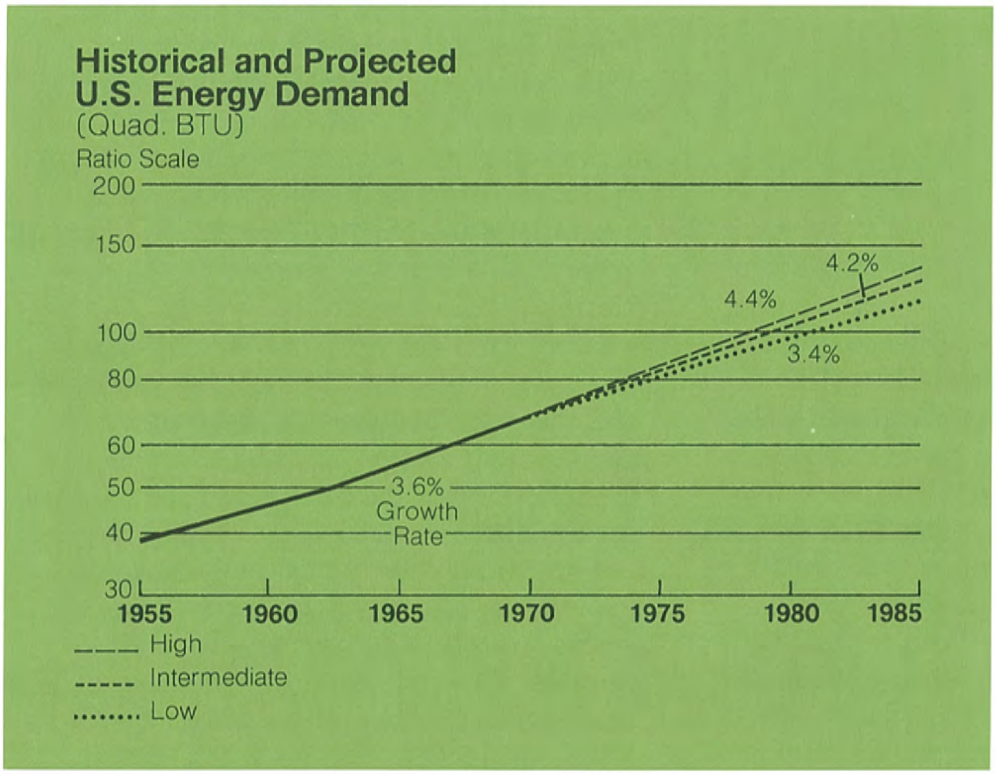


Figure 2

projections used in Case IV, represents a likely outcome if disputes over environmental issues continue to constrain growth in output of all fuels; if government policies prove to be inhibiting; and if oil and gas exploratory success does not improve over recent results.

Two intermediate appraisals (Cases II and III) were also developed. Case II postulates greater improvements in finding rates for oil and gas, and a quicker solution to problems in fabricating and installing nuclear power plants than does Case III.



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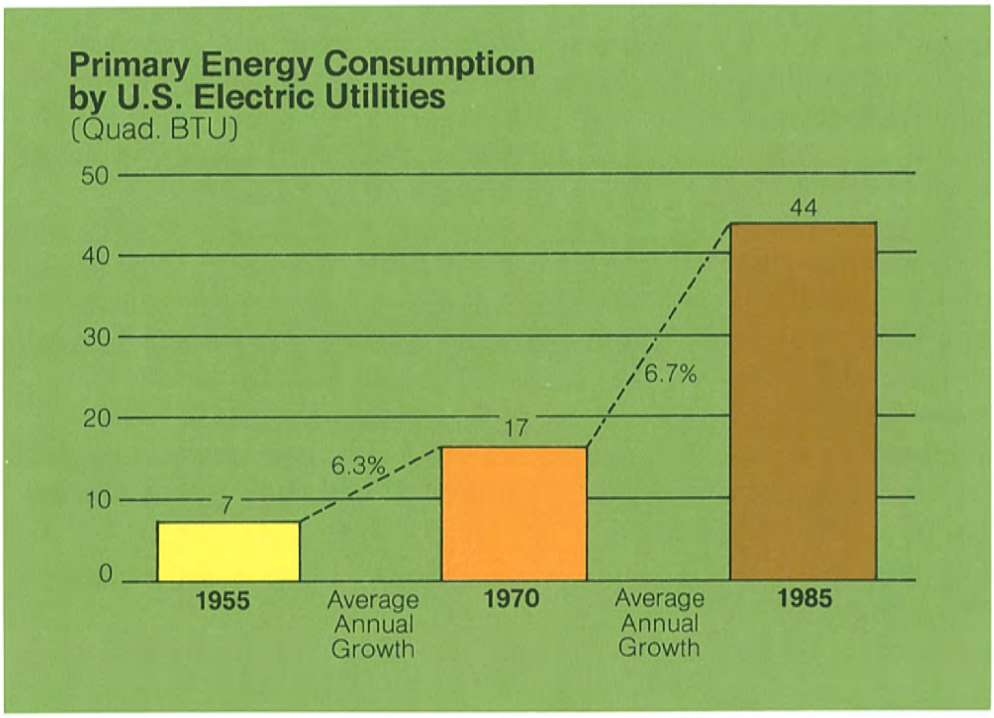

