Analysis of the Proposed National Energy Plan

August 1977

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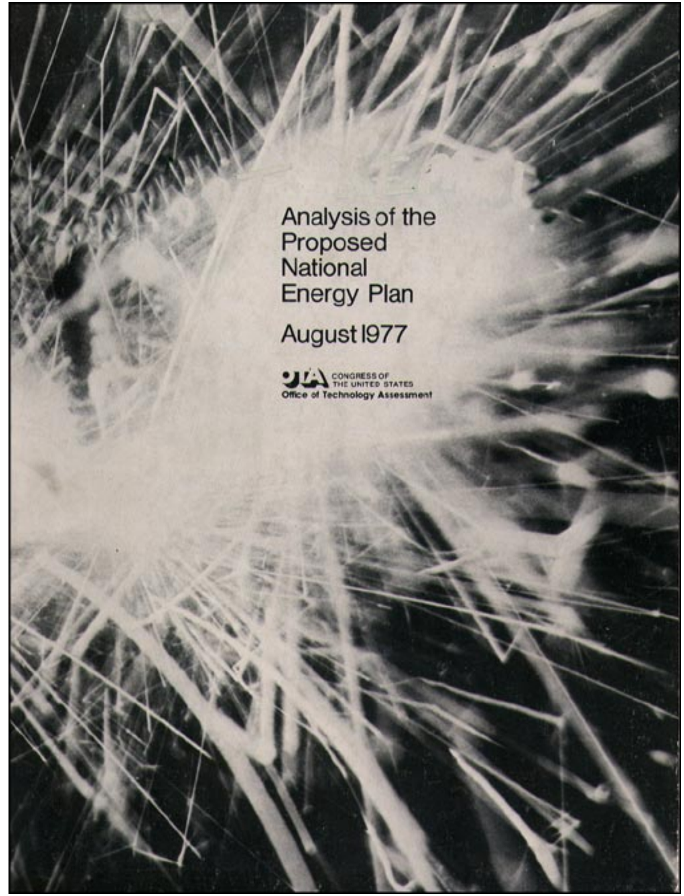

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Gentlemen:

On behalf of the Board of the Office of Technology Assessment, I am pleased to forward the results of the assessment requested by your Committees.

This report provides a balanced and impartial analysis of the Administration's proposed National Energy Plan. We hope that this analysis will serve as a useful resource, not only for the current debate on the proposed National Energy Plan, but also for the continual evaluation of the issues it presents.

Sincerely,

Edward M Kennedy

EDWARD M . KENNEDY
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Enclosure

Foreword

This report is an analysis by the Office of Technology Assessment of the Administration's proposed National Energy Plan. It was made in response to requests from Chairman Olin E. Teague of the House Committee on Science and Technology and Chairman Morris K. Udall of the House Committee on Interior and Insular Affairs.

The National Energy Plan, which was presented to Congress on April 20, 1977, prescribes goals and principles to guide the Nation's energy future. The Administration also submitted legislation to implement the Plan. The purpose of the OTA study was to provide Congress with an independent evaluation of the Administration's proposals and their social and economic effects.

Task groups were assembled to assess the Plan's likely impacts on energy supply, energy demand, and society as a whole. An additional task group examined the overall policy implications of the Plan. The task groups, whose members are identified at the beginning of this report, were assembled to achieve a balance of viewpoints. They represented major energy industries, energy demand sectors, environmental groups, consumer and public interest groups, academic institutions, and State and local governments. Each task group identified and assessed key issues posed by the Plan. The entire study was conducted over a 2-month period beginning in late April 1977.

The report begins with an executive summary, including the major conclusions on supply, demand, and societal impacts. Chapter II provides an overall perspective on the Plan and its policy implications. There follow chapters for each of the three impact areas and the issues that need to be considered. Finally, there are two appendixes: the first measures the magnitude of the energy problem; the second analyzes the effect of energy price changes on the supply of fossil fuels.

The Project Director for this assessment was Dr. Richard E. Rowberg, who was supported by the Energy Program Staff, led by Mr. Lionel S. Johns, the Program Manager.

Throughout this analysis and in the planning for it, OTA was assisted by its Energy Advisory Committee, chaired by Professor Milton Katz.

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*NOte: The OTA Energy Advisory Committee provided advice, crltique, and material assistance throughout this assessment, for which the OTA staft is deeply grateful. The Advisory Committee, however, does not necessarily approve, dlsapprove, or endorse this report. OTA assumes full responsibillty for the report and the accuracy of ıts content.

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I. Executive Summary

Executive Summary

The National Energy Plan's assessment of the world energy crisis is accurate. The problems are complex and serious and there is little time for fashioning new policies to respond to them. If the United States acts now, it may be able to reassert control over its energy future and prevent serious economic, social, and environmental impacts. To postpone decisions to raise energy prices and reduce energy waste is to risk losing that control, which could mean severe hardships for all Americans within the next 10 years. The level of U.S. oil imports is the pressure gauge that will measure how well American policies are succeeding. If imports can be held close to the goals of the Plan, the United States and the rest of the world may well manage a relatively smooth and peaceful transition to sustainable energy resources. If not, the transition may be neither smooth nor peaceful.

The National Energy Plan correctly acknowledges that energy problems exist on so many levels and in so many time frames that they must be addressed on a national scale. National security, economic stability, and other national interests are at stake. Decisions on energy must be made in consultation with State and local governments and with public and private interest groups, but the policies should reflect national concerns.

The National Energy Plan is a comprehensive and generally consistent set of policies that provides a coherent framework within which Congress can address all energy policy issues in detail. However, the actions proposed in the Plan may not be strong enough to prevent oil imports from reaching levels that could threaten national security and economic stability. The Plan's domestic oil, natural gas, and coal production targets represent the upper limits of capacity and are not likely to be achieved. Clarification of the uranium supply question is essential to an orderly expansion of nuclear power based on light water reactors. To achieve these levels of supply, the United States would have to reconcile the Nation's environmental goals with the Plan's supply goals.

The plan's central theme—promoting energy conservation primarily by moving energy prices toward replacement costs—is crucial to national energy policy. However, the Plan's overall conservation goals are modest although the picture is different for each category of energy use. The fact that goals may be reached easily in one sector should not be taken as a signal that conservation efforts may be relaxed or ignored in another. The projections for energy use in industry do not reflect the full potential for energy savings that would occur in that sector if the trend of the past *25* years continues. The goals in transportation may not be met unless transportation is addressed as a total system. Stronger measures could produce even greater savings in the residential and commercial sector than the Plan seeks to achieve, although the Plan's overall demand targets probably will be met. Because of the likelihood of supply shortfalls, stronger conservation goals may be necessary.

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Executive Summary

On the whole, the impact of the Plan on the economy and employment will be minor; the consequences of failure to achieve the Plan's goals will be far more severe, The Plan's proposals for returning revenues from its proposed energy taxes should assure financial equity for most low-income families. it probably will be necessary to expand the Plan to develop special programs to help regions where the impacts of high energy prices, new regulations, or accelerated energy production are particularly severe.

Talent, flexibility, and public support could be diminished or lost if the States are not given more responsibility for shaping and implementing policy than the Plan proposes. If State governments are partners rather than observers, it will be easier to enlist both the skills of State officials and the broad public support the Plan needs in order to succeed.

Before a National Energy Plan is enacted, it should focus in detail on programs that must be started at once to provide adequate energy sources for the years after 1985. For example, the Plan does not address the transition from a petroleum base to a new liquid-fuel base such as methanol produced from plant life. In its present form, the Plan does not address the question of whether planned changes in U.S. energy patterns between now and 1985 will strengthen or weaken the base on which longer range development will take place. After a National Energy plan is enacted, it must be monitored carefully both by Congress and the executive branch. Adjustments will be necessary to coordinate energy policy with other national policies and goals such as materials supply, employment, and air and water quality,

Panel Findings

Panel members who analyzed the National Energy Plan over a period of 5 weeks agreed that the goals are valid and the Plan is sound in principle. They agreed with the Plan's premise that the energy problem is serious enough to call forth strong new energy policies.[1] As the Plan states:

> In developing public policy toward the energy crisis, all three possibilities—the most likely case, the optimistic case, and the pessimistic case—should be considered. It would be foolhardy to base public policy on the most optimistic possibility. Even if the future should prove to be brighter than now appears likely, steps taken to curb demand and increase use of abundant resources would still have been justified to meet the immediate need to reduce vulnerability.

Each panel concluded its analysis by emphasizing that the Plan as presented to Congress provides a framework within which Congress can work toward a comprehensive set of energy policies. There was agreement that new national policies are required to carry the United States through a transition period in which it would acknowledge that cheap and abundant supplies of energy are no longer available. During that transition period, programs would be pursued to build a base for long-range reliance on sustainable resources.

The separate panel findings on supply and demand raise doubts about whether the supply targets for oil, gas, coal, and electricity can be met. These shortfalls, if they occur, could only be offset by:

- the degree by which the Plan's implied target of a 4.3-percent annual increase in the gross national product is not

[1] See appendix I

achieved and the degree to which energy demand would thus be reduced;

- an increase of oil imports to the extent that oil is available at acceptable prices, which would breach one of the Plan's most important goals; or
- an increase in supply or decrease in demand through voluntary measures or changes by the Congress or the executive branch in legislation or regulation.

The major findings of the panels, by category, are:

Supply Impacts

The levels of domestic supply projected by the Plan represent the upper limits of capacity, and supplies of all fuels are likely to fall below the Plan's production targets. For oil and natural gas, production problems are most likely to occur because of laws and regulations that may delay necessary exploration and development, particularly on the Outer Continental Shelf (OCS). Bottlenecks in production of new boilers and pollution-control devices, coupled with shortages of capital and manpower and gaps in the transportation system, could delay coal production. If delays do occur, oil production could fail short of the Plan's objectives by as much as 1 million to 1.5 million barrels per day. Natural gas production could fall short by the equivalent of up to 1 million to 1.5 million barrels a day. Coal production could miss the Plan's target by up to 200 million tons per year. Nuclear power generation could fall short by as much as 15 percent.

The Plan acknowledges that there will be conflicts between environmental protection and increased energy production, but it does not face the possibility squarely and provide mechanisms for resolving conflicts between the two. Between one-fourth and one-third of the 10.6 million barrels of domestic oil which the Plan anticipates will be produced each day in 1985 still has not been discovered. At least 1 million more barrels a day must be produced from frontier areas such as Alaska or the Outer Continental Shelf by that time to achieve the Plan's goals. Proposed new OCS laws could add to the existing lead times of 4 to 6 years or more for exploring and developing fields off the U.S. coastline. The Plan leaves unresolved the likely conflict between a doubling of the use of coal in the United States and the goals of the Clean Air Act. For example, delays in producing and installing pollution-control equipment on new utility powerplants and smaller industrial coal-fired boilers could lead to delays in achieving the Plan's goals for coal production or delays in achieving the Nation's air quality goals.

Although the Plan proposes moving energy prices toward "the true replacement cost of energy, " its proposals would continue to hold the price of natural gas below the Btu equivalent of other energy resources. This could prolong a distortion of energy consumption patterns by continuing to make gas-a clean-burning premium fuel-more attractive than alternative fuels.

The Plan's oil and natural gas price policies may provide enough funds to support accelerated exploration and development in the next few years, but some mechanism should be included in the Plan to adjust prices if more capital is needed in the long term. Increasing supplies of domestic oil and natural gas are crucial to the success of the Plan and the U.S. economy. Errors in judgment on pricing policies could cause shortfalls over the next 10 years. It is not possible at this point to be certain that the Plan's pricing policies will sustain a flow of funds adequate for developing some *3* million new barrels of oil a day in 1985 and an equivalent amount of new natural gas. For that reason, it seems prudent to devise some procedure as part of the Plan for assuring that investment capital is available to U.S. oil and gas companies and for adjusting price policies as necessary in the next several years.

Although there could be slippage in the construction schedule that could cause production of electricity from nuclear powerplants to fall 15-percent short of the Plan's goal, the midterm future of the industry is in even more doubt. Rising costs, licensing delays, and slippage in construction schedules have caused the nuclear industry to place a de facto moratorium on orders for new plants after 1985 because the risks are greater than utilities are willing to take at this time. Nuclear generation of electricity can be virtually freed from uranium resource constraints, but the technologies presently envisaged for achieving that freedom (plutonium breeders and plutonium recycle) increase the opportunities for proliferation of nuclear weapons among nations and terrorists. Alternate reactor systems may be possible that would generate economical power, substantially stretch out uranium resources, and reduce proliferation risks. However, nuclear dependence on nonbreeder reactors over the long run could lead to energy constraints, especially if the more pessimistic estimates of uranium resources prove to be correct.

Demand Impacts

The Plan's treatment of transportation energy conservation focuses too narrowly on the automobile, The Plan's goal of a 10-percent reduction in gasoline consumption by automobiles and trucks by 1985 probably is too optimistic, but there is not enough information in the Plan itself to support a judgment either way. Consumption of gasoline by automobiles alone can probably be reduced by more than 10 percent, largely through the energy-efficiency standards for new cars that are established in the Energy Policy and Conservation Act of 1975. However, increased use of fuel for trucks could partially offset reductions in automobile consumption by enough so that the Plan's goals would not be met,

Although the Plan's 1985 goal of insulating 90 percent of all homes is too optimistic, its proposals will help reduce the growth rate of residential-commercial energy demand, and the overall building projections of the Plan probably will be achieved, The Plan focuses too directly on one- and two-family dwellings, and does not propose strong enough measures to achieve the large potential energy savings from existing commercial (including multifamily buildings) and industrial buildings.

The Plan's regulations and tax/price incentives designed to encourage industrial use of coal may have unintended consequences, Expanded use of coal by industry will be impeded by the need for new coal-handling facilities, new furnaces and boilers, and pollution-control equipment. Because of the uncertainties associated with coal supplies, difficulties in converting direct heat equipment to coal, and delays in availability of pollution-control devices, industries may choose to switch to electricity rather than coal for some uses (although not to produce steam), pushing the burden of coal conversion onto the utility companies. The proposed oil and natural gas user tax, which is designed to accelerate a conversion to coal, could put U.S. petrochemical manufacturers at a worldwide competitive disadvantage. The projection of coal use in 1985 also is subject to question because it is based on an industrial energy demand growth rate about twice the *1950* to 1976 rate. If historical trends continue, the Plan's projected industrial energy demand by 1985 would be too high by the equivalent of 200 million tons of coal.

The proposed schedule for converting utility boilers from natural gas can be met, but there are circumstances that could upset this timetable. In particular, the concentration of natural gas boilers in the Southwest intensifies the capital acquisition problem to a point that unexpected demand growth in that area probably would preclude the attainment of the conversion goal. In addition, if conversion to oil on a temporary basis is prohibited, it is doubtful that both environmental and conversion goals can be met within the time period.

The tax credits proposed by the Plan for cogeneration, conversion, and conservation in industry will probably accelerate investment decisions in these areas by no more than a few months. The gap in the expected rate-of-return between conservation investments and investments made to increase production is not significantly closed by the proposed tax credits. It is doubtful that any acceleration of utility boiler conversion, beyond the schedule established by previous legislation, will result from the proposed coal conversion tax credit because the existing schedules do not allow much flexibility. Limiting the items that qualify for tax credits in industry and buildings probably will discourage innovation in energy conservation technologies. The home insulation tax credit may not increase the rate of investment in home insulation much beyond that already likely to result from high heating costs, so that any benefits might be outweighed by the reduction in tax revenues.

Societal Impacts

The National Energy Plan will cause a slight reduction in the rate of economic growth and contribute to a modest increase in the rate of inflation in the near term. The Plan is not expected to have a significant effect on employment. The consequences for the economy, inflation, and employment may be far worse in the long run if new energy policies are not adopted.

The chances for success of new national energy policies will improve if State and local governments are involved as partners in shaping and implementing the policies. Principles of federalism alone would argue for a strong role for States, regions, and communities in the National Energy Plan. A growing number of States have created organizations whose staffs know the energy problems in their regions in detail and are capable of dealing with them. The gravity of the energy crisis makes it essential that new policies have broad public support, which is more likely to develop if States and communities have more flexibility than the Plan seems to propose for resolving inequities and making and enforcing day-to-day decisions.

It is unlikely that the strong measures necessary to meet the environmental goals of the Plan are compatible with a substantial increase in the use of coal on the schedule proposed in the plan. A deliberate choice between increased use of coal- and air-quality goals probably will have to be made in the short run, at least in some regions. Emphasis on immediate accelerated use of coal may preclude the use of coal technologies that are less damaging to the environment and delay development and introduction of cleaner nonfossil technologies. Even if air quality could be protected in the coal conversion program, there are other adverse impacts of increased coal production and use, such as increased levels of carbon dioxide that are not addressed in the Plan,

A sustained commitment should be made now to a wide range of incentives for private development and deployment of solar and other alternative energy technologies. It should be possible in the long run to develop renewable and sustainable energy resources that have a relatively benign effect on the environment. But the speed with which such resources are developed will depend on the commitments that are made now to research and development, The Plan does not commit the United States to the full range of incentives that are available for accelerating development of new technologies, including subsidies for private research,

One phase of the formulation of the National Energy Plan was an effort to involve large numbers of private citizens in developing its proposals, but the Plan does not include specific programs for extending that involvement to future actions. Public participation in shaping and implementing energy policy may be the key to the success of such policy. To be effective, public participation should be well-informed, particularly in highly technical areas. A program of financial support to encourage informed public participation might contribute to a smooth transition in U.S. energy policy.

The Plan does not examine the consequences of its short-term energy strategies and tactics for energy development programs that must be put in place for the years after 1985. The Plan proposed fundamental changes in the patterns of energy supply and demand in a relatively short period of time. While it is not likely that actions taken during the next 9 years will be irreversible, any new national energy policy should address the question of whether changes between now and 1985 will strengthen or weaken the base on which long-range development will take place.

II. Overview and Perspective—Policy Panel

Overview and Perspective — Policy Panel

Policy Panel Overview

The Policy Panel is in complete agreement that the United States and all other industrial nations of the world face a serious energy problem. If the United States tries to escape short-term sacrifices that can begin to deal with the problem, it will face real hardships no more than *10* years from now. There are no painless options.

The National Energy Plan correctly diagnoses the basic U.S. problem as a case of domestic demand outstripping domestic supply. The dominant world problem, which the United States shares, is the long-run prospect of running out of oil and natural gas. The National Energy Plan properly focuses on reducing demand for oil and increasing domestic energy supplies to avoid a degree of reliance on imported oil that cannot be sustained, Without immediate action, the growth in world demand for oil could exceed the production capacities of exporting nations by the mid-1980's, If that were to happen, intense competition among importing nations over scarce supplies of oil and gas, that they all need to survive, would begin to set the stage for worldwide economic and social upheaval.

The United States cannot deal with the energy crisis one item at a time, nor can it put off dealing with what now seem to be long-range problems in order to concentrate on more immediate concerns. It must apply its vast resources and technical talents immediately to solving problems in three time frames:

- In the near term, by the mid-1980's, the United States must reduce demand and increase domestic production to reverse the rising trend of oil imports. The National Energy Plan's oil import goal of 6 million to 7 million barrels a day by 1985 may be arbitrary, but it is reasonable and achievable.
- In the midterm, over a period of about a generation, the United States must restructure energy consumption patterns so that the country depends on oil and natural gas for only a small portion of total supply.
- For the long term, the United States must begin 'now to intensify a search for ways to base its energy systems or-i renewable and sustainable resources.

The time available to achieve the near-term goal now is so short that strong measures are essential. Without effective leadership, these strong measures may fail to materialize. Many Americans, for example, find it hard to accept the existence of an energy problem, given the fact that there are no lines at gasoline stations and lights still go on at the flick of a switch.

Energy policy in all three time frames must be national in scope. Several aspects of the energy problem involve national security. These include nuclear proliferation, and the possibility of oil embargos or sudden and steep oil price increases. Neither private industry nor State and local governments can deal with energy problems at that level. Energy supplies and energy demands are unevenly distributed, not only in the United States but worldwide, and the questions of equity which this distribution poses can only be addressed from a national perspective. Present national policies have kept energy prices at artificially low levels that are not consistent with world forces of supply and demand. Energy policies must be

Overview and Perspective — Policy Panel

corrected to take fully into account the environmental and health costs of energy production and use and to set prices at levels that encourage efficiency rather than waste.

Such national policies for energy are needed not to dictate individual choices but to provide leadership and a base for shaping public policy to supplement the private market, assure that national security and national welfare are protected, and encourage regional equity.

Because energy policies affect many publics and many problems in many dimensions, they require a mix of instruments for achieving goals. policies that are adopted in 1977 may not match the needs of the United States a decade from now. Procedures must be adopted and ratified as broadly as possible for adjusting policies as the United States gains experience with a way of life in which energy is neither abundant nor cheap and as new information becomes available and new techniques are developed for producing energy.

The Policy Panel endorses several features of the National Energy Plan. It has reservations about several others. Both are addressed directly in this report and are put forward to emphasize areas which the Panel believes deserve special consideration during congressional review of the National Energy Plan,

The Policy Panel generally endorses these features of the National Energy Plan:

- The Plan underscores the gravity of the world energy problem and suggests a personal commitment by the President to the urgent task of slowing the rate of growth of oil imports before they reach intolerable levels.
- The Plan focuses on moving away from heavy dependence on oil and natural gas—both domestic and imported—and toward use of more abundant domestic fuels, particularly coal.
- As drafted, the Plan can achieve reductions in energy consumption without creating intolerable problems of unemployment, inflation, or sluggish economic growth.
- The Plan recognizes that the most effective long-range conservation measures are those that lead to improved efficiency in new buildings, new automobiles, new industrial plants and other capital stocks, and concentrates on higher efficiency standards for those areas.
- The Plan emphasizes the importance of setting more realistic prices for energy so that consumers can see total costs more clearly and can make their choices accordingly.
- The Plan challenges the wisdom of relying solely on plutonium breeders for the next generation of nuclear reactors and seeks to redirect U.S. R&D activities to seek more satisfactory solutions to the problems of nuclear weapon proliferation.
- The Plan proposes measures to reinforce existing conservation programs such as the Energy Policy and Conservation Act of 1975 where tougher enforcement actions may be necessary to reach the goals of the National Energy Plan.

- The Plan gives attention to cogeneration, which can provide flexibility in meeting future energy demands because new capacity can be brought online in 2 to 3 years after an order is placed.

The Policy Panel has reservations about the following aspects of the National Energy Plan:

- Domestic supplies of all energy resources are likely to fall below the Plan's projections. Delays in production of oil and natural gas are possible because of postponements of leasing schedules on the Outer Continental Shelf. Regulations may delay the opening of new coal mines. Slippages in construction schedules and below-maximum performance of powerplants may reduce the energy available from nuclear generators, although total generation of electricity probably will meet the Plan's targets.
- Given the seriousness of the energy supply problem, more drastic energy-saving measures than those proposed in the Plan could be justified.
- The Plan probably overestimates future energy demand in industry. However, a slower rate of growth in industrial energy consumption than the Plan anticipates should not be used to justify a relaxation of conservation measures in other sectors.
- The Plan anticipates higher-than-average growth in the gross national product, continued gains in environmental protection, and a pronounced shift toward coal as an energy source. The goals may be commendable, but the case is not made in the Plan that all three can be achieved simultaneously.
- The Plan's goal of expanded coal use is not likely to be reached. Utilities and industries are not likely to convert to coal to the extent the Plan expects because of stringent environmental standards, and uncertainties about the reliability of pollution-control equipment. The consequence of these impediments to coal use may be an expanded use of electricity for many industrial processes.
- The Plan proposes actions that tend to offset one another. It stresses replacement cost pricing for energy and residential energy conservation. At the same time, it proposes to hold residential natural gas and heating oil prices below replacement cost. While this may be reasonable in the near term, it should be reexamined for its long-term implications.
- A National Energy Plan must have the support of State and local governments to be effective, In order to assure that support, the Plan should actively engage State and local officials in policymaking, something it does not provide in its present form.
- The need for creating and supporting a variety of education and public participation programs is not stressed in the Plan. Public involvement can make citizens more aware of energy problems and more aware of the consequences of their energy choices. Programs are needed to expand channels of communication between citizens and Government officials.

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- The Plan does not discuss the alternative of allowing prices for energy to rise to the level at which supply and demand are balanced. Excessive imports could then be discouraged by imposing a tariff. Excess profits could be taxed. Revenues from both tax and tariff could be used to redress inequities. The end results of this alternative approach should be similar to those of the Plan and might be less cumbersome.

Policy Panel Perspectives

As one phase of its analysis of the National Energy Plan, the Policy Panel addressed five broad-policy questions. The conclusions presented below represent the judgments of the Panel of the effects of the Plan in these areas.

1. Are the National Energy Plan's goals for supply, demand, and conservation reasonable and are the proposals for achieving them likely to be effective?

Under the Plan, the United States will use 1.9 million barrels a day of oil equivalent less in 1985 than it would if there were no changes in Federal energy policy. In that respect, the Plan's overall consumption goals in 1985 are modest, and should be fairly easy to achieve. This is true in large part because the Plan's estimate of 1985 consumption even without policy changes—particularly in the industrial sector—is higher than most other published forecasts.

Given the serious energy problems that the United States faces, more drastic energy-saving measures could be justified. For example, the Plan would not raise the purchase price of domestic crude oil to the world price until January 1, 1980. Existing law would achieve world price levels several months before that by terminating mandatory price controls. The Plan would not raise the average price of natural gas significantly, if at all, because the proposed increase in the price of some interstate gas is offset by a decrease in the price of some intrastate gas. The average price of natural gas, therefore, will remain below the price-per-Btu of imported oil indefinitely.

The Plan's overall projection of energy consumption in the residential and commercial, industrial, and transportation sectors will probably be met, but there are a number of uncertainties which could prevent this from happening. The Plan's proposals for new capital stock may lead to larger reductions in energy use in the long-run than is apparent in the projections for 1985.

Problems exist in each consumption sector which suggest consideration of additional measures:

Residential and *commercial:* Proposed tax credits may not encourage enough homeowners to insulate their homes to meet the Plan's" stated goals. Additional measures may be needed, such as a requirement that structures meet specific energy-efficiency standards before they can be put up for sale. More attention is needed on measures to reduce energy waste in commercial buildings.

Industry: The cogeneration of electricity and process heat and steam involves both substantial energy-saving opportunities and difficult problems. Rapid conversion of industries to coal from oil and gas (in line with a major Plan goal) could lead to installation of coal-burning equipment that is either unsuited to cogeneration of electricity or is less efficient than technology now under development. It is likely that a slower rate of growth in industrial energy use than is projected by the Plan will make it possible to stretch out deployment of cogeneration and to take advantage of newer technology.

The Plan relies more on industries shifting from oil to coal than it does on conservation as a means of holding down oil imports. The very large increase in coal production called for in the Plan appears to be physically possible. Transportation for coal should be available, although difficulties may arise in delivering coal in small batches to large numbers of widely dispersed industrial facilities.

A crucial uncertainty is whether the taxes that would be levied on oil and gas burned by utilities and industries would provide a sufficient incentive for investment in coal-burning facilities. Uncertainties about coal supplies, availability of coal-handling and coal-burning equipment, and meeting Federal air pollution standards may lead utilities and companies to keep burning oil or gas and pay the tax or convert from oil and gas to electricity. Some of the oil and gas taxes or the increased costs of electricity could be passed on to consumers in the form of higher prices for goods.

Transportation: There are conflicting forecasts about the effectiveness of the Plan's system of taxes and rebates on new automobiles in reducing gasoline consumption. The tax and rebate system would, however, create a serious foreign trade problem unless rebates similar to those proposed for domestic automobiles were granted for high-performance imported cars.

The Plan's proposed standby tax on gasoline may not affect gasoline consumption significantly by 1985 because it would add a maximum of 35 cents per gallon to the cost of gasoline in 1985 while fuel-efficiency of automobiles would increase substantially. If larger transportation fuel savings are desired, a higher gasoline tax should be considered. More efficient and flexible forms of commuter transportation such as vanpools and "jitney" services also might be encouraged.

2. **Do the provisions of the National Energy Plan promote or interfere with other national goals?**

The success of any energy policy must be measured, at least in part, by its influence on economic well-being, environmental protection, and other goals. Implementing the National Energy Plan will affect all of these goals to some degree, but the influence will be relatively small in each case.

The Plan probably will slow down the growth of the gross national product slightly during the next several years, but the long-term benefits for the economy should justify the short-term costs. An orderly transition to an economy with high energy costs may cushion the United States from severe shocks in later years that could result from living with present energy policies.

The Plan relies heavily on the price mechanism to achieve energy conservation, in some cases in combination with regulatory techniques. Prices of nearly all forms of energy can be expected to rise under the Plan, led by an increase in the purchase price of oil to world market levels. Higher energy prices will be transmitted throughout the economy and will affect prices of all goods and services to some degree. Improved efficiency in the use of energy should mitigate the inflationary impact, but some additional inflation is inevitable as energy prices rise toward replacement cost. It should be easier to absorb that impact with gradual moves to reduce nonessential energy uses than to wait until world competition for oil forces sudden increases in oil prices and abrupt reductions in essential energy uses,

The National Energy Plan does not address its potential impact on employment in detail. This may not be a serious omission, because the net effect of the Plan is likely to be small, with some job losses and some job gains. To the degree that economic growth is reduced, the number of available jobs in some sectors will fall. However, increasing energy costs may also create new jobs that substitute labor for energy.

One of the principles of the Plan is that the United States must solve its energy problems in a manner that is equitable to ail income groups and it proposes a program to carry out the principle. Because lower income families spend a far higher proportion of their total income for energy than do those with higher incomes, people least able to afford higher energy prices will be hit hardest. However, the rebate system proposed by the Plan will return energy taxes to the economy and should compensate lower income groups at least partially for increased energy costs. Without the rebate plan, or some alternative, the energy policies proposed in the Plan would cause serious inequities.

The National Energy Plan addresses the need to protect the environment. At the same time, the Plan implictly recognizes the difficulty of achieving some of its energy goals without further environmental damage. The most important impact of the Plan on the environment will be a shift away from the use of oil and natural gas to the use of coal, While there is doubt that the shift to coal will be achieved on the scale contemplated by 1985, any increase in the use of coal will affect air quality and land use.

The Plan proposes a special Presidential study committee to improve national understanding of health effects and environmental constraints of increased use of coal, With or without the Plan, maintenance of environmental goals—particularly air quality standards—will be difficult without vigorous research and development of technologies to control pollution.

3. IS the mix of price increases and regulations proposed by the National Energy Plan the most effective approach to energy policy or should the Plan rely more heavily on decontrol of fuel prices?

Efforts to set new energy policies have revived a debate between advocates of deregulation of fuel prices and advocates of more vigorous Government intervention over which approach will be most effective in changing consumer habits, The National Energy Plan proposes a mix of policies that recognizes the advantages and disadvantages of both approaches. The Plan relies heavily on higher energy prices to change the patterns of energy demand and its proposals reflect an effort to retain as much as possible the flexibility of consumer and producer decisions that is characteristic of a competitive free market. At the same time, it recognizes that a pure market approach probably will not cause changes in energy consumption patterns soon enough to achieve the Plan's goals for 1985. It also recognizes that simply letting energy prices rise without controls would create serious problems of equity among different income groups. This is not to say that the Plan will necessarily be effective in every respect, but its effort to move toward "replacement cost" for energy is a valid starting point.

The Plan probably is correct in its implied judgment that higher prices for fuel alone will not change energy consumption patterns fast enough to achieve the goals it sets for 1985. In transportation, for example, there is reason to believe that, given a choice, consumers would not buy enough fuel-efficient automobiles in time to achieve a 10 percent reduction in gasoline consumption by 1985. Even the fuel-efficiency standards for automobiles set by the Energy Policy and Conservation Act of *1975* may have to be reinforced if 1985 model cars are to average 27.5 miles to the gallon.

As with transportation, higher fuel prices alone probably will not motivate enough homeowners and landlords to reinsulate buildings and take other energy-saving steps to achieve the reduction in energy demand that the Plan envisions. Additional regulations, standards, and incentives may be required.

The cornerstone of the Plan is a proposal to raise energy prices through a crude oil equalization tax, much of which would be refunded to the public. This is an improvement over the present system of price controls that hold domestic purchase prices below world levels and encourage overconsumption of scarce fuels.

Americans today pay about *$11* per barrel for oil, which represents a mix of three prices—$5.25 per barrel for "old" domestic oil; more than $11 per barrel for "new" domestic oil; and about $14 per barrel for imported oil. Domestic producers, whose prices are controlled, in effect subsidize importers to cover the differences between the $14 world price and the $11 average domestic sales price.

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The Plan would retain price controls for domestic oil. It also would raise U.S. purchase prices to world prices over a 3-year period by imposing a tax equal to the difference between controlled domestic prices and the world price. Users of oil for home-heating would be shielded from the full tax through a rebate to oil distributors who could demonstrate that they had not passed on the tax to consumers. Revenues from the equalization tax would be rebated on a per-capita basis. The effect on income distribution should be progressive because the per capita rebates generally would more than offset higher costs to families below the median income.

The wellhead tax in the form proposed by the Plan would have a smaller effect on consumer prices and on employment than some other alternatives because it would encourage small adjustments throughout the economy rather than sharply higher costs in a few sectors. One of the most important impacts of the proposal will be to end the subsidy on imports that now exists. Consumers would have to be willing to pay a higher price for all oil before they would be willing to pay a higher price for OPEC oil. This could strengthen consumer resistance to OPEC price increases, help reduce the Nation's staggering oil import bill, and perhaps lead to a reduction of total OPEC revenues.

Oil industry revenues would be lower under the Plan's proposals than they would be if oil and natural gas prices were deregulated. However, an OTA study using a model to simulate future industry response, indicates that, at least in the near term, a higher price for new domestic oil would not create significant increases in supply except in high-cost production regions off the coast of Alaska. [1]

One final equity issue is raised by the plan's proposal to impose different levels of restraint on different energy users, Broadly, the lightest burden is placed on home-owners, while industrial firms and owners of automobiles and trucks will be required to reduce consumption or pay higher costs and taxes. Within the transportation sector, the Plan proposes to shift that burden away from owners of existing cars and on to purchasers of new cars, where higher costs can influence choice.

4. **The important foreign policy questions raised by the Plan are:**

- **Are the Plan's import goals adequate to protect against another Arab embargo?**
- **Is the nonproliferation policy outlined in the-plan compatible with the Plan's objectives?**

The need for a national energy plan derives in large part from the fact that the United States now meets about sO percent of its oil demand through imports and that percentage is growing. This increase is in addition to a very high level of oil imports by Europe and Japan. With the 1973–74 oil embargo and a subsequent four-fold price increase, it became clear that Western energy supplies are fundamentally insecure, both as to price and quantity. As long as the United States depends so heavily on foreign oil supplies, it is vulnerable to the actions of oil exporting nations, including future embargos or disruptive price increases.

[1] See appendix II.

The energy problem is as much a global as a national problem, and U.S. energy objectives can be met only in the context of a favorable international environment. Energy waste or conservation by one country affects the supplies available to others. Consequently, the United States has an interest not only in moderating its own demands but in helping other countries develop new energy sources and expand their conservation programs. Because it is the world's largest energy consumer, U.S. energy policies are of major interest to other countries.

The National Energy Plan's proposal to cut oil imports to 7 million barrels a day by 1985 probably is sufficient: (a) to reduce the risk of a shortfall of import availabilities at present (real) prices and a consequent further large increase in the price of oil; and (b) to enable the United States to weather another possible embargo if the emergency oil reserve called for in the Plan is in place and the International Energy Agency's (IEA) automatic oil-sharing arrangements are implemented.

A gradual reduction of U.S. imports of oil to 7 million barrels a day by 1985 would place total world import requirements at about 35 million barrels a day. This would be within the range of forecasts of the capacity of oil producing nations in 1985. However, if U.S. demand were 4.5 million barrels per day higher, as it is estimated to be in 1985 without the National Energy plan, world demand for oil might exceed the capacity of exporting countries and market forces could create a large and disruptive increase in price.

An embargo which cut Arab exports of oil by as much as 50 percent in 1985 would reduce world oil exports by one-third, and total oil supplies in the industrial countries by roughly 20 percent. If the International Energy Agency could spread this cut evenly, the United States would suffer a reduction of 4 million barrels a day. The planned U.S. emergency oil stockpile of 1 billion barrels could supply this amount for approximately 8 months, if no special conservation measures were undertaken, and if no embargo occurred before 1985, the target year for completing the stockpile.

Concern about the spread of nuclear weapons has led the Administration to propose an indefinite postponement of further steps toward a "plutonium economy." Many countries, particularly those with breeder reactors already under development, view this proposal as a threat to their long-term energy planning. To mitigate foreign concerns about continued reliance upon the present generation of uranium reactors, the Plan offers U.S. uranium enrichment services to any country that shares American nonproliferation objectives. This approach could be augmented by a program to establish an international uranium stockpile, which could be accomplished at less cost than creating a stockpile of the energy equivalent of oil.

Other measures may have to be taken if the Administration position is to be acceptable to most countries. These include creating an international agency that could provide spent-fuel storage facilities under international safeguards, creating multinational and international management of various stages of the nuclear fuel cycle, developing market-sharing agreements among nuclear exporters, and a variety of measures to reduce the incentive to acquire nuclear weapons.

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For the proposed nonproliferation policy to work, it is important that the United States persuade other governments that there are nuclear alternatives to the plutonium breeder which promise to be economical, less conducive to proliferation, and which can be put into operation at least as rapidly as breeders. One such approach may be to operate present-day reactors on a fuel cycle employing denatured uranium-233 and thorium. This technology could be developed through a multinational effort.

Assistance to other governments in the development of alternative energy technologies such as solar, geothermal, synthetic fuels, and biomass conversion would be another part of the effort to lead the world away from the plutonium economy. An international development program for such sources, along with conservation technologies, could be a promising approach.

5. **Does the National Energy Plan allow for adequate participation in the shaping and conduct of energy policy by State and local governments and by citizens generally?**

The National Energy Plan not only fails to implement an energy partnership with the States, it appears to alter their existing planning and regulatory authority profoundly.

principles of federalism and equity alone would argue for a strong role for States, regions, and communities in fashioning and implementing energy policy. The fact that the Plan will require an extraordinary degree of cooperation from the States makes it even more essential that the Plan contain explicit procedures under which regions can achieve flexibility and resolve inequities and under which day-by-day decisions can be made and enforced in regions and States. The role of the National Government should be to step in when programs that are in the national interest are rejected or deferred on parochial grounds.

A growing number of States have created organizations whose staffs are capable of addressing energy problems peculiar to their regions. These organizations give many States a capability to work toward achieving the goals of the Plan. if they are involved in developing energy policy at an early stage, cooperation and enthusiasm could be generated which might mean the difference between success and failure in some regions.

The Plan mentions the importance of public participation in energy policy but its proposals do not address procedures and mechanisms for involving the public. Public involvement will provide a means for citizens to communicate concerns or innovations to policy makers and for Government to communicate proposals and technical information to citizens. Experience indicates that in any policy area as complex and important as the energy policies addressed in the Plan, citizens are likely to be cautious about-or even opposed to-changes in policy unless they are involved in formulating that policy.

III. Cross-Index to Issues Raised by Major Energy Proposals

Cross-Index to Issues Raised by Major Energy Proposals

The National Energy Plan makes more than 100 specific proposals for changing laws or regulations to achieve its objectives. Some of the proposals are more controversial or will influence supply, demand, and society more than others. This section presents cross-indexes of analyses of issues in eight general areas:

1. Coal Utilization;
2. Domestic Crude Oil Tax and Regulations;
3. Natural Gas Pricing and Regulation;
4. Nuclear Development;
5. Oil and Gas Consumption Taxes;
6. Utility Regulation;
7. Buildings Conservation; and
8. Transportation.

The cross-index does not imply an effort to rank proposals according to importance, although clearly the Plan's treatment of crude oil and natural gas prices will have a broader impact on energy supply and demand than appliance standards or vanpools. It is intended only as a guide to detailed discussion of issues raised by the Plan's proposals in these eight general areas.

1. Coal Utilization

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3. Natural Gas Pricing and Regulation

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5. Oil and Gas Consumption Taxes

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6. Utility Regulation

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8. Transportation

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IV. Supply Impacts

Supply Impacts

Supply Overview and Findings

The National Energy Plan correctly assesses the gravity of the world energy situation, The Plan accurately conveys the sense of urgency in its statement that:

> . . . the diagnosis of the U.S. energy crisis is quite simple: demand for energy is increasing, while supplies of oil and natural gas are diminishing. Unless the United States makes a timely adjustment before world oil becomes very scarce and very expensive in the 1980's, the Nation's economic security and the American way of life will be gravely endangered. The steps the United States must take now are small compared to the drastic measures that will be needed if the United States does nothing until it is too late.

The National Energy Plan is a comprehensive and generally consistent set of policies that will permit the United States to begin to manage its energy supplies before conflicting claims on diminishing world oil supplies reach crisis proportions, The observations and conclusions that follow are meant to broaden the understanding of the Plan's impact on the Nation's energy supply systems. They are intended to raise the question as to whether the Plan can achieve its goals and not to challenge its value as a sound base for establishing U.S. energy policy over the next several years.

The Plan is a major move in the right direction. It can be improved with adjustments in detail and in scope.—The National Energy Plan acknowledges the hard energy choices the United States must make and the high costs of those choices. The plan correctly emphasizes that cheap and abundant energy is a thing of the past. One of its most important messages is that, even if the United States could afford to import unlimited amounts of oil indefinitely, unlimited supplies of oil simply do not exist anywhere in the world. The Plan accurately perceives this in its basic supply goal, which is to begin to shift the country away from a near-total reliance on oil and natural gas toward the use of energy supplies whose resource bases have a potential for growth. The goals of the Plan that are designed to force that change—reducing the rate of growth in energy demand to 2 percent a year, reducing consumption of oil and natural gas and the level of oil imports, reducing energy waste, and increasing the application of new technologies for providing energy from other sources including coal, nuclear power, and the sun-are properly focused.

The levels of supply projected by the Wan represent the upper limits of capacity and supplies of all fuels are likely to fall below the Plan's goals.—There is little, if any, margin of error in the production schedules of the National Energy Plan. There is no room for delay in opening new coal mines, exploring for new oil and natural gas resources-particularly in the frontier areas such as Alaska and the Outer Continental Shelf—and putting nuclear powerplants into operation. Considering the past 7 years of performance in developing new energy supplies, it is unlikely that all elements of the Plan will fall into place precisely on schedule. The probable causes of delay are different for each source of energy. In oil and gas production, delays are most likely to occur because of laws and regulations that may postpone access to frontier areas for exploration and development, particularly on the Outer Continental Shelf. Ad-

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ditional coal-production facilities will be constructed by the coal industry only if new markets for coal are assured. This may require some short-term tradeoffs between environmental objectives, since the new boilers and pollution-control devices may not be available for the rapid conversion of plants to coal use. Moreover, manpower and capital shortages could delay the opening of new underground coal mines, and transportation bottlenecks could prevent coal from being delivered where it can be used, particularly in the East. If such delays occur, production of oil could fall short of the Plan's goals by as much as 1.0 to 1.5 million barrels per day. Production of natural gas may also fall below the goals by the equivalent of up to 1.0 to 1.5 million barrels of oil per day. Coal production could fall short of the goals by as much as 200 million tons per year (2.4 million barrels per day equivalent). Nuclear powerplants could produce up to 15-percent less energy (0.6 million barrels per day equivalent) than the Plan anticipates.

The Plan contains no contingency plans for stimulating production of energy or further reducing consumption in the event of slippage in one or more sources.—The incentives proposed by the National Energy Plan concentrate more on switching demand than on encouraging higher rates of production. The higher prices proposed for new oil and natural gas are expected to encourage accelerated exploration for those resources, at least in the near future. The Plan's proposals for creating new markets for coal should provide the industry with incentives to increase production. However, as noted above, the Plan's supply objectives can be achieved only if all fuels are produced at the rate assumed in the Plan. The linkage between supply and demand is particularly crucial in coal production. The Plan provides no direct incentives for new coal production but relies entirely on creating higher demand. If, for example, it appeared 5 years from now that oil production would not reach the Plan's goals, the only options would be to increase coal production or buy more oil on the world market, since there is virtually no chance that increased production of natural gas or nuclear power could take up the slack. The Plan should be more explicit about which of these options would best make up for insufficient domestic oil production and what other alternatives might be offered to make up for shortages.

