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ENERGY SUPPLY PROBLEMS FOR THE 1970s AND BEYOND

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INTRODUCTION

Everyone has become aware of a changing energy situation within the United States, whether through personal experience or through hearsay. We have been bombarded with statements on the authenticity of the claims of shortage, on its causes, and on its cures. Some claim that a genuine shortage exists, while others contend that it is a fiction designed by fuel producers to obtain higher prices. There are those who point to the large areas of unexplored potential and state that our problem should be quickly solved by the application of a bit more effort. Some blame the environmentalists for retarding the development of new energy sources, others claim that we could obtain adequate quantities from solar, geothermal, or other sources. Still others believe the solution lies in a drastic reduction in energy use.

Confronted with a mass of varying opinions and conflicting statements, many made by people who should know the facts, the public is at a loss as to what to believe. Unfortunately, the full picture often is not visible. At a time of flood, such as the recent one on the Mississippi River, we can observe from a high bridge or an airplane the devastation being wrought by the rising flood waters. Similarly, the parched land and other effects of a drouth also can be observed. But to determine the real causes of a surplus or shortage of water at a downstream point and to provide for correction and prevention of recurrence, we must go back to all the headwater sources and identify the complex series of events that occurred during a period of time preceding the flood. So it is with our current fuel and energy dilemma.

A series of studies on fuels and energy trends has been in progress at the Illinois State Geological Survey for more than 15 years. These studies led to the conclusion more than 10 years ago that oil and gas shortages were coming. Today the shortage is real, and it is serious. Things can be done to help alleviate the situation, but, despite all our efforts, energy supply problems will remain with us for several years. Those who promise quick and easy solutions have not examined all the facts.

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FACTORS CONTRIBUTING TO ENERGY PROBLEMS

Perhaps first among the factors contributing to our problem is the rapid rate of growth in total energy use. From 1951 to 1972, total U. S. energy consumption grew from 36,775 trillion Btu to 72,000 trillion, an increase of 94 percent. Per capita use increased 44 percent.

A second factor is that nearly all the growth occurred in oil and gas. Essentially no increase occurred in coal use during this period, even though the resources of coal far exceed those of oil and gas combined. In 1920 coal (anthracite, bituminous coal, and lignite) provided 80.4 percent and oil and gas only 16.1 percent of our total energy. By 1972 coal provided only 17.2 percent and oil and gas combined accounted for 77.8 percent, an almost complete reversal of their former positions.

A third factor is that we have not been making new discoveries of oil and gas fast enough to provide the reserves required for production. It has been estimated that large quantities of both oil and gas exist beneath the land and offshore areas of the United States, including Alaska. But such deposits can be discovered only through drilling, and in the late 1960s both the amount and the success of drilling activities were declining.

PRESENT SOURCES OF ENERGY

Of the total 72 quadrillion Btu of energy consumed in the United States in 1972, almost all—94.8 percent—was provided by the three fossil fuels—petroleum, coal, and natural gas. Nuclear, hydroelectric, and geothermal power combined accounted for only 5.2 percent. Almost one-third of the petroleum and about 5 percent of the natural gas came from foreign sources.

Our main problem today is that the growth in energy consumption has outrun the development of capacity to supply that energy. Our oil and gas wells are already operating at essentially full capacity. Much of the coal that can be produced today cannot meet existing and proposed sulfur limits and has been prohibited for use in numerous places. Faced with a ban on the use of a large share of the coal that is available and unable to increase domestic oil and gas capacity significantly, we are being forced to turn to an increasing degree to foreign sources.

In 1965, imports supplied 20.7 percent of the petroleum consumed within the United States. In 1972, it was almost 30 percent, and projections indicate that by 1985 imports may make up 57 percent of our supply, much of which will have to come from Middle East countries, an area that has a history of political instability. Canada, which currently is the largest contributor to our crude oil imports, is already questioning further increases in its exports.