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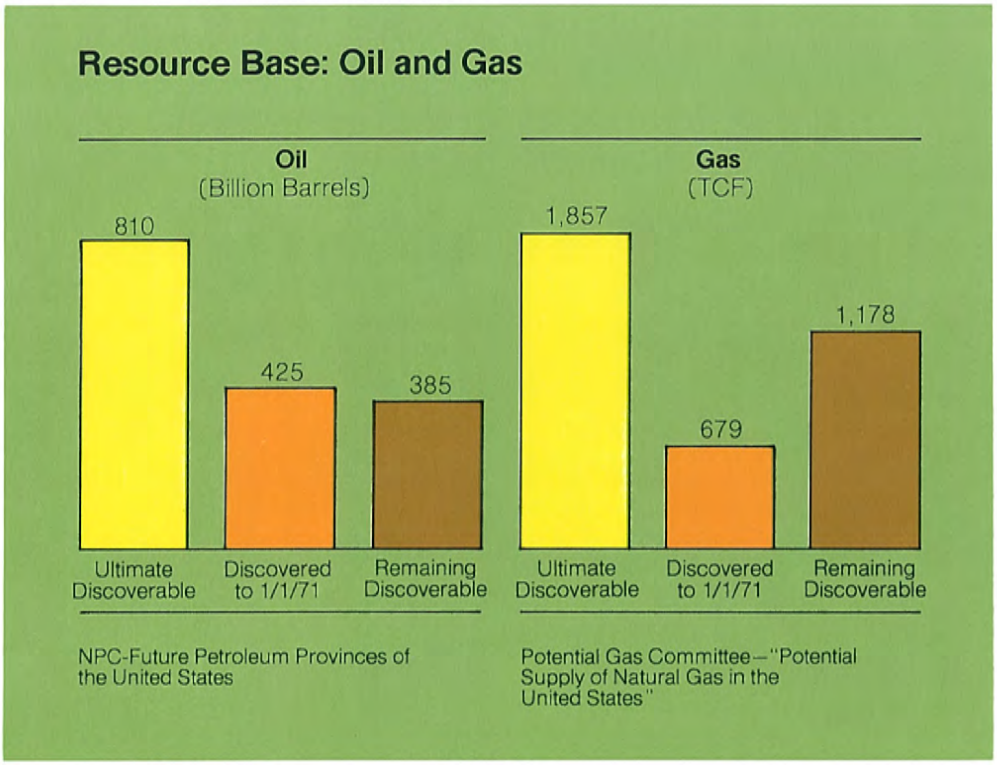