The Plan fails to acknowledge that there will be inevitable conflicts between environmental protection and increased energy production and use. It should face that possibility squarely and propose mechanisms for resolving the conflicts.—If energy production falls short of the Plan's forecasts, it is more likely to be caused by environmental and regulatory conflicts than by lack of available resources, capital, or manpower. For example, more than one-third of the oil and gas which the Plan anticipates will be produced domestically in 1985 still has not been discovered. A large share of new resources probably will come from the frontier areas, Alaska and the Outer Continental Shelf. But environmental objections and proposed new OCS laws could delay new production long enough to cause new supplies to fall short of the Plan's goals.

The Plan also may assume too much in its implied schedule for additional nuclear generating capacity. Accelerating the licensing process for new powerplants, as the Plan proposes, deals with only one factor in a process which now makes the lead time for nuclear powerplants as long as 12 years. Other factors include environmental issues, and the questions of public acceptance of accelerated nuclear plant construction and of State authority to grant or deny permits for building and operating nuclear plants,

Finally, the Plan leaves open the question of potential conflicts between air quality and a virtual doubling of the use of coal as an energy source. The Plan is designed to encourage greater use of high-sulfur Eastern coal by requiring "best available" control technology for al l new coal-fired powerplants, whether they burn Eastern coal or lower-sulfur Western coal. What the Plan does not say is that control equipment also would be required on many, if not most, new coal-burning industrial boilers, most of which are likely to be built near urban areas where air pollution already exceeds Federal standards. Delays in converting powerplants and industrial boilers from oil or gas to coal that result from the requirement for pollution control could, in turn, reduce demand and retard the increased production of coal which the Plan ant ic i pates. Delays in coal production would prolong the period during which the United States depends for more than 60 percent of its energy on oil and natural gas.

The pricing policies in the Plan may require revision in a few years to avoid distortions in both supply and demand.—The Plan projects growth in all domestic energy production. Without discoveries of new oil fields, production could decline from today's levels by as much as 25 percent; the production of gas could decline by 45 percent. To achieve the Plan's production goals, oil and gas discovery rates must at least double the industry's finding experience over the past 15 years. This optimistic goal can be justified largely by the fact that there are still areas of Alaska and the Outer Continental Shelf which have the necessary reserve potential. The higher prices proposed for new oil and gas should encourage continued exploration, but the Plan does not clearly establish that the proposed oil and gas pricing policy will provide the necessary funds to achieve its projected oil and gas production rates. Rather, the question is approached as a judgment which, in the beginning, may be acceptable. It may be necessary to reopen the question and make adjustments if discoveries and, in turn, production fall below the Plan's goals.

The Plan does move toward correcting energy price imbalances which it says have contributed to the current energy crisis by encouraging the overuse of scarce fuels, in particular natural gas. The proposal to raise the delivered cost of petroleum to U.S. consumers to world price levels in 3 years is a positive step in that direction. However, the Plan could prolong the distortion of consumer choices among available fuels by holding natural gas prices below those of alternative energy sources. The "new gas" price ceiling would be made equivalent, on a Btu basis, to the average price of all domestic crude oil which is lower than the ceiling price for "new oil". Furthermore, the transportation and refining costs of crude oil are ignored, as is the intrinsic value of natural gas as a premium fuel. Thus, even at the new price, gas is substantially cheaper than competitive fuels. Natural gas will *re*main a first choice among available fuels as

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long as it is even slightly below the price of other fuels. The long-range impact of this continued disparity in the pricing of natural gas should be addressed by the Plan.

The Plan's goal of accelerating development of solar energy is commendable, but its specific proposals are silent on serious impediments to expanded use of solar equipment.— In order to achieve the Plan's goal of installing solar energy equipment in 2.5 million homes by *1985,* sales must increase at a rate of about 75 percent each year. Considering the number of institutional barriers to wider use of solar energy units, that growth rate may be too optimistic. The Plan does not address these barriers, which include a lack of national performance standards for solar equipment that could protect consumers against flawed systems. The Plan contains no guidelines for local governments which must approve solar equipment under their building codes. It contains no direct incentives for manufacturers to expand facilities and promote sales of solar devices.

The Plan is silent on post-1985 energy development: specifically, it does not relate short-term plans to long-term energy demands and supply patterns.— The appropriate focus of the National Energy Plan is on the period between now and 1985 because actions are urgently needed during that time to adjust the patterns of U.S. energy demand and supply to try to avoid intense world competition over scarce oil supplies. If the Plan is implemented, the U.S. energy base will be different in 1985 **than it** is now. But the Plan is silent on the question of whether the new U.S. energy base will provide a strong foundation for developing new energy technologies and resources after 1985.

For example, if the Plan's petroleum goals are met, the United States will still depend on oil and natural gas for about 60 percent of its energy supplies in 1985. Domestic oil and gas production, which will represent about 42 percent of total supply in 1985, **almost certainly will continue to decline after 1985. Despite these trends, the Plan does not address the question of U.S. policies between now and 1985 that are needed to prepare the country to deal with a continuing decline in domestic oil and gas production. The Plan should address the possibility of directing capital to programs to accelerate development of synthetic liquids and gases that can replace oil products and natural gas after 1985.**

By 1985, direct burning of coal will provide 29 percent of U.S. energy if the Plan's goals are met, compared with 19 percent in 1976. Is this growth trend expected to continue after 1985? If so, the Plan should address that. Achievement of the Plan's goals by 1985 will require huge investments of capital, large manpower training programs, and extensive research and development, particularly on clean-burning technologies for coal. The Plan is silent on the question of whether similar requirements of capital, manpower, and research for the period beyond 1985 can be superimposed on the short-term requirements without straining the U.S. economy.

The President has proposed to cancel construction of a breeder reactor, partly in an effort to lead the world away from a plutonium energy economy. The decision apparently assumes ample supplies of uranium for at least until the year 2000. If the assumption about uranium supplies is wrong, however, the United States either will be left with a stock of light water reactors in the 1980's for which there is not enough fuel or reactors will never be built because of uncertainties about uranium supplies. In either case, energy supplies in the years after 1985 will be seriously affected.

Oil and Gas Introduction

The share of total U.S. energy resources supplied by oil and natural gas together would drop under the National Energy Plan from about 75 percent to about 60 percent in 1985. Even though coal is expected to be the single most important fuel domestically produced, oil and gas will be a vital element in the national energy pattern for decades to come, and petroleum will remain the sole source of fuel for most transportation.

It is the goal of the Plan to increase domestic oil and gas production, reversing a 7-year downward trend. To meet these production goals, discoveries of new oil must occur at two to three times the annual rate of discovery since 1965. Discoveries of new gas also must exceed the industry's finding experiences since 1965.

As much as one-third of the domestic production of oil on which the Plan counts to meet the overall goals must come from reserves that have yet to be discovered. If the U.S. oil industry falls 50 percent short of the higher new discovery rate that is implicit in the Plan, domestic oil production can be as much as 1.S million barrels per day below the Plan's goal in 1985. Production of natural gas would be short of the goals by about the like amount in barrels of oil equivalent.

The ability of the industry to meet, or approach the plan's goals, depends on whether:

. leases can be made available to industry fast enough for exploration and development on the Outer Continental Shelf, in Alaska, or in other frontier areas under Federal management;

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- the anticipated quantities of oil and natural gas actually exist in areas which geological evidence suggests are the prime targets for exploration.
- enough new oil and gas can be discovered to support a total incremental production of up to **6 million barrels a** day in crude oil equivalent in 1985.
- **the pricing proposals** in the National Energy Plan would provide sufficient investment funds for oil and gas companies to explore and develop new resources.

Given these uncertainties, it seems likely that oil production will fall short of the Plan's goals by as much as 1 million and 1.5 million barrels a day in 1985 and that natural gas production will fall short by a like amount in barrels of oil equivalent.

Higher prices for "new" oil and gas are likely to encourage the incentive and capital that industry needs to explore and develop new areas, at least during the next several years, However, the uncertainties dictate a continuing review of these price policies. In addition, it is not clear how proposed amendments to the Outer Continental Shelf Lands Act of 1953 will affect the pace of offshore exploration and development. As of mid-June 1977, industry analysts believed the proposals could add 18 months to 4 years to the existing lead times of 4 to 6 years for offshore production. An Office of Technology Assessment evaluation of the proposed amendments, conducted independently of the energy plan analysis, concluded that the amendments could reduce some of the delays that now exist and the overall delay introduced by the amendments could be minor.

While these analyses illustrate the range of uncertainty which exists, it is important to recognize that the energy plan depends on a significant portion of new OCS production to meet its goals. Delays in the OCS development will create shortfalls.

Because of these uncertainties, contingency plans should be included in any national energy plan which would go into effect if oil and natural gas production falls short of the Plan's goals. Alternative pricing policies, more rapid expansion of coal production, higher import levels, and further reductions in energy demand may be considered, Nuclear power is not an alternative because production of electricity by nuclear plants probably cannot be increased beyond the 1985 goal.

Issue 1

Oil and Gas Production

Can domestic oil and natural gas production be increased fast enough to meet the goals set by the National Energy Plan?

Summary

The estimated base of undiscovered resources is large and could support not only the 1985 **levels of production envisioned in the Plan but a substantial** flow of petroleum after that. But the rate of discovery and development may not occur fast enough in the next few years to reverse the present decline in production. Industry can add to petroleum reserves only if it has systematic access to unexplored areas. In order to match production with the Plan's goals, the schedule for leasing in frontier areas must be accelerated. Because of lead times of up to **6** years between exploration and production, discoveries of new oil and gas must be made in the next **2** to 4 years in order to produce the **3** million barrels per day of new oil, and equivalent of new gas from new discoveries that the Plan requires to meet its 1985 goals.

Questions

1. At what rate must reserves be added to reach the Plan's goals?
2. Which areas are most likely to yield important amounts of new oil and natural gas ?
3. Can geopressurized gas reserves, Devonian shale deposits, or other new sources provide significant amounts of new natural gas within the time covered by the National Energy Plan?

Background

There is no serious question as to whether resources are available to meet the goals of the **National Energy Plan. There is, however, a serious question about** whether new oil and gas can be discovered early enough to reverse the trend in domestic production which is a key element of the plan. The following table shows the range of "best estimates" of ultimate renewable resources.

	Oil (including NGL) Billions Bbls.	Gas Trillion CF
production in 1976	3	19
Cumulative production through 1975	126	497
– Proved reserves, end 1975	39	228
– Estimated probable additions to known fields	30–60	60–1 00
Total remaining known fields	69–99	288–328
Undiscovered fields	72–1 28	400–800
Total estimate remaining	141 –227	688–1 128

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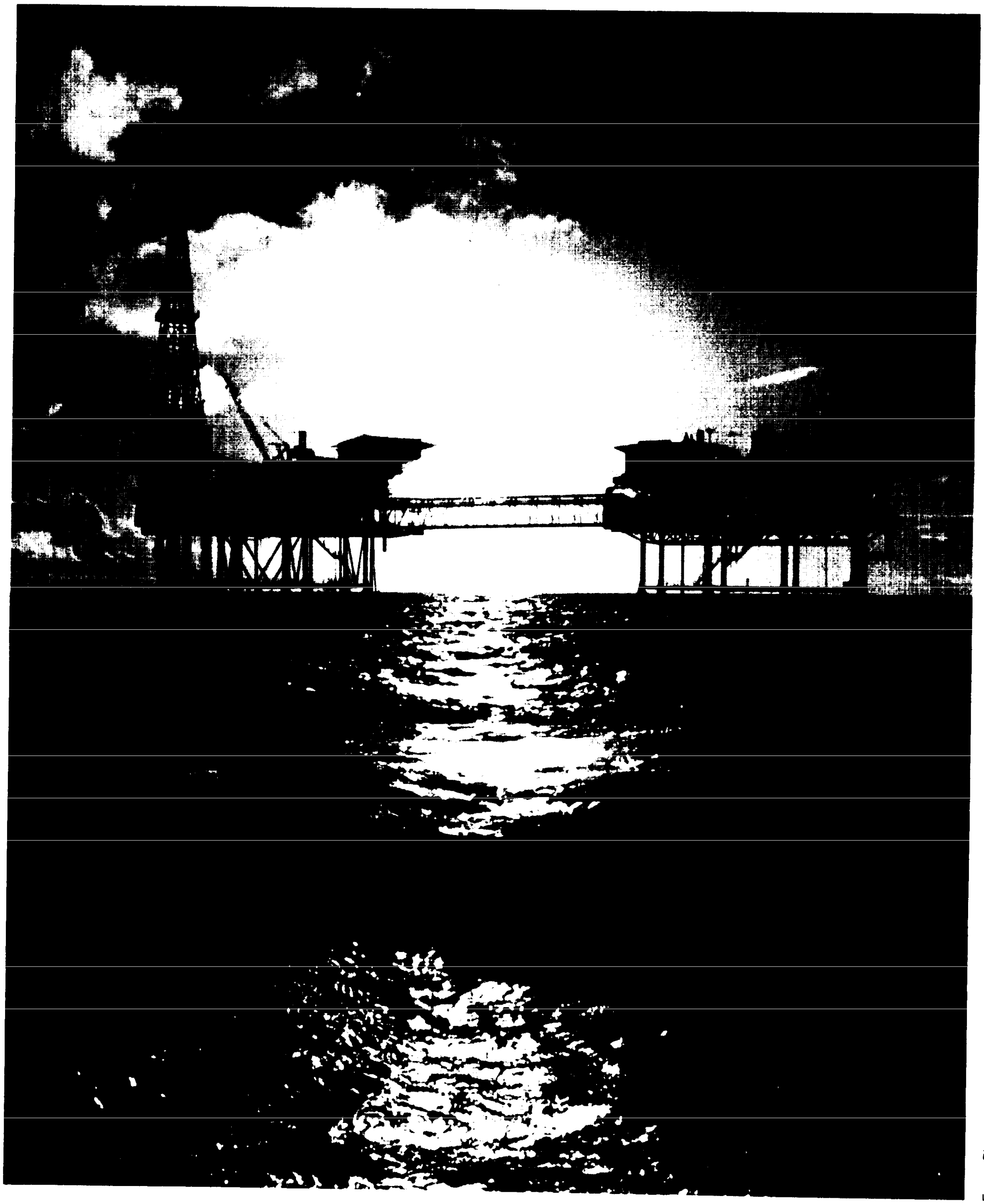

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U.S. Oil and Gas Production
(Million barrels per day oil equivalent)

Production	From Existing Fields		From All Fields Plan Goals	New Field Requirements
	1976	1985	1985	1985
Oil	9.7	7–7.5	10.6	3.6–3.1
Gas	9.5	5–5.5	8.8	3.8–3.3

Although geologists differ in their assessment of the amount and location of new resources, the prime targets are the offshore areas of the Atlantic and Pacific coasts and offshore areas in Alaska. Exploration continues on the Alaska North Slope as well as in the lower 48 States and the Gulf of Mexico.

These reserves, if confirmed, appear sufficient to support the present rate of production well past 1985. For the near future, the possibility that production will fall short of the Plan's goals involves a conflict between leasing schedules and lead times for production. As shown in the table above, oil production from existing fields containing the known reserves will drop significantly by 1985.

This means that enough new reserves must be discovered and developed in the Plan period to make up the difference between production from known reserves and the Plan's production goals.

Given overall lead times of 4 to 6 years or more between the beginning of exploration and actual production, at least two-thirds of the above deficiency (about 2.5 million barrels a day) would come from new discoveries made during the period of the Plan. However, it is probable that by 1990 more than so percent of all crude oil and gas production will depend on the success of exploration between now and 1985. Under these circumstances, the performance of the supply sectors of the oil and gas industry throughout the period of the Plan is of critical importance to the goals of the Plan, and of even greater significance to U.S. total energy supply in the years immediately thereafter,

The rate of discovery of new reserves of oil and gas during the period of the Plan must be two to three times the rate of discovery between 1965 and 1975. This would be an optimum performance and the expectation that it can be done is justified largely by the fact that there are still unexplored areas of Alaska and the Outer Continental Shelf which are judged to have the necessary reserve potential.

Federal policies are crucial to accelerated exploration because many of the potential areas for new oil and gas reserves are public lands, either along the Outer Continental Shelf or in Alaska. At present, there is a moratorium on leasing some public lands. Amendments have been proposed to the Outer Continental Shelf Lands Act of 1953 which could significantly add to lead times for offshore drilling and development. Another proposal could extend the lead

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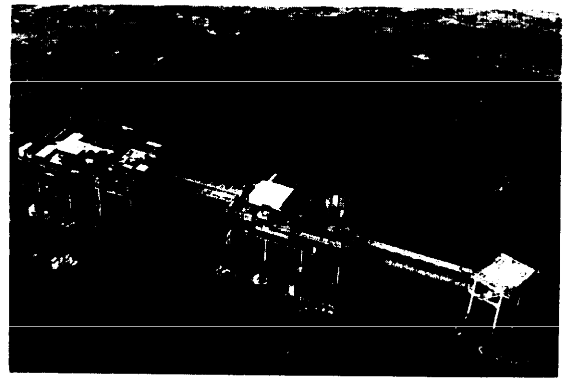

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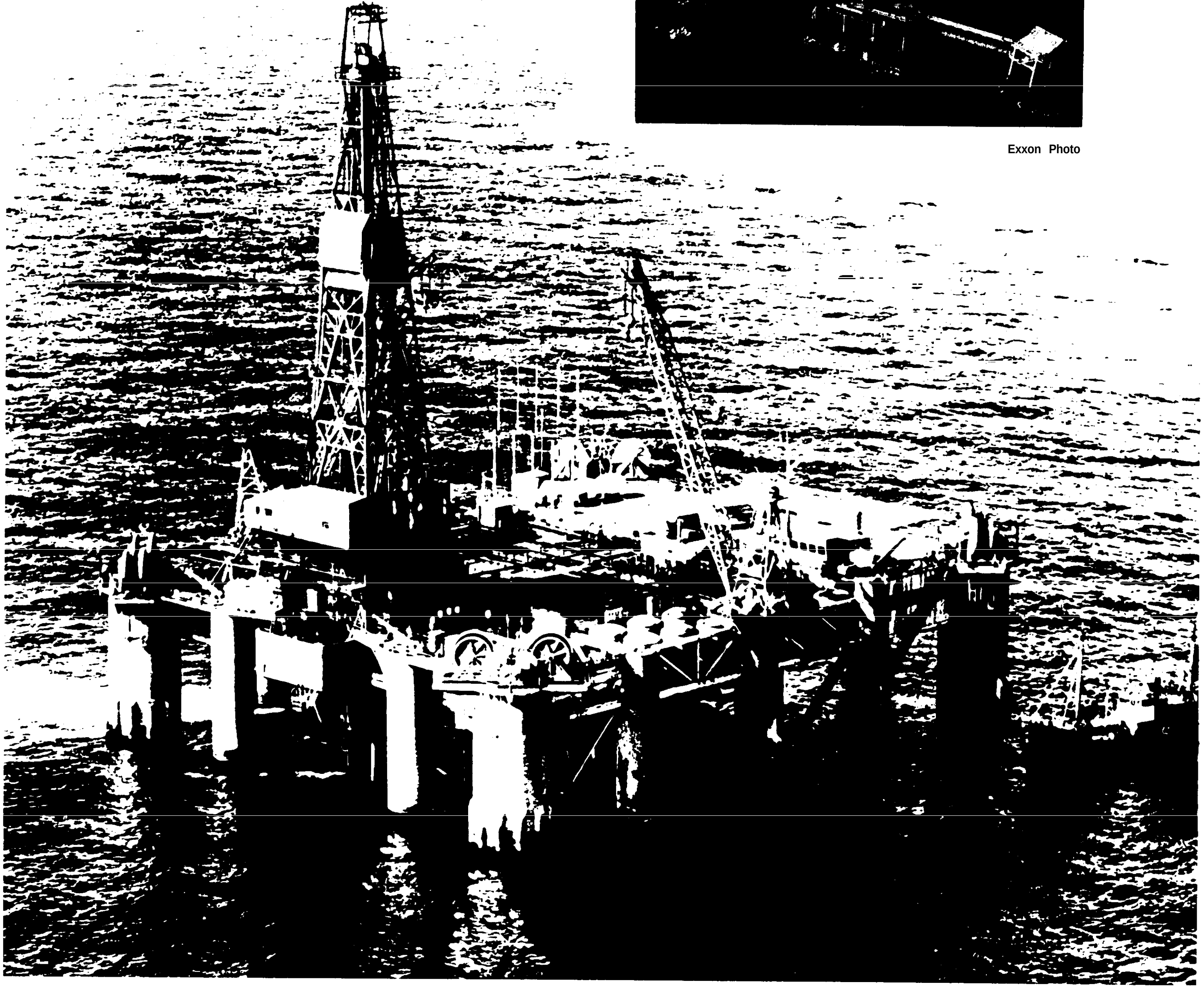

times further by requiring federally sponsored exploration of at least one structure in any proposed leasing area before bids actually are solicited. Delays of several years could result from these proposals. Another proposal would require a pause between exploration and development for preparation of an environmental impact statement of the effects of development on coastal areas. It can be argued that new environmental and leasing policies would lead to better cooperation between coastal States and the Federal Government and, in turn, to shorter lead times than now exist.

Another uncertainty involves the actual location of new resources. Oil company geologists differ sharply among themselves and with Federal geologists over the location of new resources. Some estimates show the bulk of new resources lying offshore. Others assume that most new oil will be found on land. Until promising areas actually are explored, the United States cannot put together a reliable inventory of its actual oil and natural gas resources.

Tertiary or enhanced oil-recovery techniques could add between 0.5 million and 1.0 million barrels per day to domestic production by 1985. However, these are the most optimistic ranges for tertiary production and they depend on the price of oil and on perfecting equipment and techniques that today are still in the testing stage.

Technical and feasibility studies hold out little hope that major projects to produce natural gas from Western tight sands, Devonian shale, and geopressurized gas in deep water reservoirs will be significant by 1985. Many technological and environmental problems must be solved before these resources can be widely exploited.

Issue 2

Oil and Gas Pricing

The Plan's oil and natural gas price policies may encourage enough exploration and development in the next few years but some mechanism should be included for changing price policies if changes are needed in the long term.

Summary

Increasing supplies of domestic oil and gas are important to the U.S. economy and essential to the success of the National Energy Plan. In an uncontrolled market, there does not seem to be any doubt that steadily rising world prices would ensure that oil and gas companies could generate the capital they needed to develop enough new resources to meet the Plan's 1985 production goals. The same levels of exploration and development are just as likely to occur under the Plan's proposed price for new oil, at least during the first few years. But it is impossible to tell at this time whether the Plan's price policies will support expanded industry activity indefinitely and there is no provision for monitoring the industry's capital position to ensure that incentives and capital remain at high enough levels throughout the life of the Plan. Uncertainty about the future investment climate can be cured by decontrolling oil and gas

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prices or by including in the Plan a procedure that will ensure that future pricing policies will support an adequate exploration and development effort.

Questions

1. Are the Plan's oil and gas pricing provisions consistent with its stated goal of stimulating "best efforts" to develop new supplies of oil and natural gas?
2. Will these policies, in fact, lead to development of the volumes of oil and gas which are entered as goals in the Plan !
3. Would alternatives to the Plan's pricing and taxing policies provide more assurance that the goals can be met?

Background

Under the Plan, increased supplies of domestic oil and gas would, in effect, cover a retreat from the near-total reliance on both of these fuels for energy in the United States. If domestic supplies do not rise to about the levels anticipated by the Plan in 1985, the United States would be forced to increase oil imports or reduce oil and gas demand through more stringent conservation measures.

The price and tax provisions in the Plan would increase incentives for new oil and gas production and for tertiary oil recovery. These are offset to some extent by continued price controls on all oil and by new price controls on intrastate gas. The crucial question is not whether incentives are increased but whether they are increased enough to stimulate production of about 6 million barrels a day of new oil and gas equivalent on which the Plan relies heavily to achieve its goal of reducing imports to 6 million or 7 million barrels a day in 1985.

The answer seems to be yes, at least during the next few years, It is not possible to judge at this point whether the Plan's pricing policies will sustain an indefinite flow of capital adequate for the required exploration and development, For that reason, it seems prudent to devise some procedure as part of the Plan ensuring that the pricing policy will support an adequate exploration and development effort.

The Plan does not treat oil and natural gas consistently. Controls would hold the return to producers of oil below the world market price although it does contemplate a world price for consumers through adjustments in the crude oil equalization tax. Under the Plan, natural gas would be sold to households below world energy prices indefinitely.

One aspect of the Plan's oil pricing policy that deserves closer study is the proposal that the sales price for producers be adjusted annually to account for general inflation in the United States. The Plan proposes to use the gross national product (GNP) deflator as the basis for annual adjustment, which probably will mean that the return to producers will not keep up with real costs. Costs of production have risen much more sharply than general costs since the early 1970's—in the range of 12 to 30 percent. The Plan does not explain why the GNP deflator was chosen as the basis for adjustments rather than the actual cost experience of the industry.

The Plan does recognize that costs may rise in production of old oil and that even adjustments for inflation in the $5.25 price of old oil may not provide incentive to keep oil flowing from old wells. Its requirement for a "case-by-case" adjustment in the price of oil from old wells may be difficult to administer fairly and raises the question as to whether some production may be lost because of delays in responding to requests for adjustments.

The Plan's treatment of natural gas prices raises even more serious long-term questions. Under the formula proposed by the Plan, new natural gas would be sold at a price based on the Btu equivalence of the weighted average cost to refiners of all domestic crude oil. This would be about $1.75 per thousand cubic feet (Mcf) at the end of 1977. Flowing gas that is put on the market when existing contracts expire would be priced at $1.42 per thousand cubic feet. Finally, the new and renegotiated intrastate gas would be set at the same levels as interstate gas.

The end result of the Plan's approach to natural gas is to peg its price indefinitely at levels lower than the price of other competing fuels on a Btu-equivalent basis. The only exceptions would be for gas sold to industry and utilities who would pay penalty taxes for continuing to use gas. This continues a distortion among the price levels for competing fuels which is a major factor in shortages of natural gas that have occurred in recent years. At the same time, it must be noted that the higher prices allowed for natural gas under the Plan should encourage new exploration and development in the near term.

For both oil and gas, the price incentives are limited to "new" properties, defined as locations 2.5 miles away from, or 1,000 feet deeper than, existing wells. This definition is not related to the geologic definition of "new" wells and could discourage development of the inferred reserve base,

One alternative to the Plan's proposal for continued controls combined with a crude oil equalization tax is decontrol, including a plowback provision with a tax on excess or "windfall" profits from existing wells. It might remove uncertainties about future changes in pricing policies that might be made by policymakers with different philosophies, a possibility that makes it difficult for today's investors to assess future market conditions. The past history of major changes in directions that make producers and investors wary of controls includes rollbacks on upper-tier oil prices, loss of depletion allowances for large independents, loss of tax credits for intangible drilling costs for independents, and changing administrative definitions and rules that have a major influence on returns from investments. Decontrol would also largely eliminate the significant cost and effort in the Government and industry required to administer the complex system of regulations inherent in the Plan.

Issue 3
Liquefied Natural Gas

Should the Plan encourage a flexible import policy for liquefied natural gas?

Summary

Any shortfalls in the domestic production of oil' and gas will have to be made up by imported energy sources. One of the most immediately available and least capital-intensive sources of supplemental gas supply is liquefied natural gas (LNG). Import restrictions on fuels such as LNG may diminish the diversity of energy sources that LNG imports help make possible. Decisions to impose restrictions for reasons of national economy or foreign policy should be weighed against the desirability of maximum diversity of energy sources.

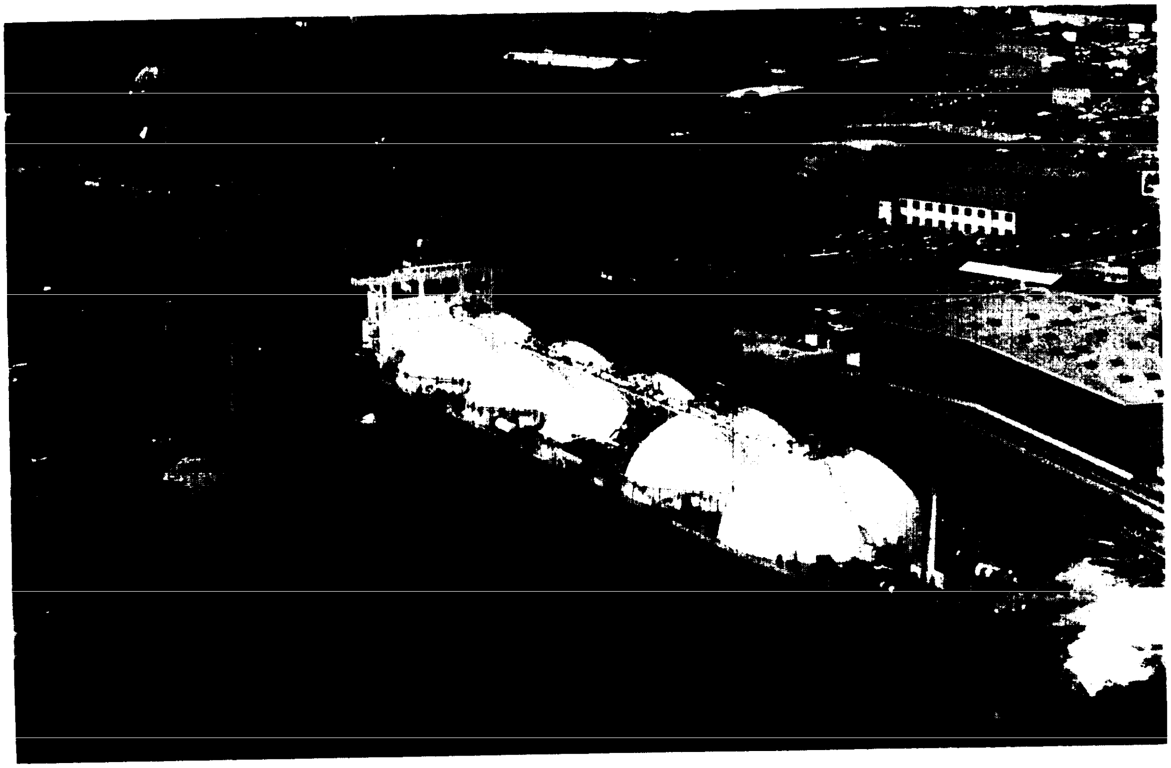
Questions

1. **Can** LNG imports make a critical difference in the event of a serious shortfall in U.S. domestic energy supplies?
2. What import policies might reconcile the need for LNG imports with the need to implement national economy and foreign policy objectives ?

Background

Large reserves of natural gas exist in several producer countries, including Algeria, Indonesia, Iran, Libya, Nigeria, and Abu Dhabi. Imports would come primarily from Algeria and, to a lesser extent, from Iran. Both countries have applications pending or approved by the Federal Power Commission (FPC), and can be expected to dominate the LNG market because they have very high ratios of gas to oil in their reserves.

Based on projects announced to date, and those now in place and under construction, LNG imports could provide nearly 1 trillion cubic feet annually by 1980 and almost 2 trillion cubic feet annually by 1985. This is about 10 percent of projected domestic gas production in 1985. The long lead times inherent in licensing and plant and tanker construction preclude significant additions above these estimates before 1985.



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Issue 4

Synthetic Natural Gas

Are synthetic natural gas (SNG) plants both practical and desirable as sources of supplemental fuel?

Summary

The manufacture of synthetic natural gas from naphtha or other petroleum feedstocks has several advantages for alleviating short-term gas shortages. The conversion process is more efficient than that used to make gas from coal, and plants are flexible and inexpensive to operate. The primary objections to SNG have been that it simply switches from one scarce fuel to another and its possible impact on supplies and prices of naphtha and other petroleum feedstocks. SNG plants, however, account for a small percentage of naphtha used in the United States, and both naphtha and other feedstocks should be available on the world market in the immediate future. All these feedstocks are easier to import than natural gas. Revision of present Federal Energy Administration (FEA) restrictions may encourage construction of SNG facilities and assure adequate feedstock for them. While SNG is expensive, it is competitive with other fuel supplements.

Questions

1. What impact will development of additional SNG facilities have on availability and price of naphtha and other feedstocks ?
2. What contribution can SNG make in alleviation of shortfalls?

Background

Synthetic natural gas facilities using petroleum feedstocks primarily provide peak-storage capabilities for gas utilities with no underground storage capacity. As domestic natural gas supplies have declined, some SNG facilities have been built to provide base-load, year-round service. While SNG is an expensive fuel supplement, it is competitive with other supplemental fuels in residential and some industrial markets.

In 1976, 13 SNG plants produced nearly 0.3 trillion cubic feet of gas. This production consumed only 0.5 percent of total U.S. naphtha supplies. Still, on a regional basis, the price pressure on naphtha, with petrochemical demand included, could become occasionally severe. Nearly 0.16 trillion cubic feet of additional SNG, a 58 percent increase over 1976, could be produced in 1977 if additional use of petroleum feedstocks were permitted, Because of past FEA restrictions, an additional 11 plants with a capacity of more than 0.6 trillion cubic feet of gas per year have been suspended or cancelled.

Naphtha and other feedstocks are now and should continue to be available on the world market in the immediate future, Increased imports of naphtha would help diversify the U.S. petroleum import picture. Notwithstanding the possible availability of feedstocks, synthetic natural gas is not expected to be a significant supplement to our natural gas supply in 1985.

Coal
Introduction

The United States has more control over the production of coal during the next decade than it has over any other energy resource. Unlike oil and natural gas, known coal reserves can meet the production targets of the National Energy Plan without any new discoveries. Lead times for opening new mines and building new transportation systems are short enough that production could, in theory, exceed the goals of the Plan, unlike those for nuclear power and offshore oil development.

According to the Plan's calculations, coal production will increase by about 400 million tons by 1985, even without changes in Federal policy. The National Energy Plan proposes to raise 1985 production by another 200 million tons for a total supply of 1,265 million tons, a 90 percent increase over 1976 production.

The Plan assumes that the higher production rate will be achieved by creating new markets for coal and by lifting restraints on demand, not through any direct incentives to stimulate coal production. It further assumes that the expanded market will result in large part from the Plan's tax and regulatory policies, which are designed to discourage the use of oil and natural gas by industry and utilities and encourage a shift to coal.

Several alternative outcomes are possible under the Plan's coal proposals:

1. production may fall below the 1985 goals because a requirement for installing best available pollution-control technology on all new coal-burning facilities may result in a smaller market for coal.
2. Boiler manufacturers may not be able to produce new coal-burning equipment fast enough to justify an accelerated coal production schedule.
3. Production could fall short of the Plan's goals if strip mining legislation forecloses development of large reserves in the West where leases already have been signed and long-range mining plans have been completed.
4. The Plan's proposal to emphasize Eastern coal production rather than Western coal production could result in capital, manpower, and transportation shortages.

Four other general conclusions result from analysis of the Plan's coal proposals:

1. Mining equipment will not be a constraint at coal production levels either with the Plan or without the Plan.
2. The penalty taxes and regulations designed to force conversion of industries and utilities from oil and gas to coal will expand demand, and, in turn, production of coal up to a point. If not offset by uncertainties noted above involving pollution controls and boilers, this point will probably be close to the goals of the Plan.

3. Transportation should not be a barrier to increased coal supplies except for some regions in the East where road-beds must be rehabilitated,

4. No single constraint will be a major limiting factor in achieving the Plan's coal production goals. Capital, man-power, access to reserves, transportation, and rising demand all will be necessary in the right combination to reach the goal. A lapse in any of these areas could cause production to fall short.

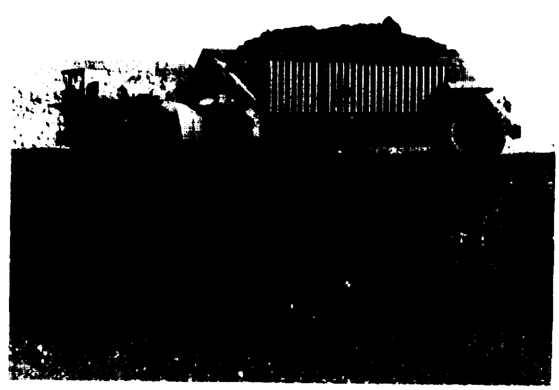
Issue 5

Coal Production and Demand

Are the provisions in the Plan sufficient to achieve the goals for production and consumption of coal?

Summary

The Plan contains no direct stimulus for higher coal production. It assumes that a complex set of related elements will converge to create a market for 1,265 million tons of coal in 1985. (The Plan assumes exports of about 90 million tons of metallurgical coal, leaving 1,175 million tons for domestic use in 1985.) Hundreds of industries and utilities must reactivate coal-burning facilities or buy new equipment before the demand for coal will expand. High costs of equipment or an inability of manufacturers of boilers and pollution-control equipment to fill orders fast enough could retard the growth in demand for coal, The Plan contains no fall back measures for dealing with these possibilities.



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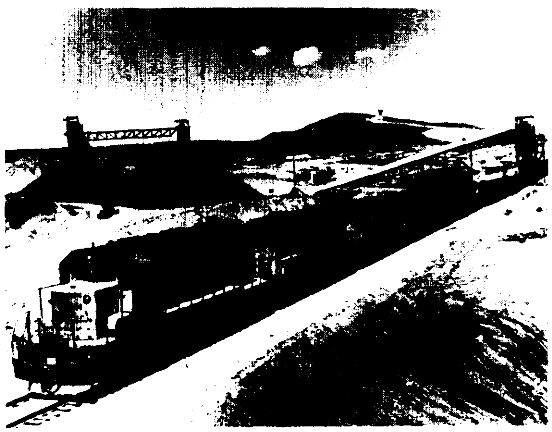
Background

Several conditions must be met before the market for coal will expand as fast as the Plan expects it will. Utilities and factories must buy far more pollution-control equipment than they ever have in the past. Coal costs must remain competitive with other fuels. Potential coal users must be assured that railroads, barges, or coal slurry pipelines can handle increased shipments and that adequate and reliable supplies will be available.

The cost of converting boilers and powerplants from oil or natural gas to coal will be high. Large industrial boilers, for example, would probably need pollution-control equipment averaging $4 million per installation. One major utility has estimated that it will cost about $4 billion to convert its 6,000 megawatts of generating capacity to coal. The question of whether these costs are *lower* than the penalty costs of continuing to burn oil or natural gas that would be imposed by the Plan must be decided case-by-case.

One potentially serious barrier to increased demand is the production of large industrial coal-fired boilers. About a dozen boiler manufacturers now produce about 200 large boilers— capable of generating between 250,000 and 300,000 pounds of steam per hour— each year. Another group of manufacturers could expand their operations to produce another 200 boilers of that size per year. However, in order to use the additional amounts of coal that the Plan assumes will be used by industry, at least 2,500 new coal-fired boilers must be manufactured by 1985 to replace existing boilers. The increased production capacity must be made available very soon to meet this goal. In the present market, coal-fired boilers are three times as expensive as oil-fired boilers.

If demand falters, whether because of cost or because manufacturers cannot fill orders for new equipment from utilities and factories, production will fall short of the Plan's 1985 goals.



ERDA Photo

Issue 6

Accelerated Eastern Coal Production

The National Energy Plan does not take fully into account the capital, manpower, and transportation consequences of its proposal to accelerate Eastern coal production.

Summary

Long-range plans of the coal industry call for mining about two-thirds of U.S. coal in the East in 1985 and about one-third in the West. The National Energy Plan proposes to reduce the Western share of total production and increase the share that will come from Eastern mines. Such a shift would mean higher capital requirements, more intensive manpower recruiting and training, and rehabilitation of Eastern railroads. These changes are not addressed in the Plan.

Background

Most forecasts assume that capital will be available to open new mines in the East-West pattern reflected in industry plans that were drawn before the Administration presented its policy proposals. Those plans assumed a trebling of the coal industry's rate of investment during the past decade. The forecasts also assume adequate manpower and a transportation network that can accommodate increased coal shipments.

The assumptions may not be valid under the National Energy Plan. One premise of the Plan is that, "Coal production and development is most economical when it is near major markets., Although coal production will expand in many areas, there should be large increases in the highly populated Eastern and Midwest regions, where coal use in industry and utilities could grow considerably in the future. " The Plan also states that its requirements for best available pollution-control technology on all plants, regardless of whether they burn low-sulfur Western coal or high-sulfur Eastern coal, "should stimulate even greater use of . . . Midwestern and Eastern coals, "

Such a shift in regional emphasis could cause capital problems. Many Western coal reserves are owned by conglomerates with relatively easy access to capital. If there is a major shift to Eastern mines, more of the development would be undertaken by smaller companies that might find it more difficult to raise money than Western companies. Transportation investments also probably would be higher if Eastern production is increased substantially. In general, more miles of Eastern roadbed would require upgrading for carrying more shipments of coal than is the case with Western railroads.

Manpower requirements would change if the United States placed more reliance on Eastern mines and less on Western mines. Productivity is higher in Western surface mines than in Eastern surface mines and is substantially higher than productivity in Eastern underground mines. Under the coal industry's present long-range plans, 80,000 new underground miners and 45,000 new surface miners must be hired and trained by 1985, Manpower requirements will increase if more coal comes from underground mines. Underground Eastern mines average about 9 tons of coal per man. Western surface mines produce about 100 tons per man. Given this ratio, it takes more than 10 times as many man-days to produce 1 million tons of coal in an underground Eastern mine as it does in a Western surface mine. Another potentially serious manpower problem involves foremen. Federal law requires that each underground crew be led by a foreman with at least 2 years of experience in underground mining. Because miners must give up their union benefits for relatively small increases in pay to become foremen, there is a chronic shortage of crewleaders in Eastern underground mines.

Issue 7

Coal Mining Research and Development

Mechanization of the coal industry with existing technology has reached a point where further increases in productivity are not likely but the plan makes no specific recommendations for assigning a high priority to mining research and development.

Summary

Productivity of underground miners reached a peak of 16 tons per man-day during 1969 and has since declined to a 1976 average of 9 tons per man-day. The downturn in 1969 ended a 20-year pattern of growth resulting from expanded mechanization of mines and reflected, among other things, the beginning of enforcement of the Mine Health and Safety Act of 1969. Underground mining is now so thoroughly mechanized with existing technology that there seems to be no hope of reversing current productivity trends unless a new generation of equipment is deployed.

One example of industry needs is a system to speedup the removal of coal from a mine face. Continuous mining machines are capable of producing coal 10 times faster than existing equipment can move it from the mine. New equipment also is needed to increase the amount of coal that

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can be mined by remote control to reduce the amount of time that now is spent bolting mine roofs. Finally, no equipment exists for mining underground coal in the West where seams run 30- to 70-feet thick, compared with an average thickness of 6 feet in the East.

Because of the importance the Plan assigns to meeting its 1985 production goals, it should designate specific mining research and assign priorities for programs that are most likely to help increase production in the relatively near term.

Issue 8

Accelerated Production of Synthetic Gas From Coal

The Plan's proposal to let market forces determine future development of plants for manufacturing pipeline-quality gas from coal should be reexamined, particularly in light of the potential barriers to expanded direct-burning systems.

Summary

The Plan does not assign a high priority to producing pipeline-quality gas from coal with existing technology. The Plan's apparent willingness to postpone significant expansion of a synthetic gas industry until new technology is available overlooks the fact that inflation probably will more than offset any cost advantages of new technology that will not be commercially feasible for 15 years or more,

Questions

1. **Why wait for the development of new technology when gas can be produced in quantity with existing technology at a** price below that of gas produced by new technology several years from now ?
2. Why does the Plan not consider loan guarantees and other means of accelerating commercial coal gasification projects, some of which could be in production on short notice?

Background

The National Energy Plan states that, “The basic Federal role in this process [conversion of coal to pipeline-quality gas] is research, development, and demonstration of new technologies. In general, the Government seeks to avoid subsidization of existing technologies. ”

The gasifier represents only about 15 to 20 percent of the capital investment for a gasification plant. That being the case, any new technology probably cannot reduce the price of synthetic gas by more than 50 cents per thousand cubic feet (Mcf). Increases in the price of natural gas in 1 year probably will offset that cost advantage of new technology and there is no sign that the new technology can be available on a commercial scale in 10 to 15 years.

Possible Government incentives for production of pipeline-quality gas with existing equipment include loan guarantees, long-term Government contracts for purchasing synthetic gas, and direct subsidies.

Nuclear
Introduction

The Plan forecasts 3.8 million barrels per day equivalent energy from nuclear powerplants by 1985, compared with 3.7 million without the Plan. This corresponds to the 141,000 megawatts of generating capacity that is now operating or under construction, with a 65-percent capacity factor. It is quite feasible for industry to install this much capacity because the period from the start of construction to online operation need not exceed 7 years. Production capability is adequate for all components, and uranium ore and enrichment demands are well within present capacity projections. A continuation of financial pressures on utilities, regulatory changes during construction, and uncertainties about growth projections could force some slippage in this schedule, however, and reduce the available output, The 65-percent capacity factor also is attainable but assumes an increase from past experience which averages about 60 percent (possibly less for the large reactors similar to those now coming on line). If either of these factors fail to meet expectations, a shortfall of as much as 15 percent (0.6 million barrels per day equivalent) could occur.