In 1972 oil imports added about 4.3 billion dollars to our international balance of payments problem; by the mid-1980s the cost may reach 20 billion dollars or more. Whether we can afford to become so dependent on foreign sources, from either an economic or national security standpoint, is highly questionable.

It is important that we realize that our national fuel and energy dilemma at this time does not represent an exhaustion of our fuel resource potential.

Instead, we have reached the limit of producibility from reserves of oil and gas discovered thus far in the lower 48 states, we are unable to produce known reserves in Alaska, and our use of huge known reserves of coal is limited by our preference for oil and gas and by regulations that prohibit coal's use for environmental reasons. At the end of 1972, production of oil and gas had reached the maximum level attainable from available reserves. A relatively small amount of unused coal-mining capacity did exist.

The estimated economically recoverable gas reserves in the United States at the end of 1972 were 240 trillion cubic feet, of which only about 9 percent can be withdrawn during one year. This excludes the 26 trillion cubic feet on the Alaskan North Slope. About one-eighth of the 33 billion barrels of crude oil and natural gas liquids is recoverable in one year. Reserves of coal economically recoverable with today's technology are estimated at from 290 to 400 billion tons, which is about 500 to 670 times the 1972 output. Existing mines are operating almost at capacity. With the technology currently available, even the most promising deposits of oil shale cannot yet be considered economically recoverable.

POTENTIAL FUTURE SOURCES OF ENERGY

Large quantities of fuel in the ground have been identified but cannot be considered recoverable reserves because the technology or economic conditions are lacking for their recovery. Ten billion barrels of oil and 26 trillion cubic feet of gas are known in Alaska but cannot be produced because no transport facilities are available. Only about 80 percent of a gas deposit and somewhat more than one-third of an oil deposit can be recovered with present technology. About 20 to 25 percent of the known coal can be recovered economically at present, but none of the oil shale. Much of the known coal is too thin or too deep to mine by present methods.

Large quantities of undiscovered fuels undoubtedy exist within our borders, but until actual drilling and discovery are accomplished there is no way of knowing exactly how much. Estimates by geologists, based on the existence of rocks favorable to the occurrence of oil and gas, indicate that as much as 2,900 billion barrels of oil and 6,600 trillion cubic feet of gas may be present. But a large share of the potential—an estimated 25 percent—lies in Alaska where we, as yet, have no means of getting it out. As much as half of the undiscovered oil and gas may lie in offshore areas, some of which are at water depths exceeding those that can be handled with present technology.

It must be emphasized that any estimates of undiscovered deposits carry a large degree of uncertainty. Much of the oil may never be discovered, and some of that which is discovered may never be produced because the technology is not available to get all of it. However, the potentially recoverable oil and gas may ultimately be 5 to 10 times the currently known reserves.

The potential for coal, including that already identified and additional deposits that may be available, is estimated at more than 4 times even the highest estimates of oil and gas combined. It is in coal that the nation's major fuel potential lies.

Although the potential existence of oil shale is very great and widespread, much of it occurs in deposits too thin to offer much hope for utilization. The thick beds of shale with high oil content that have already been discovered contain about 3 times as much oil as the recoverable reserves of crude oil currently available in the lower 48 states. Much larger quantities of oil will become available from thinner shales once proper technology is developed.

Despite the large potential that exists for additional discoveries of oil and gas, new discoveries have not been keeping pace with the growing demand.

RECENT TRENDS IN OIL AND GAS SOURCES AND CONSUMPTION

From 1947 to 1972, production of natural gas rose from 5.6 trillion cubic feet per year to almost 23 trillion cubic feet. Through 1967, annual discoveries exceeded production and total reserves continued to rise. In 1968, and each year since then, increasing production exceeded new discoveries and reserves declined. In the five years from 1968 through 1972, the cumulative production exceeded cumulative discoveries by almost 53 trillion cubic feet. Reserves declined from 293 to 240 trillion cubic feet. This was offset somewhat by the addition of about 26 trillion cubic feet of new reserves in Alaska, but it will be some years before this gas will become part of our producible reserves.