Figure 5

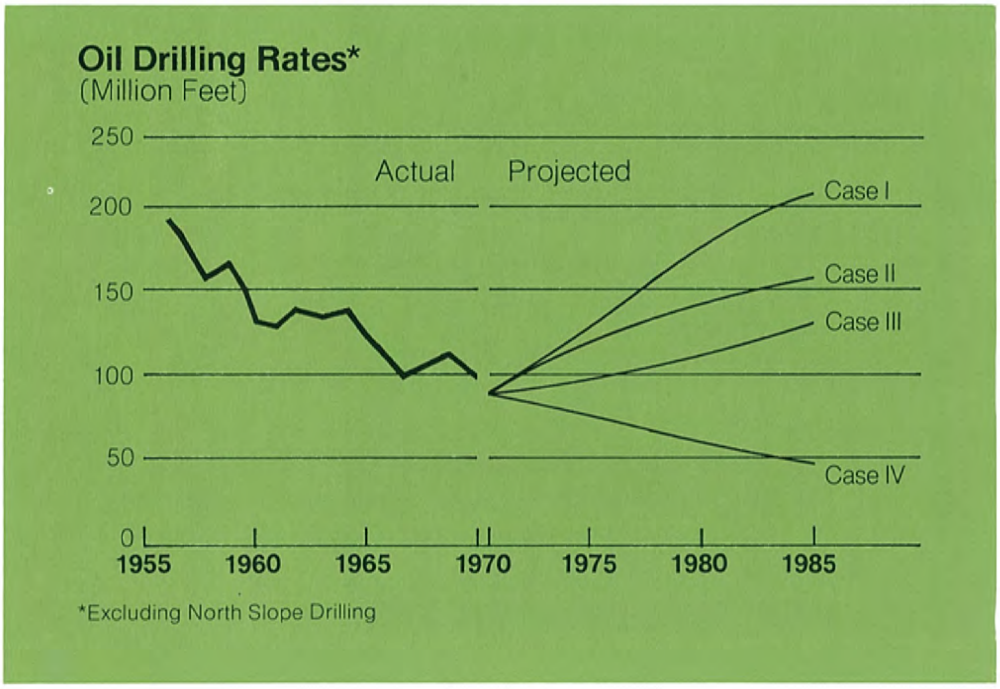


Figure 6

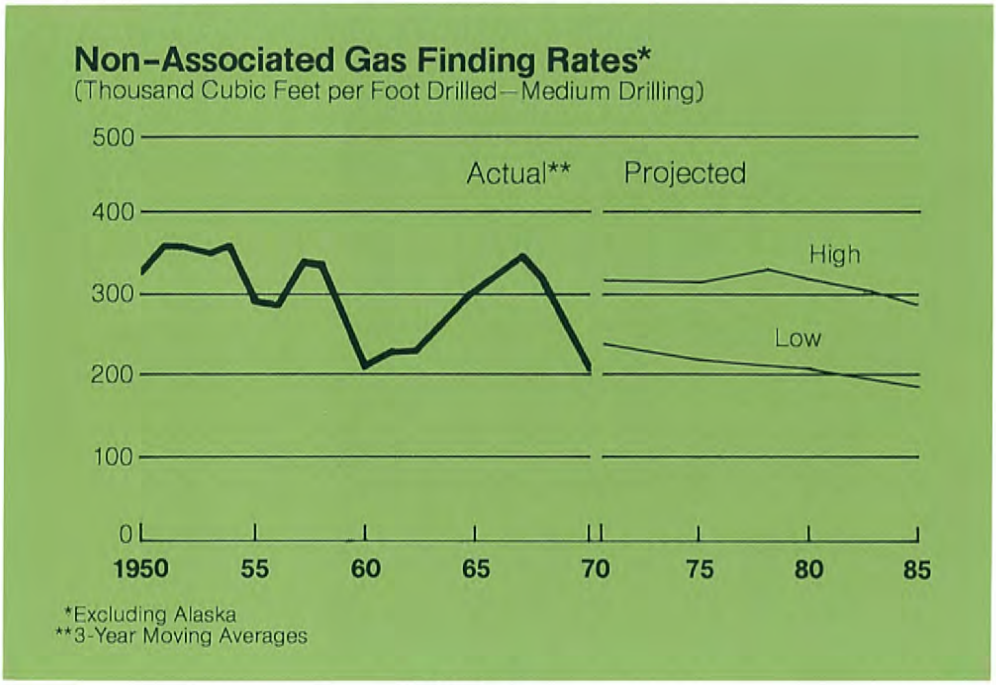


Figure 9

rate is an extrapolation of past trends and the high is approximately 50 percent higher. Figures 8 and 9 show historical trends in finding rates for oil and gas and the projected rates through 1985, assuming the medium drilling rate.

Additions to reserves are the result of both the finding rates and drilling rates.

During the past 15 years, total crude oil reserve additions for the United States, excluding the North Slope of Alaska, have averaged 2.7 billion barrels per year (Figure 10). The volume added to proved reserves as a result of new oil discoveries alone has decreased from over 2 billion barrels in 1955 to about 1 billion barrels in 1970—a decline of more than 50 percent. Total reserve additions have been maintained through greater application of improved recovery techniques to previously discovered reserves.

The lowest supply case (Case IV) maintains total reserve additions at about 2.5 billion barrels per year for the next 15 years, largely as a result of continued application of increased recovery methods. The highest supply case (Case I) adds reserves at an increasing rate—averaging 3.8 billion barrels annually.

These volumes exclude North Slope Alaska reserve additions of 9.6 billion barrels in the past and future North Slope additions ranging from 300 million to 600 million barrels per year.