The source of the increased nuclear power generation which is assumed by the Plan is not directly identified. There are references to an enhanced inspection program which could contribute to increased reliability (or to more down time depending on the intent and implementation of the program and the condition of facilities inspected). In addition, the entire licensing process is to be studied to resolve unsatisfactory aspects, but no information is

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given on how this study is to be conducted, or how its recommendations might change the situation, except for a reference to reducing individual licensing requirements for standardized plants.

The midterm future of the industry is in considerably more doubt than is its realization of the 1985 goals. A de facto moratorium on new orders by utilities shows no sign of ending. The chief reason for the lack of orders is the financial risk to which a utility exposes itself when it orders a nuclear plant. Capital costs and licensing and construction schedules have increased so much and become so uncertain that few utilities can carry the financial burden now, even though they may be confident that nuclear power ultimately will be cheaper than its alternatives.

Another critical factor facing the industry is public acceptance. Opposition has been increasing over the years, and a significant fraction of the general public adamantly rejects the technology. Some of the arguments, particularly those centered on technological issues, can be effectively answered or shown to be subject to eventual resolution. others, however, raise philosophical questions concerning the ability of our present institutions, or even of society in general, to cope with nuclear power. This opposition, especially as manifested in lawsuits and interventions in the licensing process, has become an important consideration for utilities planning on nuclear powerplants.

The long term is even cloudier than the immediate post-1985 period. The intent of the industry has been to shift to liquid metal fast breeder reactors (LMFBR) as uranium ores are depleted because breeders essentially eliminate resource constraints. The President, however, has proposed to stop funding the Clinch River Breeder demonstration LMFBR because of the increased risks of nuclear weapons proliferation this technology would entail if it were implemented worldwide. He also has proposed to defer reprocessing of spent fuel from present reactors in order to minimize the exposure of plutonium. Considerable concern has been expressed over the lack of a readily available substitute. Without some sort of breeder, nuclear capacity will be limited to several hundred reactors, depending on the extent and extractability of as yet undiscovered ores. Other breeder concepts that are less vulnerable to proliferation are even less advanced.

In summary, the plan provides only vague suggestions for increasing nuclear energy use and at the same time it proposes to virtually eliminate technologies on which industry has been counting for the long term. If Congress decides that nuclear power is to be an integral part of the Nation's energy future, more positive steps than those proposed in the Plan may be required to help the industry overcome problems.

Issue 9

Licensing Reactors

If nuclear power is to provide a significant fraction of new energy sources after 1985, constraints that have led to a virtual moratorium on contracts for new plants will have to be removed in an acceptable manner.

Summary

Utilities are not ordering reactors to be placed on line after 1985. The main reason is the financial risk that new orders involve: costs are too high and the period before any return can be realized is too long. If schedules can be reduced, costs will decrease because about 50 percent of the capital cost is represented by interest during construction and escalation, both of which are increased by delays. The schedule depends on the licensing process which has been slowing because of increasing caution on the part of the Nuclear Regulatory Commission (NRC); legal delays by interveners; antitrust considerations; Federal/State conflicts; the inclusion of generic issues for specific plants; and new constraints imposed by several recent court decisions.

The licensing process must be stabilized if orders are to resume in quantity. The Plan recognizes the problem and alludes to administrative action to reduce the licensing time. The proposed remedies, however, are vague and may be insufficient to attain the desired ends. if Congress decides it is necessary to ensure nuclear growth, it could consider allowing separate licensing of sites and reactor plants, adopting a resolution declaring that nuclear power is a vital component of the National Energy Plan, and revising antitrust laws and the National Environmental Protection Act (NEPA). Another alternative is to create a Government agency, perhaps similar to the Bonneville Power Administration or the Tennessee Valley Authority, to build and operate nuclear powerplants.

Questions

1. How will the study of the licensing process be conducted?
2. How is the licensing process to be streamlined while maintaining the highest degree of safety and the legal rights of the interveners?
3. How will plant capacity factors be increased ?

Background

The greatest impediment to installing additional nuclear power capacity is the magnitude of the exposure of utilities to financial risk, given present government (Federal, State, and local) policies on licensing and siting of powerplants and related fuel-cycle facilities. Cost estimates for post-1985 plants now are approaching $1,500 per kilowatt capacity (compared with a present $700) and the time from initial decision to operation is approaching 13 years. About half of this cost represents interest during construction and inflation, both of which are increased by delays. The present licensing procedures require a substantial expenditure (in excess of $100 million) for engineering design, environmental studies, and component fabrication for long-lead items (pressure vessels, steam generators, containment steel, etc.) before a construction permit is issued. If a plant is canceled for any reason, penalty charges can drive the total obligation close to $200 million. Thus, a utility incurs a very large obligation even before ground is broken, when it contracts for a nuclear powerplant. This obligation and the massive commitment of funds during construction considerably reduce a utility's flexibility in planning.

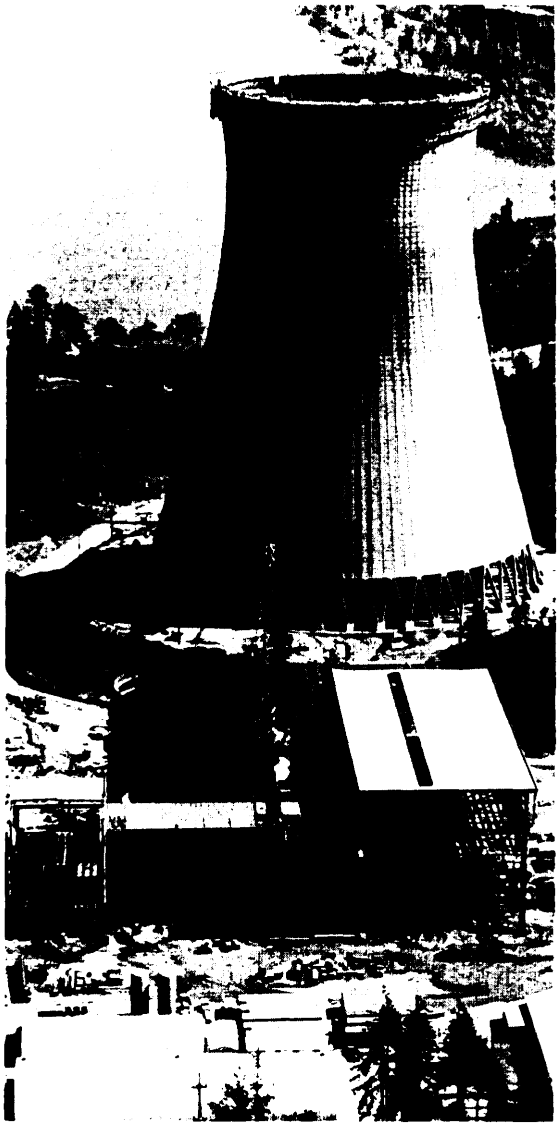
The present Federal licensing procedure is a three-way adversary process before an Atomic Safety and Licensing Board (ASLB) involving a utility, the Nuclear Regulatory Commission (NRC), and interveners. The rules of procedure are spelled out in the Code of Federal Regulations and tend to follow judicial procedures, with a great deal of discretion given to the ASLB Chairman. There are few limits to the issues that can be considered, and the Board itself can introduce issues it considers appropriate. The Board is charged with making a finding as to whether a proposed nuclear powerplant can be operated without a significant adverse impact upon the health, safety, and welfare of the public. Hearings may extend over 3 years, with transcripts resulting in tens of thousands of pages. Any party can appeal any aspect of a decision to an Atomic Licensing Appeals Board (ALAB) and ultimately to Federal courts. Issues as diverse as emergency core-cooling systems, the need for power, and evacuation procedures, are considered, with prepared testimony submitted by all parties before the hearing and cross-examination of witnesses during the hearing. In addition, NRC, with the assistance of the Justice Department, must determine that an applicant has not engaged in any anticompetitive practices and that building a plant will not disturb the relative competitive position of an applicant with respect to neighboring utilities.

Often NRC and the Justice Department require that an applicant share ownership of or the output of a plant with neighboring utilities as a condition for avoiding an antitrust hearing and/or allowing a construction permit to be issued.

A recent appeals court decision holding that NRC procedures for review of the nuclear waste disposal issue are inadequate to meet the requirements of NEPA have introduced serious questions as to whether NRC can license any nuclear powerplant until this issue has undergone a complete generic review. The Supreme Court is now reviewing the appeals court decision and a final ruling probably is many months away. Another appeals court recently declared the "limited liability" aspect of the Price-Anderson insurance to be unconstitutional, and this issue is also being appealed to the Supreme Court.

Historically, NRC (formerly the Atomic Energy Commission) has assumed jurisdiction over all nuclear and radiological safety matters under the Atomic Energy Act of 1954, and was supported in this by the U.S. Supreme Court. However, certain provisions of NEPA now allow States to set more stringent environmental conditions than those of the Environmental Protection Agency and recent disagreements between EPA and NRC and other agencies over the regulation of environmental radioactivity increases the uncertainties,

President Carter's plan offers only a "review" of the licensing process with a view to administrative changes. An alterna-



Portland General Electric Photo

tive that involves more fundamental revisions is to separate the licensing process into two stages: 1) that part associated with the plant, and 2) that associated with the site.

The plant portion of the licensing procedure could be similar to that used to approve a "license to manufacture" floating nuclear powerplants. Design approval would be basically a matter for extensive negotiations between the Federal Government (NRC, EPA, etc.) and the vendor/architect-engineer to secure approval or certification of a nuclear "island" and its associated balance of plant, with the specification of an appropriate relationship with the environment. Periodic reviews of the design might be undertaken at 5-year intervals with modification during this period limited to safety-related issues and based on value/impact analysis. Once a nuclear steam-supply system with its balance of plant has been approved, no further licensing would be required for a utility to undertake the contractual arrangements and begin the construction of such a plant on a certified or licensed site.

Siting legislation might provide for joint Federal, State, and local certification of nuclear powerplant sites. Precertification of sites for periods up to 10 years might also be provided, with the only basis for reconsidering a precertified site being a substantial change in the site characteristics. Specific provisions could be made to avoid the application of rules and regulations imposed subsequent to the site certification. Such a procedure would provide for a thorough airing of the environmental and site-related issues well ahead of construction. Site certification might be for a specified number of megawatts without regard to reactor type or individual unit size, thereby providing a utility with a maximum flexibility at decision time.

If such a procedure were fully implemented and a utility had both a certified site (with a certification good for 10 years) and an option to buy any of several preapproved nuclear powerplants, the time from initial decision to operation would be only that required for mobilization and construction. Since designs would be standardized, there should be substantial savings in cost as well as improvements in quality associated with the "learning curve" and prefabrication of components in a factory environment. Above all, the uncertainty associated with the licensing procedure and the attendant financial risk would be reduced to manageable levels.

Consideration might also be given to revisions of the antitrust review required by the 1970 amendment of the Atomic Energy Act (Public Law 91-560). Its objective of assuring that the benefits of nuclear energy, developed at public expense, are shared by smaller utilities, might better be accomplished through some form of preferred tax treatment (tax-free bonds for that fraction of the plant equivalent to the power sold to local utilities or perhaps some form of extra tax investment credit). Such revisions would reduce delays which would otherwise be unaffected by streamlined licensing procedures. Delay clearly is as burdensome to smaller co-owners or purchasers of power as to principal owners.

All of these proposals involve relatively minor modifications to present arrangements. It is possible, however, that the rapidly rising costs of construction of both nuclear and large coal plants will put them beyond reach of all but the biggest utilities. If it is deemed necessary to build plants for the Nation's energy system, new arrangements would have to be considered. This could involve mergers or consortia of even large utilities or public ownership of generating stations. The Bonneville Power Adminstration is a possible model; no single utility could have built Bonneville's dams, but all in the region benefited from the project's low-cost electricity. Even with this approach, however, the problems of the licensing process would have to be solved for nuclear energy to be produced at reasonable cost.

Issue10

Public Acceptance of Nuclear Expansion

There are growing indications of the possibility that expansion of nuclear power will be unacceptable to the public.

Summary

Opposition to nuclear power has become an important factor to consider in assessing the future of the industry. Public support is still broad, but changeable. The arguments used by opponents have shifted over the years, and many have been satisfactorily addressed. A fundamental difference between supporters and opponents is that the former see problems as solvable and generally bounded by conservative design, so that risks are very low. The latter point to a variety of unanticipated problems and have little faith in the institutions performing the analyses and imposing regulations. The truth probably is generally in between. Industry tends to neglect some scenarios while opponents emphasize worst-case possibilities which are much less probable than risks in other areas which are accepted with equanimity.

The public is confused, especially by contradictory scientific testimony. Opposition is likely to continue to grow because opponents can muster cataclysmic arguments, and the performance of the industry has been less than totally reassuring. This trend might be countered by a policy of public debate of the full range of problems involving the technology with critics invited to join in an exhaustive analysis. This might satisfy many opponents and moderate the views of others, but there would be a risk of providing ammunition to opponents who will not be satisfied until the industry is closed down.

Questions

1. What are the plans for addressing the causes of opposition?
2. How is the general public to be supplied with credible information on nuclear energy?
3. Will light water reactor safety research be augmented?

Background

in the past 5 years, significant opposition to nuclear power has developed within the United States. Specific topics of controversy have moved from one subject to another with time. Early opposition was directed at the environmental and health effects of radiological releases. In turn, the emphasis shifted to thermal pollution, to catastrophic accidents associated with possible failure of emergency core-cooling systems, and to waste disposal and proliferation. Early opposition took the form of adversary participation in nuclear plant licensing hearings, but more recently the arena has shifted to the courts, the ballot box, and demonstrations. Opposition initially came from a few environmental groups, but it is now more broadly based.

While the results 01 referenda on nuclear moratoria in six States during 1976 showed a 2-to-1 majority in support of nuclear power, the base for this support may be more closely related to economic need than to any intellectual commitment to nuclear power. There has been no nationwide plebiscite on the desirability of nuclear power. Indeed, the general public seems confused by the technical nature of the issues involved and the disparity between what equally well-qualified adversaries seem to be saying.

By contrast, opponents feel profoundly threatened by nuclear technology and are dedicated to stopping it. Their arguments can be very effective. Worst-case scenarios can indeed be horrifying, and the best-informed and most ardent support is hard pressed to flatly deny that the worst case will happen. The issue is probability, a complex and subtle consideration that has not yet even been resolved by the experts. Most agree that a serious radiological release is very unlikely at any particular plant, but that if it did occur, the consequences could be devastating. The degree of risk which the public should be expected to bear is an issue which needs thorough discussion and public involvement. The relative risk from nuclear power and its alternatives also needs considerably more study and comparison.

Critics and proponents react very differently to problems, and this often leads to a breakdown in communications between them. Proponents believe that problems are solvable, and they want to believe that their solutions are adequate. The "defense-in-depth" concept, for example, is intended to ensure designs so conservative that unforeseen problems will be accommodated by the system. Thus proponents see risks to the public as negligible. Critics are more likely to want to believe that design problems are insurmountable. Some feel that the long list of expensive retrofits and safety design changes prove that the technology is not mature, and that accidents always will find a way to happen. These very different points of view mean that proponents will argue that they have already gone beyond what is necessary to assure safety, while opponents can overemphasize worst-case scenarios that have only the remotest probability of occurring.

Many critics agree that some problems have been satisfactorily addressed and that new plants are substantially safer than older ones. Proponents admit that some of the problems raised in earlier debate were real and that many improvements have resulted. Technological problems that remain include waste disposal, reactor safety (including vulnerability to sabotage), and safeguards against plutonium diversion.

Nuclear power may not be a viable source of energy if public acceptance continues to erode. A massive public relations campaign certainly is not the answer. Industrial programs have been modestly successful in special situations (e.g., during referendum campaigns), The promotional roles played by the Joint Committee on Atomic Energy and the Atomic Energy Commission were important in bringing the industry into existence, but overoptimistic promises and heavy-handed tactics may have helped create the present crisis of credibility, There is now no Government agency with an assigned role of promoting nuclear power.

What may be required is heavy involvement of critics in a total analysis of nuclear problems and regulatory procedures. This might reassure many critics that legitimate concerns were being addressed; it also might identify new issues that should be addressed. Some critics, however, will not accept nuclear energy on any terms. Some would use access to the system to obstruct it. Others would find new, possibly stronger, arguments. Nevertheless, critics are sufficiently numerous and sophisticated to require satisfaction in some way.

Another useful step would be to improve techniques for evaluating risks and for measuring the costs and benefits of measures to reduce the risks. This would contribute to establishing criteria for safety requirements for nuclear power and other energy sources. The Reactor Safety Study (Rasmussen Report) was an important first effort to quantify probabilities. It has been subject to charges of bias, however, providing one illustration of the consequences of failure to involve critics in such studies.

Issue 11

Breeder Reactors

Nuclear generation of electricity can be virtually freed from resource constraints, but the technologies that will allow this (breeders and plutonium recycle) increase the opportunities for proliferation of nuclear weapons among nations and terrorists.

Summary

The Energy Research and Development Administration estimates uranium reserves at 1.9 million tons, enough to fuel about 375 light water reactors for 30 years. Other, less firm, reserves might fuel another 315 reactors. Reprocessing and plutonium recycle would expand these numbers by 20 to 40 percent and breeder reactors would effectively remove uranium supply constraint, Both technologies would, however, involve plutonium in a form which is relatively easy to convert to material that can be used for nuclear explosives by governments or terrorists. The President has proposed a worldwide indefinite deferral of the use of recycled plutonium, along with a delay in the construction of breeders, including this country's Clinch River Breeder Reactor demonstration plant. Other governments are strongly resisting such moves because they have fewer alternatives and they want to be less dependent on imported uranium and enrichment services. Some argue that the link between commercial plutonium and proliferation can be kept so small that other, less-controllable routes to weapons would be easier. Alternatives of

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varying practicality have been proposed to ameliorate the situation, but none, not even a nuclear power moratorium, can eliminate the risk of proliferation.

Questions

1. What will be the U.S. policy towards plutonium recycle and the liquid metal fast breeder reactor (LMFBR) if other nations continue to refuse to defer development of the technologies?
2. What would be the midterm and long-term strategies for nuclear energy if reserves prove to be lower than expected?
3. If alternative fuel cycles prove more attractive with nonproliferation as a major parameter, how will they be implemented both in this country and abroad ?
4. How much money and time are required to bring such alternate fuel-cycle technologies to the present level of light water reactor technology or to the present level of LMFBR technology?

Background

Present-day reactors extract about 1 percent of the total potential energy from uranium ores, so the total resource base can supply no more energy than what is available from remaining oil and gas resources. Breeder reactors and spent-fuel reprocessing can extract so to 70 percent of the energy in the uranium and make economical use of thorium and vast quantities of low-grade uranium ore.

The proliferation dilemma stems from the fact that fissile material can be used for nuclear explosives as well as for reactor fuel. Plutonium is produced in existing light water reactors but very little of it is now being recovered from spent fuel. If reprocessing does take place, about 400 pounds of plutonium would be obtained from a large light water reactor each year. A nuclear explosive requires between 10 and 20 pounds. The liquid metal fast breeder reactor, which is the focus of most breeder research here and abroad, would require reprocessing of about 3,000 pounds of plutonium per year, although there is a net breeding gain of only about 300 pounds after refueling the reactor.

Unlike low-enriched uranium, which requires expensive and demanding enrichment, plutonium can be purified for weapons manufacture by relatively simple chemical means. Nations which possess spent fuel today (whether from LWRs or breeders) have the necessary material for nuclear explosives but reactor safeguards probably are adequate to detect significant diversions of spent fuel. In addition, very few terrorist groups could either secure spent fuel or reprocess it to manufacture weapons.

The situation is quite different for a nation which in the future routinely reprocesses its spent fuel and recycles the plutonium. So much separated plutonium would be flowing through the system that significant diversions might not be detected. An abrogation of safeguards agreements could put the entire output of the plant and its stockpiles at the disposal of weapons makers.

The President apparently hopes to set an example for the rest of the world. By refraining from plutonium development, the

United States may avoid charges of setting double standards. Nonproliferation would clearly be easier to maintain if no government reprocesses. If the United States alone refrains, however, the effort may backfire by increasing economic incentives for other nations to reprocess. The Governments of Britain, Germany, Japan, France, and the U.S.S.R. are proceeding with construction of LMFBRs and, at least so far, have strongly resisted efforts to delay their reprocessing because they believe they have no realistic energy alternatives.

Other fuel cycles and reactors have been proposed which are less vulnerable to diversion (e.g., denatured uranium–233 in a double security system, coprecipitation, and self-sustaining reactors such as the gas core and molten salt reactors). Some of these proposals have real promise and should be studied. The opportunities for diversion can be reduced and the time required to accumulate an arsenal can be lengthened. It should be recognized, however, that none are totally resistant to diversion, though some could be virtually terrorist-proof. Most will also require a lengthy and costly development period.

Cancellation of the Clinch River Breeder Reactor demonstration plant has been proposed as part of the President's energy plan. There may be, however, nonproliferation advantages to proceeding with construction. The plant is flexible enough to demonstrate some of the alternative fuel cycles, such as the use of thorium and uranium–233 in a fast breeder, and its construction would allow U.S. breeder technology to influence world safeguards.

If nuclear power is to be a long-term option, some sort of breeder, or near breeder, and reprocessing will be necessary. The schedule for introduction depends on uranium resources and LWR growth. Based on water-reactor development experience, demonstration and prototype breeder plants should be online 15 and 10 years respectively before commercial breeders are required to meet U.S. energy demand.

About 5,000 tons of uranium are required during the 30 years of operation of a typical light water reactor. The ERDA nuclear power forecasts adopted in 1976* and 1977t and uranium requirements (0.25 percent tails) are:

Year	Nuclear GWE		uranium Committed (tons)	
	1976 ERDA	1977 ERDA	1976 ERDA	1977 ERDA
1975	39	39	234,000	198,000
1980	67	60	402,000	305,000
1985	145	127	870,000	646,000
1990	250	195	1,500,000	992,000
2000	480	380	2,880,000	1,932,000

● Edward A. Hannahan, Richard H. Williamson, and Robert W. Brown, "World Requirement; and Supply of Uranium, " presented at the Atomic Industrial Forum, "International Conference in Uranium, " September 14, 1976, Geneva, Switzerland.

tAccording to the brlefing charts in the July 7, 1977 testimony of James R. Schlesinger before the Subcommittee on Fossil and Nuclear Energy, Research, and Demonstration of the Committee on Science and Technology.

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The ERDA estimate of uranium resources based on costs of extractions are:

U.S. **Uranium Resources—January 1, 1977—Tons U_3O_8**

$/lb. U_3O_8 Cost Category	Reserves	Potential Resources: Probable	Possible	Speculative	Totals
$10	**250,000**	**275,000**	115,000	*100,000*	*740,000*
$10-$15 Increment	160,000	310,000	*375,000*	*90,000*	*935,000*
$15	410,000	**585,000**	*490,000*	*-190,000*	*1,675,000*
$15-$30 Increment	*270,000*	*505,000*	*630,000*	*290,000*	*1,695,000*
$30	*680,000*	*1,090,000*	*1,120,000*	*480,000*	*3,370,000*
Byproduct	140,000	—	—	—	140,000
Total	820,000	1 *,090,000"*	1,120,000	*480,000*	*3,510,000*

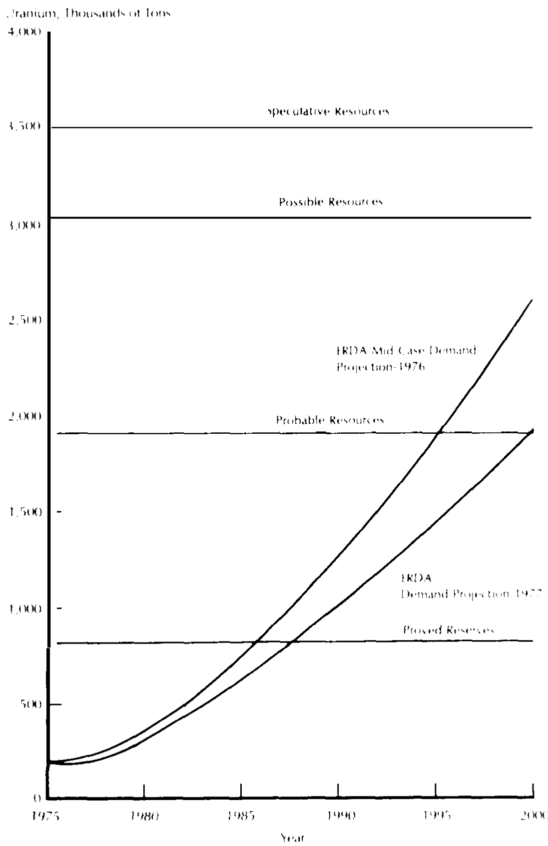
Note: Uranium that could be produced as a byproduct of phosphate and copper production during the 1975-2000 period is estimated at 140,000 tons U_3O_8.

Because the schedule for the breeder is so dependent on the rate of discovery and exploitation of uranium reserves, the level of confidence in the potential reserve estimates is a crucial factor. ERDA considers the proven reserves at $15/lb. (410,000 tons) to be accurate to within 20 percent, plus or minus, Confidence levels are not assigned to any other figures, except to say that the uncertainty is greater than 20 percent for the $15-$30 increment and continually higher for the subsequent categories. The ERDA estimates are not universally accepted. Arguments are made for both much higher and somewhat lower figures. Even the geologic origins of uranium in sandstone deposits, the most abundant U.S. source, are in dispute. Proponents of higher estimates point to a lack of exploration in many areas of the country, the experience with other ores which have shown a continual expansion as exploration and technological development progressed, and the possibility of using higher cost ores (ERDA has recently estimated an additional 800,000 tons at $50 per pound). Others caution that no major uranium districts have been identified for many years despite intense exploration and note that the rate of discovery per foot of exploratory drilling is falling rapidly.

Uranium commitments for both ERDA LWR projections are shown in figure 1, together with the ERDA estimates of reserves. The probable resources of 1.9 million tons will be committed by 1995 for the higher projection and by the year 2000 for the lower. The uncertainty surrounding these resource estimates, however, is so great that there may be a severe uranium shortage affecting utility decisions to order reactors even by 1990. Other possible outcomes would involve slipping the breeder schedule substantially, as the President proposes. If LWR sales do not resume, the breeder may never be needed. Slippage does involve a substantial risk, however, if nuclear energy is to play an increased role as suggested by the Plan. It also should be noted that both domestic and foreign consequences will be great if the breeder is needed but not available, This risk must be defined and included with proliferation concerns.

Alternative strategies have been proposed to increase the efficiency of uranium use without resorting to the LMFBR. The denatured U^{233} cycle referred to above is a dual-security concept in which one set of domestic burner reactors uses denatured fuel (a mixture of U^{233}, U^{238}, and thorium) which is produced in a second set of closely guarded, perhaps internationally controlled, breeder reactors (fueled with plutonium, U^{238}, and thorium). The burner reactors would be very similar to present LWRs with different fuel. The breeders could be LMFBRs with different fuel than presently planned. Such concepts deserve considerable study before a commitment is made to commercialize the LMFBR. These alternate fuel concepts could be tested in the Clinch River reactor or the Fast Flux Test Facility. An essential element of this strategy is a large proven reserve of thorium. Reliable data on U.S. thorium resources are not now available, however, and estimates must be assigned a degree of uncertainty even larger than that for uranium resources. Other concepts for using thorium could also extend fuel resources for at least so years. For example, the advanced Canadian deuterium uranium reactor (CANDU) is a near breeder, but it could operate with only evolutionary changes in present designs.

Figure 1. Uranium Resources and Demand



Supply Impacts

Nonconventional Sources Introduction

The National Energy Plan projects that contributions of solar, geothermal, fusion, and other nonconventional energy sources will be negligible through 1985. The "other" category of supply in Table IX-l, which rises from 1.5 to 1.7 million barrels per day of oil equivalent with or without the Plan, is virtually all hydroelectric power, a conventional source.

The only explicit goal for any of these technologies is to "use solar energy in more than 2.5 million homes" by 1985. The type of use is not specified, but presumably most installations will be solar water heating, with some space heating and other applications. Although this goal will not have a significant impact on national energy patterns, it does call for a rapid but feasible expansion of the industry.

The Plan's consideration of solar energy raises several concerns:

- There is a lack of emphasis on technology capable of producing energy in the long term. The Plan identifies three "inexhaustible" energy sources, but does not define any one of them as suitable for eventual commercialization. The Plan questions the breeder reactor's future, considers fusion a high-risk option for the long term, and acknowledges that solar electric systems, while promising, have not reached the stage of development where their economic viability can be demonstrated. The Plan does not evaluate alternative technologies in terms of technical and economic feasibility, social benefits, or undesirable impacts. As a result, it does not identify priorities, schedules, or the role of the Government.
- No coherent attempt has been made to link short-term goals to a long-term strategy. It may be that miscalculations about resources or the potential of new energy technology will mandate a shift to inexhaustible energy resources faster than the forecasts contemplate. Planning should be underway now for this contingency.
- Decentralized energy systems must be integrated with utilities. Solar- or wind-energy systems require auxillary energy sources for backup power. The Plan calls for such systems, but it does not directly address the central-station load-management and integration problems,
- The solar incentives do not go far enough. The Plan's solar goal is to be met through the use of special tax credits, a 10-percent conservation tax credit, a public education program, and a $100 million Federal Government demonstration program. These are productive measures, but they do not devote enough attention to system maintenance, replacement, improvement, and industrial and electric generation tax credits. The Plan does not call for direct assistance to manufacturers who could be encouraged to enter the large potential foreign market for solar energy equipment.

- The Plan does not address the need for a unified standardization program for solar equipment. Such standards are crucial to the wide acceptability of solar by builders and lenders.

- There are no specific goals for geothermal energy. Legislation is proposed to give geothermal producers parity with oil producers in the tax treatment of intangible drilling costs. Parity in other important areas, such as leasing, licensing, and preparation of environmental impact statements, is not addressed. The Plan states that Federal agencies and States will be encouraged to streamline review of leasing activities, but there is no estimate of likely impact on production or the environment. The Plan's proposal for research may accelerate development of new types of geothermal resources.

- Geothermal energy is available only in certain regions such as California and the Gulf of Mexico. Even between wells of the same category there are wide differences in temperature, pressure, well depth, fluid composition, and other geologic factors. This makes standardization of recovery equipment much more difficult than it is for oil and gas development and raises problems for its application.

- Fusion will not be a significant energy source in this century no matter what the research budget in the near future, and the final costs of a program will be very large indeed. Nevertheless, the promise of the technology warrants a large research investment. Fusion reactors could be inherently safer from a proliferation point of view than the liquid metal fast breeder reactor and from a safety point of view than any solid-core nuclear reactor. Although they still would produce highly radioactive waste, they need not involve nuclear fission weapons materials during normal operation (though they could produce great quantities of plutonium or uranium–233 if desired).

- The research and development philosophy of the Plan is too limited. The stated realinement of priorities "to meet the country's real needs" is commendable, but does not address the problem of basic research. Too narrow a focus on near-term "practical" goals could have serious consequences for future economic growth, which may depend on new science and technology. The cost of basic research on both near-term and far-term goals is microscopic compared with annual U.S. energy costs, and long-term programs should be fully funded and well staffed.

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Issue 12

Nonconventional Energy Goals

The goal of 2.5 million residential solar installations by the year 1985 understates the capability of the technology.

ERDA Photo

Summary

The goal of 2.5 million residential installations of solar heating/cooling systems by 1985 is ambiguous. It appears to be unnecessarily limited to space and water heating, ignoring potential industrial and agricultural uses of solar heat and opportunities for solar generation of mechanical and electrical energy. The Plan is silent on other advanced energy systems which could make a contribution to energy supplies by 1985.

Considering the large percentage of U.S. energy consumption which is used for residential heating and low-temperature industrial process heat, the goal is overly modest. Solar energy could make a significant contribution in these areas. The environmental benefits of advanced energy technologies make them attractive alternatives to increased dependence on fossil fuels.

The Plan does not address the need for a set of performance standards for measuring the output of these advanced energy systems. Care should be taken in the design of such standards to ensure they do not discriminate against promising technologies.

Questions

1. Why was a goal specified for solar energy and not for other advanced energy sources such as geothermal?
2. Why does the goal address residential installations and ignore industrial and farm applications?
3. Why is the goal limited to the solar production of thermal energy, ignoring the production of electric and mechanical power?
4. How was the goal of 2.5 million homes generated? What is the relation of the goal to plans for implementation of solar systems after 1985 ?
5. What is a solar installation? How much energy will the proposed installations produce?
6. Does the Government propose to establish a system of standards to ensure that consumers will have adequate knowledge about solar systems available in the market?

Background

The National Energy Plan sets a goal of 2.5 million residential solar energy installations by the year 1985. The goal, stressing application of one solar technology (low-temperature thermal), is limited for three major reasons:

- It ignores other advanced energy sources which could make a measurable contribution to U.S. energy needs by 1985. For example, technologies for utilization of wind and some forms of geothermal energy are sufficiently developed to be economic in some regions of the country.
- The potential savings possible from the application of solar energy to industrial process heat is overlooked. Twenty-eight percent of all process heat is used at temperatures below 550°F. Solar collectors are capable of producing temperatures up to 1000°F. in these applications. The Plan sets no goals for the use of solar energy in agriculture where needs such as crop-drying and heating animal barns are easily met by present technology.
- No goals are set for the advanced use of solar energy. While technologies for conversion of solar energy to mechanical and electrical energy cannot make as great a contribution as thermal systems in the next 8 years, they should not be ignored. They represent possible building blocks for very significant energy production after 1985. The Plan recognizes the value of research and development in these areas but does not define needed programs.

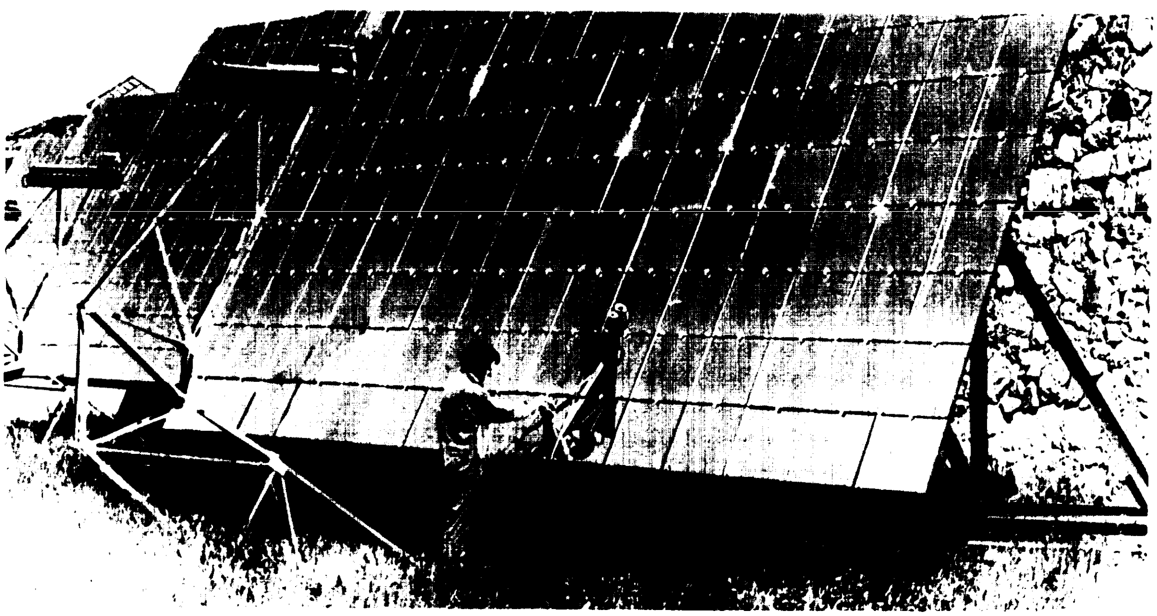
The goal of 2.5 million residential installations of solar energy is ambiguous because residential installation is not defined. It could mean small water heaters or large complex heating and cooling units. The possibilities of meeting the goal and the potential for displacement of fossil fuel are very different for those technologies.

Supply Impacts

The absence of reliable standards for solar equipment and the lack of manufacturer performance guarantees have made some lenders hesitant to provide capital for solar installations. Establishment of performance standards for measuring the energy production of unconventional technologies may be the most useful remedy for the problem. These performance standards must not be used to discriminate against "passive solar" technologies. While "passive systems" may not generate as much energy per installation as the more complex "active" systems, their low cost and simplicity make them suitable for rapid commercialization, and the energy savings which they generate can be substantial. Proper protection for passive systems in evaluating performance may call for use of an energy budget approach.

There would be significant environmental and social advantages from fostering a more rapid development of advanced energy sources. The environmental benefits of many advanced technologies are well known, as are the benefits of reduced dependence on fossil fuels. In addition the manufacture and installation of small-scale advanced energy systems would be a relatively labor-intensive industry which could create a large number of jobs, and contribute to a reduction in unemployment.

Even under the most optimistic scenarios, advanced energy systems will make a relatively small contribution to our energy requirements between now and 1985. However, there is a very real possibility that they will be significant after that time. Consumer confidence in new products must be increased. This can only be accomplished by a strong commitment to advanced energy sources now.



ERDA Photo

Issue 13

Solar Incentives

The incentives provided for in the plan are not sufficient to ensure the widespread deployment of advanced energy technologies.

Summary

All the incentives for new technologies in the plan are focused on increasing demand. There are no provisions for directly assisting the industry in setting up large, efficient manufacturing plants. Nor is there a mechanism for encouraging foreign sales of solar energy equipment.

The National Energy Plan includes both residential and industrial tax credits which are designed to encourage a conversion to advanced, inexhaustible energy sources. These incentives should provide a significant assist to the industry, but they cannot protect a homeowner against unexpected maintenance, replacement or improvement costs of solar heating equipment, which are still largely unproved. The Plan prices distillate oil and natural gas used for home heating below their replacement cost, which probably will discourage commercialization of nonconventional technologies.

It seems to be the intent of the proposed National Energy Act that advanced energy equipment loans be covered under the energy conservation loan provisions, but the wording of the draft legislation is somewhat vague. Further, there is some question as to whether the incentives provided are sufficient for primary lenders to become active in this market,

It is not clear whether solar equipment is eligible for the "normal" 10-percent plant equipment tax credit (under the Internal Revenue Act of 1954). Solar equipment appears not to be eligible for the cogeneration tax credit, nor does it appear in the definition of an "alternative energy property" which is the necessary qualification for industrial oil and gas conservation rebate.

Replacement cost pricing of oil and gas for industry and the imposition of industrial oil and gas consumption taxes make solar energy relatively more attractive to the industrial sector. However, the exemption of the farm sector from the consumption tax makes solar energy relatively less attractive for crop drying, a technology that could be implemented within the timeframe of the Plan.

Questions

1. What evidence is there that the residential solar tax credits are sufficient to induce installation of this equipment in view of the Plan's artificially low prices for home-heating oil and gas?
2. Is the Federal National Mortgage Association authorized to become a buyer of solar energy and other advanced energy system loans on the secondary market?
3. What incentives will be given to primary lenders to encourage them to make conservation and advanced energy equipment loans?

4. Is advanced energy equipment eligible for all business energy equipment tax credits for which coal energy conversions are eligible?
5. Why are advanced energy system cogenerators (specifically geothermal) excluded from the cogenerator tax credit ?
6. Why is advanced energy equipment ineligible for the industrial oil and gas conservation rebate?
7. In view of the exemption of the agricultural sector from the oil and gas consumption tax, is some further incentive not needed to encourage the use of solar energy in this sector?

Background

Incentives provided by the Plan for the introduction of advanced energy technology fall into three broad categories: 1) those provided for residential installations; 2) those provided for industrial use; and **3)** the federally financed demonstration programs:

Incentives to Homeowners.—Initially, tax credits begin at 40 percent of the first $1,000 expenditure and 25 percent of the next $6,400 expenditure on "authorized solar equipment" (to be defined by Internal Revenue Service after consultation with the Federal Energy Administration). The maximum credit would decline to $1,2IO in 1984 and be eliminated thereafter. The effectiveness of this incentive is diminished by the pricing policy on home-heating oil (distillate) and natural gas. Under the provisions of the legislation accompanying the Plan, the price of home-heating oil will be controlled at a level approximately 10 to 12 percent below the cost of oil sold for other purposes; the price of natural gas is controlled at a price per Btu below home-heating oil. These controlled prices for home-heating fuels reduce the incentive to convert to solar.

The Plan designates utilities as lenders under the National Housing Act, and further authorizes the Federal National Mortgage Association (FNMA) to become a buyer of loans made for the purpose of installing energy conservation equipment. While it seems to be the intent of the act to include solar energy equipment in the category of "energy conservation equip merit," the wording is not sufficiently clear to resolve this point. The opening of the secondary loan market is vital to the commercialization of solar technology. The high initial cost of this equipment makes obtaining credit a prerequisite for purchase. The entrance of FNMA into the market will considerably ease the reluctance of both lenders and borrowers.

The Plan calls for the "prohibition of discrimination against solar and other renewable energy sources by electric utilities," but there is no mention of this in the accompanying legislation. Further, there is a feeling among some lenders that the completion of the necessary forms and reports necessary to qualify for Federal loan guarantees coupled with the relatively small dollar value of the individual loans may make these loans unprofitable for the primary lenders. This problem deserves careful consideration and further action may be necessary to provide access to the loan market for purchase of advanced energy systems.

Industrial Tax Incentives.—Credits are included for the installation of solar equipment for plant heating/cooling and industrial process heat. Solar equipment is included in the category of business energy property and is eligible for a 10 percent investment tax credit. It is unclear whether solar energy is eligible for the cogeneration credit. Under the tax laws of 1954, equipment contained within a plant building is eligible for a 10 percent investment tax credit; therefore, "business energy property, " which also qualifies for the 10 percent equipment investment credit, receives a 20 percent total tax credit. It is unclear what kind of solar installations, if any, would qualify for this double credit. However, it seems clear that in order to encourage the use of advanced energy systems they should be made eligible for at least the maximum credit that a conventional system (e.g., coal) would receive if installed for a similar purpose. Advanced energy systems are not eligible for the oil and gas conservation tax rebate which is designed as an offset to the oil and gas consumption tax. This rebate is allowed for investment in coal-fueled equipment, and logically should also be allowed for installation of solar and other advanced energy systems.

The policy of raising the prices of natural gas and refined oil products and the imposing of industrial oil and natural gas user taxes will make solar power relatively more competitive in the industrial sector. However, the legislation controls the price paid for oil and natural gas by the agricultural sector at artificially low levels. This provides a disincentive for the use of solar energy for crop drying and barn heating. Also technical breakthroughs are necessary for the commercialization of these devices and the resulting energy saving could be substantial.

There could be a further sizable incentive to U.S. solar equipment manufacturers in foreign sales. Current prices for fossil fuels, particularly in many developing nations, are considerably higher than in the United States, and in many of these nations solar heating systems are already economically competitive. Availability of U.S.-built solar power systems could also help defuse overseas resentment over U.S. moves to reemphasize plutonium as a nuclear fuel. Another potential area for solar equipment which could serve as an incentive to manufacturers is its integration with prospective cogeneration, district heating, or total energy concepts for utilizing waste heat.

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Issue 14

Long-Term Planning

Does the National Energy Plan give sufficient consideration to the development of long-term (post-1985) supply options?

Summary

The main thrust of the National Energy Plan is properly directed toward solving the short- to mid-term energy supply problems. However, long-term planning is needed to prevent even more severe problems in the future. Fossil fuels must eventually be replaced by "inexhaustible" energy sources. Of these, only the breeder reactor has received sufficient development funds to bring it to the precommercial stage. However, the breeder involves proliferation questions which threaten to limit its widespread commercialization. Since the alternatives are in a less-developed state, their funding may have to be raised considerably if the breeder is rejected.

Questions

1. What mechanisms does the Plan set up to ensure the orderly development of long-term inexhaustible energy sources ?
2. What criteria will be used to decide the allocation of research and development funds among available energy projects?
3. What target dates and decision points have been set in the development programs for various long-term energy sources to ensure that they will be developed in time to replace fossil fuels in the latter part of this century?