The rate at which either oil or gas can be withdrawn from the wells without suffering a loss in ultimate recovery is limited. For the reserves of natural gas currently available, this appears to be about one-eleventh to one-twelfth of the total reserve during any one year. For oil, the limit is about one-eighth. In other words, the minimum ratio of reserves to production (commonly called the R/P ratio) at which production can be sustained is about 8 for oil and about 11 to 12 for natural gas.

As the production of natural gas approached the level of one-twelfth of reserves, there was a distinct break in the rate of growth in gas production despite a continuing growth in demand, had the gas been available. Production is now at about one-eleventh of the reserves, and any significant further increase in production will require a substantially greater rate of discovery. Although imports from Canada are supplying about 5 percent of our requirements, that nation currently is questioning the expedience of increasing its exports of gas, as well as of oil. The importing of liquefied natural gas by tanker has been proposed, but it would cost several times the current wellhead price of gas.

The United States became a net importer of petroleum in 1948. The imports increased steadily, even though considerable domestic productive capacity remained unused, largely because imported oil was less expensive than domestically produced oil. In some states production also was restricted by prorationing.

By 1968, total consumption of domestic and imported oil had reached the point where domestic sources could no longer meet the demand, even if we had desired them to do so. By 1972, no gap remained between productive capability and actual output.

DOMESTIC POTENTIAL FOR INCREASED OIL AND GAS PRODUCTION

The lack of exploration to find new reserves has been widely attributed to lack of economic incentive to undertake the financial risks involved in the search for oil and gas.

Since the mid-1950s the wellhead price of all natural gas moving interstate has been controlled by the Federal Power Commission. The object of this control has been to protect the consumer from excessive prices. Natural gas, despite its desirable characteristics, has carried a lower price per unit of heat content, at the source, than either coal or oil. The gas price has been only about one-third that of oil despite the fact that, in many instances, both oil and gas come from the same well. Until recently the prices of all three fuels were declining in terms of constant dollars (adjusted for inflation).

Some increases in the price of natural gas have been permitted recently, and President Nixon, in his energy message of April 18, 1973, proposed the removal of price restrictions on newly discovered gas. Hopefully, the increased gas prices, plus increases in oil prices brought about by market conditions, will stimulate drilling activity and the rate of finding. A significant increase in discovery will be required if the situation is to be improved to any extent

A graph of cumulative discoveries and production of natural gas is somewhat similar to a continuing record of a bank account, with new discoveries representing deposits and production representing withdrawals. The remaining reserve or balance at any given time is represented by the vertical distance between discoveries and production. Physical factors restrict the rate at which withdrawals can be made without penalty, just as some banks restrict withdrawals.

Numerous projections of future requirements for natural gas have been made. They are not projections of what actually will be consumed, but of what probably would be consumed if the gas were available, at acceptable prices. To supply such a growing demand it would be necessary to discover new gas not only to replace gas consumed but also to maintain an R/P level of 11 or 12. During the 1970s discoveries amounting to 456 trillion cubic feet, an average of 45.6 trillion cubic feet per year, would be necessary. This is 1.8 times the record amount discovered in one year, 24.7 trillion cubic feet.

If a 10-year projection of discoveries were based on the average rate experienced for the United States, excluding Alaska, from 1956 through 1970, only 180 trillion cubic feet of gas would be provided. Even if Alaska were included only 197 trillion cubic feet would be available. In other words, to provide the projected demand would require a discovery rate 2½ times the average for the period 1956 through 1970.

The outlook for petroleum is similar to that for gas. To supply the projected requirement without large increases in imports would require new discoveries at twice the rate of the past 15 years, without the Alaskan discoveries. Even including Alaska the discovery rate would be inadequate to forestall the need for increased imports.

A major problem at the present time, when we have no surplus reserves, is that new discoveries not only must replace the oil we use, but also provide a backlog of reserves to support any increase in annual output.