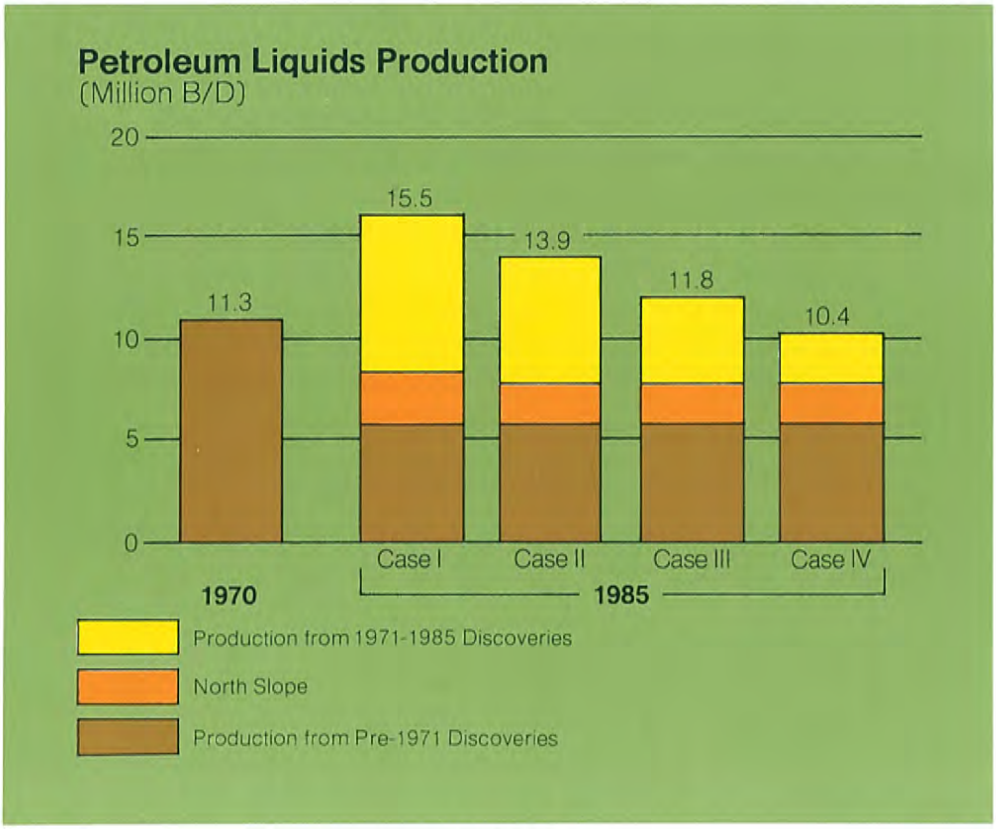


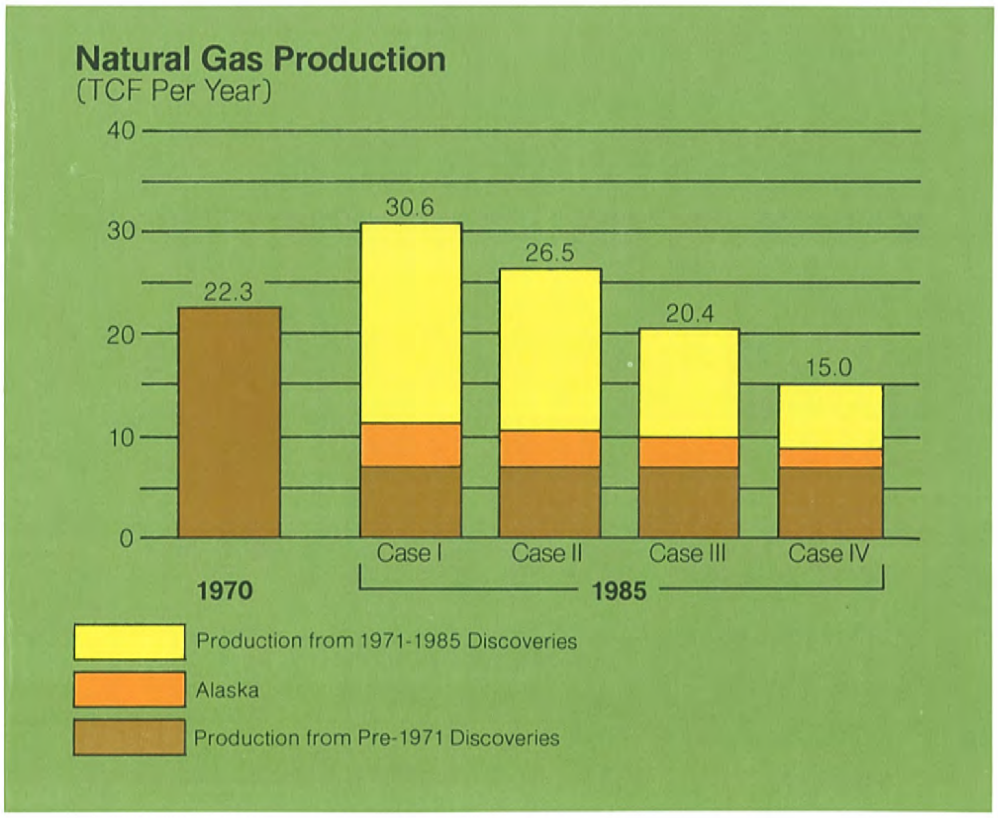
Figure 12

Historical and projected gas reserve additions include both non-associated and associated-dissolved gas (Figure 11). They averaged a little less than 18 TCF per year in the lower 48 states during the 1956-1970 period. Gas discoveries in the past three years have been well below the average and were about 11 TCF in 1970. In Case IV, total annual gas reserve additions are projected to decline further to an average of about 7.7 TCF in the next 15 years. In Case I, total annual reserve additions average approximately 22.8 TCF.

These data, both historical and projected, exclude Alaska. About 31 TCF of gas has been discovered in Alaska, of which 26 trillion was associated-dissolved gas found on the North Slope. These projected volumes likewise exclude projected Alaskan reserve additions through 1985 ranging from about 1.3 to 4.2 TCF per year.

- Based on these reserve additions, the resulting *total petroleum liquids production* rates in 1985 are projected to range from 10.4 to 15.5 MMB/D, compared with 11.3 MMB/D in 1970 (Figure 12).

The North Slope will supply approximately 20 percent of this U.S. total, or from 2 to 2.6 MMB/D. Other pre-1971 discoveries will account for about 6.0 MMB/D. The remainder, ranging from 2.4 MMB/D to 6.9 MMB/D, will come from discoveries made in the 1971-1985 period. The wide range in possible production resulting from future exploration emphasizes the need to encourage development of our conventional petroleum resources.



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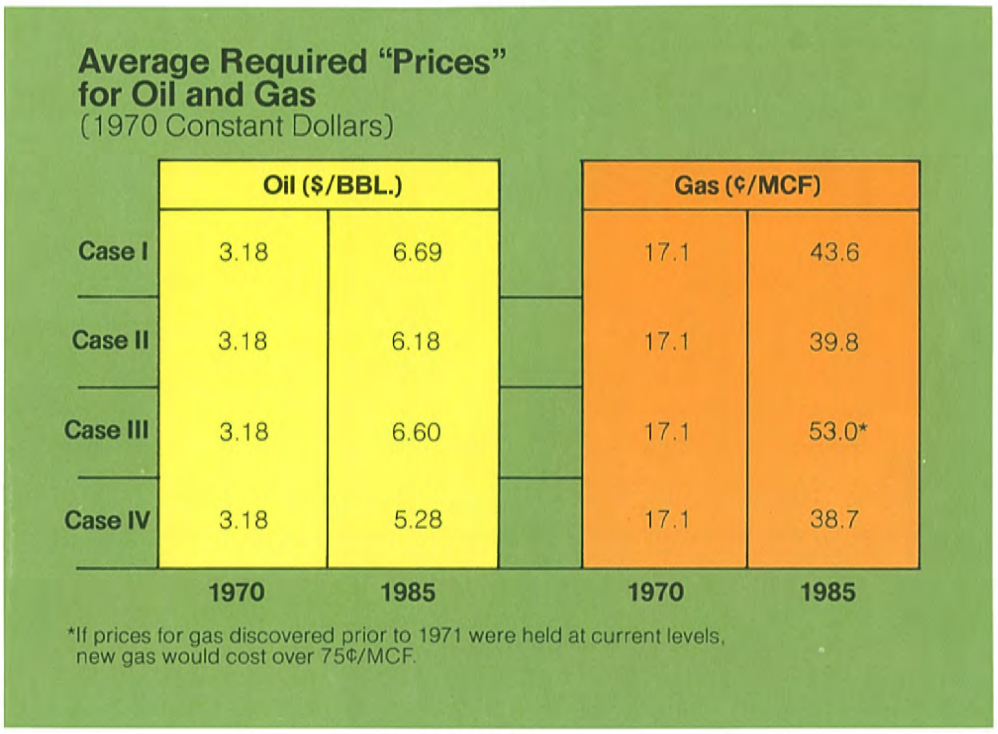

Figure 14

Coal

• Coal is abundant. The U.S. Geological Survey estimates the nation's coal resources at 3.2 trillion tons (Figure 15). Of this total, about 150 billion tons of recoverable coal are presently known in formations of comparable thickness and depth to those being mined by present technology. Maximum projected production in the next 15 years would use less than 10 percent of the 150 billion tons. This modest utilization of total coal reserves includes the output of coal for making synthetic fuels.