Background

The National Energy Plan properly stresses the implementation of short- and mid-term energy supply problems because of the present drain on world oil supplies. However, it should be recognized that long-term planning will be necessary to avoid other crisis situations in the future. Coal is planned as a transition fuel to reduce U.S. dependence on petroleum fuels until after "inexhaustible" energy sources can be brought to commercialization. The long-term use of coal as a major fuel source poses serious environmental questions, even with the use of "best available" pollution-control technology and reclamation of strip-mined land.

Presently contemplated "inexhaustible" energy sources include the liquid metal fast breeder (LMFBR) or other breeders, fusion, and solar electric. The LMFBR, however, poses sufficiently serious problems for nuclear weapons proliferation that the President has recommended deferring it pending a search for alternatives. Neither the technological feasibility nor the economic practicality of fusion has been demonstrated, and it is extremely unlikely to be a major power source in this century.

There are many promising advanced solar technologies, most of which concentrate on the generation of electricity. However, none of these systems has been demonstrated to be economic. Of the advanced systems under consideration only ocean thermal and space-based solar energy stations are by themselves suitable for base-load generation. However, central-tower solar-thermal-electric and photovoltaic, two systems which are much more likely to be brought to commercialization within this century, can be adopted to base-load requirements by the development of advanced energy storage systems. Presently available geothermal technology, while well developed (and suited to base-load requirements), is limited to specific geographic regions, Advanced systems currently under development promise to expand the geographic areas in which this form of energy can be utilized.

The present plan places so much emphasis on short-term solutions that the orderly development of far-future options may be endangered. Should the Plan's stated reemphasis of the fission breeder program come to pass, the only remaining base-load option which currently receives adequate budgetary considerations is nuclear fusion, which is at best a high-risk program. Since the Plan clearly identifies the desirability of satisfying an increasing fraction of energy demand in the future by electricity (e.g., electric automobiles, p. 101), early planning and R&D for alternative base-load options is essential. The high costs and long-lead times of these programs necessitate considerable attention to their performance and to the question of how the technologies would be implemented.

V. Demand Impacts

Demand Impacts

Demand Overview and Findings

The National Energy Plan offers a series of principles and objectives that are sound and long overdue. If they are translated into policy, the Nation will take a major step toward solving its energy problems. An emphasis on conservation is particularly important because it offers the greatest potential for keeping U.S. dependence on imported energy within the limits imposed by total world production capability and world demand. The Plan's principle that energy should be priced at replacement cost is fundamental to achieving the needed conservation levels. The strategies and tactics proposed by the Plan are, for the most part, moves in the right direction to increase energy-use efficiency and expand the use of more abundant domestic energy supplies,

There are certain general features of the Plan with regard to demand that need to be strengthened.—The Plan's only provision for increasing supply, other than raising the price of new oil and natural gas, is to depend on the creation of demand to stimulate supplies. This is particularly true of coal, where the conversion proposals in the Plan are expected to be sufficient to bring forth the needed coal. It is important that there be constant monitoring of the Plan's proposals in this regard so that, if "midcourse" corrections are needed, prompt action can be taken. The Plan probably does not go far enough in moving the costs of natural gas and electricity toward replacements costs. The Plan's proposals could continue existing price distortions and reduce the effectiveness of price signals in motivating consumers to conserve energy. Finally, the Plan does not adequately coordinate its conservation and conversion goals with the need for research and development on more efficient ways to use energy, either in the near term or the long run. Care must be exercised that the Plan's proposals do not inhibit innovation and are flexible enough to permit rapid implementation of new technologies when they are ready for the commercial market.

The 1985 projections for energy demand given by the Plan appear achievable in most cases and may actually underestimate the potential energy savings, although uncertainties exist in some sectors.—The Plan's forecast for the energy growth rates, principally in the industrial sector, may be higher than what will actually occur. The energy price increases of the last few years are likely to accelerate efforts to increase energy efficiency. There is insufficient information in the transportation sector, because of the focus on automobiles and gasoline, to determine whether or not the Plan's projected 1.1-percent annual energy demand growth rate will be met. In the buildings sector, the Plan's provisions seem adequate to reach the projected 1.1 -percent per year growth rate in energy use. In the utilities sector, the 4.4-percent growth rate appears reasonable, although there is enough uncertainty, primarily about industry plans for electricity use, so that the rate could range from below this projection to higher than the 5.8-percent growth rate which present utility plant construction schedules anticipate. Finally, in

Demand Impacts

the industrial sector, the Plan's projected energy demand growth rate of 4.6 percent per year appears to be much higher than what will occur, even considering the high rate of growth in the gross national product (GNP) assumed by the Plan. Continuing the historic relationship between GNP and industrial energy demand growth rates would result in a lower energy demand in 1985 than the Plan's forecast by the equivalent of 200 million tons of coal.

The Plan's proposals in the transportation sector appear to be too narrowly focused.— The Plan concentrates on automobiles and gasoline consumption and does not propose an overall transportation energy policy, The Plan's goal of a 10-percent reduction in all gasoline consumption by 1985 probably is too optimistic. Consumption of gasoline by automobiles alone is likely to be reduced by more than the 10-percent as a result of fuel-efficiency standards established by the Energy Production and Conservation Act of 1975, However, increased use of fuel by trucks could partially offset this, with the result that the overall goal is not reached. The standby gasoline tax proposed by the Plan probably will be triggered, but that alone probably will not reduce consumption by enough to reach the goal. Finally, automobile fuel-efficiency standards may be achieved even without the Plan's proposed excise taxes.

The Plan does not consider mass transportation in its proposals, Efforts should be initiated to increase the use of public transportation to promote gasoline savings in the long term. The Plan also should consider changes in transportation regulatory activities to improve overall transportation fuel efficiency.

The Plan's provisions for the buildings sector could be expanded in scope and consideration should be given to restructuring the Plan's proposed tax credit proposals.— While the 1985 goal of weatherproofing 90 percent of all homes and new buildings is overly optimistic, the emphasis of the Plan on improving the thermal efficiency of buildings should accelerate an important energy-saving trend. It may be necessary to require either that information on thermal efficiency of housing be made available to potential buyers or that housing meet specified thermal-efficiency standards at the time of sale if the goals are to be realized. The Plan's emphasis on single-family dwellings and duplexes could mean that large potential savings from conservation measures in commercial structures will not be achieved. Further, the Plan's lack of strong incentives for conservation in rental housing may result in a negative impact on the poor, because most low-income families are renters.

Homeowner tax credits proposed by the Plan may not be justified because rising fuel costs are already encouraging homeowners to reinsulate. Tax credits to encourage solar systems seem justified, but no consideration is given to potential savings that can be achieved through improved design and other elements of "passive solar" technology, The Plan should consider expanding application of buildings conservation tax credits to innovative technologies which carry higher risk than existing methods but which might result in greater long-term gains.

The Plan's proposed schedule for converting utility boilers from natural gas to coal can be met, but there are circumstances that could easily upset the timetable.—Although the capital required to convert present natural gas-fired utility boilers is manageable on a national scale, the concentration of gas boilers in Texas, Arkansas, Louisiana, and Oklahoma may place intolerable burdens on some utilities in these States, particularly if demand growth should exceed expectations. The conversion schedules that are necessary to reach the 1990 goal are so tight that the Plan's proposed oil- and gas-user tax probably cannot accelerate conversion rates. If there is a choice between converting and paying the tax, utilities may choose the tax with a result that some conversion will not take place on schedule.

The rate-reform proposals of the Plan move in the direction of cost-based rates but some provisions may hinder reaching the objective.—The Plan's proposal to prohibit declining block rates may not always be consistent with 'cost-based' rates, Small customers often cost more to service than large customers on a per-unit energy delivered basis, and a strictly flat rate across all customer classes may not resolve rate discrimination problems. Within a given class, however, a flat rate should increase the incentive to conserve. Time-of-day rates will be of limited effectiveness until economical storage systems are developed. Consideration also must be given to regional differences when setting time-of-day rate schedules. The probability of success of the Plan's rate-reform proposals can be enhanced if they are made more flexible.

The Plan's provisions on energy prices and taxes could lead to significant shifts in the market and operation of natural gas utilities.—The decline in natural gas consumption by industry which probably will be accelerated by the tax on gas consumption may be accompanied by an increase in residential use, provided existing prohibitions on new hookups are lifted. This will decrease load factors and could lead to increased costs to consumers. In some areas, reduction in industrial use and voluntary customer conservation will be sufficient to create a surplus. If these utilities are not permitted to sell this gas to new customers, the utilities are unlikely to promote additional conservation efforts and seek new gas supplies.

Much of the industrial switch from oil and natural gas, particularly for direct heat process, may be to electricity rather than to coal as contemplated by the Plan.—The Plan's objective to substantially increase industrial coal consumption with a series of price and regulatory incentives may not be met. The lack of coal marketing and distribution systems on a scale small enough to handle industrial loads contemplated by the Plan, the need for new coal handling and combustion equipment, and the requirement for pollution-control equipment are likely to make shifts to coal so expensive in many cases that industry will export the problems of conversion to the electric utilities. Under the Plan's provisions, conversion could be required for units that would need as little as 25,000 tons of coal per year. By comparison, a moderate-sized, coal-fired electric utility will use about 1.5 million tons per year, Conversion to electricity is not the intention of the Plan, but it is not necessarily an undesirable result. The relative efficiencies between coal-combustion and electric-resistance heating in direct-heat processes would compensate for coal-to-electricity conversion losses. Research should be expanded to use electricity more efficiently in these processes.

The Plan's cogeneration provisions address the major problems inhibiting its growth, although the proposals need to be more closely coordinated with those for coal conversion.—The Plan offers a set of proposals which are necessary to remove barriers to cogeneration development. Utility interest in cogeneration probably will remain limited, however, because utilities are not likely to require more generating capacity for the next several years than the plants already under construction would provide. Utilities cannot be sure that they will receive an adequate return on resale of purchased cogenerated power. They also are concerned about the technical problems and costs of adding dispersed generating capacity over which they do not have complete control. If a rapid industrial shift to coal were to occur as a result of the Plan's proposals, and utility interest in cogeneration remained low, much potential cogeneration capacity would be lost because industry probably would install low-pressure, coal-fired boilers. To take advantage of the long-term cogeneration potential, the Plan's coal policy should have enough flexibility to maintain the 'cogeneration resource base' and accelerate research and development on technologies for coal-fired cogeneration.

The pricing and tax proposals of the Plan will increase incentives for industrial conservation and conversion, although the tax credits probably are not large enough to significantly accelerate industrial conservation investments.—The oil and natural gas consumption tax, the oil equalization tax, and the price increases proposed for natural gas will provide additional incentives for industrial energy conservation and accelerate a reduction in industrial use of natural gas. But price increases will occur even without a plan, and the proposed investment tax credit will probably do no more than accelerate industrial investment decisions in conservation technologies by a few months. Even though the proposed 10-percent credit would be added to an existing 10-percent investment tax credit, it will not substantially close the gap between what industry can expect as a rate of return on conservation investments and what it can expect from investments to increase production output. The designation of a list of items that qualify for the tax credit probably will inhibit innovation in other technologies and processes that might be much more effective in reducing energy use.

Issue 1

Expected Energy Use to 1985

The growth rates in energy use projected by the National Energy Plan, particularly in the industrial sector, could overstate actual increases in demand.

Summary

The National Energy Plan projects average annual growth rates for energy use of 1.1 percent in the residential and commercial sector, 1.1 percent in the transportation sector, **4.4** percent in the utility sector, and **4.6** percent in the industrial sector. Except for industry, these are al I significantly below historical trends, particularly the 1960-73 period. For total energy use, the forecast is 2.5 percent, again below historical trends. However, the Plan's projections are higher than a number of others for the 1976-85 period, giving rise to the question of whether the Plan has understated the potential for conservation by 1985.

The growth rate for the residential /commercial sector appears to be achievable, although the original goal of insulating 90 percent of all residential buildings is probably too optimistic. The transportation forecast cannot be evaluated because the Plan focuses on automobiles and the effect of the Plan on the other components is not established. The utility sector projection appears achievable, provided the increase in demand for electricity from the industrial sector, caused by a large shift from oil and natural gas to electricity, does not exceed planned capacity additions. Alternatively, there is the prospect that the utility sector would have a substantial excess of capacity by 1985 if the Plan's projected energy growth rates prove correct and the generating plants now under construction are kept on schedule. Finally, the growth rate forecast in the industrial sector appears to be too high. The latter, however, depends critically on the growth rate of the gross national product (GNP) and could approach the Plan's value if the GNP growth rate projection of 4.3 percent per year holds. If industrial energy demand grows at a rate close to historical trends, industrial coal requirements may be as much as 200 million tons below the Plan's estimate.

Background

The National Energy Plan forecasts energy use in 1985 that would result from the Plan's proposals. The average annual growth rates derived from these projections are considerably below the historical trends, except for the industrial sector. This is shown in the following table:

Average Annual Growth Rate (Percent)

Sector	Plan, 1976-85	1950-1976	1960-1976	1950-1973	1960-1973
Residential/Commercial	1.1	4.0	4.2	4.2	4.7
Transportation	1.1	3.1	3.7	3.4	4.3
Industry	4.6	2.3	2.3	2.95	3.3
Electricity	4.4	7.1	5.9	7.7	6.6
TOTAL ENERGY	2.55	3.0	3.2	3.5	4.0

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As seen, the Plan calls for large decreases in the residential/commercial, electric utility, and transportation energy-use growth rates. On the other hand, the industrial energy-use growth rate is forecast to be double the rate between 1950 and 1976.

Residential/Commercial. —Recent large increases in fuel prices, along with higher energy-efficiency standards for buildings and appliances, should act to reduce the growth rate of energy use in buildings. The measures proposed in the Plan are aimed at increasing the incentive to homeowners and building owners to install conservation equipment and to tighten regulations regarding standards for buildings and appliances. The Plan's goal of insulating 90 percent of the Nation's residential buildings by 1985 does not appear to be achievable. However, one analysis by the Oak Ridge National Laboratory indicates that the overall projections in this sector will be reached under the Plan. The principal areas of uncertainty are discussed in the issue papers in the buildings section of this chapter.

Transportation.—As described in the transportation section of this chapter, the plan focuses primarily on automobiles and gasoline consumption. Although cars and trucks make up the major portion of the transportation sector, other components are large enough to make overall demand goal unachievable e even if the Plan's proposed 10-percent reduction in gasoline consumption is achieved 10-percent reduction is itself uncertain because the Plan is not clear about future fuel efficiencies of trucks. These uncertainties are discussed in detail in the transportation issue papers.

Electric Utilities.—The annual utility growth rate forecast in the Plan of 4.4 percent appears to be reasonable, if the Plan's other forecasts hold. There is considerable uncertainty in this sector, however, which results from a combination of the possibilities of a large shift by industry from oil and natural gas to electricity, of a considerable excess generating capacity by 1985, and of the likelihood that industry energy-demand growth rates, as forecast by the Plan, are too high.

Data from the Federal Power Commission indicates that enough new base-load generating plants have already been scheduled for construction by 1985 to meet an annual growth in electricity demand of between 5.1 and 5.8 percent. This is well above the Plan's projection, and brackets the 5.5-percent per year growth rate recently forecast by the Edison Electric Institute. Some of this construction can be deferred or canceled, as has been done over the past few years, and it is possible that environmental challenges and safety considerations may slow down or stop construction of other plants. While there is the possibility that excess capacity could be in place in 1985, it is by no means certain.

There are uncertainties in demand which further complicate the situation. The biggest uncertainty is the extent to which industry will shift to electricity rather than direct use of coal in its effort to use less natural gas and oil. This, in turn, depends on the growth rate of industrial energy use, the availability of natural gas and oil to industry over this period, and the willingness of industry to pay the user tax and higher prices for oil and natural gas if utilities can be assured that those fuels will be available. The electricity demand, considering just these uncertainties in the industrial sector, would range from a value less than that projected by the Plan to a value that would endanger electric supply reliability even if all the plants presently under construction were completed by 1985. **An upsurge in electric use by the residential/commercial sector is not likely because** oil and natural gas prices for homes will be kept below prices of electricity. In fact, if moratoriums in hookups of natural gas to new homes are lifted, the present growth rate in electricity in this sector would probably decrease.

Such uncertainties about future growth in demand for electricity mean that utilities will have to monitor demand closely to balance their plans for new generating capacity with real demand growth. It should be noted that to the extent that demand growth for electricity exceeds presently planned capacity growth, cogeneration will become more attractive to electric utilities, because lead times for installation are shorter than those for cental powerplants.

Industry.—This sector is the most uncertain with regard to energy-use projections. The Plan assumes that industrial energy demand grows 0.35 percentage points per year faster than GNP, which is a substantial departure from the 1950-73 period, during which energy demand grew 1.1 percentage points per year slower than GNP. If this long-term trend were to continue, an industrial growth rate of 3.2 percent would be expected, leading to industrial energy use of 18.3 million barrels of oil per day equivalent by 1985. There is also a possibility that the 4.3-percent growth rate of GNP assumed by the Plan is too high in the light of historical trends. The principal reason for this is that during the 1963-73 period, the annual GNP growth rate of 4,2 percent was accompanied by a very large increase in employment, which grew at a rate of 2.5 percent per year. This compares to 1.4 percent per year from 1947 to 1963. The large increase was a consequence of the post-World War II baby boom, which will run its course by about 1980, with the result that the labor force growth rate should decline considerably. Therefore, even if the productivity growth rate resumes its 25-year average of 1.7 percent per year, the GNP rate would be less than the 4.3 percent forecast by the Plan.

This is not as clear-cut as it appears, however. Because of the large amount of unemployment and the increasing number of women entering the labor force for the first time, the growth rate in employment may not decline to pre-1 963 levels by 1985 even though the effect of the baby boom ends before then, although it may fall below the 1963-73 level. In addition, the Plan assumes a very large increase in the Manufacturers' Index-about 5.5 percent per year—in order to drive the unemployment rate down to 4,5 percent by 1982. This is a large departure from historic trends. The 0.9-percent per year difference between the index and the projected industrial energy-use growth rate is near the historical 1.1 -percent per year differential. Therefore the long-term efficiency trends are still maintained. Under these circumstances, the 4.6-percent per year industrial growth rate may not be as far out of line as it first appears. The crucial variables are the expected increase in employment and productivity, and the extent to which manufacturing will have to contribute to the economy over the next 9 years.

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Implications.—The Plan projects that total energy use will grow at an average rate of 2.5 percent per year to 1985. Combined with a 4.3-percent annual growth rate in GNP, a significant decline of the ratio of these growth rates is forecast. Whereas it has been about 1.0 for the last 25 years, it is now forecast to average about 0.6 for the next 9 years. This is a substantial change and serves to highlight the significance of the rate of GNP growth in affecting energy-use projections. For example, continuation of the 1950-76 GNP growth rate of 3.4 percent per year in conjunction with this 0.6 ratio would produce an annual average energy-use growth rate of 2 percent and an energy demand of about 44.4 million barrels of oil equivalent per day by 1985. This 2.0 million barrel per day reduction below the Plan's assumption is equivalent to about 200 million tons of coal. That amount represents nearly two-thirds of the projected increase of coal use by the industrial sector. Although the effect that any such reduction of energy requirements may have on coal use will depend on oil and natural gas availability and industrial conversion to electricity, it can be seen that the degree of difficulty in meeting the coal goals of the Plan depends intimately on the Nation's actual energy-demand growth rate.

Issue 2

Replacement Cost Pricing

The National Energy Plan's efforts to move energy prices toward long-term replacement costs represents a positive step in achieving the goals of economic efficiency and informed consumer choice.

Summary

The Plan proposes replacement cost pricing as an essential principle in any national energy policy, The provisions of the Plan move toward the principle, but not far enough to reach replacement cost in every case. The concept of replacement cost pricing will not be easy to implement, however. It will be difficult to account for externalities because of an extensive need for new information, and moves toward replacement costs must be phased in at a rate which will avoid severe economic impacts. At the same time, until full replacement costs are charged for all fuels, there will be less incentive to invest in alternative energy technologies that could compete with existing fuels at replacement costs. Present price policies clearly deter conservation; until they rise to replacement costs, they will inhibit wider introduction of such alternative technologies as solar energy.

Replacement costs are obtained for oil under the Plan's proposals, although not all consumers will pay these prices. Natural gas prices reach replacement levels only for industrial users and then on a schedule that will raise oil prices first. Electric rates will approach replacement costs upon application of the Plan's rate-reform proposals, but consumer choice among these rates is voluntary. Coal costs are left to be set by the market, although they will be affected by other features of the Plan that affect the purchase price of competing fuels. While most of these price compromises are proposed to achieve a measure of equity, they should be carefully monitored to ensure that they do not forestall even greater benefits in resources allocation that would result from full replacement cost pricing.

Background

It is an accepted principle of economics that to ensure efficient operation of markets and allow maximum expression of consumer choice, the price paid for a product should reflect what it would cost to replace, or produce one additional unit of, the product in question, (This point is also called the marginal price.)

Where private markets function freely, the prices at which demand and supply are in balance can be said to reflect replacement cost values. The fact that U.S. energy prices have been controlled, both by Government policy and private action, has led to the present disparity among fuel costs.

For example, many people believe that the regulated rates for electric utilities, which are based on "historically imbedded" or average costs of production rather than on the incremental costs of adding new capacity, have created a continuous bias toward over investment in new facilities. As a result of average-cost pricing, electricity demand has been higher than it might be, and a barrier has been created to investment in conservation. For a consumer, paying the "average" cost of a unit of electricity is more attractive than making an investment in energy-saving measures that would eliminate the need for that unit of energy.

Similar choices have been made with natural gas. Past policy which set prices far below the replacement cost has discouraged conservation. The Administration now seeks to reinforce conservation with additional, offsetting Government policy, such as the proposed insulation tax credit. Finally, an unwillingness by policy makers to let prices rise above the controlled level has given rise to a policy debate over whether to subsidize substitute fuels, such as synthetics or foreign liquefied natural gas, which are likely to be much more expensive,

The failure to achieve replacement cost pricing also deters the introduction of alternative energy technologies which do not have the benefit of "rolled-in" or average pricing. The primary example is solar technology. There is evidence that there would be a larger market for solar equipment if all fuels were priced at their replacement level. As with conservation, additional Government policy has been proposed to stimulate this market, which will expand slowly as long as other energy sources are held at artificially low levels.

Although replacement cost pricing is a desirable goal, it could have undesirable side effects. For example, a preoccupation with the incremental cost of expanding electric-generation capacity might crowd out opportunities to experiment with peak-

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load dampening by time-of-day rate schedules as an alternative. Another case in which replacement cost pricing may be an imprecise guide to decisions is where prices must account for externalities. Such externalities, interpreted literally, may place impossible data requirements on the pricing system and frustrate the realistic application of replacement cost pricing. A precipitate shift towards replacement cost prices from far lower levels may also cause marked impact on income and its distribution, and on employment and geographic development. These short-term costs must be weighed against the benefits of improved resource allocation resulting from the change.

Nevertheless, the Administration's effort to force energy prices towards long-term, replacement cost levels, as expressed in the National Energy Plan, represents a move towards the desirable goals of economic efficiency and informed consumer choice. The Plan's initiatives on pricing would affect all energy forms to some extent:

- By decontrolling some domestic crude oil production and imposing an equalization tax, domestic crude oil prices would move to current world price levels. Replacement cost principles are partially compromised by the plan's proposal to authorize a ceiling on price levels if world prices rise too sharply and by the Plan's provision for rebates of equalization taxes.
- New natural gas prices are allowed to reach a ceiling of $1.75 per thousand cubic foot. Replacement cost principles are substantially compromised by shifting the highest-cost gas supplies exclusively onto industry, setting the ceiling for other uses below the world crude oil price equivalent, and retaining "rolled-in" gas utility rate-making practices. The continued use of averaged prices shields homeowners and others from cost increases.
- Electricity-rate reform proposals call for study and subsequent implementation of pricing practices that more accurately reflect cost of service, including seasonal and time-of-day peak demands. While consideration is given to utility costs which increase as a result of capacity additions, the language of the Plan appears to call for placing financial responsibility for such additions on those customers who cause the increase. True replacement cost principles would distribute such incremental system costs to all users because those who do not help create a need for new generating capacity would still be using a commodity at a price below its replacement value,
- No pricing initiatives are proposed for coal, which remains the one energy source governed by the interplay of demand and supply. Coal will be indirectly affected by regulatory provisions governing the price of competing fuels in the electric power market.
- While gasoline could escape direct taxation under the Plan, the tax on fuel-inefficient cars is designed to dampen gasoline consumption. The differential tax on a car that will get 21 miles to the gallon instead of 27.5 is $600. If a car is driven 100,000 miles in 10 years, the differential gasoline consumption is about 1,000 gallons and the discounted value (at 10 percent) at

the time of purchase, at today's gasoline prices, corresponds to a gasoline tax of $1 per gallon. This is substantially above replacement cost at prevailing world petroleum prices, but presumably is justified by considerations of national security and the environment. This is one example of an attempt to include externalities in the price.

In assessing the Plan's proposed pricing policy, it is fair to recognize that, in the case of some depletable natural resources, there is a view that replacement cost is not an adequate measure of the fuel cost to society of energy production and consumption. This view holds that environmental damage and the denial of fuel resources to future generations must be factored into today's costs by pricing energy commensurate with the cost of so-called "income" or "replaceable" resources. The new costs would be based on the requirements for providing energy derived on a sustainable and ecologically benign basis from the sun. imposition of energy depletion taxes on current resource use would be one means of moving toward "permanent replacement costs." Another method would be direct rather than indirect pricing; the full costs of nuclear services provided by the Government, for example, would be paid by the electric utility and its customers rather than indirectly by subsidization and general taxation.

Had the Plan opted for complete decontrol, energy prices would have been governed by the OPEC world oil price, which is not a freely determined market price. As a result, there would have been sharply higher producer revenues. Such an approach might also have generated much higher prices. But if a price rise to OPEC crude-oil equivalents did generate unacceptable windfall profits, tax policy could be designed to reduce excess earnings and induce investment in new energy development.

A final question on the proposed price policies asks which course of action involves more Government intervention in the Nation's economic affairs. Mechanisms proposed to hold prices below replacement levels will require an extensive system of Government regulation, control, and monitoring. The extent to which this role is sought for Government will influence the acceptability of the policies.

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Transportation

Issue 3

The Automobile Excise and Standby Gasoline Taxes

The structure of automobile taxes and rebates in the National Energy plan may not be needed to meet standards set in the Energy Policy and Conservation Act of 1975 (EPCA), and the standby gasoline tax may not yield large enough gasoline savings to justify the difficulties it raises.

Summary

Existing penalties under the Energy Policy and Conservation Act of 1975 (EPCA) should persuade manufacturers to hold to the energy-efficiency schedule set out in the EPCA automobile tax/rebate system. If not, the penalty could be raised. The surcharge/rebate system proposed in the Plan for increasing costs of "gas guzzlers" and decreasing the costs of fuel-efficient automobiles substitutes a Federal pricing structure for one that manufacturers probably would impose themselves in order to maintain a balance of high-mileage and low-mileage cars to keep any year's production within the EPCA standards. The "standby" gasoline tax, if fully triggered, will reduce gasoline consumption, but its incremental effect in comparison to improved automobile efficiency is likely to be small. In addition, the combination of the gasoline tax and rebates would affect some segments of society more than others and questions as to its "fairness" are therefore raised. Finally, the Plan only proposes to tax gasoline directly and does not deal with other transportation fuels such as jet and diesel fuel.

Background

The National Energy Plan combines three policies in an effort to induce consumers to use less gasoline:

- an oil equalization, or wellhead, tax;
- a standby gasoline tax; and
- an excise tax for inefficient automobiles and a rebate on efficient cars (so-called "gas guzzler" tax).

Although the taxes influence automobile costs and usage as a package, gasoline price increases and automobile excise taxes are examined separately below.

Gasoline price Increase.—Under the Plan, U.S. prices for oil at the wellhead would be raised to world prices over a 3-year period by imposing a tax equal to the difference between the controlled domestic price and the world price. The passthrough from the oil equalization tax to motorists would be about 7 cents per gallon in the Plan's first year, assuming a world price of $14 per barrel and an equalization tax of $3 per barrel, to raise the U.S. delivered price to the world price. In addition, the Plan proposes, starting in 1979, to raise gasoline taxes by 5 cents per gallon in each year the gasoline consumption exceeds the Plan's targets, which move downward from an

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estimated consumption in 1977 of 7.3 million barrels per day to a goal of 6.6 million barrels per day in 1985. The tax could reach 35 cents per gallon in 1985 and 50 cents per gallon in 1988.

It appears likely that the year-by-year gasoline-use targets will not be met and the tax would be triggered. If the full tax is implemented and inflation increases at an annual rate of 5 percent, the net effect by 1988 would be a 29-cent per gallon increase in 1977 dollars. Combined with the oil equalization tax, the net effect will be an increase of around 32 cents per gallon by 1988. This is in addition to any increases in the world price of oil. Even with these tax-induced price increases, the improvements in the average energy efficiency of new automobiles would reduce the average real cost per mile of gasoline.

The increased cost of gasoline to the consumer due to these taxes will have two direct effects on consumption: (1) it will encourage people to replace fuel-inefficient cars sooner than they might otherwise; and (2) it will reduce automobile usage and increase use of other transportation forms such as carpooling, mass transit, bicycles, and jitneys. Several projections based on gasoline usage, although a majority of projected reductions will probably come from improved automobile efficiency. Of course, all such projections are uncertain.

In this connection, increased gasoline prices may have positive psychological effects. Although gasoline prices increased drastically immediately following the OPEC oil price increases in 1973-74, real (adjusted for inflation) gasoline prices have not increased since that time. This probably contributes to a wide-spread skepticism about whether there really is an "energy crisis." The gasoline tax would serve as a reminder that the energy problem is real and has not gone away. However, the standby tax as proposed in the Plan would probably be less effective than a predetermined tax in reducing consumption of gasoline. The Plan apparently assumes that consumers will curtail gasoline use to forestall annual tax increases, but it is just as likely that consumers will figure their individual purchases will have little effect on national consumption. If consumers know that a tax would increase regularly, they might be more readily persuaded to select a more efficient car sooner rather than later.

Probably the most sensitive issue regarding the gasoline price increases is whether they affect different segments of society equitably, The two groups of most concern are the poor, who generally spend a higher proportion of their income on gasoline than other income groups, and the rural population, which has no real alternative to the automobile. There is no doubt that these two groups (many citizens fall in both groups) will suffer greater adverse effects than others, although the expected net effects on the average poor or rural dweller should not be significant under the proposed tax-rebate system.

Another important concern raised by the proposed standby gasoline tax is that it focuses on iust one component of a barrel of oil, ignoring jet fuel, diesel fuel, and other refinery products. It is not clear why the

Plan specifies incremental increases in the cost of gasoline but not in the cost of jet or diesel fuel. An alternative to the standby gasoline tax would be to implement higher taxes on crude oil, both imported and domestic. Such tax increases would be progressive if they were covered by the same rebate schedule proposed for the wellhead tax.

Automobile Excise Taxes and Rebates.—The Energy Policy and Conservation Act of 1975 imposes fuel economy standards (FES) on new automobiles. A Department of Transportation study indicates that if manufacturers meet the standards, passenger cars will use 17 percent less gasoline in 1985 than they do now, even though there may be 20 percent more cars on the road.

One course that manufacturers could take to keep the fuel efficiency of their total mix of automobiles within the law is to charge more for cars that perform below the standard and use that money to cut prices and promote sales of cars that perform above the standards. Under such a pricing structure, the costs of gas guzzlers could climb high enough to substantially reduce their sales. In order to meet the standards in 1985, a manufacturer would have to produce five cars that got 36.2 miles per gallon in order to sell one car that got only 12.5 miles per gallon, assuming a mandated fleet average of 27.5 miles per gallon. (The figure is calculated in terms of a harmonic mean that assumes a total number of miles driven and not as an arithmetic mean.)

The Plan proposes to supplement EPCA fuel-economy standards with an excise tax on new cars that perform below standard, graduated according to their variance from the prescribed fleet average, and rebates for cars that are more efficient than the standard requires.

The requirements of the Energy Policy and Conservation Act prescribe the market within which automobile manufacturers must operate over the next 9 years (the time-frame of the energy plan). If the tax/rebate system is implemented, the excise tax would replace the higher price that a manufacturer might charge for a less efficient car. Those funds, then, would be taxed away and no longer would be available for the manufacturer to use to reduce prices of more fuel-efficient cars. In addition, the Plan's proposed tax/rebate schedule is fixed over a full 9-year period and could not be altered (except by amending the law) in a year in which the tax (or higher price) for a fuel-inefficient automobile might have to be raised substantially in order to discourage purchase of inefficient cars and keep a manufacturer's fleet in balance.

The Plan suggests that the tax/rebate structure is proposed because there is doubt that existing penalties are sufficient to keep manufacturers on the fuel-efficiency schedule outlined in EPCA. The penalty under EPCA is $50 on each car sold in a year for each mile per gallon by which the company's average falls short of the law's fuel-efficiency standard, Because the penalty is a fine and not a tax, it would be levied against after-tax profits and would be the equivalent of at least $96 for each mile per gallon. For a company like the Ford Motor Co., selling about 3 million cars per year, the penalty for falling short of the standard by one mile per gallon would be equivalent to $288 million. If this is not considered to be sufficient to encourage manufacturers to meet the standard, Congress could increase the penalty, perhaps by doubling the $50, as an added inducement to meet the standards. All of this assumes that the current standards and penalties will be enforced. Experience with the Clean Air Act leaves some room for doubt as to whether this will actually be the case, although on May 25, 1977, one industry representative stated before the House Ways and Means Committee that the industry sees no alternative to meeting the EPCA standards.

Issue 4

The Impact of Truck Fuel Consumption on Meeting the Gasoline Consumption Goal

Without a goal for truck fuel consumption that is as unambiguous as that for automobiles, it will be difficult and perhaps impossible to measure the effectiveness of any set of policies designed to reduce transportation fuel consumption.

Summary

The National Energy Plan proposes a national goal of a 10-percent reduction in gasoline consumption by 1985. Although automobile gasoline consumption will decrease by more than 10 percent by 1985, such a decrease could be partially offset by increases in truck fuel requirements. The National Energy Plan does not offer a goal for trucks, nor does it consider policies to promote increased energy efficiency in truck transport.

Background

The National Energy Plan establishes a national goal of a 10-percent reduction in gasoline consumption by 1985. Automobiles presently account for about 72 percent of the Nation's gasoline consumption. The Department of Transportation m-edieted, before publication of the National Energy Plan, that gasoline consumption by domestic automobiles will decrease approximately 23 percent by 1985 as a result of fuel economy standards established by the Energy Policy and Conservation Act of 1975. If the Transportation Department forecast is modified to include imported automobiles (which would show a smaller percentage increase in efficiency) the decrease in consumption would drop to about 17 percent. Automobile gasoline consumption, therefore, would be well within the target of a 10-percent reduction as proposed in the Plan.

Nonhighway uses account for about 6 percent of gasoline consumption and trucks for about *16* percent. These important shares are not specifically addressed in the Plan, however. If the overall goal of a 10-percent reduction in gasoline is to be met, truck gasoline consumption cannot increase by more than about 13 percent. The strategies needed to achieve this goal are not dealt with in the Plan, although light trucks (under 6,000-pounds gross vehicle weight) are subject to fuel economy standards beginning in model year 1979, and the President has directed the Secretary of Transportation to commence rulemaking for heavier trucks.

Any attempt to regulate fuel economy of heavier trucks raises a number of serious issues. These issues include:

- The great diversity of body types, power-train combinations, and cargo requirements,
- The equally great diversity of duty cycles, trip types, and loaded-to-empty ratios.
- The fact that fuel economy in trucking is a l ready a highly competitive-, marketable feature which has achieved some degree of optimization for each application.

As a consequence of these and other issues, the study concluded that a voluntary program of fuel economy improvement was the preferred course of action, and that mandated standards were inappropriate.

At the same time, however, many forecasts are predicting an increase in truck use in order to support economic growth. As a consequence, it may be extremely difficult to limit the increase in truck gasoline use to the 13 percent necessary to meet the Plan's goals. Accelerated conversion to diesel engines in trucks and automobiles would have the effect of reducing the level of gasoline consumption and could prevent the imposition of the tax on motor gasoline. Of course, switching vehicles to diesel fuel does not yield a proportional decrease in total oil consumption, but it does have some advantages in that diesel engines are more energy efficient and less energy is used in processing diesel fuel than gasoline at a refinery.

Department of Transportation Photo

Issue 5

State, County and Local Government Transportation Fuel Conservation

The Plan does not address the potential for energy savings from changes in operation of State, county, and local motor vehicles.

Summary

State, county, and local governments own and operate large numbers of motor vehicles, and there is considerable opportunity for reducing the energy consumption of these vehicle fleets. However, the National Energy Plan does not explicitly recognize this opportunity nor does it address the role that the Federal Government could play in encouraging energy conservation in this area.

Background

State, county, and municipal governments operate approximately 1,862,000 cars, trucks, motorcycles, and other miscellaneous motor vehicles. While the implementation of energy-conservation measures in vehicle fleet operations requires that consideration be given to the greatly varying needs of the users, improvements in operation and management of these vehicle fleets presents a major opportunity for energy conservation.

An initial step that would have both immediate and long-term benefits is the maintenance of a detailed inventory of the vehicles owned, their use, and their gasoline consumption, Full-sized cars are often used to transport one person, large trucks to deliver small loads, a number of small cars to do the work of a large station wagon or van, pick-up trucks for site inspection when subcompact cars would be adequate, etc. Such surveys could provide a basis for matching existing vehicles with their most efficient use, and help to plan future purchases to meet real needs. Matching the existing fleet with its most efficient usage requires an administrative effort at the respective State and local government department level in order to:

- plan trips for most efficient vehicle use;
- combine trips whenever possible;
- match vehicles to job requirements to achieve maximum efficiency.

Once existing vehicles and their uses are identified, future vehicle purchases can be planned to optimize fuel economy by matching vehicle capabilities with needs. To promote these types of gasoline conservation activities, the Federal Government should consider the following:

- Development and distribution of guides to State and local governments outlining suggestions on how to promote gasoline conservation.

- Support actions by State governments by developing technical assistance teams, to assist State and local governments in their efforts.
- Incorporating energy conservation provisions into existing regulations on the use by State and local governments of general revenue sharing funds. (Many State and local governments use these funds to purchase and operate fleet vehicles).
- . Early action by the proposed Department of Energy, to identify specific programs and incentives which would encourage State and local governments to conserve gasoline.

Issue 6

The Role of Mass Transit in Transportation Energy Conservation

Although the Plan gives some recognition to the potential for energy savings with mass transit, no specific proposals are given for direct action to exploit this potential.

Summary

The expanded use of mass transit can assist in meeting energy conservation goals in the transportation sector. While the impact on energy conservation is relatively small in the near term (1 977-7985), increased use of public transportation could play a major role in promoting gasoline savings in the longer term.

Background

The National Energy Plan notes that mass transit must play a significant role in reducing energy consumption in the transportation sector. At the same time that the Nation is creating disincentives for inefficient transportation, it must begin to explore a system of incentives for more efficient alternatives to the private automobile. However, the Plan does not propose any direct action that would stimulate the development of mass transit ,systems.

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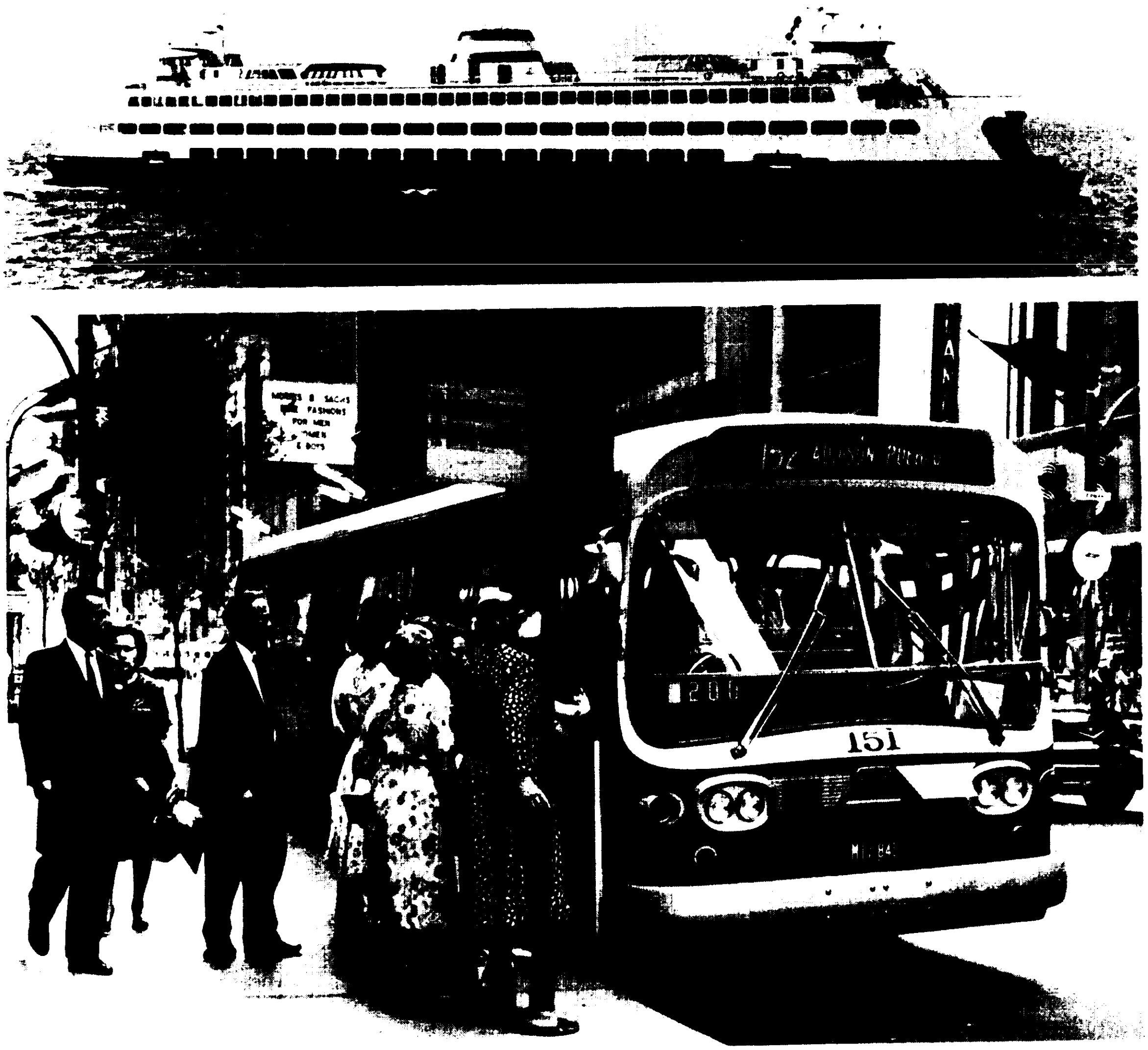
The Office of Technology Assessment conducted a study for the Congress in late 1975 on "Energy, the Economy and Mass Transit," which provides valuable insight into the mass transit - energy conservation issue. Listed below are selected major findings of the OTA report:

1. Transit's share of total energy consumption is very low at the current time-less than 1 percent.
2. The energy efficiency of bus transit is higher than for automobiles. A transit bus with 30 passengers is six times more efficient than an auto which carries an average of 1.4 persons. The operating energy efficiency of heavy rail transit is also high, but the construction of fixed guideway systems can consume large amounts of energy.
3. Automobile energy conservation strategies of various kinds are much more effective in reducing oil consumption than any transit incentive strategy. **In particular, gas taxes or other actions which would raise the price of gasoline by 50 percent would result** in higher transit use and a reduction of about one million barrels per day of gasoline consumption-more than ten times the reduction resulting from a maximum pure transit strategy for oil conservation.
4. A combined strategy incorporating both transit incentives and auto restraints is the most effective strategy to promote energy conservation without lowering the efficiency of the transit fleet.
5. Achieving major increases in the use of transit and reducing energy consumption has long-run implications for national land-use and urban policy.

Department of Transportation Photo

There is conflict among the various analyses conducted to estimate the energy saving of increasing public transport. A recent study by the Federal Energy Administration projected that doubling transit ridership by itself would produce a less than l-percent saving, or about 40,000 to 50,000 barrels per day. In another report, the American Public Transit Association implies that transit usage can save up to 178,000 barrels per day.[1] The OTA report notes that the amount of energy saved will depend upon how public transport ridership increases are achieved, incentives versus disincentives, or combinations of both.