To provide one unit of increased gas production on a continuing basis would require a recoverable reserve base of 11 units. Because only 80 percent of the gas in the ground is recoverable, the discovery of about 14 units actually would be required. The discovery of 20 to 24 units of crude oil would yield about 8 units of recoverable reserves. These 8 units would support an increase of only one unit of production annually.

Any hopes for significant increases in the production of natural gas and crude oil within the United States lie in two directions:

(1) Intensified exploration and drilling, both onshore and offshore, in the lower 48 states and Alaska.

(2) Expanded research into ways of obtaining greater recovery from producing deposits and from the known deposits that are not amenable to production with today's technology.

PAST AND POTENTIAL FUTURE ROLE OF COAL

Over the past 150 years coal has provided about 47 percent of the total energy obtained from domestically produced fuels. As previously noted, coal's relative importance as a source of energy has declined from 80 percent of the total in 1920 to 17 percent in 1972.

Much of the gain in the use of oil and gas has been for transportation, household, and commercial uses for which coal is considerably less suitable. However, 27 percent of the oil and about 64 percent of the natural gas are used for industrial and electric utility purposes, many of which, from an efficiency standpoint, could be served equally well by coal. Oil and gas are preferred for convenience and cleanliness and, especially in the case of natural gas, from a cost standpoint. But coal has other serious problems in competing for today's energy market—the emission of particulate matter and sulfur dioxide. Technology is available for the control of particulates by electrostatic precipitators. However, despite numerous advertisements and claims to the contrary, up to today, April 20, 1973, no full size, commercial-scale process for the removal of sulfur from stack gases has been operated successfully and continuously in the United States for a sufficiently long period of time to be considered fully proved. Some are reported to do the job when operating, but operations have been intermittent because of technical difficulties. Some foreign processes are reported to be successful, but questions remain as to whether their performance can meet United States conditions and requirements.

Research also is under way to remove sulfur from coal prior to combustion. Sulfur occurs in two forms in coal—as pyritic sulfur and as organic sulfur. Standard coal washing and preparation procedures can remove part of the pyritic sulfur, but there is as yet no means of mechanically or physically removing the organic sulfur. It must be removed chemically from the coal. There are at least two processes under study for chemical solution of sulfur.

One, solvent refining, dissolves the coal in a coal-derived solvent, the sulfur and ash-forming materials are filtered out, and the liquid or solidified product is used as fuel. The other process dissolves only the pyritic sulfur, which in most coal still leaves a product too high in organic sulfur to meet the standards.

Two other ways of using coal could eliminate the problem of sulfur emissions and also supplement our supplies of petroleum and natural gas—coal liquefaction and gasification by processes in which the sulfur is removed. Although the conversion of coal to liquid and gaseous fuel is chemically possible, the economic and commercial feasibility of a full-scale operation remains to be proved.

One of the most promising means of providing coal-based sulfur-free fuel for use by utilities or large industries is the conversion of the coal to low Btu gas. The remaining low-sulfur char could be used either as fuel or for making other products. The Lurgi low Btu gas process is currently in commercial use in other countries, and efforts are being made to upgrade the gas through methanation. While the low Btu gas would provide a clean fuel for some purposes, it could not be used as a general substitute for natural gas.

Pilot plants to produce liquid fuel and high Btu gas are in operation, but problems, including water availability and capital requirements, remain to be solved before the processes can be considered commercially feasible.

Coal gasification plants of the size most frequently proposed would produce 250 million cubic feet of gas per day, or 90 billion cubic feet per year. It would take 11 such plants to produce one trillion cubic feet per year, an amount approximately equal to 5 percent of the natural gas now being consumed annually. At 250 million dollars each, the 11 plants would require an investment of 2.75 billion dollars, plus another 500 million dollars for mines to feed the plants.