• Potential production of coal in 1985 was projected to range from 1,570 million tons in Case I to 1,004 million tons for Case IV (Figure 16). As indicated later in the discussion of energy balances, all this coal may not be used because of demand limitations. Case I reflects a 5 percent sustained rate of growth in conventional uses, compared with a 3.2 percent annual increase in the 1960's decade. Reserves similar to those presently being worked will be ample to sustain the 5 percent growth rate. Cases II and III reflect a 3.5 percent growth rate in conventional uses, while Case IV is based on a 3 percent growth rate.

The projections of 1985 coal requirements for synthetics vary between 339 million tons for Case I and 47 million tons in Case IV.

Coal availability and use through 1985 will be affected by several factors:

– Air quality standards and the development of effective means to control the emission of SO_2 into the atmosphere when coal is burned will determine the extent to which coal can be used for electric utilities and industrial purposes. Stack gas control devices are one way to cope with the problem. Combined cycle plants are another.

– Surface mining regulations may restrict growth in coal production and may inhibit development of synthetics from coal.

– Expanded coal transportation facilities are required to handle increased coal production.

– Manpower availability will be a crucial factor.

– Government leasing policies will affect availability of coal from western coal lands, which is required for synthetic fuel production.

– Synthetic fuels production requires further technological improvements, particularly for making synthetic liquids.

– Water availability will be sufficient to support moderate levels of synthetic fuel production in the West, but additional supplies would be needed to permit aggressive development.

• Coal prices have been rising in recent years and additional increases are expected through 1985. In terms of 1970 constant dollars and based on a 15 percent discounted cash flow (DCF) return on investment, 1985 "prices" from underground mines are projected to be about $9.60 per ton, a 20 percent increase

Average Projected Coal "Prices"
($/ton in 1970 Constant Dollars, 15% DCF)

	1970	1985
UNDERGROUND MINES	7.84	9.60
SURFACE MINES	4.87	6.80

Figure 17

Nuclear Generating Capacity
(Thousand Megawatts)