'American PublIC Transit Association, "Energy Conservation & Public Transit," 1975.



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Because mass transit can have a favorable long-term impact on energy consumption, the National Energy Plan should address Federal policies to encourage the development of expanded, energy-efficient transit systems. The policies should consider the following points:

1. As petroleum supplies dwindle and increase in cost, transit systems should be capable of shouldering an increased burden of providing mobility. Ensuring that this capability exists requires continuing support of transit operations. In addition, mechanisms should exist to ensure fuel availability to transit.

2, Research and development programs centering on means to increase the energy efficiency of urban transportation systems should be emphasized. Improved technological solutions for vehicle efficiency are needed, along with greater understanding of energy savings possible through improvement of management systems. There should be increased support for investigations of the linkages between transportation facilities, development patterns, and energy demand.

3. To finance transit-related actions, gasoline taxes might be used (possibly with a direct rebate to State/local governments) to support ventures such as:

   — A transit program for the construction, acquisition, improvement, and maintenance of mass transit facilities and equipment and for the operation of transit systems:

   —Vanpooling or similar commuter programs with incentives for institutional purchase and management of vehicle fleets;

   — Integrated communications and management for urban transportation systems incorporating taxi, van and car pools, bus service, and the special transportation needs of some citizens;

   — Combinations of reserved lanes for multiple-occupied vehicles, restrictions on parking, and incentives for ride sharing which would promote high-occupancy commuting.

Federal actions can have dramatic impacts upon the shape and character of urban areas. For example, policies which promote energy conservation through such measures as encouraging growth in a manner that can be served by energy-efficient transportation should be explored. Long-term success in reducing transportation energy consumption will depend on the relative home and work locations of future urban dwellers.

Issue 7

Transportation Regulation and Energy Conservation

The Plan does not address transportation regulatory changes with regard to energy conservation even though there is a large potential among regulated carriers for fuel savings.

Summary

There are several transportation areas where regulatory actions could foster energy savings. These include changes in airline routing and duplicate flight allowances, relaxed restrictions on truck weight and empty backhauls, allowed joint rail-truck ownership, and encouragement of innovative urban transportation actions and rail operations. Economic, institutional, environmental, employment, or competitive issues usually dominate the discussion of such actions, rather than the energy-savings potential. The Plan should consider regulatory actions which have the potential for energy savings in transportation.

Questions

1. Are there reasonable modifications to Civil Aeronautics Board policies (e.g. reduction in duplicate routes with low load factors) that could improve the energy requirements without significantly affecting the quality of service?
2. Could policies or regulations affecting trucking be modified in order to promote energy conservation; for example, could actions be taken to promote full backhauls without other adverse effects ?
3. Could combined rail-truck or barge-rail companies save energy? If so, are the savings large enough to warrant reexamining existing policies in these controversial areas ?

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Buildings

Issue 8

Scope of Buildings Conservation Programs

The Plan's insulation* proposals do not adequately cover all opportunities for energy conservation in buildings.

Summary

The National Energy Plan places great emphasis on the conservation potential of voluntary, incentive-based decisions of homeowners to insulate and otherwise improve the thermal efficiency of single-family and duplex dwellings. Similar opportunities for savings exist in commercial and institutional buildings. Failure to provide adequate incentives for owners of rental and commercial property reflects a gap in the program which may not only have a strong adverse impact on renters but which will result in significantly lower energy savings than could otherwise be achieved.

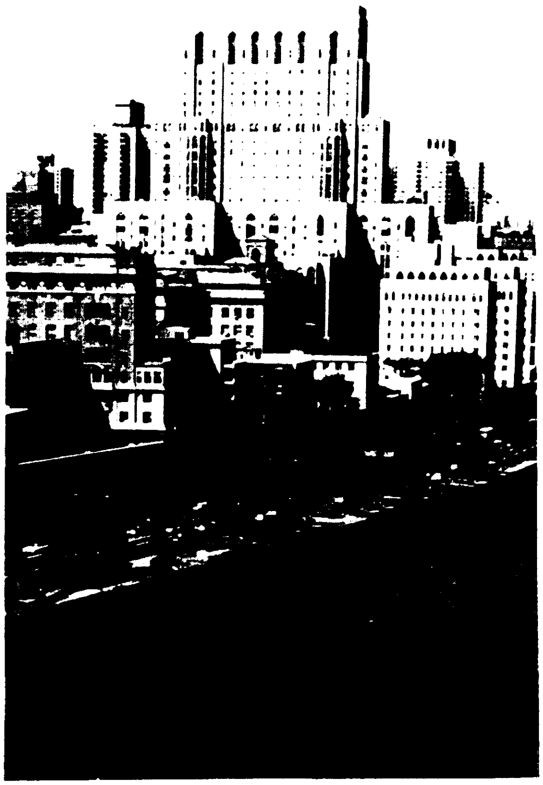
Questions

1. Why does the Plan focus almost exclusively on single-family homes and duplexes in promoting savings through insulation ?
2. What real incentives exist in the Plan for owners of multiple-family dwellings and commercial buildings to save energy ?
3. Why are buildings conservation programs voluntary in nature?

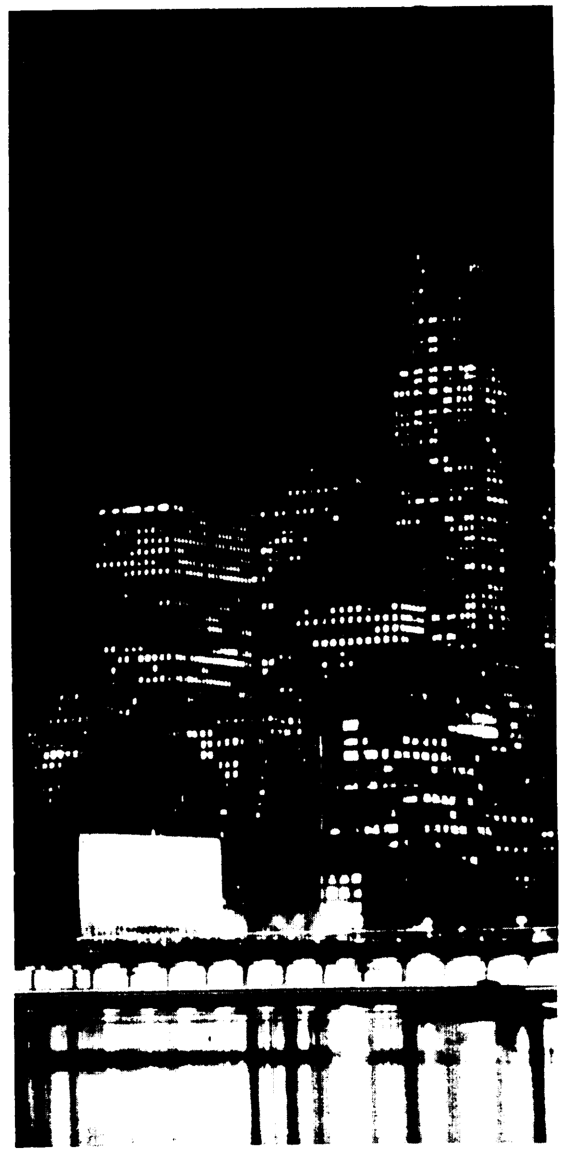
Background

Homeowners now appear to be reinsulating at a brisk pace to save money as costs rise and uncertainties grow about the availability of future fuel supplies. The Plan seeks to accelerate this trend with tax credits and utility-based financing opportunities. While single-family and duplex residential savings are important to aggregate reductions in fuel use, great potential for savings also exists in multifamily, commercial, institutional, and industrial buildings. Field studies indicate that the potential for energy savings in commercial and institutional buildings is between 25 and 50 percent of present demand (American Society of Heating, Refrigerating and Air-Conditioning Engineers). Since the types of equipment and labor required for these larger buildings are different from the materials and skills used for single-family insulation, the two efforts are not competitive. Overall savings can occur faster in the commercial/institutional area, because of high energy demand levels for these buildings and the smaller number of owners.

"Insulation as used in this paper and elsewhere in this section refers to the covering of a building with nonconducting material to prevent or reduce the transfer of heat; it is meant to include caulking, weatherstripping, and other actions which achieve this goal.



Environmental Protection Agency Photo



Department of Transportation Photo

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The incentives for homeowners to invest in conservation are already strong. It is generally accepted that an insulation project will pay for itself in 3 to 5 years. On top of that, the Plan would allow a homeowner to write off up to **25 percent of the initial** investment.

The Plan relies solely on a new IO-percent investment tax credit to provide incentives for owners of rental units to improve insulation. More research needs to be done to determine whether this incentive is sufficient or whether other rewards or motivations (such as expansion of the Plan's utility financing program to include these buildings) are needed. An apartment building owner who does not pay utility or fuel bills for tenants has little incentive to make a major investment in insulation; the only return would be a credit against the cost. Tenants would profit from the fuel savings. Owners of commercial property who pass on heating and cooling costs would be in the same position.

A low level of insulation activity by apartment owners who provide rental units is likely to have the most severe impact on low-income families, who must either pay fuel costs directly or through rent increases.

A related problem may occur with the Plan's proposal to prohibit electric utilities from providing service to new buildings with master meters. The measure is designed to foster conservation by tenants—in some cases, up to 30 percent, according to the Plan-but it also would have the effect of requiring tenants to pay utility costs in electric heat buildings, thus freeing a building owner from fuel bills and removing the motivation to insulate.

in view of the high percentage of income which the poor pay for energy, and the large number of people who would be eligible for direct assistance in reinsulating their homes (approximately one-half of the poor own houses) funds for the insulation grant program established under the Energy Policy and Conservation Act probably should be increased by more than the Plan proposes. The Federal Energy Administration estimates that 14 million families are considered poor or near-poor, with incomes for a family of four ranging from $5,850 to $7,300. At the proposed level of funding, fewer than 1 million families would be assisted over the 3-year life of the program.

Consideration also should be given to expanding the proposed 40-percent matching conservation grant for insulating public and nonprofit schools and hospitals to include all publicly owned buildings and facilities.

The Plan purposely makes all buildings conservation efforts voluntary, but states that it may be necessary to invoke such mechanisms as required minimum levels of energy performance for buildings at time of sale. While this approach avoids imposing requirements which impinge on the private lives of citizens, it also entirely relies on the decision to avoid higher utility bills as the motivator for installation of energy-saving devices. This raises questions of equity, such as the problem of a low-income tenant who bears the direct costs of heating fuel. There also are questions as to whether voluntary decisions will meet the Plan's goals for reducing the amount of fossil fuel used to heat and cool homes, offices, and factories. Establishing standards for measuring the energy efficiency of buildings might produce stronger conservation efforts. Such standards could be used for energy performance labeling. Requiring that information about expected fuel costs be provided to potential home buyers could be an additional incentive for insulating.

Issue 9

Materials Availability for Building Conservation

Shortages of insulating materials may delay achievement of the National Energy Plan's conservation goals for buildings.

Summary

It is not clear that adequate material supplies will be available to insulate 90 percent of U.S. homes and all new buildings by 1985. It may be necessary to design and test new types of electric meters and accelerated production of such meters will be necessary. For insulation and other products, increased demand may inflate prices.

Questions

1. What consideration has been given to the availability of materials in setting Plan goals for insulation?
2. Can private industry supply the types of meters which will be needed for proposed utility-rate reforms at reasonable prices?

Background

In response to an expanding market for insulation, many manufacturers of insulating materials have already expanded capacity. Expansion of capacity cannot be expected to continue at a level necessary to meet a sharp, short-term increase in demand caused by a one-time push for insulating existing buildings. If increased demand leads to higher prices for material, the incentive to insulate may be partially offset,

The cellulose insulation industry can be expected to expand, but there are difficulties involving standardization and quality control in this industry. Also, some shortages exist in the raw materials needed to manufacture cellulose insulation, particularly paper and chemicals,

The section of the Plan that addresses electric utility rates requires that utilities offer their customers either time-of-day (peak load) pricing or the opportunity to install load management devices. This provision may create an abrupt and large demand for sophisticated metering devices capable of recording usage at two or three different rates. Such meters, containing small computers similar to pocket calculators, are not now mass produced and are consequently not available at a reasonable price for small volume electricity consumers. Manufacturers are not likely to begin the necessary research and development until they know the form that peak-load pricing programs will take. Manufacturers also will need large orders before they can begin the kind of mass production that will reduce prices. Thus, a meter supply problem is very likely to cause a bottleneck in the implementation of utility rate reforms.

Other delays in reaching Plan goals may be caused by the uncertainty as to what performance standards will be required under new energy criteria for minimum property standards. The Plan calls for the Department of Housing and Urban Development to release these new standards, required by the Energy Policy and Conservation Act, in 1980. Materials and devices manufactured for new construction will be responsive to these standards.

Issue 10

Tax Credits for Energy Conservation in Buildings

The proposal to encourage home energy conservation with a Federal income tax credit may result in losses of revenue that are larger than could be justified by the tax credit's effectiveness in accelerating energy savings.

Summary

A substantial increase during the last 3 years in home insulation and other conservation measures raises doubts about whether the Plan's tax credit proposal could accelerate the pace. Unless a tax credit provides a major increase in home insulation projects, the reduction in tax revenues could not be justified. It may be more effective to direct the tax credit at innovative technologies which carry higher risks but which could result in higher long-term gains.

Questions

1. What is the likely impact on the Federal budget of the proposed tax credits ?
2. Does available evidence suggest that privately initiated insulation programs will accomplish much of the Plan's goal even without a tax credit?
3. **Should consideration be given to the use of an "energy budget" for qualify-**ing buildings for a tax credit?

Background

The National Energy Plan calls for a tax credit to homeowners of **25** percent on the first **$800** and 15 percent on the next $1,400 invested in residential conservation measures. This effort to upgrade the thermal efficiency of buildings could result in a substantial impact on the Federal budget. If as the Energy Plan says, "conservation pays" at today's energy prices and will pay even more handsomely as energy prices rise, it may not be necessary to offer tax credits to stimulate home energy conservation. Private investment in home insulation and other

Federal Energy Administration Photo

heat-retaining measures has increased sharply as homeowners have reacted to increasing fuel prices. A tax credit would increase the reward to owners who invest in conservation, but it is not clear that the national benefits would be commensurate with the loss of revenue or that greater gains could not result from the use of these tax expenditures as direct subsidies for alternative programs to save energy.

The Plan correctly assumes that investments in insulation and other measures such as storm windows and furnace-efficiency devices will lead to energy savings. In some circumstances, however, these savings may not occur. It is also possible that consumers will invest any money they save from insulation in energy-consuming devices such as air-conditioners or balance out the dollar savings with higher thermostat settings after insulation is added.

In light of these possibilities, it may be desirable to direct the tax credit at actual energy savings rather than at designated hardware. A tax credit, for example, could be triggered upon demonstration that total energy consumption in a household had been reduced below a given base period. This approach would also allow for continuing flexibility in implementing the tax credit proposal, and avoid the problems inherent in a program based upon a list of devices specified as acceptable for credits,

Citizens in local jurisdictions which implemented district heating systems could also receive tax credits in amounts related to the quantities of energy saved.

Issue 11

Mandatory Standards for Major Appliances

The Plan's proposal to make home appliance standards mandatory could be expanded to make it more effective.

Summary

The proposal in the National Energy Plan to make mandatory the home appliance energy efficiency standards developed under the Energy Policy and Conservation Act (EPCA) could be strengthened by setting a short-term standard based on existing technology for immediate application, and a long-term standard so that research and development could begin now. Additionally, the Plan should clarify whether or not States could establish more stringent standards where these are shown to be more cost-effective.

Questions

1, Are there plans to provide sufficient lead time for efficiency standards which will go beyond present technological capacity?

2. What measures are being taken to ensure Federal-State coordination in selling standards and to allow maximum flexibility for regional differences?

Background

The National Energy Plan proposes the replacement of the present voluntary program, as established by the Energy Policy and Conservation Act of 1975, with mandatory minimum standards on certain major home appliances. Presumably, the mechanisms set by EPCA for establishing the standards, with the National Energy Bureau of Standards performing technical evaluation, will remain. The proposal could be more effective if a two-part standard was set. The first part would be based on existing technology and could be applied immediately. Studies at the Oak Ridge National Laboratory have shown that significant energy savings can occur over the next 25 years if more efficient major appliances, including heating and cooling systems, are introduced into the market at this time. To allow for continued development, a second standard could be set now and introduced at a later time. This would act as an incentive to begin extensive research and development to improve major appliance efficiency even further.

Federal Energy Administration Photo

While energy labeling for small appliances is important in providing correct information to consumers, by far the largest energy savings will accrue through greater efficiency in heating, air-conditioning, and water heating. Appliances generating central heating account for more than 50 percent of residential energy use. in *setting* performance standards, emphasis should be given to these devices. There are well-established standard tests to measure the coefficient of performance of heat pumps and the steady-state, full-load efficiencies of direct combustion furnaces. Use of these standards will make consumers more aware of the sources of various reductions in seasonal performance such as cycling, pilot light, and hot air duct losses. Finally, the standards should make homeowners more willing to replace their existing central heating systems as they become aware of the economic benefits of using more efficient heating systems.

A final consideration is the question of interaction between State and Federal governments in setting standards. Some States have already set major appliance efficiency standards and the Plan is not clear on how its proposals will coordinate with those. For example, it might be useful to allow States to set more stringent standards than the Federal Government for some appliances when it can be shown that that is more cost-effective for residents of a State. This would most likely be the case for heating and cooling systems because of large regional climate differences. Before such an allowance is made, its effect on appliance manufacturers who could be required to build to a number of different standards, should be carefully examined.

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Issue 12

Communication of Conservation Information

Effective implementation of a major insulation program will require increased access to technical and cost/benefit information for homeowners. The commitment of homeowners to conserve will be reinforced by Government actions showing serious efforts to conserve.

Summary

Although the importance of energy conservation in buildings has been widely publicized, many owners find it difficult to decide which technical information is valid when they are making conservation decisions. General public skepticism about the importance of conservation is underscored when governmental agencies appear to be wasting energy, A national energy policy should emphasize better communications programs as well as highly visible Government conservation programs.

Questions

1. How can correct and useful information on the technical aspects of buildings conservation best be made available to the public?
2. What can be done to reduce energy consumption by governments to provide a symbol of equitable sacrifice?

Background

Many homeowners express a desire to conserve energy, but surveys indicate that many also are unsure about which actions are most cost-effective, and many others believe that "someone else should do it". Homeowners have little faith in existing sources of conservation information such as utilities and oil companies because they perceive the sources to have a financial interest. Consumer surveys also indicate that Government efforts to encourage conservation through general slogans such as "Don't be fuelish," have little or no effect on consumer behavior. These surveys suggest a need for specific practical advice on how to conserve, preferably delivered by parties perceived to be objective, trustworthy, and well-known to the consumer.

Many organizations with long histories of public service can provide energy saving information. Financial institutions, professional organizations, labor unions, and other groups with national and local chapters or units could effectively participate in a national effort to disburse correct and credible information. Existing State energy offices and the energy extension services already authorized by Federal law could play a major role in providing information to the consuming public. These organizations could be particularly effective in dealing with special local or regional needs and could maintain contact with civic organizations which are close to the people affected by energy policy changes and price increases. An energy plan should be explicit in providing both a role and the necessary financing for such agencies to help promote conservation policies.

Public skepticism about the importance of conserving energy is reinforced when Government agencies and officials appear to waste energy. Every Government car that exceeds Federal speed limits, every Government building that is lighted for purely decorative purposes, every Government office that is too warm in winter or too cool in the summer contributes to public doubt that the energy crisis really exists. It probably is necessary to reduce Government consumption of energy for symbolic reasons as well as conservation.

Issue 13

Crude Oil Equalization Tax and Heating Oil Use

The proposal to spare homeowners from the full impact of the crude oil equalization tax is at cross-purposes with the National Energy Plan's efforts to reduce energy consumption in homes.

Summary

The National Energy Plan proposes a crude oil equalization tax to raise oil prices to world levels over a 3-year period. The Plan also proposes to reduce the tax—through a refund to distributors-n domestic oil delivered to residential and small commercial consumers of heating oil. The effect of this provision runs counter to the Plan's goal of reducing energy use, because these customers would be buying oil at prices that would reduce their incentive to conserve. The administrative burdens of the proposal on heating oil distributors may put them at a disadvantage compared with electric and natural gas utilities; the proposal also may cause regional inequities.

Questions

1. Could the conflict between the Plan's proposals for conservation and its proposals for lower cost home heating oil be resolved by distributing the rebate

on an annual lump-sum basis rather than as a current price reduction or withholding tax reduction ?

2 Will the rebate scheme place excessive administrative burdens on fuel oil distributors?

3. Since imported oil is not eligible for the rebate, will the rebate create inequitable benefits and hardships in different regions according to the relative availability of domestic supplies in those regions ?

Background

The National Energy Plan proposes to assure lower prices for home heating oil primarily by subsidy payments to distributors who do not pass on the full crude oil equalization tax to users of home heating oil.

The proposal to cushion residential energy users from sudden and significant cost increases is in conflict with another—and central component of the energy plan: conservation. The more secure homeowners are against oil price increases, the less inclined they may be to reduce consumption.

If the rebate were given as a lump sum at years end-as is proposed with gasoline taxes and the general crude oil equalization tax revenues—there would be a significant time delay between payment of the higher cost and receipt of the refund. A relative price increase for fuel oil would then be apt to dampen demand, despite the fact that the real income effect of a subsequent lump-sum rebate would reduce net savings slightly.

It may be that concerns other than those for energy savings compel the proposed treatment of residential oil heating customers. If, for example, the proposed scheme is dictated by concern for low-income families, other solutions may be available that will not undermine conservation impulses.

Another concern raised by the home heating oil tax-rebate system is the administrative burden it will place on distributors. Under the Plan, distributors would be primarily responsible for holding down the purchase price of home heating oil. The Plan also requires separating domestic from imported distillate oil when giving the rebate because imports do not qualify. Aside from the problem of convincing customers that all of this is being done correctly, the mechanics of implementing the Plan may be a burden for some heating oil distributors, particularly small companies. The approach also is likely to create intense competition for domestic supplies. Consumers in regions heavily dependent on imported distillates will not benefit from the rebate unless a complex allocation system is devised to spread domestic supply equitably across the country. Such a system is likely to be unworkable. If the tax rebate proposal is to be carried out, other means for administering it should be explored.

Issue 14

The Role of Financial Institutions

The Plan's proposals probably are not strong enough to encourage financial institutions to increase the funds available for loans for home energy conservation projects. However, the impact of rising fuel prices on home-owners may force a more active role on these institutions.

Summary

Financial institutions have not promoted loans for residential insulation for two reasons: 1) most such loans are too small to provide an attractive return to lending institutions; and 2) banks and savings and loans associations have not been able to package such loans and pass them on to the secondary mortgage market.

Questions

1. **What incentives are needed to encourage more activity among primary financial institutions in financing energy conservation ?**
2. **What types of new financing mecha-**nisms can be created to meet the specific needs of homeowners, particularly those planning to invest less than $1,000 in projects?
3. Is it appropriate for utilities to function as federally insured lending institutions for insulation projects as proposed by the Plan?

Background

The National Energy Plan offers a number of mechanisms to expand the role of financial institutions, both primary and secondary, in making loans for home energy conservation measures. While these mechanisms may make some difference in the flow of funds, the market signals being generated to homeowners and mortgage holders by rising fuel prices may exert more influence on the attitudes of banks and other lenders.

The Plan would amend the Federal Home Loan Mortgage Corporation Act to allow the Corporation to deal in packages of small residential energy conservation loans. This should help generate more loans. The high fixed costs of servicing small home improvement loans could, however, continue to be a barrier to real growth in volume of such loans. other efforts that could be made to make small loans profitable to lenders include uniform processing requirements and arrangements to permit homeowners to reopen their existing mortgage instruments and borrow a "future advance" against accrued equity.

Barriers to home ownership arising from fuel costs are now beginning to block home purchases for growing numbers of Americans. Delinquent payments and even mortgage defaults could grow as utility costs rise. An erosion of savings already has begun as homeowners draw on funds to compensate for high winter fuel payments. These factors alone may encourage first-line institutions to make small conservation loans if for no other reason than that they might protect the investment of the lender and reduce the rate of mortgage foreclosures.

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A possible signal to lending institutions of the magnitude of energy costs would be the inclusion of information on ability to meet fuel costs on forms used to qualify borrowers for federally backed loans. In addition to present calculations used to determine principal, interest, taxes, and insurance (PITI), energy costs could be indicated (PITI + E). This would focus attention on this cost component of home ownership, and, because of the widespread use of these forms, might also increase general awareness of energy problems.

The problems of financing insulation investments seems to affect middle-income families most severely. More affluent homeowners tend to purchase energy saving improvements without outside financing. Low-income families must rely on Federal grant programs.

The Plan proposes a 2-year study by the Secretary of Housing and Urban Development to determine an actuarially sound premium rate for energy conservation loans, as the basis for setting such a rate. This should be a valuable base for reflecting risks of, and the proper rate of return on, innovative or ‘‘unproven” technologies.

Financial institutions could play a larger role in providing information on the costs and benefits of energy conservation in all buildings. However, lenders are often reluctant to quantify the savings which might result from a specific investment, because they might be held accountable if the savings were substantially below expectations. Lenders, utilities, and contractors might do well to cooperate in developing technologies for performing energy audits so that estimates of potential energy and dollar savings would be a shared responsibility of experts in finance, energy, and construction.

Under the Plan, utilities would become federally insured lending institutions for purposes of energy conservation loans to residences. This proposal raises many questions about competition with lending institutions, and about the ability of utility companies to conform with the regulations imposed on lending institutions. For many utility companies, the required paperwork may not be worth the Federal loan insurance or guarantees that the Plan seems to offer.

Utilities

Issue 15

Conversion of Electric Utilities From Natural Gas

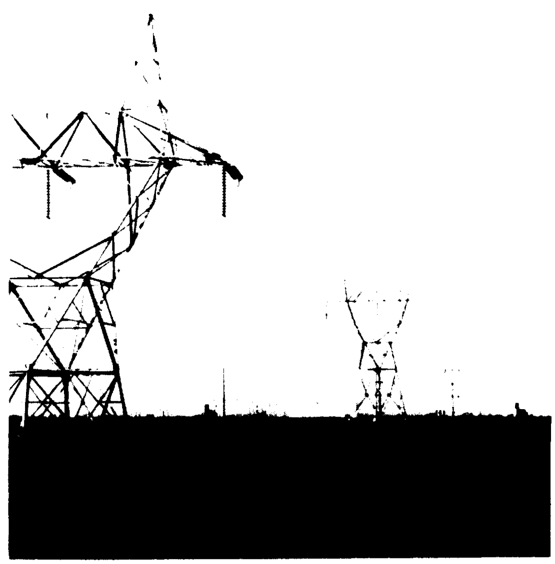
It may not be possible to achieve the National Energy Plan's goal of a ban on the use of natural gas to generate electricity by 1990.

Summary

The goal of eliminating the use of natural gas by electric utilities by 1990 can be met, but the schedule could be easily upset. The total investment required to make the conversion from natural gas to coal is manageable on a national scale, but regional differences may place intolerable burdens on utilities in some locations. A major uncertainty is the extent to which industry may shift from the use of oil or gas to electricity rather than coal. If the trend is to electricity, the added capacity requirements, coupled with the ban on the use of gas, could easily exceed the financial capabilities of some utilities. The Plan's proposals could pose other problems as well. The Plan excludes only those peak-load plants which are a "substantial portion of the total generating capacity" from the ban on use of natural gas, which means that minor uses of gas must be converted, These conversions may be very difficult and costly relative to the amount of gas that would be saved. Finally, the Plan's proposed restrictions on converting to oil, even on a temporary basis, may force some facilities out of service if an equivalent coal capacity cannot be developed by 1990.

Background

The National Electric Reliability Council reports that in June of 1976, 59,000 megawatts of gas-fired generating capacity was in operation in this country, approximately 12 percent of the Nation's total. The Edison Electric Institute estimates that the conversion of this capacity would, under favorable circumstances, take 8 to 10 years and cost at least $22 billion in current dol-



Energy Research and Development Administration Photo lars. Virtually none of the gas-fired generators is capable of operating with coal and conversion would essentially involve building a completely new steam supply system.

An incremental expenditure of $22 billion for the industry as a whole is a significant, but perhaps manageable, undertaking. However, Federal Power Commission data indicate that during 1976, utilities in four states consumed nearly 70 percent of all of the natural gas used to generate electricity: Texas, Oklahoma, Louisiana, and Arkansas. Due to rising prices for, and declining availability of, natural gas, electric utilities in those four States are already on crash programs to reduce their dependence on natural gas; their construction budgets are heavily committed to this purpose, For instance, one major Texas utility system which relied exclusively on natural gas in 1972 had converted approximately one-third of **its** powerplant capacity to coal by 1976 and expected **to** produce more than two-thirds of its **power with coal and** nuclear units by 1982. Additional expenditures of the magnitude which would be necessary to accelerate these existing construction programs will be very difficult, if not impossible, to achieve.

A number of uncertainties greatly diminish the likelihood of meeting the 1990 **natural gas goal. One is whether demand for electricity will increase because industrial plants decide to use electricity instead of oil and natural gas. It appears that this will be the choice** for a large share of industry which will try to avoid the difficulties and unknown costs of direct coal use. Such an increase **in demand would** occur at the same time that utilities were trying to replace natural gas units with coal units.

Two aspects of the Plan seem to compound the gas conversion problem. The primary emphasis of the utility industry conversion program is directed at converting intermediate and baseload equipment, where most of the natural gas used by utilities is burned. Present utility plans do not contemplate accelerated replacement of peak-load generators because they consumed minor amounts of natural gas and because costs of replacing facilities would be very high compared with the small amounts of natural gas that could be saved. However, the Plan may upset the utility timetable with its proposal that peak-load plants may be exempted, only if it can be shown that a peaking plant “is a substantial portion of the total generating capacity” of a utility system. The Plan’s goals might be better served if it required conversion only of peak-load plants that provided a significant amount of a system’s total capacity. In any event, some effective exemption for small use of gas in peaking plants should be considered, especially where utilities face a significant conversion burden under the 1990 deadline for ending the use of natural gas. Another potentially serious problem arises from the Plan’s apparent intent to restrict conversion of gas-fired plants to oil. Most of the units involved are designed **for gas firing, but could burn oil at reduced capacities. Utility conversion plans generally anticipate moving some gas units to oil as part of a phased shift to coal or nuclear power.** If natural gas is to be eliminated as a boiler fuel by 1990, utilities may have to be permitted to shift gas-fired units to oil as an interim measure.

Issue 16

Electric and Natural Gas Utility Rate Reform

Some of the specific utility rate design and regulation provisions in the National Energy Act might reduce the likelihood of achieving the objectives of rate reform.

Summary

The rate reform proposals in the National Energy Plan provide an opportunity to move electric and gas utility rates closer to a "cost-based" level. More flexibility is needed in the proposals, however, to increase the probability that this goal will be achieved. In particular, the prohibition of declining block rates may not always be consistent with "cost-based" rates. As for time-of-day rates, flexibility is also needed to account for regional differences and to ensure that implementing such rates does not create new peaks. Time-of-day rates for residential customers will also be of limited effectiveness until economical storage systems are developed and the public is made more aware of the advantages of, and opportunities for, load shifting. Finally, more consideration should be given to the use of marginal or incremental costs in setting rates which would more closely approach replacement costs.

In the administrative area, the Plan should consider extending the coverage to all utilities generating at least 200 million kilowatt hours per year to pick up some of the Nation's fastest growing utilities. The Plan should also consider financial assistance to State utility commissions to help them carry out the Plan's provisions more effectively.

Questions

1. Would the suggested reforms bring about a large enough decline in electricity growth rates and new capacity needs to justify the Plan's proposal for an unprecedented Federal intervention in a traditional State jurisdiction?
2. Is there an irreconcilable inconsistency, at least in some instances, between the goal of cost-based rates and the prohibition of declining block rates?
3. Is the legislation too rigid because it specifies the kinds of rates which must be offered—i.e,, time-of-day, seasonal, and interruptible?
4. Should Federal energy policy require that rates be based on marginal or incremental costs, which reflect the expense of providing additional generating capacity, rather than the "embedded" cost of existing capacity?
5. Does the Plan apply to enough utility systems across the country to provide maximum coverage and effectiveness ?

Background

The avowed purposes of the proposed utility rate reform measures are to encourage economic efficiency, reduce consumption of oil, natural gas, and other energy resources, ensure additional generating capacity, provide fair and reasonable rates, and prevent States that adopt such

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reforms from being at a competitive disadvantage with States that do not.

Current utility rates and practices do not necessarily discourage conservation and create demands for new capacity to the extent that mandatory federally imposed and enforced reforms are justified. The Administration's estimate of 1985 electricity demand under the Plan is only the equivalent of 800,000 barrels of oil per day lower than the demand would be without the Plan, but it is not clear how much of the projected reduction in demand would result from rate reform, It is possible that tampering with peak loads might simply create new peaks, without reducing new capacity needs. Questions have also been raised about the constitutionality of the proposed Federal role,

Residential customers who use relatively small amounts of electricity often are the most expensive customers to serve, due to requirements of meter installation and reading, bill collection and processing, connection and disconnection, and the ratio of transmission costs to usage. True "cost-based" rates must reflect these costs, yet the Plan proscribes rates which decline as consumption increases. In apparent recognition of a possible conflict, the Administration's draft bill adds the caveat, "to the maximum extent practicable, " to the mandate for cost-based rates. Yet there is no room for compromise in the proscription on declining block rates.

Utilities can be expected to recover the added costs of serving low-volume customers by imposing two-part billing systems consisting not only of an energy charge (a per-kilowatt-hour rate reflecting generating costs), but a "demand charge" (based on a customer's peak demand during the billing period, and reflecting capacity costs). Spreading demand charges over greater kilowatt-hour usage inevitably tends to reduce the unit cost of demand. This would appear to violate the requirement that the effective rate per kilowatt hour not be allowed to decline as usage increases. Spreading metering costs and other fixed customer costs over varying consumption levels poses the same problem.

This raises a question as to the wisdom of the extreme specificity of the rate-design requirements in the proposed Plan legislation. Greater flexibility of actual rate design, subject to review by the Administration for consistency with national policy goals, may be more productive.

To illustrate, the table below shows three rate options for a given situation. Rate No. 1 is the true apportionment of each customer's costs to the charge he pays, as mandated by the Plan. It is actually a declining effective rate. Rate No. 2 is a single flat-commodity rate which observes the Plan's prohibition on declining rates, but fails to reflect true costs of serving each customer. Rate No. 3, a traditional declining block rate, relieves the small user of part of his full cost, but still recovers from him more of his costs than does the flat-commodity rate. These examples suggest that greater flexibility in the specifics of rate-design judgments may be desirable.

Example:

	Customer A	Customer B	Customer C	Customer D
Monthly usage	250 kWh	500 kWh	750 kWh	1000 kWh
cost of service (in dollars)	37.50	45.00	52.50	60.00
Rate 1. Charge under 2-part rate Effective cost per kWh	37.50 15¢ per kWh	45.00 9¢ per kWh	52.50 7¢ per kWh	60.00 6¢ per kWh
Rate 2. Under flat single rate (7.8¢$ per kWh)	19.50	39.00	58.50	78.00
Rate 3. Under declining block rate (9¢ for first 500 kWh; (6¢ for next 500 kWh)	22.50	45.00	60.00	75.00

The blanket prohibition of declining block rates for natural gas utilities also should be reconsidered. As with electric utilities, it is not clear that prohibiting declining block rates for natural gas is consistent with the concept of basing rates on the actual cost of service. About 60 to 70 percent of the total revenues represent the cost of natural gas. The rest covers fixed costs and the cost of storage to meet winter peaks, Further, as a system's load factor declines, the fixed costs make up a higher percentage of the total revenues and the cost per unit of gas to the customer increases. Since small users (residential customers with high seasonal peaks) have the lowest load factor, the cost of servicing these customers per unit of gas is usually highest among all classes of customer. Current rate schedules are set to reflect these differences, although they may more than compensate, leading to subsidies of large volume users by small users. A flat rate would eliminate this subsidy, but probably would go too far and favor small users at the expense of large volume customers. A provision which permitted more flexible rate setting, perhaps determined after experimentation and on a regional basis, could eliminate the problem. Elimination of declining block rates within a given class, but not among consumer classes (i.e., residential, commercial, and industrial), would increase the incentive to conserve. A two-part rate schedule probably would be required, however, as in the case of electric utilities.

As a general proposition, time-of-use rates are effective in reducing peak demands, improving load factors, and reducing needs for additional generating capacity. However, there has been little actual experience with these rate devices to date, and it remains to be seen how effective they are in actually changing load patterns. Additional measures could be adopted to substantially increase their effectiveness. For example, a concerted Federal R&D effort in developing economical thermal-storage devices could eventually enable many more consumers to shift their use to off-peak periods. In addition, a vigorous public education campaign is a necessary part of any peak-load pricing scheme, Utilities must help customers adapt to new rate structures, for example, by showing them how to change their daily habits with regard to such uses as water heating and air-conditioning. Presumably, these would be part of a utility's conservation program.

There is some concern, too, that peak-load pricing could backfire in certain cases by creating new peaks. This could be a serious problem in summer-peaking areas where there is a rapid increase in electric heating. Care should be taken to design rates which do not encourage off-peak uses likely to create new peaks, It may be desirable, too, to test load-management options before mandating that they be offered.

Finally, it may be desirable for the legislation to go a step further, requiring that rates be based on marginal, or incremental, costs, which reflect the expense of providing additional generating capacity rather than the "embedded" cost of existing capacity. Under the Administration's draft legislation, customers who increase on-peak consumption pay historic costs for that increased use, even though the marginal cost of meeting those needs is much higher. Thus, the consumer has an economic incentive to use more electricity, even though conservation might be a considerably cheaper alternative under marginal cost pricing.

Dramatic and sudden price changes should be avoided; gradual changes will permit adjustments to be made in an orderly manner and, at the same time, provide appropriate signals for future prices. One means to achieve the same result as marginal pricing would be to include construction work-in-progress (CWIP) in the current rate base. Although this would result in slightly higher prices in the short term, price increases would be more gradual than with orthodox marginal cost pricing.

The utility regulatory proposals in the Plan and the draft legislation apply only to utility companies which sell more than 750 million kilowatt hours (kWh) per year. This excludes approximately 50 (out of 200) investor-owned companies and the majority of publicly and cooperative owned companies, but it does cover between 85 and 90 percent of the Nation's electricity generation. it contrasts with electric rate-reform legislation introduced in the House of Representatives earlier this year, which covers all companies selling over 200 million kWh annually. The extra administrative burden which would be imposed by the lower cutoff may be justifiable in order to cover some of the Nation's fastest-growing electricity companies, such as the rural electric cooperatives.

The Plan's electric-rate proposals do not include Federal financing aid for State utility commissions. The workload of these agencies is bound to increase as a result of these Federal requirements and most are already understaffed and underfunded. It is not likely that many State governments can afford to follow the proposed Federal regulatory policies. The Plan should provide Federal funding for State commissions to help cover the higher costs.

In sum, the Plan's rate proposals need refinement and added flexibility, but they can be effective tools for encouraging conservation,

Issue 17

The Impact of the Plan's Tax Proposals on Electric Utilities

The tax proposals of the National Energy Plan could affect electric utilities in ways which would be contrary to the Plan's long-range goals.

Summary

The Plan proposes a series of fuel taxes and tax credits which will affect electric utilities both directly and indirectly. These proposals may produce unintended consequences that would impede progress toward the Plan's overall goals. The most serious of these could arise from the consumption tax on oil and natural gas, which is intended to discourage the use of oil and natural gas to generate electricity. Since utility conversion schedules are fairly rigid, many utilities might choose to pay the tax on oil and gas rather than push construction projects to meet the conversion schedules. The Plan's tax proposals also may result in a temporary price advantage for homeowners who use oil and gas for home heating over those whose homes are heated with electricity. Owners of all-electric homes will not receive rebates under the Plan; in addition, they will be paying fuel taxes to the extent that the utility in their service area uses oil and natural gas. Finally, the question of whether electric utilities are entitled to tax credits for cogeneration and conservation technologies needs to be clarified.

Questions

1. What side effect will the oil and gas taxes on utilities create?
2. What effect will the crude oil equalization tax and rebate program have on the consumption of electricity and on utility load factors and expansion plans?
3. What effect will the proposed tax credits for energy conservation expenditures and solar expenditures have on utility load factors, peaks, and capacity needs?
4. Will utilities be eligible for the 10-percent business energy tax credit which the Plan proposes for cogeneration and other conservation measures? If not, will there be sufficient incentives for utilities to enter into cogeneration arrangements ?

Background

Utility Oil and Gas Consumption Tax and Rebate.—Beginning in 1983, utilities will be taxed for the oil and gas they use to generate electricity. The companies will be eligible for rebates of these taxes if they make investments in equipment needed to convert to coal or energy sources other than oil or gas. The tax/rebate combination is intended to provide both a penalty and an incentive, which together will induce a rapid shift of generating plants away from oil and gas. The essential question is whether these provisions will, in fact, accelerate such fuel conversions. There appears to be little or no flexibility on conversion schedules between now and 1983, and the tax and rebate proposal may have little effect on conversions even after that date. In fact, if the tax is imposed without a parallel mandate to stop using oil and natural gas, some utilities may choose to pay the tax and stretch out their conversion schedule. This becomes plausible when the impediments to conversion are considered. These include the long-lead times required for capital expansion planning; the uncertainties associated with complying with ambient air-quality standards; "best available technology" requirements; nondegradation policies; limits on the capacity of the mining industry to meet rapid increases in coal demand; and bottlenecks in the acquisition of boilers and other equipment needed for conversion to coal. In short, it may be both easier and cheaper, in many instances, for utilities to pay the tax and forgo the rebate rather than accelerate their conversion schedules. Although taxes can be rebated up to amounts equal to conversion costs, there can be no net financial gain. A more appropriate mechanism for accelerating conversion might be a direct requirement to meet conversion schedules, coupled with exemption from the user tax if the schedule is met.

Crude Oil and Equalization Tax and Rebates.—From a utility company standpoint, the major impact of the crude oil equalization tax is a sharp increase in the cost of fuel. This can be expected to dampen demand, but it also could cause economic hardship for all-electric residential customers. Because the Plan provides for means to keep residential costs of natural gas and heating oil lower than the industrial price, the lack of a similar price break for all-electric residential customers will be discriminatory to the extent that electricity is generated by oil and natural gas.

Tax Credits.—The portions of the bill that provide tax credits for homeowners who invest in conservation measures and/or solar facilities and for businesses that make similar investments, do not appear to affect utilities in major ways. There is a possibility that peak-load problems could be aggravated by extensive shifts to solar heating and heat pumps as a result of the tax credit incentives. Extremely cold weather could cause sudden increases in peak loads as heat pump and solar-unit owners switched to electric backup systems, It may be that specific incentives should be provided for heat pumps that use oil rather than electricity as a backup. Incentives also are probably needed for onsite storage systems that can provide energy when heat pumps and solar systems cannot bear the full load.

The tax credits for residential users who invest in nonsolar conservation measures apply only to houses built by April 20, 1977. Drafters of the National Energy Plan apparently felt that new construction standards would require investments in conservation measures, so there was no need for a reward in the form of a tax credit. However, there will be a time lag of 3 years before such standards must be adopted by the States. In the meantime, utility companies might be required to refuse service to new residences that lacked specified energy-conserving features.

The energy bill is unclear about whether the 10-percent business tax credit for cogeneration facilities could be taken by utilities for their portion of a cogeneration arrangement. It is not clear, in fact, whether the business energy tax credit applies to utilities at all. If utilities are ineligible because of the separate consumption tax rebate there may not be enough incentive for utilities to invest in cogeneration, combined-cycle plants, or other conservation measures.

Issue 18

Impacts of the Plan on the Gas Utility Industry

The pricing and regulatory provisions of the National Energy Plan regarding natural gas use will significantly alter the market for and operations of natural gas utilities.

Summary

The provisions of the Plan which discourage the use of natural gas by industry and electric utilities could lead to substantial shifts of natural gas to the high-priority, residential-commercial sector, provided moratoriums on new service are lifted. This appears to be an implied goal of the Plan, which states that natural gas supplies should be reserved for high-priority use. This shift, however, would decrease a gas utility's load factor and increase its storage requirements, which would, in turn, increase a customer's fixed charges. Prohibition of new hookups, however, would deter utilities from finding new supplies and encouraging conservation measures. The provision which permits large volume customers to be compensated if their supply contract is terminated will ease the burden of making the shift. However, not all industrial customers have entitlements to their gas supplies and customers who do not have entitlements will not be able to obtain compensation. Therefore, inequities

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would be created, possibly between direct competitors, which could be avoided with a more flexible compensation policy.