While I believe we can assume that coal gasification and liquefaction plants will play a large role in providing clean fuels in the future, the problems to be overcome in bringing large numbers of plants on line, even after the technology is perfected, will be immense. Large contributions of gas and oil from such sources are a number of years away.

Until effective means are fully developed and operational for removing sulfur from the coal or stack gases, and fully applied, we are limited to burning the coal we have, with whatever amount of cleaning is possible by standard cleaning methods. Very little of the coal existing east of the Rocky Mountains and only a portion of the western coal can meet the standards. Standards already established for some metropolitan and regional areas limit the permissible sulfur content to from 1.0 to 0.3 percent. A Federal standard, applicable to major installations whose construction or modification began after August 1971, will limit emissions to 1.2 pounds of sulfur dioxide per million Btu of input.

There is a wide variation in chemical content of coals, which influences their heat content. Heat contents range from less than 8,000 Btu per pound for lignite to more than 15,000 Btu per pound for low volatile bituminous coal. A large share of the coal in the Appalachian fields is of the high volatile A, medium volatile, and low volatile classes, carrying high Btu values. The coals of the Interior Province, in which the Illinois coal area lies, are generally in the high volatile B and C categories that have a somewhat lower heat value. Some of the coal of the Rocky Mountain and Northern Great Plains Regions is bituminous coal, but most of it is subbituminous and lignite. With emission standards based on heat input, a lignite containing 7,000 Btu per pound can carry only half the percentage of sulfur permissible in a 14,000-Btu bituminous coal to meet the same standard.

If we assume that all of the sulfur enters the combustion gases, virtually none of the coals from the Interior Basin can meet the 1.2 pound per million Btu emission standard. This region contains 29 percent of total bituminous coal reserves and provides 23 percent of the output. In the Appalachian coal fields, which contain 35.5 percent of the bituminous reserves and provide 60 percent of annual output, an estimated 14.4 percent of the coal can meet the standard.

The western fields contain an estimated 54 percent of coal of all types and 34 percent of the bituminous coal. Although we have always considered this area as a potential source of huge supplies of low-sulfur coal, much of this coal cannot meet the 1.2-pound limit because of its low heat content.

Several midwestern utilities have turned to western coals in order to comply with local sulfur standards. Coal from Wyoming already is being shipped into the Chicago area at a rate of 5 million tons per year, and announcements have been made of plans to ship Wyoming coal to east Texas and eastern Oklahoma. This movement of coal over distances up to 1,200 miles and into the fourth largest coal-producing state (Illinois) and the first and fourth largest oil-producing states (Texas and Oklahoma) is truly "hauling coals to Newcastle."

I have attempted to estimate the amount of fuel that is required to haul coal from Wyoming to the Chicago area, based on average railroad fuel consumption. To haul 7 million tons of coal per year, the amount that has been projected for the near future, would require about 750,000 barrels of railroad diesel fuel per year. Because of our shortage of domestic oil-producing capability, this oil either must be imported oil or be replaced in the economy by oil that is imported. Ironic as this seems, it illustrates some of the types of problems that must be overcome if our environmental and energy problems are to be met.

In addition to Federal standards now in existence, state standards are scheduled to go into effect in 1975. A recent study by MITRE Corporation for the Federal Environmental Protection Agency (EPA) indicated that the application of these standards in 1975 would be accompanied by a yearly national shortage of about 300 million tons of low-sulfur coal producing capacity and a surplus of 385 million tons of high-sulfur coal capacity. The likelihood of the surplus high-sulfur capacity is debatable. The uncertainty of markets after the standards go into effect will tend to inhibit the construction of new mines and the maintenance of existing capacity.

If we should want increased quantities of coal there is a hazard that we will not have the capacity to provide it quickly. The construction of new mines requires from 2 to 4 years, the investment of large amounts of capital, and the employment of additional skilled mine workers, who even now are scarce.