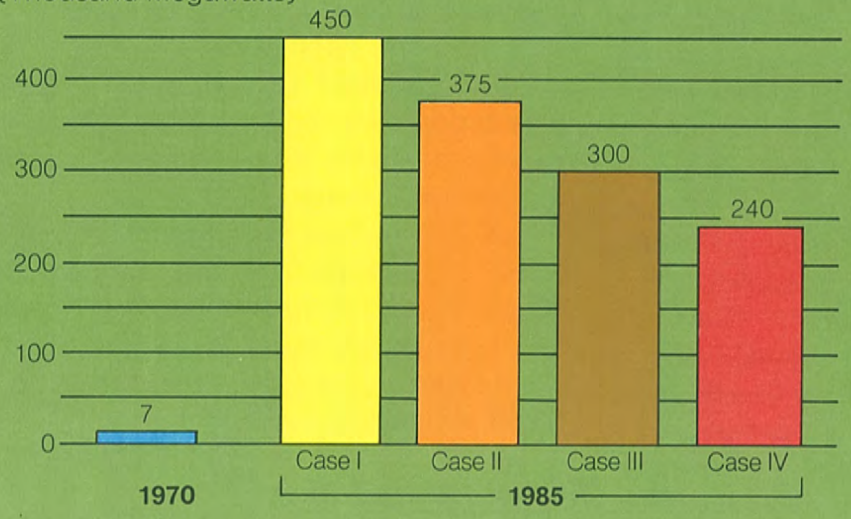

Figure 18

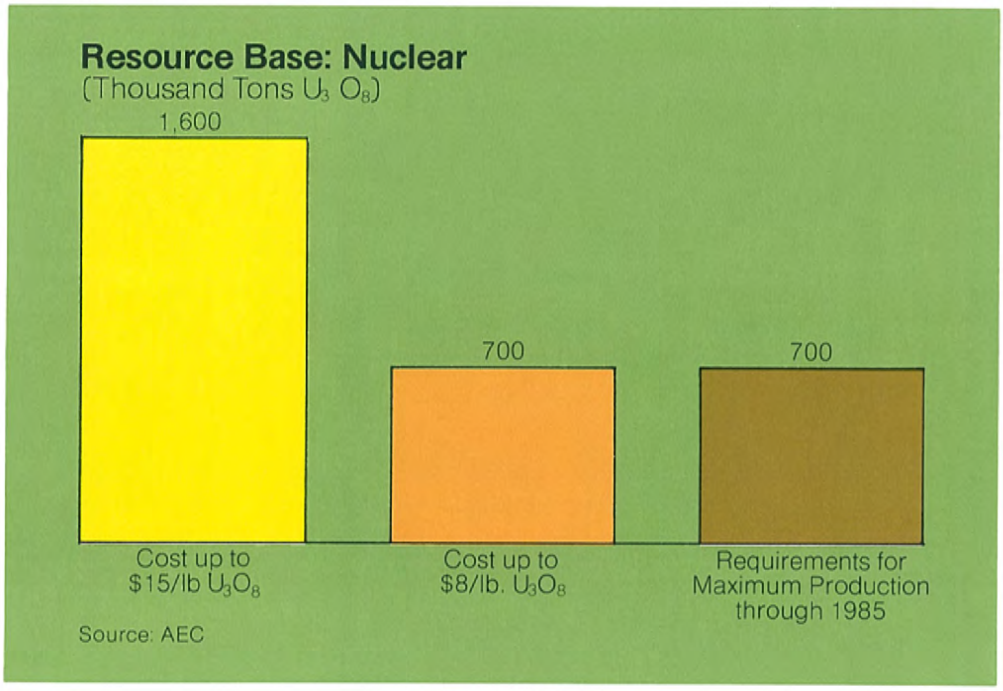

Figure 19

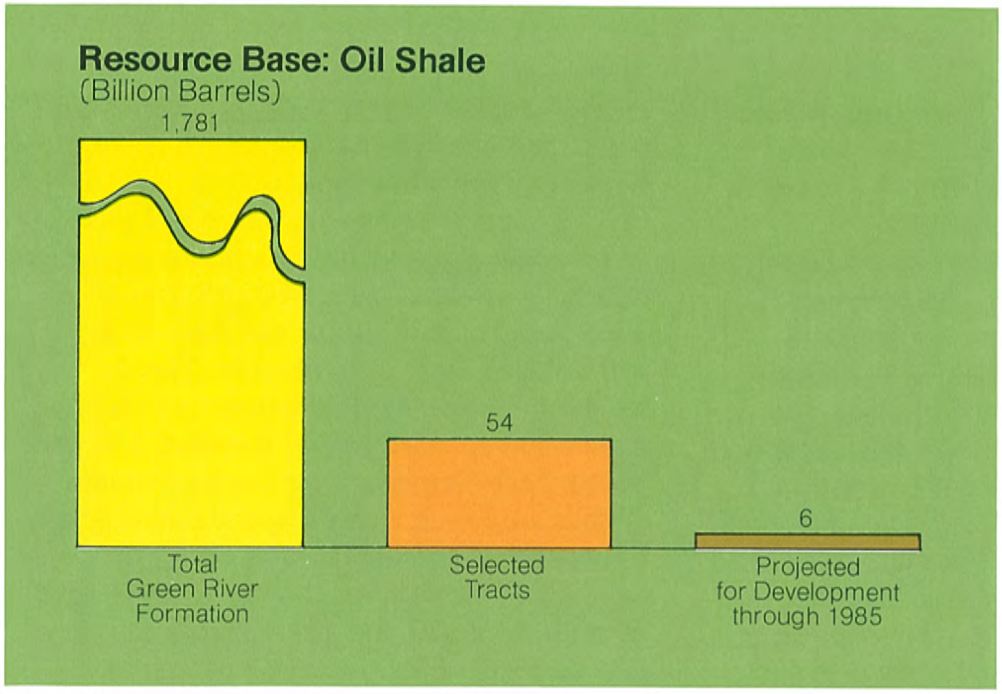

Figure 20

Energy Balances

The range of conditions that might characterize the U.S. energy situation in 1985 has been summarized in Figure 2. With the fuller examination of potentially available supplies and demand requirements, it is now possible to see more clearly (a) the time required to effect improvement in the nation's energy position, and (b) the size and complexity of the nation's energy problems.

Time Dimensions

Without remedial actions, the deficit in domestic energy supplies will become greater over time. However, longer time periods will provide an opportunity to take corrective measures to reduce this potential deficit. Because of long lead times required to increase domestic production, energy imports must inevitably increase in the next few years.

Possibilities for improvement in the energy situation over longer time periods are illustrated by a comparison of the various cases for 1975, 1980, and 1985—using the intermediate projection of demand.

1975 Situation (Figure 22). In the short term, through 1975, options are limited for altering the trend toward greater dependence on foreign energy sources. In all four cases, imports will rise above the 1970 level of 12 percent. The percentage of domestic requirements expected to be met by imports will vary from 20 percent in Case I to 26 percent in Case IV. Despite the stepped-up activity of the high supply case, there will be relatively little difference between import requirements under the high and low supply cases. This is caused by long lead times needed to alter trends in domestic supply availability.

1980 Situation (Figure 23). Options for improving domestic availability of energy supplies are greater in 1980 than in 1975. The percentage of domestic requirements projected to be met by imports ranges from 16 percent for Case I to 38 percent for Case IV. The spread among the cases is considerably wider than in 1975.

1985 Situation (Figure 24). By 1985, there is a large spread among the cases in regard to projected imports. Imports would range from 11 percent of domestic requirements for Case I to 38 percent for Case IV.