Background

The National Energy Plan contains provisions which are designed to decrease industrial and electric utility use of natural gas. The Plan dedicates the highest priced gas to industrial customers and requires that there can be no natural gas used as a utility boiler fuel after December 31, 1990. These proposals are designed to accelerate a shift away from gas that began 3 to 4 years ago. In some service areas, natural gas surpluses are forecast for the next few years. Because the lowest priced natural gas is reserved for high-priority users (residential and small commercial), there could be a substantial shift from the industrial and utility sector to the residential sector. This would take place if moratoriums against new hookups that occur in many service areas were lifted. Such a shift appears to be an implicit goal of the Plan, because it specifies that natural gas should be reserved for the highest priority customers who would have the most difficulty converting to alternative fuels.

There would be some difficulties with this shift, however. First, the greater the percentage of residential customers in a utility's load, the smaller the load factor. As the load factor decreases, the average cost per unit of gas to a customer rises because fixed charges represent a greater percentage of the total cost of servicing a customer. Therefore, as the shift occurs, residential customers will see increased bills if the utility is to maintain its financial health. Further, increased storage capacity would be needed to take care of the relatively higher winter peaks. This will also cause the customer's bill to rise. One method of reducing the problem would be to increase gas use in the summer with a higher air-conditioning load, preferably through efficient gas-fired heat pump/air-conditioner systems now under development. The benefits of doing this would have to be weighed against the increased use of gas that would be created.

Another path that may be taken by the utilities is to encourage industrial customers to keep using gas and pay the higher prices. Since most industrial customers appear to be more concerned with availability of natural gas than with the possibility that prices will rise to levels comparable to alternative fuels, they will be inclined to use gas if a utility can assure supply. This would benefit the utility since it would maintain their load factor and keep revenues steady.

The second situation is even more likely to occur if moratoriums are not lifted; utilities would otherwise face the prospect of losing surplus gas to regions where supplies are curtailed. If this occurs, it would deter utilities from finding new supplies and encouraging conservation. An aggressive conservation effort could free-up a substantial volume of gas in any given region. If a utility were forced to give up this new supply of gas to another region in short supply-even in an emergency situation—rather than sell it to new customers, the utility would have no reason to promote conservation programs. Therefore, if one of the purposes of the Plan is to shift as much gas as possible to the residential market, it appears that the moratorium on new hookups will have to be lifted.

One other provision in the Plan is involved in this issue. The proposal to permit customers who shift away from gas to sell their contract entitlements will ease the financial burden of making the conversion and will add to the industry's incentives to do so. But not all users can take advantage of this compensation because many customers do not have such contract entitlements. These cases usually occur with large gas utilities who offer "full service" to industrial customers and do not sell to them under specific sales contracts. Therefore, inequities will arise among firms which do and do not have these contract rights. In certain cases, such firms may be direct competitors and some could be placed at a severe competitive disadvantage. By permitting a more flexible compensation policy under which all customers would be compensated upon termination of the contract, this problem would be removed. This would require involvement of a gas utility in those cases where entitlements were not owned by the customer, with the consequence that the utility would probably have to receive some compensation too,

Issue 19

Electric and Natural Gas Utility Conservation Programs

The National Energy Plan's proposal to put utilities in the energy conservation business is a departure from present practice that raises legal, technical, and economic questions for which there are presently no answers.

Summary

The National Energy Plan's utility program may be an appropriate and effective means of insulating 90 percent of existing homes by 1985, although the goal probably is too optimistic. However, it is not clear that the utility conservation program is the only, or even the best, means of meeting the Plan's objective, The proposals raise several legal questions, including those of liability, restraint of trade, and fraud; the potential effects of the program on consumer interests and on the financial integrity of utilities are not clear; there could be adverse impacts on competing suppliers of conservation measures; and there is a possibility that a prescribed list of measures will stifle innovation.

Questions

1. Do the difficulties associated with making such a program mandatory for utilities outweigh the advantages, in light of other potential means of ac-

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complishing the goal of insulating or reinsulating 90 percent of existing homes?

2. Are State utility rate-making authorities to implement the conservation program?
3. How far will utility companies be required to go in pressing their conservation services on their customers?
4. How are utility companies to deal with potential legal problems arising from the program?
5. What are the financial implications of the program for the utility companies ?
6. What will be the criteria for determining whether a utility is offering its conservation services at "fair and reasonable prices and rates of interest" and is not engaging in "unfair, deceptive, or anticompetitive acts"?
7. Will utility programs have an adverse effect on existing businesses and on consumer interest?
8. Does the legislation take the proper approach in listing conservation measures to be included in the utility programs ?

Background

It is not clear that the utility program should be mandatory, in view of the fact that other means of conservation delivery and financing are available, including a voluntary utility program. The proposal to use convential lending institutions to finance weatherproofing projects also may present obstacles, including a general reluctance to make loans of less than $1,000, and the prohibition against refinancing mortgages that have been purchased by the secondary market. It does seem clear that adding financing and marketing of conservation devices to the traditional functions of utility companies is a break with past custom that should at least be preceded by careful analysis to determine whether the benefits are worth the difficulties.

The Plan and the draft legislation require utilities to offer conservation services to all customers, to inspect residential buildings, and to estimate the energy savings that can result from weatherproofing and other conservation measures. Customers are not required to accept an offer of such services. To meet the terms of the Plan, a utility must go well beyond its traditional relationship with residential customers-reading electric or gas meters and billing for services.

The change in relationship raises a number of legal issues. Does a utility's use of a particular product of the services of a contractor imply a warranty of products or services ? When a utility supplies its customers with lists of alternative financing and servicing options, does the implied warranty extend to these alternative sources? If a utility fails to list or recommend a particular source, does the installer or manufacturer have legal recourse against the utility company?

The draft legislation gives a proposed Secretary of Energy responsibility for determining whether utilities are charging fair prices and interest rates, or are engaging in anticompetitive practices, but the draft does not spell out criteria for these decisions. Presumably this will be done by rulemaking. It is not clear, however, whether uniform critiera can be applied to all utilities and/or al l states, since applicable laws vary widely. For example, does a Government determination of "fair and reasonable prices" imply price fixing, restraint of trade, and a potentially anticompetitive practice? Most States have delegated interest rate-setting (or at least ceiling-setting) authority to agencies that regulate financial institutions. Does the proposal create legal and economic conflicts? If so, how will they be resolved?

Under the Plan, a utility company's conservation program must be designed and administered as an integral part of the company's overall operations. How is capital to be raised? What will be the impact on a company's overall debt service, bond ratings, profit margin, and rate structure? How will the requirement to enter an essentially new line of business affect stockholders? These questions must be answered on an individual company basis. To do so, companies must have sufficient flexibility within the Federal and State requirements.

At present, approximately 75 percent of home insulation business is handled by building supply marketers or do-it-yourself retailers. The effect of a massive utility program on such businesses, and—to a lesser extent—on competing installers, could be severe. The "reasonable price" guideline proposed in the Plan will affect the competitive positions of existing installers and suppliers.

[t may be unwise to fix in law the conservation measures that may be taken under a mandatory program. While there is some flexibility built in (the Administrator can add to or subtract from the list by regulation, and there is to be variety in the "suggested measures" for different climates and construction categories), the very existence of a list may discourage development of new technologies. For example, is it wise to offer financing and installation of add-on devices for old furnaces but not to offer the same terms for purchases of new furnaces or heat pumps?

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Issue20

The Research and Development Role of the Electric Utilities

The tax and expense status of electric utility research and development (R&D) expenditures are not adequately addressed by the National Energy Plan.

Summary

The ninth principle of the National Energy Plan calls for large-scale conversion from oil and natural gas to more abundant energy resources, which for the short term to mid-term will be coal. However, the ability to use more coal will depend on the development of new technologies that allow coal to be burned in an environmentally safe and economically efficient manner. Thus, coal research and development in the private as well as the public sector ultimately will determine the degree to which utilities can reduce consumption of oil and natural gas. Consequently, it is important to clarify the tax and expense of the R&D expenditures of electric utilities so that their efforts can be maximized.

Questions

1. What is the appropriate role of the Federal Government in encouraging utility expenditures in R&D?
2. What is the Electric Power Research Institute (EPRI) role in meeting the R&D goals implied in the National Energy Plan?
3. Will the Internal Revenue Service (IRS) and State utility commissions continue to determine the tax and expense status of utility R&D expenditures?
4. IS it possible that under the National Energy Act certain R&D expenses could be construed as "promotional" expenses ?

Background

Under the terms of the Administration draft of the National Energy Act, no new electric powerplants would be permitted to use natural gas or petroleum as an energy source. By 1990, no utility would be permitted to burn natural gas. In order for electric utilities to be able to expand their use of coal to meet this schedule for phasing out oil and natural gas, a significant R&D effort will be needed, as the Plan points out.

Until 1973, when the Electric Power Research Institute (EPRI) was established, most R&D involving electric energy, including equipment and facilities, was performed by major equipment manufacturers. As a result, R&D costs were included in the price of equipment purchased. EPRI is currently funded by all major electric utilities, both investor owned and public, with a budget of $179,5 million for 1977. There are two schools of thought as to how R&D by utilities can best be accomplished. On the one hand, legislation could encourage electric utilities to continue, and even to increase, funding of R&D activities in both the energy supply and the energy utilization functions. Such legislation might provide that the Federal Power Commission (FPC) and State regulatory bodies stipulate that money spent either for funding EPRI or for individual utility R&D could automatically be incorporated into rate base and/or expenses, as appropriate, for determination of electricity rate levels. At present, rate base treatment of R&D expenditures is subject to approval on a case-by-case basis, although approval usually is automatic, at least by the FPC. Such legislation might also provide that R&D expenditures be considered as fully tax deductible and not be construed as "promotional" expenditures. Alternatively, there may be a need for Federal legislation to encourage increased utility expenditures for R&D since present arrangements may be insufficient.

In practically all cases, utility R&D expenditures are considered tax deductible by the Internal Revenue Service (IRS) and classed as operating expenses (rate base items) by the utility commissions, Yet, according to one interpretation of the National Energy Plan, the IRS or a public utility commission could disallow an R&D expenditure as a valid expense for tax or ratemaking purposes. Under the circumstances, consideration should be given to the appropriate role of Federal law in relation to the right of the IRS or the State utility commissions to determine whether certain expenses may properly be included for ratemaking or tax purposes.

Industry

Issue 21

Cogeneration By Industry

The Plan addresses the major problems inhibiting growth of cogeneration, although the proposals promoting cogeneration need to be more closely coordinated with coal conversion policies.

Summary

Considerations of energy conservation, environment, and economics offer strong incentives for the expansion of cogeneration of electricity and process steam by industry and utilities. The provisions in the Plan are both necessary and desirable to remove barriers to development of cogeneration. Some areas of concern remain, however, which could keep the Nation from realizing cogeneration's full potential. Principally, utility interest in cogeneration will probably be very limited for the next several years because planned expansion of generating capacity will meet or exceed demand. A policy promoting a rapid industrial shift away from oil and natural gas could reduce the long-term potential of cogeneration. To this end, there is a need to identify cogeneration opportunities and to monitor their progress in order to gauge the adequacy of the Plan as it addresses cogeneration. More information is also needed for specific site development.

In addition, enough flexibility in the coal conversion policy should be maintained so that the "cogeneration resource base" is preserved, and research and development should be accelerated on advanced technologies for coal-fired cogeneration.

Other proposals in the Plan will affect the cogeneration potential. The investment tax credit may be too small to encourage industry to invest because industrial firms generally pay higher financing costs than electric utilities. Taxes on oil and gas used in industry cogeneration will be about twice those for electric utilities, thus encouraging industry to buy power rather than to develop cogeneration. The Plan does not consider the problems of potential reductions in reliability that may result from adding several industrial generators to electric utility systems over which the utilities do not have complete control. In addition, the Plan does not answer the question of what constitutes a fair rate of return to the utilities on purchasing and wheeling cogenerated electric energy. Finally, strategies are needed for retrofit of cogeneration facilities. Although these are not insurmountable difficulties, they will slow up progress on cogeneration until they are resolved.

Questions

1. What is an appropriate level of electricity generated by cogeneration ?
2. Will the provisions of the Plan result in achieving that level?
3. How will progress in expanding cogeneration be measured?
4. Are the Plan's coal policies compatible with its cogeneration proposals?

Background

While it is reasonable to expect that an expansion of cogeneration will be in the public interest, the low rate of construction of new cogeneration facilities indicates that the practice is not always in the private interest.

There are a number of ways in which the existing energy system discriminates against cogeneration. Strongest of the barriers to cogeneration by industry, perhaps, are financial practices that favor supply of electricity by conventional utility systems. A utility has access to capital at lower rates than does a cogenerating industry. Industry must determine the cost of power from a new facility on marginal considerations. The price of utility power with which cogeneration must compete is determined from the average cost. Even the energy program contains subtle disincentives to cogeneration. The oil and gas consumption taxes of Sec. 1501 are about twice as high for industrial cogenerators as they are for electric utilities.

There are many considerations that make electric utilities wary of industry cogeneration. They are concerned that they may have to pay too high a price for cogenerated power, and that it will not always be available when needed. Further, utilities may be required either to make major additions to transmission grids to accommodate small blocks of cogenerated power or to sacrifice transmission capacity in serving this power. Unless a utility makes an investment in cogeneration equipment, it is not permitted under most State regulations to make any profit on the purchase and resale of cogenerated power,

Another concern is the effect cogeneration facilities will have on utility system reliability. The addition of many relatively small generating systems over which the utilities do not have complete control may magnify the problems of load flow and economic dispatch (mix of generators online). In this context, it may be appropriate to establish standards that the cogeneration supplier must meet when selling to a utility.

The proposed legislation contains a number of features which either remove obstacles to or provide incentives for the practice of cogeneration by industry. Sec. 521 enables any qualifying cogenerator to intertie with utility transmission facilities in order to sell surplus power and buy backup power at fair prices. In Sec. 522, qualifying cogenerators are assured fair rates in the above transactions; they receive exemptions from Federal and State public utility regulations. In Sec. 109, qualifying cogenerators could be exempted from oil and gas conversion in cases where exemption is necessary to stimulate construction of generators. Finally, it is proposed that cogeneration property purchases should be entitled to an additional 10-percent tax credit.

These provisions are felt to be necessary and desirable for the extension of cogeneration. They are not perceived to have significant adverse impacts on any sector of the economy or the society. The principal concern with the proposals, in fact, is that a credit considerably higher than 10 percent probably would be needed to motivate potential industrial cogenerators to construct such facilities. Consideration should also be given to determining new criteria for rates utilities can charge for resale of cogenerated power.

There are other aspects of the energy plan which motivate cogeneration. Preeminent is the increased cost of energy to the industrial user as a result of price increases and taxation, which should make the price of cogenerated electricity attractive. In an indirect fashion, the conversion to coal also offers an incentive. The technical complexity of burning coal as compared with gas or oil makes a shift to more complex cogeneration relatively less formidable. The proposals to promote industrial conversion to coal, however, also create a potential impediment to the long-term development of cogeneration. This can be seen in the following context:

Demand for new cogeneration capacity will probably not develop on a large scale before 1985 because there is a possibility of excess central station generating capacity. In 1975, the average utility reserve margin was 35 percent. Excess reserve margin will not drop to the 15 to 20 percent range, which utilities prefer, before the mid-1980's if electricity demand grows at the average rate of 5.8 percent per year in this period and present plant construction schedules are maintained. The Plan envisions growth at 4 percent per year, however, leading to the possibility of an even longer period of excess reserve capacity unless many plants presently under construction are cancelled or deferred or demand grows more rapidly than expected. Therefore utility interest in cogeneration projects will be minimal for some time. Also, if a shift of industrial boilers to coal is made too rapidly, a con-

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siderable fraction of the long-term potential savings from cogeneration may be lost. If they are forced to shift to coal before advanced coal technologies are commercially available and while there is a national excess of generating capacity, many firms will be unable to work out satisfactory agreements with utilities for the sale of excess power generated onsite or for the purchase of backup power. In that case, they may either install low-pressure, coal-fired boilers (that cannot be converted for cogeneration) or they may install steam turbine cogeneration systems (which can produce only a fraction of the electricity for a given steam load that a combustion-turbine system could). In either case the maximum cogeneration potential would not be achieved for many years. If industry should convert steam functions to electricity (e.g., steam drives to electric motors) rather than install coal-fired boilers-as now seems likely in cases where this is an option—the cogeneration potential also could be reduced because the excess capacity might then be used to meet the added industrial electricity demand. If industrial conversion to electricity were great enough to use up the excess capacity rapidly, cogeneration could become very attractive to utilities because additional capacity could be put online relatively fast. This would most likely occur if industrial energy growth equal led the Plan's projected rate of 4.6 percent.

Under these circumstances, consideration should be given to scheduling coal conversion with enough flexibility to permit the introduction of coal-fired combustion turbines when fluidized-bed combusters are perfected and commercialized. This would need to be coupled with a research and development policy, as suggested by the plan, to accelerate the development of advanced coal-combustion techniques. The important point is to not lock out technologies that would have a much greater potential for long-term energy savings.

To facilitate this, provisions for identifying and monitoring cogeneration opportunities, as long as they exist, should be made. This would also greatly enhance the energy program by providing the most valid test of the adequacy of cogeneration provisions. This record could provide information long before the actual plants went into service, Since the information is site specific it would probably be best compiled at the State or local level. California electric utilities are implementing such a program for the State government.

The requirements of cogeneration in new facilities compared with those in a retrofit situation are not explicitly treated in the energy program. Incentives which are adequate to induce cogeneration in the first situation will fall far short of those required for retrofit. It is safe to say that the energy program will produce no retrofit cogeneration except where existing facilities are being scrapped and replaced for reasons other than cogeneration.

Issue 22

Industrial Conversion From Oil and Gas

The Plan does not propose methods to remove the principal constraints on conversion of industrial processes to direct use of coal.

Summary

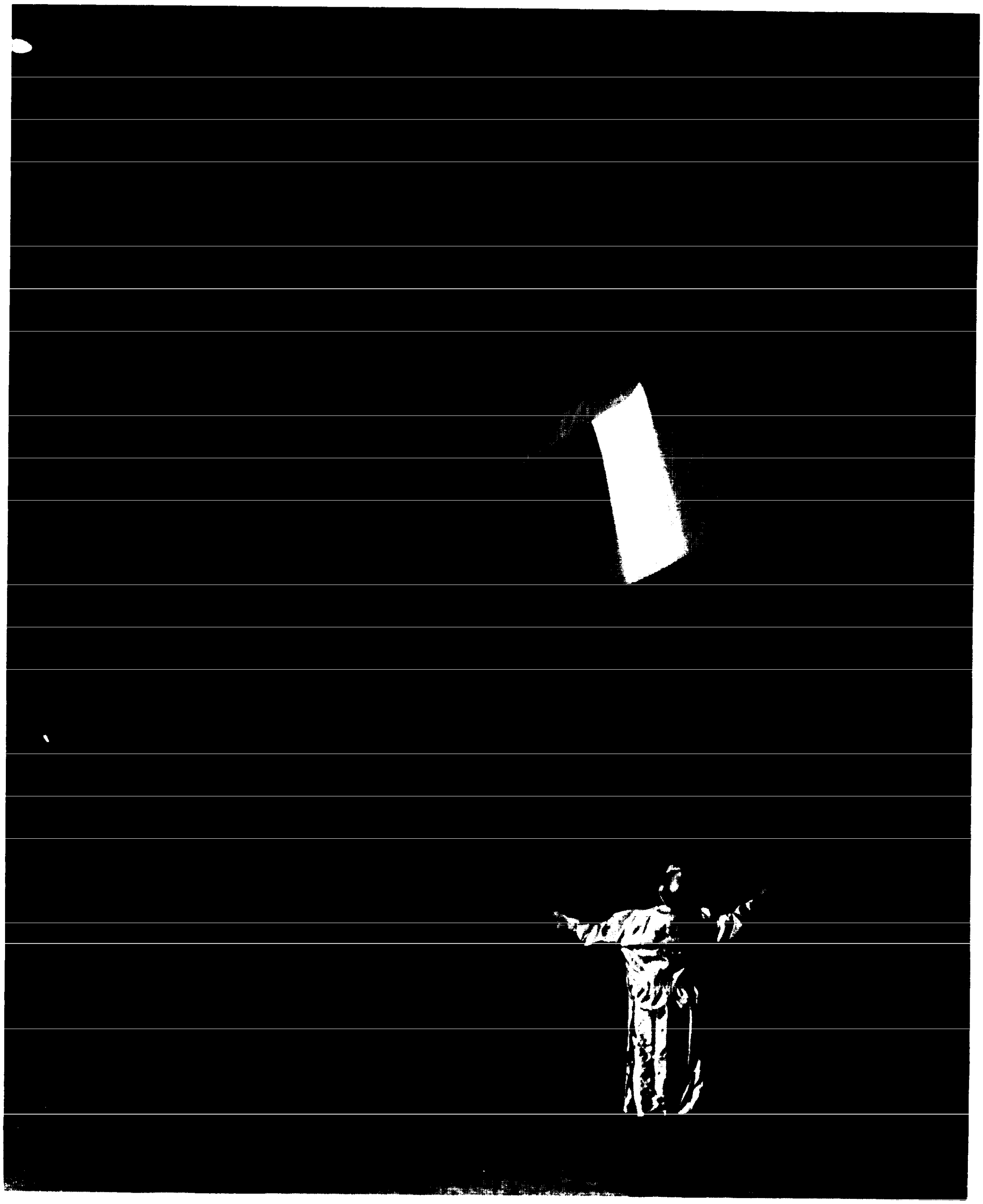
The Plan does not recognize that increased industrial demand for coal is incompatible with presently available means of distributing and marketing coal. As a consequence, industry may well convert to electrified processes where possible, and export the coal-handling problems to the electric utilities. This will be particularly true when direct heat equipment must be converted but it also could involve replacing some steam functions with electricity (e.g., steam drives with electric motors). Although apparently not the objective of the Plan, the direct use of electricity in this manner could be desirable because of the relatively low efficiency of direct combustion of coal in many process applications. In this context the plan should emphasize support by the Federal Government for scientific and technological innovation leading to the development of effective electrified processes. The Plan does not appear to adequately take into consideration the consequences of failing to meet the planned conversion goals, and it should contain specified programs for midcourse corrections. Finally, the Plan touches only lightly on the feasibility of the industrial use of solar energy, fuel wood, and burning of refuse to reduce industry's dependence on oil and natural gas.

Background

The Energy Plan relies heavily upon an increase in demand for coal among present industrial consumers of oil and gas. However, the plan omits specific incentives for production of coal and for development of systems for coal transportation and marketing to industrial users. At present, the most effective means for transporting and marketing of coal is in large-volume shipments of more than 100,000 tons per year in unit trains or on barges. Coal slurry pipelines may offer another effective means of transporting coal in volume. However, the large-scale systems for coal slurry transport have not yet been built, and it is questionable whether a large coal pipeline network can be built within the next 7 years.

By contrast, the market for coal that would be created by industrial users switching from oil and gas consists of a large number of widely dispersed installations, each of which can consume only relatively small amounts of coal. Therefore, the market would be incompatible with the present system of distributing coal.

The disparity is important. For example, unit-train and other volume shipments of coal become justifiable at about 600,000 tons per year and become economically attractive at about one million tons per year, but a typical large-scale industrial facility can consume only about 80,000 tons per



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year; a very large industrial boiler plant may be able to consume as much as 130,000 tons per year. The Administration draft of the National Energy Act defines major fuel-burning facilities as those using 100 million Btu's or more per hour and places the oil- and gas-user tax on facilities using 500 million Btu or more per year. These lower limits correspond to about 25,000 tons of coal per year. By comparison, a 500 megawatt coal-fired powerplant operating at 10,000 Btu per kilowatt hour would use about 1.7 million tons of coal per year. Coal transportation and marketing systems on the smaller scale envisioned by the Plan once existed but were abandoned when industry switched to oil and natural gas, and the present system has been developed primarily for utility markets. To accommodate the Plan, industries might be relocated so as to concentrate the demand for coal to utilize present transportation and marketing systems. This is not possible within the period covered by the Plan. A system of coal transportation and marketing might be developed to serve the industrial market as it is presently constituted, but this would require new coal retailing facilities to handle vastly increased volumes of coal shipments in urban areas where most of the industrial market exists. It is rather unlikely that this could be done before 1985. Even if either course of action were possible, they might increase the costs of using coal to the point at which using electricity would be less expensive. Coal costs would also increase because conversion would require coal combustion equipment not now commercially available and pollution-control equipment to meet environmental standards.

A third alternative is to use existing distribution systems to deliver coal to central facilities where it could be converted to forms of energy suitable for the industrial market. One possibility is to convert coal to high-Btu gas and distribute it by pipeline. But the present costs of high-Btu gasification of coal are so high that industry probably would not help finance gasification -plant construction and it is therefore very doubtful that high-Btu gas can play any significant role in reducing industrial consumption of oil and gas by 1985.

Low-Btu gasification has limited applicability because low-Btu gas cannot be piped more than 30 miles and still be competitive in price. Thus the same storage, coal handling and delivery, and environmental constraints that exist for direct burning of coal by industry apply as well to low-Btu gas.

One final alternative is to convert coal to electricity in large utility plants and to use the electricity for industrial processes that now depend on direct combustion of oil and gas. Because of the barriers to direct use of coal, industries that abandon use of oil and natural gas will probably turn to electricity. Because such a decision would require a substantial investment in facilities to replace existing oil and gas combustion equipment, a conversion to electricity would mean that industrial processes would not be changed again for many years. It is important to note, however, that the use of electricity rather than direct-coal firing would not necessarily be wasteful. First, electricity would not be used to produce steam in large boilers but to replace the functions of the steam, such as using electric motors rather than mechanical steam drives. For direct-heat applications, most coal-fired processes operate with end-use efficiencies of around 33 percent. Since the end-use efficiency of electricity when used for direct heat is nearly 100 percent, the difference is sufficient to compensate for the conversion losses at the powerplant. Further, it may be possible to develop electrochemical processes that would use even less total energy.

If the goals of conversion in the Plan are to be met without compromising conservation goals, a major research effort is required on the science and technology of industrial processes, with a strong emphasis on electrified processes to replace those which now rely on direct combustion of oil and gas. This would be most effective if the Plan were to include support of basic scientific research, support of critical demonstration programs, and Government leadership through its own research programs and purchases of effective electrified processes.

Furthermore, the plans for conversion depend on the feasibility of modifying industrial processes so that they may use the energy from coal as indicated above. If for any number of economic, technical, or environmental reasons the modifications cannot proceed within the time frame of the Plan, then the national energy policy should contain specific programs for midcourse correct ions.

Finally, a more aggressive approach toward other means of conversion away from the use of oil and gas such as solar energy, burning of refuse, industrial wastes, and fuel wood, and other energy sources should be embodied in the Plan. Greater incentives than those presently proposed would most likely substantially speedup industry's use of solar energy.

Issue 23

The Industrial Conservation Investment Tax Credit

The investment tax credit designed to provide incentives for industrial conservation technology may be too small and too restricted in scope to do an effective job.

Summary

The National Energy Plan recognizes the legitimate need to stimulate industrial investment in energy efficiency and to reduce the disparity between the regulated rate of return on an electric utility's investment in new energy supply and the rate of return on industrial capital investment.

The latter, along with the difference in returns on investment that an industry requires on cost-reduction measures compared to those it expects from plant expansion measures, are significantly greater than 10 percent. The proposed tax credit, even in conjunction with the existing 10-percent tax credit, appears to be too small to have a significant impact on industry investment decisions. Designating specific items that qualify for the credit, as the Plan does, might discourage innovation which could increase efficiency or even eliminate the use of energy for a particular process. A more general qualification for the credit would be more appropriate. No distinction is made in the Plan between investments that produce large efficiency gains and those that yield small gains, and consideration should be given to developing a performance indicator on which to base a sliding scale of credits.

Background

The disparity between rates of return for various energy-related investments are such as to discriminate against energy conservation investments. Industry generally expects a higher rate of return on investments in cost-savings measures (such as energy conservation) than on investments in plant expansion or in other measures to increase productivity. In addition, regulated rates of return for utilities that invest in energy-supply facilities are at least so percent below rates available to industry for measures to reduce demand.

The investment tax credit proposal attempts to address differences in these rates. In its investment decisions, industry generally requires a 1 5-percent or larger rate of return after tax, while a utility is regulated at roughly 10 percent. Thus, decisions to build new powerplants, for example, are made with something closer to a 33-percent advantage over industrial investments, such as conversion and cogeneration, than a 10-percent advantage. The investment disparity is less for oil and gas, but those fuels are not considered as replacements, whereas electricity is.

Industry also appears to require a higher rate of return on investments that increase energy efficiency and reduce costs than for those that increase product output. The latter is perceived as most crucial for a company in order to maintain its competitive position. At least a 25-percent rate of return is generally required for conservation investments compared to about 15 percent for "production" investments. These large differentials are not reduced significantly by the 10-percent tax credit, even though it is added to the present 10-percent investment tax credit. At most, it appears that the proposed conservation credit will accelerate decisions to invest in conservation by only a few months.

it is likely that designating a specific list of qualifying investments, such as those listed in part C of the Administration draft of the National Energy Act, would foreclose many options for conservation. Innovation for increasing efficiency or outright elimination of energy use is discouraged because true breakthroughs in the future are not likely to be considered in a specific list drawn up today. At a minimum, procedures should be included in the Plan that allow new items to be added without delay, It is also important that investment in new processes or systems be included in the tax-credit provision, since the potential for energy savings is very substantial. If a general performance indicator could be developed on which to base the tax credit, many of these concerns could be eliminated. The tax credit also could be graduated to match absolute levels of efficiency achieved by investments in conservation measures.

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Issue 24

Oil and Natural Gas Price and User Tax Provisions

price and tax provisions designed to promote industry energy conservation and the use of coal probably will succeed in the long run, although industry decisions will not be uniformly affected by the Plan's pricing proposals.

Summary

The Plan establishes a number of price and tax provisions which would increase the price industrial users pay for oil, natural gas, and electricity. The prime purpose is to achieve a substantial reduction in use of oil and natural gas by encouraging more efficient use of energy and an expanded use of more abundant energy sources. These measures will serve this purpose over the long run. However, distortions will appear along the way because the proposals do not uniformly achieve replacement costs for all energy sources. The Plan is likely to achieve its goal with oil, but to be only partially successful with natural gas and less so with electricity. As a result, economic waste of energy may well continue, although on a smaller scale than at present.

There will be adverse impacts on industry as production costs rise with increasing energy costs. These impacts will vary regionally and by size and type of the industry. In addition, severe problems for gas utilities could arise, depending on the rate at which industry reduces its demand for natural gas. The application of oil and gas taxes to industry 4 years before they are applied to electric utilities could result in an inefficient allocation of resources to boiler conversion or the selling of such facilities to utilities to avoid the tax. Finally, the tax and price provisions should provide a strong stimulus to innovation in developing more energy-efficient industrial processes and equipment.

Questions

1. What portion of the Plan's goal of a 6 million to 7 million barrel a day reduction in imports can be traced to the oil pricing provisions? Is the provision a cost-effective means of achieving the goal ?
2. What are the impacts of the oil pricing provisions on competition in the industrial sector (especially with regard to smaller companies)?
3. Have the regional effects of the gas pricing provisions on industry been considered ?
4. Has switching to No. 2 oil as an alternative to industrial gas use been considered as a transition phase in the conversion to coal?
5. In general, do the industrial oil and gas user tax provisions contradict the Plan's stated principle of equity?

Background

Oil Pricing Provisions.—The National Energy Plan retains price controls on oil as long as world oil prices remain "subject to arbitrary control, and domestic supplies are insufficient to meet domestic needs. " Thus, as established under the Energy Policy and Conservation Act of 1975, current lower- and upper-tier price ceilings of $5.25 and $11.28/bbl. are retained for producers selling previously discovered oil. The producer's selling price of newly discovered oil would rise over a 3-year period to the 1977 world price, adjusted for inflation, and would increase each year after 1980 to keep pace with general domestic inflation rates.

The results of these provisions would be to raise the price of oil products by the same absolute amount as the rise in crude price (i.e., a $1 per barrel rise in crude price would increase the price of each product by $1 a barrel). Demand elasticity would presumably result in reduced consumption in industry at a rate determined by the ability of a particular industry to pass on the oil cost increase in the price of its product or products, the ability to convert from oil, the ability to institute conservation and the degree of that conservation, and the degree of competitive advantage that would be gained through conversion and/or conservation. The latter, in turn, depends on the relative prices of alternative energy sources, the cost of conversion and conservation, and energy costs in that industry as a percent of total costs.

The effectiveness of these provisions can be measured against the goal of reducing oil imports, It should be kept in mind that industry is not a particularly large user of oil products. In 1975, for example, it consumed only 7.4 percent of No. 2 oil and 18,2 percent of No. 6 oil. Moreover, the relationship of the increase in the oil price, and its effect on industrial use, to the goal of a 6 million to 7 million barrel daily reduction in imports is not clear. There will be some positive response, however, because demand will be reduced through increased use of conservation technologies and conversion to less expensive, more abundant energy sources.

These provisions could have adverse impacts on industry. Competition could be lessened in some industries if smaller, marginal firms who do not have the financial resources to conserve energy or pay the higher prices were forced to close. The proposals would also have different effects in different regions, with consequent disruptions, owing to regional differences in industrial fuel mix. By raising energy costs to industry, the Plan would make imported goods from areas where producers have access to cheaper energy relatively cheaper than domestic goods.

Although a tradeoff of these impacts normally would occur in determining the cost effectiveness of an oil price increase, it should be noted that fuel prices are likely to climb sharply with or without the Plan. Therefore, the real question is whether or not the strategies proposed in the Plan will reduce the potential disruption as the United States makes a transition to more abundant energy sources and more efficient use of all energy.

The effect of the oil price increase on technological innovation should be positive. By forcing industry to conserve and switch to more abundant fuels, the Plan would improve opportunities for the introduction and adoption of new technologies.

Natural Gas Pricing Provisions.—The proposed natural gas policy would remove the interstate-intrastate distinction from "new" gas. All new gas would be subject to a "price limitation at the Btu equivalent of the average refiner acquisition price (without tax) of all domestic crude oil. " A price limitation of about $1.75 per thousand. cubic feet (Mcf) is established at the beginning of 1978.

Initially, new gas would cost $1.75 per Mcf, which is equivalent to crude oil at $9.43 per barrel. Flowing natural gas would be guaranteed at its present price and be allowed to move up to $1.42 per Mcf upon expiration of existing contracts. The highest-priced gas in this mixture would be dedicated to industries and electric utilities. The results of these provisions would be to raise the price of gas to industry by an amount determined by the mix of new gas, old gas, and gas from high-cost supplemental sources, The natural gas pricing proposals, however, do not move as far toward meeting the "replacement cost" principle as do the proposals for oil. Although "replacement price" to industry is not defined as precisely for natural gas as it is for oil, it would seem to be at least as much as the Btu equivalent for oil.

The goal of the natural gas proposals is to reduce industrial use of gas through increased conservation and conversion to other energy sources, a change that already is taking place because of curtailments in industrial natural gas supply. The price and tax provisions in the Plan will undoubtedly accelerate the trend. However, certain uses of gas cannot be replaced by alternative fuels as easily as others. Although technically there are no irreplaceable uses of gas, there are those which would be far more costly to replace than others. A consequence of this would be to increase the attractiveness of No. 2 fuel oil, even though it may be a higher-cost fuel, because it is the principal substitute fuel for natural gas. In addition, industry would be affected by the pricing proposals in much the same way as described above for oil. Regional effects would tend to be greater because of a greater disparity in regional use of gas by industry relative to regional disparity in oil use.

The effect on technological innovation would be positive, for the same reasons that are true for oil.

Oil- and Gas-User Tax Provisions.—Under Sec. 1501 of the Administration draft of the National Energy Act, a consumption tax would be imposed on industrial use of petroleum and natural gas beginning in 1979. The tax on electric utility use of the fuels does not begin until calendar year 1983. **Ultimately, the tax rate to industry will be twice that** for electric utilities. The user tax attempts to pull oil and natural gas prices into equivalence for industrial users, but this will not take place immediately and is limited to the largest industrial users.

The tax on oil and gas use in addition to oil equalization taxes would mean large total increases in prices for industry. As noted, this should accelerate the shift in industry from gas to electricity, coal, or No. **2** fuel oil, depending on the process undergoing conversion and the availability of coal and fuel oil.

There are several possible consequences of the differing rates and time schedules for taxing electric utilities and industry. The principal reason given for these differences is that utility boilers, being larger, are more difficult to replace than industrial boilers. Limited resources for boiler and stack-gas scrubber fabrication may be used to convert smaller industrial facilities, rather than large utility boilers, thereby adding to the constraints on expanding the Nation's use of coal. This problem would be reduced to the extent that industry converts steam functions to electricity. Industry might also sell some of its steam-generating facilities to electric utilities to avoid the tax. These two possibilities alone suggest that the way the tax provisions are applied differently to industry and electric utilities should be reexamined.

Finally, the oil- and gas-user tax would increase incentives for technological innovation since it would stimulate investigation of ways to reduce or eliminate the use of natural gas and oil.

Utility Rates.—The combination of flatter rates and peak-load pricing as outlined in the National Energy Act (Sees. 512-51 7), would raise electric rates to industry. The effect on demand would be mixed. In the short term, the response would be small because the present pattern of industrial use of electricity shows a high load factor and rather low elasticity. In the long term, however, there would be greater response through improved efficiency in new furnaces and electrolytic processes. New design could allow a peak-load response with furnaces that could be turned on and off daily. This would have an adverse impact on utility load factor because industrial loads would become more cyclical. The efficiency of electricity use would increase, however, because furnaces could be shut down when not in use, which is not now common practice. The impact on industry in terms of higher energy prices would be the same as for oil and natural gas. With the exception of centers of aluminum production, however, these would be fewer regional differences.

It should be noted that while these proposals may permit electric rates to approach replacement costs, the differences between replacement cost of electricity and embedded costs are substantial, not because of fuel costs, but because new plant costs have escalated in recent years. This should be recognized in the Plan since it may inhibit industrial investments in more efficient electric processes and equipment in the short run and encourage the uneconomical use of electricity. The proposed user tax on oil and gas may aggravate this problem since there is no comparable tax on electricity no matter how it is generated. Somehow, the replacement costs of electricity must be apparent to the consumer if the utility rate proposals are to be most effective.

With regard to natural gas, the proposal for cost-based gas utility rates is in keeping with the replacement cost principle. Regardless of wellhead prices, if the costs of new gas are not somehow reflected in the rates to consumers, rather than as an average of all gas prices, decisionmaking will differ between consumers and producers. In this proposal, the Plan seems to recognize the need to maintain State and regional cost differences in rates.

The influence on technological innovation would be especially strong as there are large opportunities for efficiency improvement through the development of electrochemical processes to replace many thermal-chemical processes now in use. These considerations apply in a similar manner with regard to natural gas rate measures,

Issue 25

The Effect of the Oil and Gas Use Tax on Petrochemical Feedstocks

The tax on oil and natural gas for industries that use those fuels as feedstocks for petrochemicals other than ammonia and fertilizer could put these industries at a competitive disadvantage in the world market.

Summary

The National Energy Plan recognizes a need to maintain a healthy economy and high levels of employment. Moreover, one of the policy principles set forth is for an equitable solution to energy problems in all sectors of the economy. However, by taxing oil and gas used as raw materials as well as for fuels, a selected few industries are disproportionately burdened. The objective of the tax, to stimulate conversion to coal, cannot be practically achieved by the petrochemical industry with available technology. The affected industries will be put at a competitive disadvantage in world markets, and their domestic growth rate will be slowed.

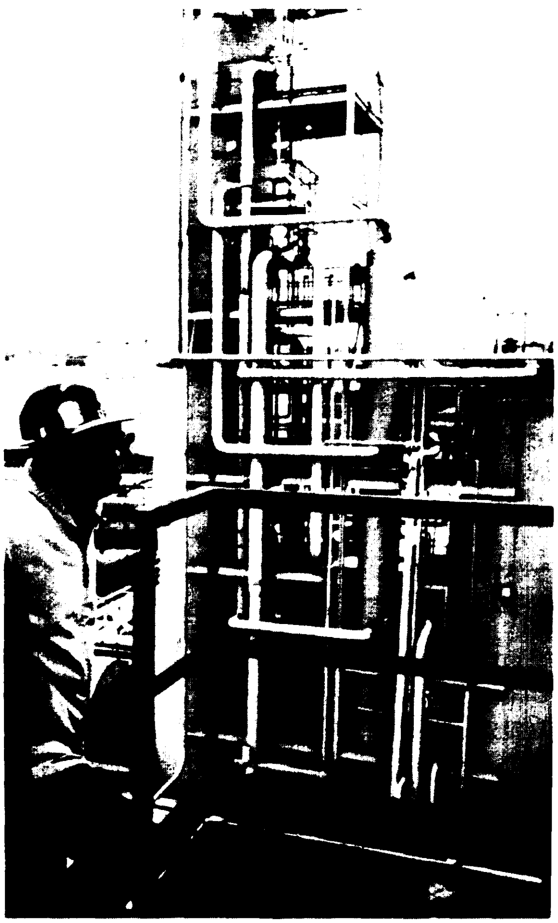
Questions

1. What is the justification for a tax on oil and gas that are used as raw materials?

2. If conversion to coal as a raw material for industries using oil and gas as feedstocks is not technically feasible, what will be accomplished through these taxes with regard to feedstocks?

Background

A consequence of oil and gas consumption tax for industry s that all industry must share the burden of increased costs for oil and gas used as fuel . In addition, many industries will experience a small incremental increase in raw material costs due to the increased costs of oil and gas used in the production of their raw materials. A selected few industries, however, will be disproportionately burdened because they will have to pay the full tax on their raw materials (oil and gas).



Federal Energy Administration Photo

The tax may encourage the use of coal rather than oil or natural gas in many large boilers and some reduction in the use of oil and gas may be possible for process heat or steam. However, no technology is available that will permit industries which use oil and gas for feedstocks to use coal as a raw material, nor is such technology likely to be developed before 1985-90.

in effect, these industries not only will be doubly taxed-once for their industrial fuels and once for their raw materials-but they cannot escape the double tax because they must continue to use oil and gas to manufacture their products.

Prior to the introduction of the National Energy Plan, projections were for a petrochemical growth rate that would double the demand for oil and gas feedstock over the 1975-85 decade. If the cost of feedstocks rises, the growth rate of the industry is likely to decline. Because the tax is to be imposed on top of a world price for oil and gas, the affected industries will be at a competitive disadvantage in the world market.

The Plan recognizes these problems and provides exemptions for oil and gas used as feedstock in the manufacture of ammonia and fertilizer. There does not appear to be any good reason why the same exemption should not apply to all users of energy materials for feedstock.

Issue 26

Federal Leadership in Industrial Energy Conservation

The Plan should place greater emphasis on the leadership role the Federal Government can play in encouraging industrial energy conservation and innovation by the private sector in developing conservation technologies.

Summary

There are four areas where Federal encouragement and action could provide significant incentives to more efficient use of energy in industry. Federal leadership could:

- take advantage of industry's unique capacity for innovation to adapt to new circumstances, if it led to an attractive investment climate for industry in new conservation ideas;
- emphasize long-range research and development efforts in the basic technology and science of industrial processes;
- demonstrate, through equipment purchase, production contracts, and research grants, that energy efficiency is a prime consideration;
- provide Federal grants' and/or loans to the Nation's universities and technical schools to train engineers in conservation techniques.

Background

The Plan calls for fundamental alterations in energy use, which generally emphasize conservation. The alterations entail both changes in the form and quantity of energy to be used. These alterations probably will be accompanied by intense activity to exploit opportunities to optimize them. This will take place, in large measure, through the efforts of individual inventors, innovative firms, entrepreneurs, research and development organizations, and others in the private sector. The effort will probably concentrate on total systems and processes rather than individual items of equipment, process steps, or unit processes.

The capacity of industry to adapt to new circumstances through innovation, scientific progress, and other measures is not adequately recognized by the National Energy Plan. In fact, the only explicit mention of innovation in the Plan is in connection with development of nonconventional sources of energy. The Plan should recognize that industrial innovation in the use of energy can be at least as important as innovation in development of nonconventional sources. For example, the Plan's listing of conservation devices that would quality for special tax credits may well direct industrial efforts toward installing these devices or improving the performance of existing equipment when the most effective step might be to adopt new processes that offer much greater overall improvements in performance.