POTENTIAL FOR OTHER SOURCES OF ENERGY

Attention has already been called to the fact that the fossil fuels—oil, gas, and coal—provide almost 95 percent of total energy consumed. Nuclear energy, hydroelectric power, and geothermal power provide the remainder, but with present technology these sources are used almost exclusively to generate electric power.

Projections of nuclear power indicate a significant growth for the future. Estimates in 1970 indicated that by 1980 nuclear units would generate 21 percent of the total need and by 1990 would account for almost 38 percent of it. However, development of nuclear power has encountered a continuing series of obstacles involving technical difficulties, questions of safety, and concern for the environment. A recent announcement by the Atomic Energy Commission revised the projected 1980 level of generating capacity downward to 132 million kilowatts, compared to a projection for that year of 151 million kilowatts that was made in 1971. The estimate for 1985 has been revised downward from 306 million to 280 million. In addition, the Federal Power Commission has reported that five fossil-fuel fired plants and 30 nuclear plants scheduled for operation this summer will not be ready. While nuclear power will undoubtedly play a major role in the future, it has not, as yet, been able to live up to expectations. Furthermore, concern has been expressed that unless the breeder reactor is available by 1985 to 1990, further expansion may be hampered by a shortage of moderately priced uranium fuel. If the projected capacity does materialize, the as yet unsolved problem of permanent disposal of radioactive waste will reach major proportions.

Hydroelectric power has consistently provided about 4 percent of the total energy in the United States. A projection by the Department of the Interior indicates an increase of 20 percent in hydroelectric power by 1985. The 1970 National Power Survey of the Federal Power Commission forecasts that by 1990 conventional and pumped-storage hydroelectric capacity could conceivably be doubled. As in the case of nuclear plants, construction of hydroelectric plants has been delayed because of environmental concern. Most of the more suitable sites have already been developed.

In 1972 the only sizable geothermal electric power generating units operating in the United States were at the Geysers, about 90 miles north of San Francisco. They have a combined capacity of 290 megawatts. Considerable activity is under way to increase the use of energy from this source. A recent projection indicates that California may have as much as 7,500 megawatts of capacity by 1991. This is equivalent to 2.2 percent of the electric power generating capacity in 1970 but less than one percent of the total energy projected for 1991. Several other states in the West, of course, have geothermal potential, but, because of the time required to develop such capacity, only relatively minor contributions to the over-all energy supply can be anticipated from geothermal energy for the next decade or so.

Newspapers and magazines have carried numerous articles recently about new or exotic sources of energy that are reportedly able to solve our energy problems, at low cost and with no detrimental environmental effects. Unfortunately in each case it has been, as someone has stated, a situation where publicity has outrun the technology.

Among the likely sources for future development are the conversion of coal to liquid and gas, and the expanded use of geothermal energy previously mentioned.

The production of liquid fuel from oil shale has been accomplished on a pilot-plant scale, but has not yet been proved economical. It has been estimated that it would take a crude oil price of 4 to 5 dollars per barrel to make oil shale operations economically feasible. The estimated average wellhead price for domestic crude oil in 1972 was $3.41 per barrel.

One problem is the huge amounts of shale that must be processed to produce sizable quantities of oil. A 30-thousand barrel per day output would require the mining of 36 to 42 thousand tons of shale containing 30 to 35 gallons of oil per ton. The same output of liquid could be produced from only 10 thousand tons of coal. Other problems to be overcome in the development of oil shale will be the disposal of waste (with its accompanying environmental problems), the large amount of capital required, and the large amount of water required by the process, for only limited amounts are available in most of the areas where the shale occurs.

Oil is currently being produced from tar sands in Canada, but development of the generally thinner tar sands in the United States has not appeared economically attractive.

Much publicity has been given recently to the possibility of using solar power on a large scale. The potential for solar power is tremendous, but the technology to gather and store energy from this source on a large scale has not been proved. Relatively small applications have been made for heating, and proposals have been made for larger scale developments. Much more research and development will be required.