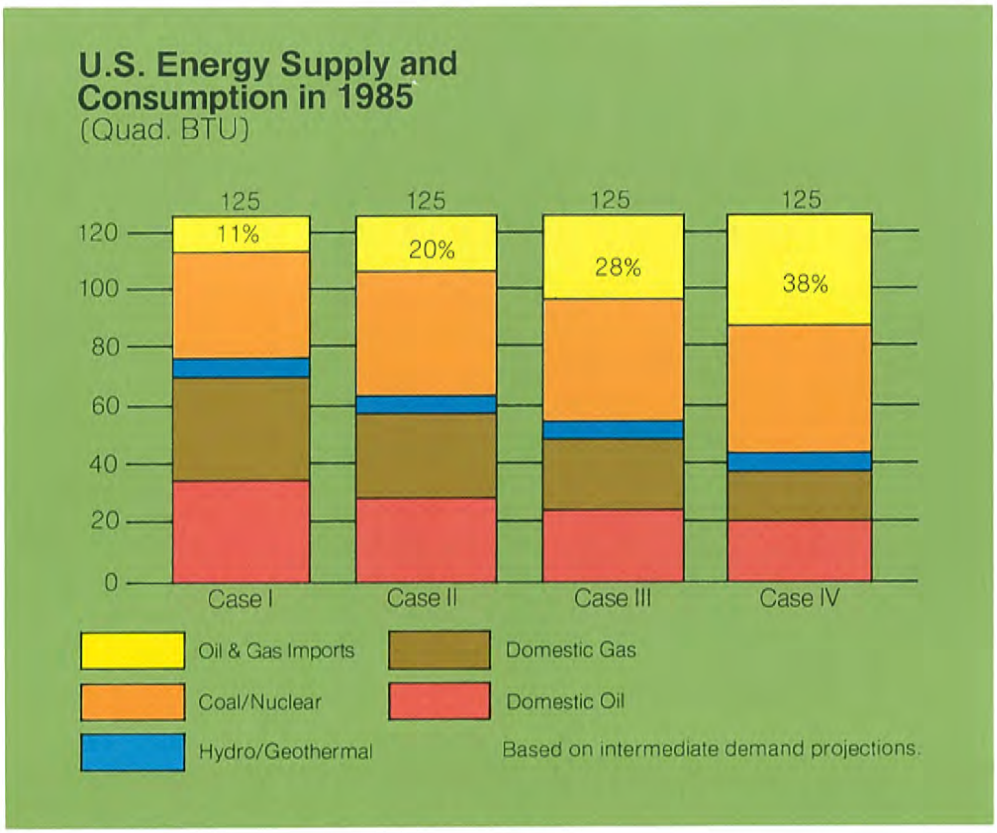

Figure 24

Oil Imports (Figure 25). The volume of oil imports, which is the balancing figure in computing an energy supply-demand balance, is of particular significance. Oil imports in 1970 totaled 3.4 MMB/D. Oil imports in 1975 vary from 7.2 MMB/D in Case I to 9.7 MMB/D in Case IV. By 1980, the level of oil imports varies from 5.8 MMB/D for Case I to 16.4 MMB/D for Case IV.

By 1985, the spread becomes quite wide. Case I projects imported volumes at 3.6 MMB/D. Case IV, on the other hand, shows an import level of 19.2 MMB/D in 1985.

Complexities of Analyses

If all fuels were completely interchangeable, energy balances could be struck by adding all domestic fuel supplies and comparing the total with energy demands. The difference between domestic supply and projected consumption would be either available to be exported or required to be imported.

But all fuels are not completely interchangeable in all uses. An automobile can be converted to run on natural gas; a residential coal furnace can be changed to burn oil or gas; but neither an automobile, a gas furnace, nor an oil furnace could burn coal without extensive modification.

In projecting an energy balance of the various fuels, certain assumptions were

Implications

Implications of the foregoing projections of energy supply and demand include the following:

New Facilities to Handle Imports

Logistical arrangements must be devised to accommodate increased oil and gas imports. The use of very large crude carriers of 250,000 to 400,000 deadweight tons (DWT) is desirable for two reasons. Transportation costs are lower and possibilities of oil spills are reduced.

At the present time, however, there are no U.S. ports capable of handling vessels of those sizes. Without such port facilities by 1985, imports of an estimated 13.5 MMB/D of crude oil (Case III) would require the unloading of about forty 50,000 DWT tankers somewhere along the nation's coastline each day. Deepwater terminals must be built on the Gulf Coast, East Coast, and Pacific Coast if the benefits of larger carriers are to be gained. Oil imports to the Gulf Coast and East Coast will necessarily increase, and as they do, large-diameter pipelines and increases in water-borne commerce into the interior will be needed.

Similar considerations are involved in the importation of natural gas, LPG, LNG, and syngas feedstocks. New gas pipelines from the Canadian Arctic will also be needed. LNG imports will require substantial capital investment, both foreign and domestic, for facilities such as liquefaction plants, LNG tankers, regasification facilities, and storage.

Capital Requirements

Total capital requirements for the period 1971-1985 for development, processing, and primary distribution of all fuels are projected to range from $215 billion to $311 billion. Of these amounts, $88 to $172 billion will be needed for oil and gas exploration and production (Figure 26).

An additional $235 billion will be required for power plant construction and transmission facilities, bringing total capital requirements to a range of $451 billion to $547 billion.

Fuel Prices

Real energy prices of domestic fuels at the wellhead or mine must rise significantly by 1985. Since the prices cited for the fuels do not consider differences in quality, distribution costs, or use characteristics, the prices calculated in this study cannot be meaningfully compared with one another. The projected range of percentage increases in average prices required to 1985 (in terms of 1970 dollars) over 1970 for individual fuels is as follows:

Oil at the wellhead—up 60% to 125%
Gas at the wellhead—up 80% to 250%
Coal at the mine—up about 30%
U_3O_8 at the mill—up about 30%

Dependence on Foreign Supplies

Besides the possible large increases in volumes of imports, a shift in the source of imports through 1985 is indicated. A larger share of U.S. imports will come from the Eastern Hemisphere. Thus, as imports rise, the country will become increasingly dependent on the political and economic policies of a small number of distant countries. This, in turn, can have important consequences with respect to the military, political, and economic position of the United States.

Consideration should be given to (a) the need for additional storage to cushion the impact of possible near-term interruptions of foreign supplies, and (b) the desirability of utility plants being constructed to burn more than one type of fossil fuel.

Worldwide supplies will tighten between 1971 and 1985 as ready availability of low-cost oil declines. The reserve/production ratio in non-communist countries will drop from 27 in 1972 to between 14 and 19 in 1985. Besides the United States, other countries of the world, especially developing countries, will need increasing quantities of fuels to support industrialization programs and will become increasingly important purchasers in world fuel markets. Toward the end of the century, foreign oil supplies may prove insufficient to meet all potential demands.

Balance of Trade

Greater oil and gas imports will have a major impact on the nation's balance of payments. The cost of imported fuels, less the sales revenue from fuel exports, results in a sizable net dollar drain. This dollar drain was $2.1 billion in 1970. It will range from about $9 billion to $13 billion in 1975 and from about $7 billion to $32 billion annually by 1985 (Figure 27). These projections indicate a threefold to fifteen-fold increase in foreign exchange requirements by 1985 over current levels.

To pay for our imports of fuel, we will need to seek additional exports of other goods and services. The magnitude of the potential problems in this area is highlighted by the fact that today our total annual exports of all goods and services are only about $65 billion.