In dealing with innovation, the Government should recognize that despite the many formal computer-assisted techniques for risk analysis in use today, risk-taking and progress generally result from sharp conflicts of opinion. The existence of such conflict is healthy and should be maintained. It is the process through which basic assumptions are tested. Government must draw upon private initiative and private commitment of resources if it is to foster progress toward solving energy problems.

The Plan also should recognize the need for long-range R&D in the basic technology and science of industrial processes instead of just focusing on demonstrations of nearly marketable technology. The tests of "relevance" and economic justification presently employed for R&D projects do not recognize that the most important results of research often are related only indirectly to the original expectations, and motives, of investigators. Those projects that can pass rigorous tests of justification or "relevance" do not represent the really venturesome investigations from which progress comes, or that reflect the popular expectations of research. In related efforts, the Plan should incorporate specific measures to elicit wide-ranging innovative contributions toward improved energy use and improved processes through direct Government financing of R&D and its use of its powers to affect the climate for private investment in R&D.

Through direct purchase of industrial-process equipment, the purchase of manufactured products, and the sponsorship of research and development programs, the Federal Government can influence the extent to which energy efficiency is taken into account in developing and using industrial equipment. Similar actions have occurred in the past. For example, numerically controlled machinery processes, which are used extensively in U.S. manufacturing, were brought into being by early efforts of the Defense Department to fabricate advanced defense systems. In another example, a large part of the capital stock of the aircraft and shipbuilding industries is owned by the Federal Government. Opportunity exists here to influence the development of more efficient process equipment.

Finally, there is a need for engineers with special capabilities in various aspects of industrial energy conservation. This does not necessarily mean that more engineers are needed, but that those who are trained in the plant and process areas should be taught to identify and implement conservation opportunities. The problem is essentially one of disseminating information bringing practicing engineers up to date in the current methods available to design improved processes, to instrument production lines, and to use computer simulation.

Although the National Energy Plan does not take note of this possibility, a series of short courses could be developed by universities or not-for-profit organizations, handbooks could be written to bring together the best current design techniques, and numeric data could be published in convenient forms for practical use at relatively small cost to the Government, Some significant efforts have already been made in this direction by the Federal Energy Administration, the Energy Research and Development Administration, and the Department of Commerce, but an expanded effort could help the industrial sector, particularly in small businesses which have limited technical staff to help improve existing practices.

VI. Societal Impacts

Societal Impacts

Societal Impacts Overview and Findings

In addition to influencing energy supply and demand, the National Energy Plan will affect, directly or indirectly, immediately or eventually, most aspects of life in the United States. Although some of the individual impacts are clear, the net effect of the Plan on particular regions or income groups or sectors of the economy cannot be predicted with certainty. Moreover, all the elements of the impact equation are not present: some measures for mitigating adverse impacts are not discussed in the Plan, e.g., in the case of regional impacts. As in any major policy shift, risk and uncertainty exist and this must be recognized, although alternative policies to deal with these risks could be formulated.

The indicated effects of the Plan on the overall economy and employment are likely to be minor but adverse, but these costs appear small compared to the cost of increasing reliance on foreign energy sources.— The basic energy choice to be made is between a series of immediate actions that may result in an economic slowdown which the Nation can endure, and a failure to act at all, which would lead to a major economic disruption in the future.

Even though the effects of the Plan on the overall economy are likely to be small, certain regions, sectors of the economy, and income groups could be more seriously affected, either by the provisions of the Plan itself, or by the failure of the Plan to redress adverse impacts resulting from the general energy situation as has developed since 1973. The Plan may not fully cushion lower-income persons from the effects of rising energy prices, although the general effect on income distribution should be progressive. Although no plan should be expected to foresee and offset all inequities, the National Energy Plan could usefully include a program to monitor its equity effects and those of the general energy situation, and a mechanism for proposing programs to redress inequities.

A number of participants in the analysis felt that a discussion of energy-related market structure, in particular horizontal divestiture, would be useful. However, OTA, in review, concluded that it did not have the materials in hand to do an analysis in enough detail to be a useful contribution to the debate in Congress.

it is unlikely that the strong measures necessary to meet the environmental goals of the Plan are compatible with a substantial increase in the use of coal on the schedule proposed in the Plan.— A deliberate choice between increased use of coal and air-quality goals will probably have to be made in the short run, at least in some regions. Moreover, emphasis on immediate, accelerated use of coal may foreclose some more acceptable, longer-range coal uses and other energy technologies. Even if air quality could be protected during the coal-conversion program, there are a number of other adverse environmental and social impacts of increased coal production and use that are not addressed in the Plan. These range from water pollution, to mining safety, to transportation impacts.

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The Plan does not provide enough emphasis on health research.— Health impacts are especially uncertain for coal and other fossil-fuel technologies because health research in these areas has been more limited than the research on the effects of ionizing radiation. Questions of thresholds and synergisms are of especial importance to a thorough understanding of health effects from all energy technologies. Possible long-term health effects from coal gasification and liquefaction are of particular concern. There is an urgent need for a comprehensive and comparative assessment of the health effects of energy supply systems and for an environmental monitoring system to provide an early warning of unanticipated environmental problems. Research also is needed on the possible adverse effects of tight insulation on the indoor environment, and on outdoor emissions from diesel automobile engines.

For a variety of reasons, the role of nuclear electricity generation is subject to controversy.— There is no public consensus on the questions of safety, standardization, waste disposal, the environmental effects of normal operating conditions, and the probability of sabotage. It may be especially important to undertake a systematic comparison of nuclear power with other energy alternatives, with full public participation, so that a broader con-sensus about the relative desirability of nuclear power can be developed.

More encouragement should be given to less polluting technologies, especially solar energy systems.— The solar tax credit is limited to solar cooling and heating in principal residences, and fails to encourage a wide variety of applications solar could have now or in the near future. The encouragement a tax credit would give to solar photovoltaic devices, for example, might have a very small immediate effect on energy use, but it could serve to accelerate the eventual economic competitiveness of a wider range of solar photovoltaic applications.

The roles of State and local governments in implementing the National Energy Plan are not clear.— There is a **serious** question, not addressed in the Plan, **of how** to identify and respond to regional differences in economies, environment, resources, and social conditions. National energy policy will have to not only take such differences into account, but reconcile them through continuous interaction with and participation by the governments affected.

By emphasizing the leadership role of the Federal Government to the neglect of State and local roles, the Plan appears to downgrade the importance of these levels of government in energy decision making. It is not clear from the proposal what information from the Plan's proposed three-part energy information program would be available to the States, although their need for accurate, up-to-date information is as great as that of the Federal Government.

The chances for success of a national energy policy will be enhanced by a deliberate effort to involve large numbers of citizens in the technicalities of shaping that policy.— participation in shaping energy policy by the large numbers of organized and unorganized parties with a vital interest in that policy requires involvement from the earliest planning stages through every phase of the process. To be effective, such participants should be well informed. Since much energy information is highly technical, citizens' groups will need access to expertise which, in turn, requires sustained financial support. The Plan also should include a program to provide financial and technical support to help link citizens' groups to energy policy development.

Implementation of the National Energy Plan will have serious and inequitable impacts on some regions of the country, but the Plan contains no provisions for giving regions that will be particularly hard hit either time or money to adjust.— Some regions of the United States will be able to adjust to the Plan's goals for conserving gasoline more easily than others. Some areas have particularly great energy needs for heating and cooling. It is not possible, given existing technologies, to burn coal in some regions without risking severe health problems. Some rural areas, particularly in the West, are likely to experience severe community impacts as a result of accelerated fossil-fuel development. There are also regional differences in the potential for conservation in the industrial sector. Many of these differential impacts would occur with or without the Plan. All of them are increased by the Plan, which aside from a statement that recognizes regional diversity takes no general account of it.

The acceleration of domestic energy development mandated by the Plan will depend significantly on increased production from resources on Federal lands.— If the Plan's production goals are to be met, problems and controversies associated with managing the development of federally owned energy resources will have to be addressed more directly, particularly those problems relating to the role of States in determining which resources are to be developed, which laws and regulations are to be applied, and whether accelerated development can occur without compromising important economic, environmental, and social values.

The Plan does not adequately link its short-term proposals to a long-range energy picture and examine the consequences of its strategies and tactics from the perspective of post-1985 energy development.— The Plan proposes fundamental changes during a relatively short period of time in the patterns of energy supply and demand. It does not address the question of whether those changes will provide a stronger or weaker base for planning and development after 1985. For example, the Plan assumes business-as-usual production of automobiles and trucks between now and 1985, but does not relate that assumption to the fact that domestic supplies of oil will almost certainly continue to decline after 1985. This raises the question of whether more emphasis should be placed on developing new sources of fluid energy immediately in the hope that supplies will be available in the future to power the stock of motor vehicles.

The Plan also does not propose specific programs that could make a start toward achieving new land-use patterns that are inherently more energy efficient than existing patterns. Nor does the Plan recognize that

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continued population growth, including immigration, could jeopardize the goals of *any* energy plan. Finally, the Plan does not examine the basic philosophical questions of continued economic growth and what environmental amenities are to be absolutely protected, no matter how severe the energy situation may become.

Issue 1

Macroeconomic Impacts

What are the likely effects of the National Energy Plan on the growth rate of real GNP, the rate of unemployment, and the rate of inflation?

Summary

The indicated effects of the Plan on the economy and employment are likely to be minor but adverse. Moreover, the macroeconomic costs of the Plan appear small in comparison to costs of increasing reliance on foreign energy sources.

Prices of energy products as well as other products which use energy in their manufacture or distribution will rise as a result of the Plan. It should be noted that present law would increase domestic oil prices to the world market level in 1979 in any case, because current price controls are scheduled to expire at that time. These price increases will add to existing inflationary pressure and may reduce consumer purchasing power (aggregate demand), thereby slowing economic growth and increasing unemployment. The extent of such effects, however, will depend on the effectiveness of proposed rebates of energy tax revenues in offsetting reduced purchasing power and the ability of the economy to respond to changes in relative prices as energy costs rise. The latter issue relates to the ability of the economy to institute more labor-intensive processes as the relative

prices of energy, capital, and labor diverge from their historic relationship, and to the degree to which public policy can be designed to encourage labor-intensive processes.

The near-term (1 977-79) macroeconomic effects of the Plan appear to be relatively small. However, the mid-term (1 980-85) effects will probably be larger and of greater concern. The Plan does not address the changing influence on the economy it will have over time, nor does it recognize or plan for the use of monetary and fiscal tools in addition to rebates to reduce the adverse effects of increased prices and taxes.

Forecasts of future macroeconomic impacts are far from reliable. Economic forecasting models are an important source of information for policy makers. Because of the fundamental limitations of models as simplified representations of the world, even the best model cannot ensure that the future will match its projection. Efforts to ascertain and bound the risks that are implicit in forecasts of macroeconomic impacts would appear productive, as would the design of alternative policies to deal with such risk.

Questions

1. What is the estimated cost to the consumer of higher prices and taxes for each year of the Plan, compared with those that would result without the Plan? How are these costs divided among the several tax and price proposals?
2. Are there measures that can mitigate the inflationary impact of the proposed price and tax increases?
3. To what extent will the various proposed rebates offset the loss in consumer purchasing power caused by higher prices, taxes, and inflation?
4. How will the income redistribution features of the tax-rebate system affect consumption, savings, and wage demands?
5, What impacts will a net loss of real consumer purchasing power have on the rates of economic growth and unemployment ?

Background

For the past two decades, the consumption of energy and the production of real GNP have grown together, both at somewhat over 3 percent per year. The energy plan proposes the growth of energy consumption be reduced to an average of 2 percent per year by 1985, This proposal raises the possibility that GNP growth will be slowed correspondingly and that the rate of unemployment will increase during the period covered by the Plan.

Virtually all forecasts agree that the effect of the Plan on GNP growth and employment opportunities will probably be quite moderate. Industrial use of energy, the source of most of the GNP output and job opportunities, is expected to grow at a slightly higher rate than heretofore, with energy savings coming largely from reductions in transportation and residential-commercial energy use. As a result, a GNP that might amount to $2 trillion in 1985 (in 1972 prices) would be reduced as a consequence of the Plan by perhaps $1s billion, or less than 1 percent. Clearly, such estimates make no pretense of precision; they merely indicate the general degree of impact. In this instance, the estimated effect can be interpreted as almost negligible from the standpoint of the overall economy, but it is more likely to be adverse than favorable.

The likely impact on overall unemployment also is very small. A fairly reliable historical relationship is that a l-percent decline in real output corresponds to a 0.3-percent increase in the unemployment rate. The anticipated reduction in 1985 output therefore translates into an overall unemployment rate that is higher by 0.2 to 0.3 percentage points. Again, this is a very tentative estimate, but indicative of the small macroeconomic impact of the Plan. Public policy initiatives which would encourage a transition from energy-intensive to labor-intensive processes would assist in mitigating any impacts on employment.

An important feature of the Plan is to induce energy conservation and a shift to more abundant fuels by encouraging the prices of oil and natural gas to rise. The direct impact of these price increases are more likely to be felt by industry than by the consumer because petroleum products are already being priced on a marginal cost basis. New taxes will be imposed on oil and natural gas used by industries in 1979 and utilities in 1983 to encourage the use of coal and the adoption of energy-conserving technologies. These taxes are likely to be passed on to the consumer indirectly through the prices of purchased goods. The crude oil equalization tax would be reflected in higher gasoline prices. The only direct increase in consumer prices for energy products would result from a proposed standby gasoline tax.

As indicated, however, increases in the price of energy to the industrial sector will lead to greater or lesser increases in the prices of all commodities, and indirectly to increases in wages, with further inflationary consequences. This is a slow process, and the magnitudes of the effects are hard to foresee. Econometric estimates suggest that during the first 5 years of the Plan the cumulative inflationary impetus will be of the order of 2 percent (i.e., 0.4 percent per year).

Although the inflationary impact discussed above is not negligible and could be regarded as a necessary cost of reducing dependence on imported oil, its full impact may be avoidable. Coordinated monetary and fiscal policy could be used to moderate the Plan's adverse effects on inflation, just as the Plan's rebate system is aimed at reducing the impacts on real purchasing power and the associated growth-employment impacts.

Issue 2

Distributional Impacts

The National Energy Plan will impinge on many explicit and implicit social goals. The economic impact will vary by income class, region, and sector, posing equity questions that may require mitigating policies.

Summary

It appears that the Plan will affect various groups in American society in different ways, Some groups could be economically advantaged by the Plan while others will most certainly be harmed. If the Plan is to be successful, all Americans will need to change consumption patterns with respect to energy and possibly, to some extent, lifestyles. Income classes, regions and economic sectors all will feel these impacts, often in conflicting and inconsistent ways.

The question is whether any one group is disadvantaged so adversely as to require Federal assistance. The Plan deals with this problem on only one level—that of income equity. Socially and politically, other distributional classifications will also be important. Moreover, it is even unclear whether the measures designed to mitigate the Plan's impact on the poor will be adequate.

Since distributional impacts of substantial policy changes are often widespread, diffuse, and uneven, there is probably no way to foresee the total ramifications, much less design mechanisms at the start to offset all inequities. What the Plan could include, however, and what is lacking, is a program to monitor its own equity impacts and those of the general energy situation plus a mechanism for effectively proposing programs of redress.

Questions

1. The Plan attempts to minimize adverse impacts on lower-income persons. How likely are these attempts to succeed ?
2. What mechanisms should be designed to identify important adverse distributional impacts which might result from Plan implementation?
3. Can industries and regions be identified which will be directly affected by the Plan in a substantial way—either advantageously or disadvantageously?
4. Have potential secondary equity impacts of the Plan been identified?
5. Can differential equity impacts with and without the Plan or with alternative policies be ascertained?

Background

U.S. equity goals have never been stated as clearly as many other goals but general agreement might be reached on the following principles: (1) No industry, area, or individual, should be importantly affected by a public policy unless these impacts have been weighed carefully; and (2) The adverse impacts of policy should be borne progressively, i.e., the greater impact should be borne more than proportionately by those better able to bear it.

Societal Impacts

There is no national consensus on whether the mitigation of inequitable situations should occur as an organic part of the programs or policies that create them or be left to the operation of more general ameliorative measures. In the present instance, the former choice has been made since the Plan contains mitigating or ameliorative measures along with its direct energy proposals. As a result, it can be evaluated as an equity-preserving or enhancing plan.

There is, however, a complication. The energy situation of the United States will be creating its own impacts on social goals. The Plan can therefore be evaluated in two ways, First, it can be judged to see if its provisions minimize its own adverse impacts on equity goals. Secondly, it can be judged to see if its provisions effectively offset the adverse impacts on equity goals stemming from the Nation's overall energy situation as it would exist without the Plan, Both standards of judgment are relevant.

Industrial Sector Effects—it is reasonable to expect that uneven effects of the overall energy situation will be felt in industry, with the largest effects on those whose direct energy consumption is greatest. The two largest energy-consuming industries are chemicals and allied products, and primary metals. Another obvious target for large impacts is the automobile industry.

Areas and individuals dependent on these industries are likely to bear a relatively heavier burden of adjustment to the general energy situation as the industry product prices rise at an above-average rate, as demand for their product changes, and as they alter their techniques and rates of production to adjust to changes in input prices and output demands. These impacts of the overall energy situation are likely to be exacerbated by the Plan, which makes no proposals to mitigate these general effects or the extra adversity the plan may impose.

Moreover, the Plan creates price differentials which are likely to create additional differential impacts. If all tax and rebate proposals are implemented, oil will cost consumers quite different prices for different uses. By 1988, a barrel of oil at today's prices will cost a utility $14, an industrial user and commercial aviation $17, and a user of gasoline $36.68. The Plan contains no explicit recognition of these newly created differentials nor of the effects they may have on different industrial sectors.

The Plan clearly contains no estimation of the relative ability of industries to bear the differentials created either by the general energy situation or by the Plan. It seems unlikely, therefore, that impacts will be equitably borne. No mitigating proposals are made.

Regions—Since regions are not uniform with respect to industrial mix (see above) or relative income distribution, differential impacts on areas are to be expected from these two sources. There are other reasons for expecting differential area impacts as well. Some areas are more rural and will be most affected by the particular emphasis the Plan places on curbing gasoline consumption. Some areas have extraordinary energy needs for heating and cooling because of climate extremes. Some areas are likely to experience greater environmental impact from fuel production and conversion than others. Community facilities and services in some areas will be strained by expanded energy production projects.

The most prominent example is coal mining. The Plan calls for a 100-percent increase in U.S. coal production by 1985—more than 600 million tons per year of new production, and possibly as much as 700 million tons when replacement of depleted mines is considered. The primary areas for increased production will be Appalachian States and States in the northern Great Plains and the Southwest. Areas where production takes place will experience an expansion in regional employment, total income, and demand for community services and housing. (See Issue #14.)

Additional examples include families in rural areas that spend more of their income for gasoline than urban families, and families in the South and West that spend more on this energy product than those in the North and East. Similarly, an increase in the cost of home heating and cooling will more strongly affect areas with more extreme winter or summer climates, depending on the regional mix of fuel oil, natural gas, and electricity as sources of energy for home space conditioning. There are also regional differences in the potential for conservation. Because South-Central States use more fuel per manufacturing employee than Western or New England States, they may be more heavily affected by the Plan.

Many of these differential impacts would occur without the Plan. All of them are increased by the Plan, which in general takes no account of them.

Individuals—The Plan was drawn up with particular awareness of differential effects on individuals in different income classes and consequently cannot be faulted for overlooking these impacts. Though there are differences of opinion (to be discussed below), some commentators (the Congressional Budget Office, for example) conclude that the overall effect of the Plan's taxes and rebates would be modestly progressive. (It should be noted that this conclusion was based upon the Plan as a whole. Modifications to the Plan could change that conclusion.) That analysis, however, relates only to changes that would result from implementing the Plan and does not cover differential effects by income class of the overall energy situation.

The data confirm what would be expected—the share of income devoted to energy-related expenditures falls sharply as income rises. One estimate is that the lowest-income quartile spends more than 30 percent of its income directly or indirectly on energy, while the highest quartile spends about 10 percent. The Plan does not address this issue in a substantive way. It promises "a reformed welfare system" and a "redesigned emergency assistance program" to help (p. 90), but these proposals may not go far enough to protect low-income families, Even the Plan's proposed per capita rebate of wellhead taxes will not necessarily assure equity because not all of the tax will be rebated to individuals (some will go to offset revenue losses from investment tax credits) and the tax will not be rebated progressively (Sec. 1403). The proposed welfare and emergency assistance programs may aid the poorest groups but those just above that level are likely to have the largest burden imposed upon them by the overall energy situation.

Societal Impacts

If there should be an added increment to inflation, as seems likely, or if the Plan should prove to adversely affect economic growth, lower-income groups will bear the brunt of this. The young may be affected by a further slackening in job opportunities, coupled with added inflation. The situation of the young, as affected by the Plan, is not addressed.

The poor, and particularly the rural poor who probably comprise most of the half of the lower-income group who own cars, will be hit most heavily by the increases in gasoline prices the Plan proposes. Not only do they spend a relatively larger proportion of their income on gasoline, they suffer from two other handicaps that would make it difficult to adjust to higher transportation costs. First, mass transit is not available for all essential travel, such as to work. Secondly, the poor generally cannot afford new, gas-economizing cars. They will be the purchasers in the second-hand market of "gas guzzlers" whose relative prices will fall as gas prices rise, bringing them within reach of lower-income groups. Thus, those who can afford new, fuel-efficient cars will be saving money on gasoline while the poor will be spending more on gasoline. No element in the Plan recognizes or offsets these possible inequities.

A comparable lack of capital will preclude lower-income homeowners from taking advantage of the tax-credit programs for residential insulation or solar energy units. They may not be able to meet "front end" costs and they may not be paying enough taxes to get the full tax credits proposed by the Plan.

One group of Americans who will not be able to benefit from residential energy conservation programs are tenants who pay for their fuel but who cannot be reimbursed for insulation expenses. Tenants who do not pay for the added cost of heating oil directly will do so indirectly through higher rents, but they are not likely to benefit from rebates on home-heating oil. The Plan's proposed increase in the federally financed weatherization program will help in sheltering the poor against higher fuel costs. However, the current program does not extend such help to renters. In addition, the level of funds available for insulation assistance may be too small. At present, there are approximately 9 million substandard homes in the United States, homes which for the most part are inhabited by the poor. The weatherization programs will handle only a small fraction of these structures.

Probably no plan could foresee and offset all inequities. What the Plan could include, however, and what is lacking, is a program to monitor its equity effects and those of the general energy situation and a mechanism for effectively proposing programs to redress inequities.

Issue 3

Air Quality Impacts of Increased Combustion of Coal

Strict enforcement of strong environmental regulations will be necessary to protect air quality while coal production and use increase under the National Energy Plan; such environmental policies may, in turn, slow the pace of growth in coal utilization.

Summary

A major shift from petroleum fuels to coal is a central element of the National Energy Plan. Under the Plan, coal would provide 29 percent of U.S. energy requirements in 1985, compared with 18 percent in 1976, reducing demand for oil by the equivalent of 2.4 million barrels a day. As the Plan's coal proposals are implemented, strict environmental protection policies will be required to avoid adverse impacts on air quality. The Plan requires installation of best available pollution control technology on all new coal-burning facilities. Pending amendments to the Clean Air Act also would cancel credits for tall stacks, require control equipment to be installed on all facilities that do not meet emission standards, and set penalties for noncompliance with standards and failure to maintain control equipment in good working order. It is not likely that such strong environmental measures are compatible with a substantial increase in the use of coal on the schedule proposed in the Plan. A deliberate choice between increased use of coal and air quality goals may have to be made at some point in the future.

Questions

1. Under what, if any, circumstances would a coal-burning facility be issued a variance from Clean Air Act emission standards ?
2. Under what conditions would a powerplant or industrial facility be allowed to continue to use oil or natural gas rather than coal ?
3. If all new coal-burning facilities are required to install flue-gas desulfurizers (FGD), currently considered the best available technology, would development of other technologies such as fluidized-bed combustors be delayed?
4. What level of funding is contemplated in fiscal year 1978 for developing more effective control and combustion technologies ?
5. To meet the goals of the National Energy Plan, how many new FGDs or scrubbers must be manufactured and installed between now and 1985 ? Can suppliers meet that production schedule?
6. Will efforts to make coal combustion environmentally acceptable delay development of alternative technologies such as solar which are environmentally cleaner?

Societal Impacts

Background

The National Energy Plan states that energy goals are to be achieved "without endangering the public health or degrading the environment" and "without sacrifice of air quality standards . . ." A Presidential review panel would evaluate the health effects of expanded coal use (pp. 67-68). These are commendable goals, but it is possible that they cannot be achieved without sacrificing the Plan's goals for coal utilization.

For coal combustion, the Plan proposes that the best available control technology (BACT) be required on all new coal-burning facilities. If the Plan's proposals and the strongest features of pending amendments to the Clean Air Act are implemented on schedule and without exceptions, the sulfur dioxide, particulate, and nitrogen oxide levels in the air will 'not change significantly as a result of the Plan, assuming the conservation goals of the Plan are also met.

However, combustion of coal releases more carbon dioxide into the atmosphere than either oil or natural gas and there are other inherent conflicts between the Nation's air quality goals and the Plan's coal utilization goals. For example:

1. In certain regions of the United States that do not yet meet ambient air quality standards, no new coal combustion can occur unless pollution from other sources is reduced at a faster rate than is now scheduled. This cannot be accomplished either easily or immediately.
2. Compliance with Federal air quality regulations depends on State implementation plans and State monitoring and enforcement mechanisms, which would delay the effect of new Federal programs. Some States have adopted more stringent standards than the Federal Government, in some cases restricting or forbidding coal utilization even where Federal regulations would allow it.
3. Rapid implementation of air pollution abatement policies using stack-gas cleaning is opposed by most public utilities on the grounds that it is not reliable, that scrubbers that use lime or limestone produce unacceptable amounts of sludge, and that better pollution control technology will be available by the 1980's.
4. It may not be possible to manufacture scrubbers or other pollution control equipment fast enough to meet the 1985 goals of the Plan. Delays of compliance may result.
5. The Plan's emphasis on rapid conversion to coal, coupled with its requirement that the best available control technology be installed, may divert capital from research and commercialization of alternative technologies, such as solar energy units, and conservation technologies.
6. Delays in expanding coal production at the pace proposed by the Plan may be necessary or desirable because of environmental, social, and institutional problems associated with increased coal production. (See Issue #1 4.)

7. Uncertainties exist as to which pollutants need to be regulated and what levels are tolerable. To the extent that these uncertainties reflect inadequate correlations between environmental causes and health effects, the uncertainties eventually can be solved by expanded health research and monitoring. (See Issue #5.)

For these reasons, it is likely that Federal and State regulatory agencies will be asked to issue variances from air quality standards for new powerplants and industrial facilities and for existing industries to enable a shift from oil or gas to coal. Arguments for variances may be compelling: Some coal-burning facilities could not be operated without violating air standards. Better control technology may be available within a few years. A firm's economic analysis may indicate that it makes more sense to shut down operations than to convert to coal and comply with air quality regulations. Past experience indicates that some regions will prefer deterioration of environmental quality to losing a major employer. If decisions in such cases are to stress conversion to coal, granting of variances that delay air quality compliance schedules probably will become so common that air quality will decline in some regions. To a limited extent, the pressure for variances can be eased by siting facilities outside metropolitan areas.

One consequence of limited conversion of oil- and gas-burning facilities to coal combustion will be continued reliance on oil as a fuel source. In that case, it would be important for refineries to retrofit to produce low sulfur oil. An increased supply of low sulfur oil will result in decreased sulfur dioxide pollution from oil-burning sources and hence permit more coal conversions without degrading a region's ambient air quality.

Emphasis on immediate, accelerated utilization of coal may foreclose some more acceptable, longer-range coal uses. Additional research is warranted on post- and pre-combustion cleaning techniques. New combustion techniques using nonconventional boilers show promise of reducing emissions, especially nitrogen oxides. For example, fluidized-bed combustion offers higher combustion efficiency and cleaner burning than traditional boilers. Investment credits or other market incentives could advance these and other cleaner technologies.

Achievement of air quality standards is also dependent on meeting NEP conservation targets. However, conservation savings tend to reduce national emission levels (as in the case of more fuel-efficient autos) and these savings will normally have far less significance in particular local situations where coal conversion is at issue.

Environmental Protection Agency Photo

Societal Impacts

Issue 4

Other Environmental Impacts of Coal Utilization

Even if air quality could be protected, meeting the coal production and utilization goals of the National Energy Plan may result in other adverse environmental and social impacts.

Summary

Although the Plan "intends to achieve its energy goals without endangering the public health or degrading the environment" (page **67),** its only specific environmental protection proposals concern air quality and strip mining reclamation. However, both combustion of coal and conversion of coal to synthetic gaseous and liquid fuels may result in a much wider range of environmental and social impacts, some of which are not presently regulated. The magnitude of those effects could jeopardize the realization of the coal utilization goals of the Plan, even if air quality standards were met.

Questions

1. The Plan supports amendments that would strengthen the Clean Air Act. What policies and procedures presently addressed by the Federal Water Pollution Control Act will protect water from pollutants such as acid and water runoff from coal mines, disposal of water used in precombustion washing of coal, and in coal transportation?
2. What are the environmental impacts associated with disposal of waste products (e.g., sludge) from scrubbers in the quantity envisioned by the Plan?
3. What assumptions underlie the Plan's conclusion " that "it appears that railroads could transport the additional coal" (p. 65) ?

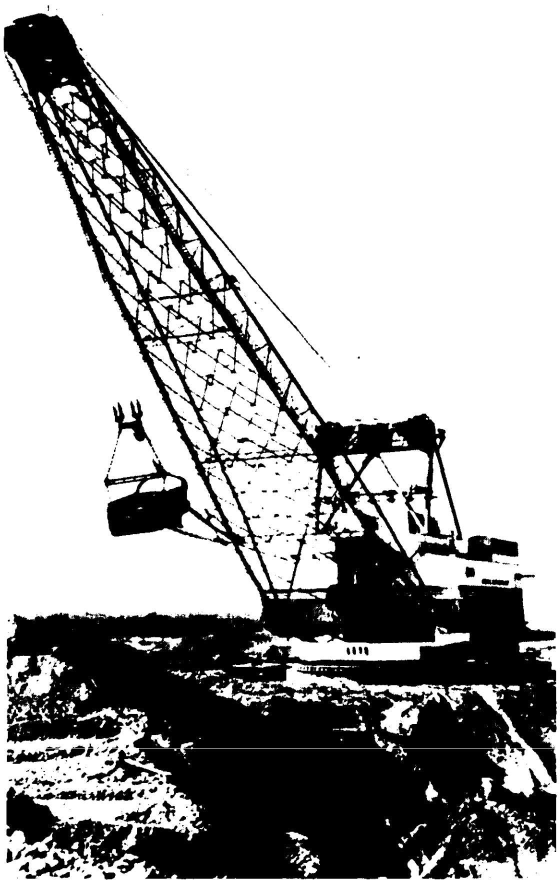
Background

The National Energy Plan, in outlining its environmental policy regarding coal (pages 67-68), emphasizes the protection of air quality and the need for national strip mine legislation. Mitigation of other specific environmental impacts is omitted from the Plan except for impacts on public services in local communities (p. 89). (See Issue #14.)

The potential impacts of a major expansion of coal production and utilization are extensive. Impacts other than those mentioned in the Plan include the following:

1. Environmental and social impacts of coal mining. In the West, potential problems include water consumption for surface reclamation, contamination or loss of ground water aquifers, drainage of highly alkaline waters from Western mines, and rapid population increases and boomtown development in rural areas. In the East, potential problems include acid-water runoff from mines (especially after mine abandonment, or reactivation of old mines, and in mines above valley floors), and land surface subsidence.

2. Safety in underground mines, Coal extraction and processing pose health and safety hazards to miners, other coal workers, and local populations. The health and safety record in coal mining has been among the worst in the United States, with fatal and disabling injuries most prevalent among newly employed miners.



Federal Energy Administration Photo

3. Currently uncontrolled air emissions from coal combustion. Although subject to some regulation, emissions of nitrogen oxides are not adequately controlled by best available control technology. Radioactive materials, hydrocarbons, carbon monoxide, and heavy metals in gaseous, liquid, or solid states are not regulated at all.

4. Climatic and weather effects. Coal, like other fossil fuels, releases carbon dioxide and particulate into the air during combustion, both of which may contribute to global climatic changes. Conversion to coal would increase carbon dioxide emissions because-per unit of energy delivered-coal yields 11 percent more carbon dioxide than oil and 67 percent more than natural gas. An accelerated use of coal would therefore aggravate any long-term adverse effects on climate that result from carbon dioxide.

5. Waste products from pollution control devices. The harmful emissions from coal combustion do not disappear when control technologies are introduced. Rather, the technologies convert them from one form to another-gaseous to dissolved solid, for example. Consequently stack-gas cleaning produces waste as sludge. Some scrubbers produce about 3,000 tons of solid suspended in several thousand tons of water per day for each Gigawatt of power generated. Because of the large quantities of sludge produced, disposal may cause land-use problems. The moisture content of the sludge, for example, must be contained to avoid contamination of ground and surface water.

Societal Impacts

6. Emissions from coal gasification and liquefaction plants. Even if air pollutants from these facilities are controlled under provisions of the Clean Air Act as amended, waste water and solid wastes could present problems. For instance, gasification waste water may have a concentration of inorganic materials that is as high as that in sea water, plus organic substances including cyanide, thiocyanate, ammonia sulfide, phenols, and oils. Waste-water treatment in the Lurgi gasification system requires tar-oil-water separation (three stages), filtration, phenol recovery, ammonia recovery (in an ammonia still), and activated carbon treatment. Several components in the system are new techniques, and an integrated system has never been operated at commercial scale. Total quantities of solid wastes will depend on the ash content of the coal, generally ranging from 2,000 to 3,300 tons per day from a 250 million cubic feet per day gasification plant; these solid wastes will contain most of the heavy metals from the coal.

7 Transportation system requirements, Although the Plan asserts that the Nation's railroad network is adequate to deliver anticipated amounts of coal (p. 65), the railroad industry's capacity to handle this increased traffic will depend on investment in rolling stock, and in some areas, improved track and signal systems. Even where the present rail network is adequate, increased coal transportation could result in longer trains and more frequent trips. This, in turn, could lead to more accidents, railroad congestion, more frequent delays at automobile crossings, greater sustained noise levels, and more dust and air pollution along railroad rights-of-way. These effects will be especially noticeable in small rural towns.

   Other transportation and conversion alternatives, including slurry pipelines, minemouth power generation, and liquefaction or gasification of coal prior to transportation should be considered, especially in the West.

8. Other long-term impacts. Some scientists believe that coal burning releases not only relatively well-known and harmful emissions, but other compounds whose health impacts are presently unknown. These compounds may have long-term carcinogenic or mutagenic effects or they may contribute low-level radiation to the environment.

The inescapable conclusion is that coal is a "dirty" energy source. The sulfur, ash, heavy metals, radioactive substances, and carbon usually found in coal are all present, in altered states, after combustion. Additionally, coal must be extracted and transported, which requires extensive use of land, people, and equipment and creates a range of environmental and health hazards. Managing these processes so as to avoid the adverse effects is a challenge which the National Energy Plan does not fully address.

Issue 5

Health Impacts

The long-term health effects of the energy priorities established by the National Energy Plan are uncertain.

Summary

Even where standards have been defined for emission levels and environmental quality, the following energy-related administrative or information gaps exist: (a) scientific evidence to document the health impact of different levels of pollutants; (b) an effective system to monitor pollutant levels and maintain health impact statistics; and (c) a consistently applied approach to correlating pollution levels and human health. The uncertainties are especially great for coal and other fossil fuels, because health impact research has been sparse compared to research on ionizing radiation. Consequently, there is an urgent need for a more comprehensive and comparative assessment of health effects of energy supply systems and for an environmental monitoring system to provide an early warning of unanticipated environmental problems.

Questions

1. Have the human health impacts of the National Energy Plan been estimated (e.g., morbidities and mortalities in 1985 with and without the Plan) ?

2. IS the threshold concept of pollution regulation compatible with the protection of human health? Do present pollution regulations include the synergistic effect of some pollutants? How frequently should environmental standards be reevaluated?

3. As a result of the energy plan, how will the level of radiation in the environment (nationally and regionally) be affected by (a) coal utilization, (b) nuclear power generation, and (c) geothermal energy development? Are radiation effects of coal and geothermal facilities monitored?

4. How will human health be protected from carcinogenic substances in the process stream of coal gasification or liquefaction facilities?

5. What is the present status of research on the long-term genetic effects of compounds produced by the conversion of coal to a liquid or gas?

Background

Although environmental protection and human health and safety are prominent concerns of the National Energy Plan, too little is known about the health effects of the energy technologies, processes, and resources included in the Plan to be certain of their impact on human health.

Health effects are relatively well understood in at least two areas: (a) physiological impacts of relatively high radiation levels and certain radioactive isotopes, and (b) physiological impacts of relatively high levels of other possible energy byproducts (such as heavy metals, cyanide, and some air pollutants) which have been identified by searching for the major causes of specific human deaths and illnesses. But even in those well-studied areas, there is disagreement on the level below which there is no hazard to human health-or even whether such a threshold exists.

The energy plan embraces present environmental legislation which regulates sulfur dioxide, particulate, and nitrogen oxide emissions from fossil fuel combustion, but the Plan fails to address other possible environmental contaminants, some of which may pose greater long-term threats to human health. Current regulations fail to provide for synergistic or long-term health effects. Regulation or precursors, such as sulfur dioxide, may be insufficient when reaction products, such as sulfuric acid, cause the significant health effects. The Plan supports present protections against contamination from highly radioactive materials, but it does not consider the possibility that a general rise in low-level radiation may be a health hazard. Other kinds of possible effects that are overlooked include long-term global climate modification as a result of carbon dioxide build-up and long-term genertic damage from chemical byproducts of coal gasification or liquefaction.

In addition to the general lack of information on environmental health, it is still uncertain whether current environmental protection standards are appropriate. Monitoring of air quality and correlation of air quality changes and human health effects are needed. Interagency and interoffice coordination of research on pollutants, overall air quality, and human health statistics would help ensure that emission standards are neither too lenient, allowing too many adverse impacts on health, nor too strict.

Scientific and environmental health research is necessary in areas beyond "best available control technologies, " including those health effects and pollutants which have not yet been identified. A process for reviewing and assessing the adequacy of national systems for protecting human health may help accumulate environmental health data. The mechanism and process need to have at least three elements:

1. A continuing assessment of the health impacts of energy supply technologies, including (a) an accelerated assessment of the long-term impacts of solid fossil fuels (coal and oil shale); (b) special attention to the human health significance of any chemical compounds and radioactive materials that are produced by energy supply processes; (c) identification and analysis of key morbidity and mortality indicators in the U.S. population, as they relate to pollution levels; and (d) an increased emphasis on environmental health in the training of personnel in health professions, together with special support for training in understaffed fields such as environmental toxicology.

2. Improvements in monitoring the quantities and characteristics of byproducts of energy supply facilities, with a special emphasis on improving the instrumentation for identifying byproducts of facilities burning or converting coal (a recent joint study by the National Academy of Sciences and the Nuclear Regulatory Commission found the Environmental Protection Agency's current monitoring programs seriously deficient).

3. A review of the requirements for measuring byproducts of energy supply facilities other than light-water reactors, to see if additional monitoring requirements are needed.

Issue 6

Impacts of Nuclear Power

The National Energy Plan's proposal to increase nuclear electricity generation raises environmental and social questions.

Summary

Although the National Energy Plan emphasizes the increased use of coal to generate electricity in the United States, it also calls for light-water nuclear reactors to play a major role in reducing the Nation's domestic energy deficit. "By 1985 . . . nuclear power could provide as much as 20 percent of electricity supply" (p. 71), twice its current share. "There is no practicable alternative" (p. 70). But questions remain about the safety of nuclear reactors, the impacts of fuel cycle activities necessary to meet the needs of expanded nuclear power generation, the potential for sabotage, and the social desirability of concentrating electricity generation in the kinds of large central-station plants implied by nuclear energy options.

Societal Impacts

Questions

1. In what ways might the protection of nuclear reactors from sabotage abridge the civil liberties of the American people?

2. What is the potential for nuclear power generation on a small scale (e.g., the "nonproliferating reactor" design concept recently investigated by the Energy Research and Development Administration) ?

3. Are there plans to undertake a systematic comparison of nuclear power generation with other supply alternates? To what extent and how closely would representatives of the public participate in this comparative assessment ?

Background (See also Supply Issues #9, #10 and #11)

According to the National Energy Plan, as many as 75 additional light-water nuclear reactors could be in operation by 1985, joining the 63 presently operating plants (p. 71). The Plan calls for increased attention to reactor safety, waste management, proliferation, and other impact issues; but disagreement continues to exist about whether the risk of serious environmental and social impacts is acceptable.

In addition to concerns about the reliability of light-water reactors, the impact issues include:

1. The safety of nuclear reactors. The Plan notes that "the safety record of light-water reactors has been good, " but many people and groups in the United States believe that even a small risk of a serious accident is unacceptable, especially as the number of operating reactors increases. Although considerable attention has been given to the prevention of major accidents such as a core melt-down, much less is known about design alternatives that improve containment of radioactive materials in case of an accident. Evacuation plans for population in the vicinity of nuclear plants may be inadequate. If a major accident were to occur despite the low probability, not only could the immediate consequences be devastating, but the public outcry could force the shutdown of all other reactors. If a major commitment to nuclear power had been made, the disruption to the energy economy would be severe,

2. Other impacts of fuel cycle activities. A doubling of the number of nuclear plants will require additional mining, milling, enrichment, and transportation of nuclear fuel; and it adds to the economic and* energy-efficiency arguments for fuel reprocessing and recycling, especially if uranium resources turn out to be no higher than the more pessimistic assumptions. Each of these kinds of activities has environmental, economic, and social impacts; for example, mining, milling, and enrichment facilities produce tailings that add to radiation background. In addition, the nuclear reactors themselves may affect the local ecology by discharges from cooling towers to receiving waters or the atmosphere (dispersing heat, moisture, salts, other chemicals, and low-level radioactive products).

3. The potential for sabotage. There is no agreement on how difficult it would be to sabotage a reactor so as to cause serious damage in an area near a plant. It should also be noted that seizure and occupation of a reactor with a threat of sabotage could cause widespread disruption, even if sabotage efforts were unsuccessful or the threat was not carried out. Although NRC has recently upgraded security at nuclear reactors, questions about reactor safeguards remain.

4 Social impacts of centralized energy supply. An element in the social protests against nuclear plants is the opinion that nuclear power furthers the centralization of the U.S. energy supply system, favoring capital-intensive infrastructure and requiring technocratic elites. There are also civil liberty concerns about security and safeguards requirements at nuclear facilities.

For these principal reasons, even a supplementary role for nuclear electricity generation is open to controversy, and the issues need to be addressed more clearly and specifically than in the Plan. It may be especially important in the next few years to undertake a systematic comparison of nuclear power with coal and other energy supply alternatives. This comparison should involve extensive public participation, so that a broader consensus about the relative desirability of nuclear power can be developed.

Societal Impacts

Issue 7

Alternative Technology-Solar

The National Energy Plan underestimates the variety of contributions to energy production, conservation and environmental quality that can be made by solar technology.

Summary

Solar technologies can play an increasingly significant role in meeting the Nation's energy needs in the near future. These technologies protect the environment, create jobs, employ an inexhaustible renewable energy source, and provide an alternative to dependence on large-scale central electrification. To fully realize its potential for meeting a variety of the Nation's energy needs, solar technology requires incentives beyond the measures of the Plan.

Questions

1. Why does the solar tax credit apply to only the taxpayer's principal residence, (National Energy Act, Sec. 1101 (a)) and not to vacation homes, rental property, light industry, or commercial buildings ?
2. Why does the solar tax credit apply only to equipment used to heat and cool buildings and heat water and not to other applications, which may be as economical and practical (e.g. photovoltaic power generation for certain remote-sensing applications) ?
3. What incentives, other than funding for research and development, are applicable to alternate energy technologies such as biomass technology, wind energy, and solid waste?
4. Some of the most useful applications of solar technologies may be in developing countries, especially in rural and remote areas. What are the plans for international cooperation in developing solar systems compatible with the energy and social needs of developing countries?