The development and use of the breeder reactor, and later the fusion reactor, will be essential if the nation's long-term needs for energy are to be met. Despite the potential for discovery and production of large quantities of fossil fuels, they ultimately will become inadequate, and nuclear energy is at present the only source that appears capable of picking up the load at that time. However, the breeder reactor is unlikely to be perfected before 1990, and the fusion reactor will not be ready before the turn of the century.

Wind has been used as a source of power on a relatively small scale for several centuries, but because of its intermittent availability and for other reasons most windmills have been replaced by electricity or other sources of power.

Although tidal energy has been harnessed in some parts of the world, proposals to develop even the best sites in the United States have been abandoned after extensive study.

Magnetohydrodynamics, fuel cells, and other devices for more efficient conversion of fuel energy to electric power have been under study for many years. Applications on a significant scale, however, still remain to be developed.

Recent proposals have been made for the large-scale production of hydrogen by electrolysis for use as a fuel substitute for natural gas. While hydrogen could have some appeal as a nonpolluting fuel, numerous questions regarding technology, economics, and practicality must be answered.

Another suggestion frequently presented is that of using waste materials as fuel for heat or to generate electric power. This has considerable appeal from two aspects—disposal of the waste and the generation of energy. Although a few plants of this type are in operation, they have not received wide acceptance, possibly because of the problems of acquiring the fuel from widely scattered sources at a considerable gathering cost. As the problem of waste disposal continues to grow, such operations may become more general.

While the less conventional sources of energy may make significant contributions in the long-run, most of the energy needed for the immediate future in the United States must still be met by the fossil fuels. Even coal gasification, on which research is perhaps the furthest developed at present, is still several years away, as far as any significant commercial contribution is concerned. The other new sources of energy are even farther down the road.

In addition to seeking new sources we must also find ways to use more efficiently the energy we consume.

ENVIRONMENTAL IMPLICATIONS

In recent years the public has become increasingly concerned about the environmental effects of the production, transportation, and utilization of fuels and energy. Some tend to blame our entire energy situation directly on those whom they term "environmentalists." This is not accurate, for the trends leading to our dilemma have been in effect for more than a decade.

Although efforts at protecting the environment were not responsible for the fuel shortage, they have, however, intensified an already developing problem over the past two years. Regulations prohibiting the use of high-sulfur coal have caused consumers to attempt to turn to natural gas and oil, thereby intensifying the demand for these scarce fuels. Concern for the Alaskan environment is delaying construction of the 800-mile Alyeska pipeline, which would bring 2 million barrels of oil per day, or three-fourths of a billion barrels per year, from the Alaskan North Slope. Fear for the effects of oil spillage has led to delay in development of offshore areas, which offer some of the greatest potential for future discoveries and production of oil and gas.

Some efforts at solving one problem lead to severe problems of another type. For example, concern for the environmental effects of strip mining has led to proposals not only for effectively controlling the effects of mining but for the immediate and total banning of all strip mining of coal, despite the fact that there would be no way of replacing this fuel either by coal from underground sources or by oil or gas.

The substitution of coal from a more distant region for coal from sources near the consumer creates a new problem in that it requires an increase in the consumption of energy for transportation. Energy consumed in hauling coal from Wyoming to Illinois is equal to about 4 to 5 percent of the energy contained in the coal being hauled. And use of devices to control undesirable exhaust emissions from motor vehicles has been found to result in lowered mileage and increased total consumption of energy.

Our energy problems and our environmental problems, thus go hand in hand.

Today, in 1973, we have no alternatives to further increasing our imports of foreign oil to help meet our energy needs, accepting the undesirable features that accompany such a dependence. But in accepting this route as a temporary expedient, we will be remiss if we do not also examine our use of energy and, as expeditiously as possible, intensify our exploration and our research efforts to develop the potentials that still lie within our own borders.

And we must, of course, accomplish these tasks without undue detriment to the environment.

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(Exclusive of Lake Michigan Bottom Studies)

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