Energy Demand Trends to 2000

	Volume (Quadrillion BTU)		Growth Rate	
	1985	**2000**	**1971-85**	**1985-2000**
High Case	130.0	215	4.4%	3.4%
Intermediate Case	124.9	200	4.2%	3.2%
Low Case	112.5	170	3.4%	2.8%

Figure 28

Energy Trends to 2000

Long-Term Domestic Output Potential

Conventional Energy Sources

	Units	**1985**	**2000**
Oil Total Domestic Liquids Production	Million B/D	14	10–18
Natural Gas Production	TCF/yr	27	15–25
Coal, Traditional Uses Only	Million Tons/yr	863	1,200–1,700
Hydro	Billion KWH/yr	316	340–380
Nuclear	Billion KWH/yr	2,463	7,500–9,500
Total	Quadrillion BTUs	106	131–211

Figure 29

Policy Recommendations

Basic Policy Options

In the period between now and 1985, the nation has *three basic options* to balance energy supply and demand:

The United States could rely on increased imports to meet energy requirements. This alternative would not well serve the nation's security needs nor its economic health because of uncertainties regarding both availability and price. To obtain the necessary imports, the United States will be competing with sharply expanding requirements in Western Europe and Japan. Greater reliance on imports would also result in major balance of trade problems that could affect the value of the dollar.

A second option would be to seek reductions in energy demand growth. Consideration was given to (a) imposed restrictions on demand, and (b) increased efficiency in the utilization of energy.

Imposed restrictions on energy demand growth could prove expensive and undesirable. Among other things, they would alter life-styles and adversely affect employment, economic growth, and freedom of consumer choice. Such restrictions would arouse political resistance and be difficult to implement in any substantial way between now and 1985 because of the enormous problems involved in changing a nation's social and economic framework.

More efficient use of energy is clearly desirable, and some improvement is possible and likely as energy becomes more costly and as technology advances. There are, however, inherent limitations on the amount of the improvements that can be accomplished during the next 15 years. Better home insulation, for example, will conserve energy, but many years will elapse before the construction of new homes and the rebuilding of old homes can effect a material reduction in the nation's total requirements.

The Committee concluded that significant departures from the 4.2 percent intermediate demand growth rate were unlikely. A range of 3.4 to 4.4 percent annual growth was deemed to embrace the likely possibilities. The lower growth rate would reduce 1985 demand by 10 percent from the intermediate projection and almost 15 percent from the higher projection.

The third alternative—increasing the availability of domestic supplies—is the best option for balancing energy demand and supply.

Actions taken soon could increase domestic supplies in the longer term, thus reducing dependence on imports markedly by 1980. Fortunately, no major source of U.S. fuel supplies is limited by the availability of resources to sustain higher production.

This approach requires increased incentives to promote the development of domestic supplies, many of which may cost substantially more than in the past. Hence, the price of energy would necessarily rise to cover higher costs and yield a sufficient return to attract necessary investment. Accelerated development of domestic energy supplies would benefit all segments of society: employment would increase, individual incomes would rise, profit opportunities would improve, government revenues would grow, and the nation would be more secure.

Specific Policy Recommendations

In requesting the NPC to undertake this study of the nation's energy outlook, the Department of the Interior requested emphasis on those areas where federal policies and programs could effectively and

areas is essential if the nation is to increase the availability of indigenous energy fuels. For oil and gas, the largest potential for developing new domestic reserves in the period to 1985 is located in offshore and frontier areas of the United States. If the nation is to achieve Case II oil and gas production estimates, lease sales totaling 21 million acres on the outer continental shelf will be required over the next 15 years—three times the 7 million acres that have been made available over the last 17 years. If no new leases were offered in the offshore areas, it would cost the country about 2 million barrels per day of domestic crude oil and nearly 6 trillion cubic feet per year of gas in 1985. Federal leasing policies will also have a considerable impact on all other energy sources—coal, uranium, oil shale, and geothermal.

Assure Water Availability for Energy Production

The maximum development of synthetic fuels production (Case I) requires (a) an immediate government program to provide necessary dams and aqueducts in the western United States, and (b) timely resolution of jurisdictional disputes over water rights.

Continue Tax Incentives

Fiscal policies should be designed to encourage discovery and development of all energy supplies. Recent developments have had a contrary effect. For example, the 1969 Tax Reform Act alone placed an additional tax burden on the domestic petroleum industry of some $500 million per annum. Fiscal policies should encourage the creation of capital requisite for increasing energy supplies and reducing costs to the consumer.

Long-established tax provisions for the extractive industries—such as those dealing with percentage depletion and current deduction of intangible costs—have historically promoted the development of energy supplies. Weakening or eliminating such provisions would inevitably increase energy costs to the consumer. For instance, complete removal of the statutory depletion allowance would necessitate an immediate "price" increase on the order of 50¢ per barrel for all oil and 3¢ per MCF for gas. In later years, as costs rise, these required increases could become as great as $1.00 per barrel of oil and 7¢ per MCFof gas by 1985. Until more effective tax provisions can be devised, existing measures should be retained.

Maintain Oil and Uranium Import Controls

The continuation of oil import quotas is essential primarily for three reasons:

- A secure domestic energy base is a vital element of national security.
- Elimination of oil import quotas would have an adverse effect on the U.S. economy by aggravating the balance of payments problem, reducing government revenues arising from domestic oil operations, and reducing employment in oil and oil-related activities.
- Oil import quotas are needed to encourage development of all indigenous energy resources.

To encourage the growth of the domestic uranium mining industry, existing policies for imports, enrichment operations, and government stockpile disposal should be continued. Present import policy requires that uranium enriched in U.S. government facilities for use in domestic reactors must be of U.S. origin until the Atomic Energy Commission determines that a viable domestic uranium mining industry has been established. Restrictions on imports of uranium are necessary to aid industry in making the transition from supplying primarily a government market to supplying a mature commercial market.

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