Federal Energy Administration Photo

Background

The National Energy Plan provides a tax credit for installation of qualifying solar equipment, funding for installation of solar equipment in Federal buildings, and increased funding of various aspects of solar research and development (pp. 75-76). Also, the industrial tax credit for conversion from oil and gas may encourage use of solar energy as well as coal. Solar technology is the only available energy technology which can claim a neutral environmental impact in operation, which becomes a positive impact when one factors in the environmental degradation avoided by the replacement of fossil-fuel sources, as well as beneficial social impacts including job creation and reduction of total dependence on external, centralized electric power. The tax incentives specified by the Plan may be ineffective in realizing the variety of contributions solar energy can make.

Solar energy is a renewable energy source which has undeniable long-term applications. Additionally, solar technologies have some immediate applications. On a life-cycle costing basis, solar space and water heating is competitive with electric space and water heating in many parts of the country. Use of solar equipment to produce air-conditioning, mechanical power (for pumps and other applications), and electricity is technically feasible now but too expensive to compete with conventional energy sources in any but a few specialized applications. The market for all solar equipment may grow rapidly even without Federal support as the price of nonsolar energy sources increases. The policy which keeps the cost of residential energy low is a great disincentive to solar energy.

Societal Impacts

Additional incentives for solar technology may be needed to achieve even the limited solar goals of the Plan. Specifically, solar incentives, along with energy conservation measures, are needed for new-start housing. Some States have mandated installation of extremely inexpensive equipment which will permit the installation of, or retrofit to, solar water heating. Because of the overriding public policy considerations, mandating solar installation, where appropriate, or at least evaluating solar water and space heating has been considered. increased loans for small businesses would help develop the solar market in the small industry-commercial sectors. Making nonprofit organizations eligible for guarantees under the amendments to the Energy Policy and Conservation Act would also increase marketability. Mandating consideration of solar technologies where appropriate for Federal and State building programs would encourage public acceptance. Further, public acceptance can be heightened by rewarding States and localities for plans which emphasize renewable energy sources, through matching grants, revenue sharing systems, or various other Federal programs.

Additionally, the Plan mentions three specific legal and regulatory impacts of implementation of solar technology-+ quipment certification and installation, legal protection of incident sunlight, and utility rate regulation which affects solar users when backup power is required, The Plan omits specific recommendations in these areas, but encourages State and local action, The imprecision of these recommendations further diminishes the likelihood of expeditious implementation of solar technologies. (See Issue #1 O, on State-Federal relations.)

Finally, in the general area of alternative technologies, the Plan fails to address the issues of economies of scale, respective capital and labor requirements of the various energy sources, and social, demographic, and environmental impacts. For example, biomass conversion for portable fuels, and medium- and small-scale energy production systems, except for district heating, are not discussed. A growing number of energy specialists believe that the long-range implications of the social, environmental, and demographic impacts favor the careful matching of energy quality to end-use requirements and the use of decentralized, renewable energy sources. Because of the variety of solar technologies, its applicability to a variety of applications must be considered.

The Plan limits institutional attention of small-scale alternative technologies to creation of an Office of Small-Scale Technology (p. 80). The Energy Research and Development Administration's Office of Small-Scale Technology is currently authorized at $5 million for 1977-78. To have a sufficient impact on policy-program design, the administrative structure for alternative technologies should be prominent and well funded. Compared to the funding level of conventional energy sources, the current funding of the Office of Small-Scale Technology may be insufficient,

Issue 8

Indoor Environments

Energy conservation in buildings may aggravate some existing health problems and create new ones.

Summary

Tight insulation in buildings and increased recirculation of indoor air in air-conditioning systems are effective tactics of energy conservation. However, these tactics may substantially increase concentration of pollution indoors. Further, recommended indoor temperatures need to take into account in a systematic manner factors of health, behavior, and efficiency.

Questions

1. How much is known about the effects of tight insulation and recirculating air-ventilation systems in concentrating pollutants indoors?

2. How much work has been done on ways to ensure that energy-conserving building designs and energy-conserving modifications to existing buildings are compatible with clean indoor air?

3. What are the projected increases in indoor environmental contamination from the increased use of potentially or demonstrably hazardous insulation materials (e. g., asbestos, rockwool, fiberglas) ?

4 Does the range of indoor temperatures recommended for summer and winter take into account the temperature sensitivity of special population groups (e.g., the elderly, the chronically ill), the possible effects on susceptibility to infectious diseases, and the effects on performance efficiency?

Background

Although Americans spend about 75 percent of their time indoors, it was not until recently that studies of indoor pollution were commissioned; present information on the health aspects of indoor environments is very limited. In promoting conservation measures in buildings, such as insulation (including weatherstripping, caulking, and other measures for thermal isolation), use of recirculated air, and restraint in heating and cooling, energy policy should fully take into account the possible effects of such measures on health.

Indoor air quality can be worse than that outdoors especially for particulate, including toxic substances like asbestos. Asbestos reaches air in rooms mostly from indoor sources, such as use of asbestos-containing talcum powders and the blowing of asbestos fibers into rooms from asbestos-lined ventilation ducts and wall interiors. In addition, gases such as carbon monoxide and nitrogen oxides can build up indoors from the burning of natural gas or oil for home heating and cooking. Lead is sometimes present in higher concentrations in nonindustrial buildings than outdoors. Toxic organic vapors arise indoors from cleaning fluids and aerosol sprays. Tobacco smoking further deteriorates indoor air quality.

Improved insulation of buildings proposed by the Plan will tend to seal in air pollutants and toxic substances in the course of achieving its primary purpose, which is to retain heated and cooled air. Increased recirculation in forced ventilation systems also will concentrate pollutants.

Although improved insulation is strongly encouraged only for residential buildings, rising fuel costs and tax incentives for fuel conservation could result in increased insulation for all types of buildings, and a decrease in fresh air in forced ventilation systems, This could, for example, affect the transmission of bacteria and viruses in hospitals, and schools, and other public buildings.

A preliminary study at Lawrence Berkeley Laboratory under contract to ERDA (LBL-5918) suggests that some indoor pollutants in the home may rise to levels several times those in peak polluted outdoor urban areas when the air-change rate approaches that being considered for energy conservation purposes. A more imaginative approach to energy conservation could take advantage of building design features which promote both energy conservation and good indoor air quality.

The effects of temperature on performance, health, and disease transmission have not received the attention they deserve, except for the extremes of heat and cold. Persons with heart disease, for example, are very sensitive to heat' and their chances of surviving a heat wave are smaller without air-conditioning. Because daily mortality rates in cities change significantly with slight changes of temperature and humidity, there is reason to suspect that there are more subtle effects as well.

Issue 9

Health Effects of Diesel-Powered Automobiles

The National Energy Plan indirectly encourages the use of diesel-powered automobiles but little consideration has been given to the unregulated harmful emissions of diesel engines.

Summary

The automobile gasoline efficiency standards of both present Federal legislation and of the energy plan indirectly encourage the use of fuel-efficient, diesel-powered automobiles. Although diesels produce less carbon monoxide and hydrocarbons than do gasoline engines, they may also produce greater amounts of harmful sulfates and fine particulate.

Questions

1. What diesel market penetration has the Administration assumed for passenger cars and light and intermediate trucks for its projections of automotive energy demand to 1985? To 1990? To 2000?
2. Have studies been undertaken of the unregulated emissions from diesel technology? What are the potential health effects of diesel automobiles, especially in dense urban areas?

3. What studies have been undertaken to assess the real fuel savings related to a large-scale adoption of diesel technology for passenger car service? What are the results?

Background

Federally mandated fuel economy standards in effect for 1978-85 model year cars (27.5 MPG fleet average for 1985) have produced considerable interest on the part of legislators, automakers, and agencies such as the Transportation Department in diesel technology for passenger cars. General Motors Corp. will introduce a diesel engine in one of its lines in 1978. Others may follow its lead; foreign diesel-powered automobiles are already available. Some sources have assumed a 25-percent diesel market penetration, especially in large cars, by the 1985 model year.

Diesels are inherently fuel efficient and produce relatively low carbon monoxide and hydrocarbon emissions, although emissions of nitrogen oxides with present technology exceed current statutory standard of 0.4 grams per mile. However, diesels also produce a number of unregulated emissions that could, under heavily congested conditions, become a serious public health hazard.

Like conventional spark-ignition internal combustion engines, diesels emit a variety of air pollutants, odors, and noises, but of different degrees and kinds. The important emissions from diesel engines include visible smoke and fine carbon particles, sulfates and sulfur dioxide, aldehydes, and selected nonreactive hydrocarbons, as well as the conventional gasoline engine emissions. What little is known about diesel emissions suggests the need for considerable caution. This is particularly true for a group of compounds known as polycyclic organic matter (POM).

The partial combustion of organic matter produces POM, which contains two classes of carcinogens: 1) polycyclic aromatic hydrocarbons, and 2) aza-arene heterocyclic compounds. Numerous types of POM have been measured in soot: pyrene, anthacene, benz(a)anthracene, benzofluoranthenes, chrysene, coronene, fluoranthene and benzo(a)pyrene. A number of these have been found to be carcinogenic in animal-exposure studies.

The internal combustion engine also is a source of POM, but current efforts to reduce other emissions from such engines have also reduced POM emissions. Anticipated future measures point toward continued reductions as a result of catalytic controls. However, careful attention should be paid to the misuse of diesel-powered vehicles such as overloaded operation or poor maintenance. Idle operation typical of congested urban centers results in high POM emissions from diesels.

The bulk of POM from diesels is thought to be associated with fine particulate aerosols. As a result, POM longevity depends on both the rate of its chemical alteration and the lifetime of its carrier aerosol. Estimates of the lifetimes of fine aerosols exceed 100 hours and range up to 40 days. POM may undergo chemical reaction within a few hours or up to a few days, depending on degree of exposure to sunlight. in addition, some of the products of **POM reaction with oxygen may also be carcinogenic.**

Recent studies have shown that 90 percent of the particles in diesel exhaust are less than 1 micrometer and that 50 percent are about 0.3 micrometers or smaller. These sizes are precisely within the range which is respirable and which is deposited within pulmonary air spaces. There is significant retention within the lung of aerosols of this size. In addition, retention is increased by hydroscopic sulfate which is present in diesel emissions.

There presently are several active projects under EPA sponsorship to determine whether diesel engines emit nitrosamines or any of their potential precursors (in addition to nitrogen oxides). However, it is not known if any studies are underway that address the retention of fine diesel particles in animal lung tissue. Such experiments should be carried out before any large changeover to diesel-powered autos or light-duty trucks occurs.

Issue 10

The Role of State and Local Governments

Unless State and local governments have substantial responsibility for national and regional energy policy, the goals of the National Energy Plan may be jeopardized.

Summary

The Plan calls for a "foundation of partnership and understanding" in the implementation of a variety of energy programs, built upon "active roles" and "major responsibilities" for State and local governments. With few exceptions, however, it is not clear what these roles and responsibilities are to be. In fact, by emphasizing the leadership role of the Federal Government and largely ignoring problems of intergovernmental cooperation, the plan appears to downgrade the importance of other levels of government in energy decisionmaking. This is partly an issue of the nature of federalism in the United States, but it is also a question of how to identify and respond to regional differences in economies, environment, resources, and social conditions. National energy policy will not only have to take such differences into account, but reconcile them in a cooperative manner with continuous interaction and participation of the governments and peoples affected. Failure to do so could jeopardize success of the Plan.

Questions

1. To what extent does the Plan set the stage for a major change in planning and regulatory functions now exercised by the States?
2. To what extent has national energy planning anticipated the great degree of cooperation that will be required by the States to implement the strategies of the Plan?
3. What will be the role of State and local governments in: (a) returning rebates from energy price increases and taxes to the consumer? (b) developing and enforcing energy efficiency standards? (c) facilitating the development of alternative energy sources?
4. Could State governments be given a role in the classification of oil and gas production as "new" or "old?"

Background

The Plan emphasizes the importance of State and local government participation in the process for making energy resource development decisions. And, in some areas, the Plan defines future State and local implementation roles. For example, attention is given to State enforcement of the 55 miles per hour speed limit, State responsibilities in public utility reforms and conservation services, and State review of proposals to expedite the movement of Alaskan oil from the West Coast. In most cases, however, the Plan only mentions a possible State or local responsibility or implies some future intergovernmental requirement.

The only specific reference to an active positive role for State or local governments involves State utility commissions, which are directed to reform rate structures in accordance with Federal guidelines. There is a general reference to an unspecified role for States in the development of geothermal resources (p. 78) and in the proposed energy information system (p. 89). Otherwise, States are essentially treated by the Plan as enforcers of Federal laws and standards (pp. 40, 63, etc.) or allocators of Federal funds (pp. 42, 77, etc.). In some cases they lose powers that they now have (e.g., over the pricing of new gas for intrastate markets and over cogenerated electricity). The discussion of nuclear facility siting and licensing (p. 72) does not mention State governments at all, even though the Nuclear Regulatory Commission has recognized that the positive involvement of States is essential to effective nuclear facility regulation.

This appears to represent a reduction of the present role of State governments in energy policymaking. State governments now play a central role in the regulation of resource extraction, surface mining, reclamation, energy facility siting, electricity pricing and transmission, and in enforcing mineral rights laws on other than Federal lands. In addition, many States are active in energy conservation efforts, energy demand estimation, and comprehensive energy planning. Local governments engage in land-use planning, enforcement of building codes, and a variety of other activities that influence energy supply and demand. It has even been suggested that a "new federalism" has been formed in recent years, in which the States have been restored to a full policymaking partnership with the Federal Government.

Societal Impacts

Without significant roles and responsibilities for State and local governments, and a reconciliation of Federal policies with State policies, a National Energy Plan runs the risk of failing to reach its goals. Although the Plan does not exclude a strong State role, it does not assure it. Examples of cases where State and local responsibilities need to be clarified or conflicts resolved include:

1. The implementation of the policy of conversion to coal;
2. The role of the States and localities in residential/commercial weatherization programs;
3. The requirement that State energy offices "encourage" fuel suppliers to undertake conservation services similar to those offered by State utilities;
4. State responsibilities in the siting of nuclear energy facilities;
5. The exemption from State utility regulations for cogeneration facilities;
6. The role of the States in alternative energy resource development—specifically the need to encourage waste heat utilization, to overcome the barriers to using solid waste as a fuel, to facilitate the leasing of geothermal resources, to modify property taxes to encourage the use of solar energy, and to develop criteria and standards for solar equipment.

In addition to these areas requiring further explanation, almost nothing is said in the Plan about the roles of State and local government in channeling tax rebates to the consumer. Nor is there an adequate examination of the role of the States and localities in determining and enforcing mandatory energy-efficiency standards for new buildings and certain home appliances.

Finally, the Plan does not adequately identify and explain the role of State and local governments in its proposed energy information program, (See Issue #1 2.)

In part, this raises serious questions about the implementation of the Plan as a truly national plan-not just a Federal Government plan. In a broader sense, the Plan's proposals are insensitive to regional differences in the economic, environmental, and social impacts of energy programs, For example, new coal production will be limited to a few regions, which makes the Plan an instrument of economic growth and a regional allocator of undesirable effects. Although the Plan shows a clear concern with equity, it overlooks the likelihood that some inequities in benefits and costs will be regional. The process for dealing with these effects (and the regional concerns that anticipate them) will need to incorporate State and local governments as full partners. In particular, they might help on "fine-tuning" energy programs to adjust to local circumstances,

The details of Federal-State relationships are as important as the policy conflicts themselves. For example, Outer Continental Shelf oil development, strategic and tactical planning for Alaskan North Slope oil, and Western Federal coal and geothermal leasing could be facilitated by new planning arrangements, New policy proposals such as that of conversion to coal will also have to take into account a series of complex factors including local preferences for diversity and risk aversion, air quality constraints, logistics, and potential land- and water-use conflicts. For example, if conversion to coal becomes national policy, the States should share in setting federally supervised exemption provisions and/or alternative technical compliance schedules.

Finally, in many cases the States are best able to determine the most appropriate internal agency or agencies to administer delegated Federal programs. State-to-State variations in institutions and infrastructure may require delegation of responsibility to the States for efficient administration of such programs.

Issue 11

The Impact of Utility Rate Reform on Federal-State Relations

The National Energy Plan does not fully address the consequences of some of its proposals for the traditional relationship between State and Federal utility regulatory agencies.

Summary

The traditional relationship between State and Federal regulatory agencies has been formulated over a long period and provides a forum for the development of diverse and innovative approaches. Several aspects of the National Energy Plan would significantly increase the authority of Federal regulatory agencies (particularly that of the proposed Department of Energy) by providing mandatory requirements in several areas where State commissions now have exclusive jurisdiction. Thus, the Plan could lead to changes or modifications in the historical roles of Government or administrative agencies in energy-related areas. The long-range consequences of these changes should be fully explored and debated.

Questions

1, To what extent could the Plan's proposals disrupt well-established relationships between Federal and State regulatory bodies ?

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2. Are there alternative approaches that might be less disruptive and equally effective ?

Background

Several aspects of the Plan would substantially increase the authority of Federal regulatory agencies in matters now the province of State commissions. Federal authority in mandatory weather-proofing programs, conversion strategies, and national utility rate standards are examples of fundamental changes proposed by the Plan. The proposals for national rate design standards are a good case in point.

The Plan's approach is similar to those of the Clean Air Act and the Federal Water Pollution Control Act. States are given a period within which to demonstrate that they can enforce national standards; if they fail to meet nationally determined deadlines, responsibility shifts to the Federal level. One major difference is that at the time the clean air and water pollution acts were adopted, States did not have the experience and competence in environmental law that they have in utility regulation.

While there is general agreement that peak-load pricing for electric utilities can lead to energy savings, for example, there are situations in which the problems of offering such rates might outweigh the advantages. Mandatory national standards might override such atypical situations and create conflicts with State regulatory policies. A national standard should be used only where national interests cannot otherwise be protected. One possible alternative approach would be to offer Federal funds to support State regulatory activities on the condition that a State undertake research leading toward programs to implement the Plan's broad goals. In rate design, for example, a State might be obligated to implement rates that would advance the conservation of oil and natural gas in order to qualify for Federal funds. This would preserve the concept that the Nation's energy situation is serious enough to warrant national policies which State regulators must follow.

Issue 12

Information Systems

The National Energy Plan may not meet the needs of State and local governments for reliable and credible information to use in their energy planning and programs.

Summary

The Plan proposes a three-part energy information program designed to inform the Federal Government on petroleum production and reserves, possible anticompetitive behavior of major oil companies, and local energy supplies and consumption patterns for use in supply emergencies. Except for collecting and maintaining data on local supplies and consumption patterns, the role of State and local governments is not specified in the Plan. For example, it is not clear what information on petroleum production and reserves and petroleum company finances will be made available to the States, although data of this type is important in State energy planning and policy development. In general, detailed and reliable information is needed by all levels of government if the overall objectives of the Plan are to be met.

Questions

1. What specific Information will States be charged with collecting and will the Federal Government provide funding and technical assistance to the States for this endeavor?
2. Will oil and gas reserve data and the information about company finances be available to State and local governments or will the data be treated as proprietary and withheld?
3. State and local governments need information in connection with energy facility siting and licensing proposals. How will this need be met?
4. Will data be made available to the States in a quickly accessible manner, for example, through computer terminal links?

Background

The National Energy Plan proposes a three-part energy information program:

1. A petroleum production and reserve information system.
2. A petroleum company financial data system.
3. An emergency management information system.

These three systems meet a number of high-priority information needs of the Federal Government. However, except for collecting and maintaining data on local supplies and consumption patterns, the roles of State and local governments in the energy information program are not discussed. This seems to overlook the substantial requirements for reliable information of governments outside of Washington, D. C., on which to base energy planning and policies, including allocation and contingency programs. For example, it is not clear whether State governments would have access to the petroleum production and reserve information system or the petroleum company financial data system.

Societal Impacts

Information shortages are a general problem in energy policymaking, and have made it difficult for all levels of government to deal effectively with energy problems. A major consequence has been that many public officials and private citizens are not convinced that a serious energy problem exists.

Information shortages are particularly acute at the State and local levels. What appears to be reasonably adequate data on a national scale often turns out to be inadequate when put to the test of providing support for State or local programs. The problems include: (1) the aggregation of data on a national or large regional scale, when State/local concerns are more detailed; (2) the selection of factors to be measured, which may omit items of local concern; (3) a lack of timely access, either because Federal data are not made available or because States and localities find it difficult to determine what is available; and (4) a question of credibility, when Federal data have not been subject to verification by State or local representatives.

Involving State and local governments in an extended energy information program would improve the information base and enhance its credibility. In addition, it would assist State and local governments to do their part in implementing the energy plan more quickly and effectively. One alternative, for example, would be to expand the proposed emergency management information system to a more comprehensive energy management information system, exchanging information about demand projections and baseline environmental characteristics (collected locally) for information about technology characteristics and siting projections (collected nationally).

Issue 13

Public Participation in Energy Decisionmaking

Failure to develop mechanisms for continuing participation by the public in energy decisions will make successful implementation of the National Energy Plan more difficult.

Summary

As presently formulated, the Plan does not provide any formal mechanism for public participation in the formulation and implementation of energy policy. Such participation is a prerequisite for successful implementation of the Plan. Public involvement provides a way for citizens to communicate their concerns to decisionmakers at all levels and a framework for communicating governmental proposals and technical information to the public. Without a well-defined role, citizens may be cautious about-or even oppose-Government policy. Because effective participation requires technical expertise and full-time attention, financial support could be extended to groups with limited resources that desire a role in the shaping and implementation of the Plan.

Questions

1. Is there a Federal commitment to establishing programs for public participation in policy decisions that would broaden public understanding and open channels for citizen response to policy proposals?

2. Will procedures be established to provide citizen groups with reliable and credible energy information ?

3. Because effective public participation requires technical expertise and, at times, legal representation, can public funds be provided to ensure that groups with limited resources can help set policy proposals?

4. Can administrative details of the National Energy Plan be effectively coordinated through existing agencies to avoid proliferation of bureaucracies with which citizens must deal ?

Background

During the past decade, public insistence on participating in policy decisions has increased. Requirements for public participation programs have been written into many Federal laws, in recognition of the fact that individuals and groups who are not part of decisionmaking institutions are affected by Government decisions and frequently can contribute information and judgments that improve public policy. There also is recognition that in a republic, public policy requires public support if it is to succeed. An informed and supportive public consensus is crucial to policies as basic as energy policies which will require some sacrifice, or at least some change of habits, by all Americans.

Public consensus on energy policy is particularly difficult, because awareness that an energy problem actually exists still is growing and there is no majority opinion about its causes or its consequences. The willingness of people to support new energy policies will depend entirely on their understanding of the problem in detail.

The National Energy Plan acknowledges a need for comment on energy-related legislative proposals as they are considered by Congress and on administrative procedures as they are implemented. The Plan also indicates that the Administration will encourage broad national discussion of its proposals. However, the Plan does not describe a program for achieving structured public involvement.

Several steps must be taken to involve the public in energy policy. Access to the decisionmaking process must be available. A national energy data center should be established to provide reliable and credible information about energy resources and reserves, the characteristics of energy technologies, and proposed energy facility siting schedules, Information will best meet the tests of reliability and credibility if it is: (1) responsive to the concerns of interested parties, (2) produced by people or institutions who are perceived as being professionally competent, and (3) produced by people or institutions without a vested interest in the decisions to be based on the information. Information also must flow in both directions. Public involvement, for example, could facilitate the identification of important secondary design goals in research and development programs and the evaluation of prototype demonstrations of technologies prior to a commercialization decision.

The linkage of citizens with energy policymaking may require that Federal funds support broad participation. Participants with limited financial or technical resources often find it difficult to enter into discussions of energy technologies with industry or Federal agents because technical details are not available to them. Financial support for these parties would ensure that they can develop professional staff representation.

The particular aims of a program for public participation must be: (1) to involve the public early in the policymaking process; and (2) to make public participation a standard part of policymaking. Many citizens (and some local and State governments as well) do not have a clear picture of how energy policy decisions are made. When avenues for public participation are blocked, citizens often use legal and political means to delay proposed actions. Early and regular involvement is one way to increase public understanding of energy problems and policies and to permit public sharing of responsibility for the consequences of policy.

Issue 14

Regional Impacts

Implementation of the National Energy Plan will have serious and inequitable impacts on some regions of the country.

Summary

Energy-use patterns, the presence and extent of energy resources, and environmental, economic, and social conditions vary considerably among the regions of the country. As an overall approach, the Plan does not give these problems sufficient weight or recognition. As a consequence, social, economic, health, and environmental impacts that will occur when the Plan is implemented will be distributed inequitably among various regions of the country. For example, regions that produce and export energy will absorb most of the impacts of energy resource development; regions that already have air quality problems will suffer from the Plan's emphasis on coal conversion; regions whose industries will be affected by conservation and higher energy prices will disproportionately bear the economic costs of the Plan.

While the Plan notes that regional differences exist, it does not indicate how they are to be identified, what equalizing or mitigating actions will be taken, or what the role of State governments and other interested regional parties are to be. It may not be possible in setting national policy to meet the needs of all regions of the country, particularly when some regional needs conflict with national needs. However, it is possible to seek equitable regional distribution of impacts. Failure to do so, and failure to involve States and regional organizations in the process, may mobilize opposition to the Plan.

There is a need for review and evaluation of existing regional intergovernmental organizations and agreements to determine their adequacy. Organizations and regional compacts may have to be restructured and rewritten in order to deal coherently with energy problems.

Questions

1. How are significant regional differences that will affect the equitable distribution of impacts to be identified ?
2. What mitigating actions are to be taken with regard to the regional distribution of impacts?
3. Can policies be developed to accommodate regional diversity through flexibility in the application of regulations, rules, timetables, and tax rates?
4. Could the regional impacts of the Plan be addressed by establishing regional groups of States to work out ways of dealing with environmental and economic impacts?
5. What can be done to protect air quality and human health in areas such as Southern California, where coal burning would aggravate already serious air quality problems?

Background

The National Energy Plan will cause a wide range of impacts, some of which will be peculiar to, or more serious in, some regions of the country. Impacts on communities in coal-producing regions, particularly in the West, could be particularly severe, as could impacts of increased use of coal in areas which already have serious air quality problems.

Increased Coal Production.—To achieve the objectives of the Plan, coal production in the East, Midwest, and West must increase significantly. Increased mining in the East and Midwest will take some pressure off of the environment and established communities in the West. All three regions, however, may be asked to bear burdens in the national interest. In many cases, development can result in significant changes in land- and water-use patterns, air and water quality, and lifestyle.

In the West, for example, energy development will occur for the most part in sparsely populated, predominantly agricultural areas. Farmers will be displaced and some of their water supplies will be diverted to coal producers.

Some of the most severe impacts in the West will result from energy-related population increases. In small localities, existing schools, medical services, and water and sewer facilities could not cope with a sudden influx of population, and in many cases could not be expanded fast enough to meet the needs of growing communities. Capital to expand needed public services and facilities will not be available to most local governments in the short term. Over the long term, revenues from energy production usually will go to counties, while the greatest demand for services and facilities will occur in towns. Lending institutions often hesitate to make loans for homes or other private facilities in communities which are in a boom and bust cycle.

The mismatch between the demand for services and the capacity of local governments to deal with boomtown situations can result in a wholesale degradation of the quality of life in some communities, State help would be available in such situations, but the Federal Government also has a role to play, since national policies often will trigger projects that cause boomtown problems. The Plan should specifically address creating a system for evaluating such impacts and for providing Federal assistance.

Few Federal housing, water and sewer, and transportation programs were designed to respond to the needs of communities which are disrupted by major new energy production projects, Some Federal programs are being modified but assistance programs tailored to the needs of such communities are needed,

Conversion to Coal.—The National Energy Plan proposals to increase the use of coal will have considerably different regional impacts than the coal production goals discussed above. By shifting industry and utilities from oil and gas to coal, air quality problems almost certainly will be exacerbated in regions that already have air quality problems, even when the best available control technology is required,

Some areas such as Southern California will not be able to burn coal without creating serious health hazards. Oil-fired powerplants were not originally designed to burn both oil and coal and must be replaced. There is no transportation system to deliver coal. In addition, most Southern California powerplants are in densely populated air basins where air quality is already bad. Conventional coal plants, even with the best available control technology, are likely to emit more particulate and sulfur than State law allows. Clean burning systems such as low-Btu gasifiers or fluidized-bed coal combustion may resolve these problems, but these technologies are not likely to be commercially available until the late 1980's.

If coal is to be used in California, more effective air quality control than that proposed by the Plan will be required. The Federal Government already has a substantial coal conversion R&D program, but its focus has been primarily on basic process technology and economics. Reorienting the program to accelerate development of clean coal technologies could help. In addition, the coal conversion schedule in the Plan could be adjusted to select a more realistic clean-coal commercialization timetable. For example, combined cycle powerplants could be exempted from taxes on oil use until 1990, especially where coal conversion and new coal-burning capacity are limited by special regional economic and environmental characteristics. Oil and gas taxes could be deferred in cases where States produced a long-range coal conversion schedule consistent with national goals. in such cases, States could administer conversion programs with occasional Federal monitoring.

Issue 15

Energy Resource Development on Federal Lands

The National Energy Plan does not identify and define the role that State and local governments are to play in energy resource development on Federal lands.

Summary

The acceleration of domestic energy development mandated by the Plan will depend significantly on increased production from resources on Federal lands. The production goals of the Plan are not likely to be met unless controversies and problems concerning the management of Federal lands are resolved.

Much of the accelerated development called for by the Plan will probably occur on Federal lands in the West. State governments in the West have expressed concern that the current Federal land-management system does not adequately provide for State participation in decisions about which resources are to be developed and which rules and regulations are to apply to development. Specifically, some State officials object to current procedures which allow developers to nominate areas for development, allow States and other regional interests to object to the nominations, but leave the final judgment to Federal officials. States also are concerned about long delays between nominations and development which characterize the present system. In addition, they are concerned about whether effective controls can be applied when producers activate hundreds of dormant coal leases that were signed years ago.

The Administration has acknowledged that problems exist in current Federal land management programs. However, if the Plan's production goals are to be met, problems and controversies associated with managing the development of federally owned energy resources will have to be addressed more directly, particularly those problems relating to the role of the States in determining which resources are to be developed, which laws and regulations are to be applied, and whether accelerated development can occur without compromising important economic, environmental, and social values.

Questions

1. What role will State governments play in managing and controlling the development of federally owned energy resources ?
2. Can a land management system be established which will protect environmental, social, and economic values and still allow for acceleration of public resource development? Specifically, can the present mineral leasing system for federally owned resources be streamlined without compromising environmental standards?
3. What can be done to control production of coal on land that was leased years ago?

Societal Impacts

Background

Historically, public lands have been prime candidates for development because they are under direct Federal control. The Federal Government owns or controls vast holdings of coal, oil, natural gas, oil shale, and uranium, particularly in the West. Any attempt to greatly accelerate the development of domestic energy supplies will depend upon the expeditious development of the resources located on these public lands.

In the Rocky Mountain-Great Plains region, the Federal Government owns about 43 percent of the land and controls more than **60 percent** of recoverable coal reserves, 80 percent of the estimated oil shale potential, and more than 90 percent of recoverable uranium.

At the present time the West is producing approximately 11 percent of the Nation's crude oil. It is estimated that 10 percent of the Nation's natural gas reserve is located in the region, as well as 42 percent of the coal, and 94 percent of the uranium. All of the Nation's high-quality oil shale is in the West. It is estimated that 80 percent of future coal development in the West will occur on Federal land or will involve federally owned resources.

Energy Research and Development Administration Photo

The production potential implicit in the above data is obvious. However, there are a number of significant problems that must be resolved if this production potential is to be realized. For example, several Western States are concerned that they will not be able to influence development on Federal lands. Some States have more stringent laws and regulations governing development than does the Federal Government. This has led officials in these States to argue that their responsibility to protect the health, welfare, and safety of their citizens will be compromised if State laws and regulations are not applied, first, in designating areas as unsuitable for development, and second, to control resource developments on Federal lands. These issues are beginning to be resolved. Recently, the Secretary of the Interior negotiated agreements with Wyoming which permit more stringent State controls to apply to development. The Department is also reviewing State reclamation statutes. When State requirements are as stringent or more stringent than Federal requirements, States will be given as much control on Federal lands as is constitutionally possible. Federal strip mine legislation pending before Congress contains a provision for the application of State reclamation laws. An issue which is still unresolved is whether States should be able to apply broad energy facility-siting laws to development on Federal land, Because many Federal projects are planned for location on public lands, the States' roles with respect to siting criteria must be resolved in the near future.

A second issue which has significantly delayed the development of Federal coal reserves is the present mineral leasing system, The leasing system is a complicated set of procedures that allow for the nomination of lease sites by potential developers followed by "disnomination" suggestions by State governments and other interested parties. A particular lease could be disnominated on the grounds of its general unsuitability, the unusual nature of an area, or the expected acute adverse effects of the development, Under the present system, the Federal Government asserts a right to make preemptive decisions, a position that the States are challenging. Unless this challenge is dealt with, development on Federal land will be likely to proceed even more slowly than it does now.

The leasing system itself is only one of a number of steps that must be taken to develop Federal resources. The environmental impact statement process must be completed and numerous State and Federal environmental requirements, such as air- and water- quality standards, must be met. Therefore, while the decision to issue a lease is usually based upon very few criteria, a potential developer, after he has obtained the lease, must go to a number of State and Federal agencies seeking various permits. Since these processes (i.e., leasing, environmental impact statement, and acquiring various permits) are generally independent, it can take us as long as 10 years to open a coal mine after a developer expresses interest in a given site. A new leasing system that would allow for the early consideration of a variety of important environmental, social, and economic values put forth by Federal, State and local governments could greatly speed up the process. If these values were established as criteria for a lease, not only would there be more competition for lease sites, but the lease would be immediately consistent with the requirements of State and Federal environmental standards. In all, the processes of environmental impact statements, the review and issuance of the lease, and the application of environmental standards through various permits could be compressed into a unified process.

The final major problem which exists concerning the development of Federal resources is the fact that more than 400 inactive or undeveloped lease sites now exist throughout the West. For years, developers bid on, and received, coal leases that they did not intend to develop immediately. Instead they held these in an inactive status awaiting a rise in the price of coal. These leases were made at a time when little attention was given to environmental values. Consequently, public interest groups and Government officials alike are now greatly concerned that if these sites are developed, a high degree of environmental degradation will result. As improvements are made in the leasing system generally, these nonproducing sites must be examined for their potential as well as their social and environmental impacts.

Issue 16

Coordination of Energy-Related Programs

Some Federal policies and programs may be incompatible with the goals of the National Energy Plan.

Summary

Many Federal programs were established long before it was clear that the United States faced a major energy problem. Some programs, for example in transportation, may not be compatible with the goals of the Plan and may, in fact, require actions that would work at cross-purposes with energy policies. In some cases, the conflicts can be resolved by Executive Order. In others, Congress may have to choose between energy goals and goals in other programs and amend laws to reflect that choice, Although adoption of the Plan need not await an identification and resolution of Federal program inconsistencies, effective management of the Plan will require such a review.

Questions

1. What process should be used to identify Federal programs that are not compatible with the goals of the Plan?
2. When a program supporting an Energy Plan goal and a program in support of some other national goal are found to be incompatible, how should the conflict be resolved?
3. **To what extent can (and should) Ex**ecutive Orders be used to establish priorities among national goals?

4 IS there a mechanism for ensuring that national energy goals are compatible with State and local plans in energy and in other program areas?

Background

The Energy Plan represents a major step in the direction of improved planning for energy conservation and use. Questions will arise, however, as to how the goals of the Plan are to be made compatible with other goals such as those for transportation, environmental protection, water conservation, land use, and housing.

The coordination of Federal programs with respect to particular policy goals is a well-known problem. The Plan—for understandable reasons-does not identify and assess the dozens of Federal programs that affect energy supply, conservation, and conversion. Although the significance of any single case cannot be evaluated without extensive review, examples of possible inconsistencies include: home mortgage programs that give preference to single-family housing; antitrust policies that may jeopardize the proposed petroleum company financial data system if the information sharing is interpreted as affecting competition; and the extensive investment of Federal agencies in energy-consumptive, intercity employee travel.

Two problems arise: (1) how to identify inconsistencies, and (2) how to resolve any inconsistencies that are identified. Neither is easily settled, and the Plan should not be delayed as a result. However, effective management of the Plan will require an early start on the process.

In addition to close interagency coordination, possible alternatives for identifying incompatible programs include requiring an energy-impact section in all environmental impact assessments and requiring, on a one-time basis, a broad-brush energy impact assessment of each program for which Federal funding is sought.

Possible options for resolving inconsistencies ‘ include (1) Presidential Executive Order, (2) interagency coordination, and (3) congressional action. Because many of these decisions will amount to establishing priorities among national goals, it is important that resolution strategies be considered as soon as possible, so that future action is not unduly delayed.

Societal Impacts

Issue 17

Adequacy of the Plan's Oil Import Goals

Will the Plan's oil import goals significantly reduce the danger of an oil shortage in the mid-1980's and the vulnerability of the United States to another oil embargo?

Summary

One major concern that motivated the plan was a fear that world oil exporting countries would not be willing or able to produce as much oil as the importing countries would want to import (at the present real price) by the mid-1980's. The Plan also is designed to respond to the danger of another politically motivated embargo.

The Plan proposes to hold oil imports in 1985 **to between 6 million and 7 million barrels a day, about 4.5 million below the estimated amount that would be imported without changes** in U.S. energy policy. If that import goal is met and if the strategic oil reserve is developed on schedule, the ability of OPEC to impose another embargo or further steep price increases should be sharply limited.

Questions

1. Is a reduction of 4.5 million barrels a day sufficient to avoid a strain on production capacity and a consequent sharp rise in oil prices?
2. Could the United States adjust to any likely oil embargo without unacceptable economic strain?

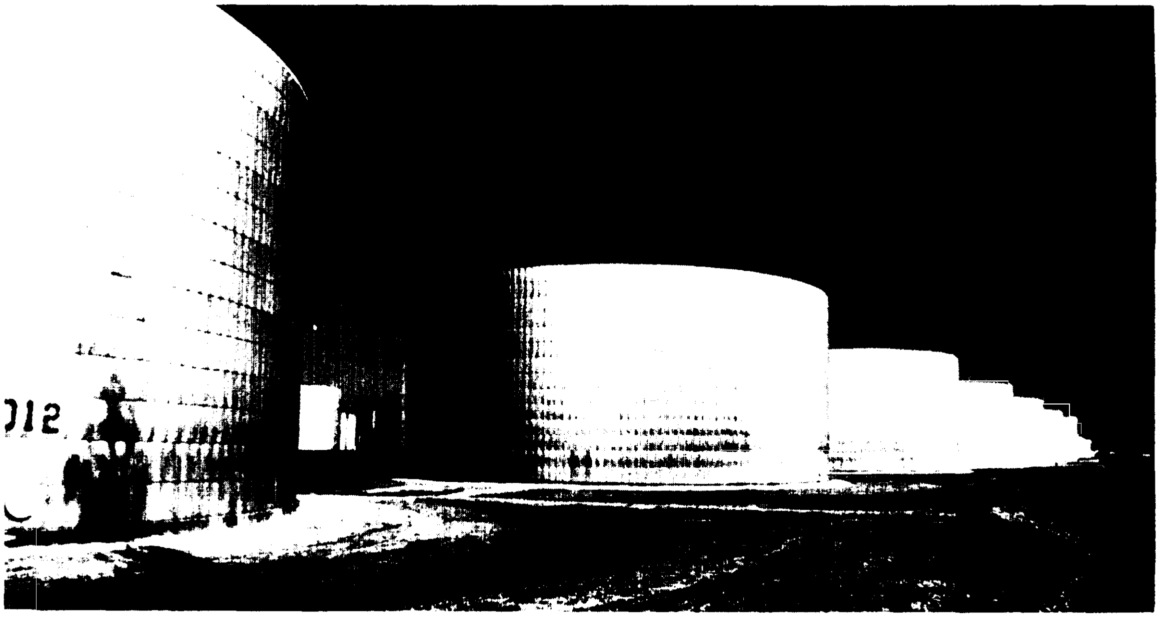
Background

The most pessimistic published forecast of future world energy demand estimates that by 1985 the members of OPEC will have to export between 43 million and 47 million barrels of oil daily to meet demand in the oil-importing countries. World demand, under that circumstance, could only be met if Saudi Arabia produced between 19 million and 23 million barrels a day.

Saudi Arabia may not be either able or willing to expand its capacity to that level, more than twice its 1976 production. There are a number of reasons for adopting a more optimistic view of world oil supply and demand. For example, the Organization for Economic Cooperation and Development (OECD) projects world oil import requirements in 1985 (OECD reference case) at about 35 million barrels a day, some 8 million to 12 million barrels below the most pessimistic case. Under the OECD assumption, Saudi Arabian production could be as low as 7 million barrels a day with a maximum of 15 million barrels.

The embargo problem is somewhat different. The key questions involve the depth and duration of any curtailment of foreign oil supplies. The Arab embargo and supply restrictions of 1973-74 did not, in fact, cut very deep; at its worst point, only about 3.4 million barrels a day were removed from the world market. Also, the embargo lasted only about 5 months.

For purposes of this analysis, it will be assumed that any future embargo would cut Arab oil exports by half. It will further be assumed that by 1985, those countries will



be supplying two-thirds of the total oil import market. Cutting their exports in half would therefore reduce o i l i report availabilities by one-third. Imports, however, will represent only about two-thirds of total oil requirements of the industrialized countries in 1985, so the cut in total oil supplies would be roughly 20 percent. If the International Energy Agency (IEA) emergency plan were to spread this cut evenly among industrial countries, the United States would lose about 4 million barrels a day in total oil supplies, and could adjust to that loss even over a prolonged period,

A somewhat more difficult problem would arise if the IEA plan were not put into effect and if Arab producers simply cut off all oil exports to the United States. In 1976, nearly half of U.S. oil imports came from Arab countries, By 1985, dependence on Arab imports could exceed 60 percent. Without the Plan, this would mean a reduction of U.S. oil supplies of about 7 million barrels a day, or nearly one-third of total consumption. If the Plan's import goals were achieved, the United States would lose about 4 million barrels a day, or about 22 percent of supply.

It appears unlikely, even without the IEA plan, that the Arabs could prevent any of their oil from reaching the United States. Even if they did, the United States could adjust for some time to a loss of 4 million barrels a day. The emergency oil reserve of a billion barrels called for in the Plan would provide half of that amount for a year and a half. The other half could be made up by additional conservation measures. The situation would be much more serious if the loss were 7 million barrels a day. In that event, either the emergency oil reserve would be drawn down much more rapidly, or relatively drastic measures would be taken to cut oil consumption.

Societal Impacts

Issue 18

The Question of Growth

The National Energy Plan assumes that economic growth can and should continue indefinitely and does not discuss the desirability or even the possibility of achieving such growth in a world with finite resources.

Summary

The National Energy Plan presents a long-run objective of sustained economic growth without questioning the appropriateness of this objective. It is widely recognized that growth of the gross national product (GNP) is not an adequate measure of social well-being, particularly when GNP would measure wasted and valuable energy resources but would not reflect savings in energy. Furthermore, continued growth of GNP may not be necessary to achieve basic social objectives; for example, it may be possible to maintain high levels of employment while reducing the rates of growth of GNP and of energy consumption by substituting labor for energy. Such a shift in the structure of the economy, and the long-term changes in capital stock that would be required, are not addressed in the Plan.

In any case, resource availability and ultimate environmental constraints may make sustained economic growth unattainable.

Questions

1. Is per capita GNP a satisfactory measure of national economic well being? is a more than 4-percent annual growth in GNP necessary to achieve social goals?
2. What changes in capital, technology, and population distribution will be necessary to sustain agriculture as oil and gas become more scarce?
3. Will future energy sources and delivery systems require decentralization of the structural and spatial patterns of our society?
4. Will extensive additional sources of future energy like nuclear fusion be wisely used to increase human well-being? Can and should these sources be applied to indefinite growth?

Background

The National Energy Plan encourages conservation and solar energy development, and plans to replace energy-wasteful capital stocks, both of which actions are needed over the long term. While the plan is significantly more farsighted than existing energy policies, it still does not fully reflect the long-term problem.

The president's Plan is based on the premise that economic growth, measured by the gross national product, can and should continue. It is generally accepted (even among economists) that human benefit does not derive from annual-average rates of flow (GNP) but from the stock, quality, and distribution of the goods available to the population and from other intangible but important values such as access to cultural amenities or to wilderness. Furthermore, there is wide agreement now that recent growth in GNP to a large extent has in fact been growth in resource-wasting activities. If waste is to be reduced and human well-being increased, it will be necessary to abandon the practice of equating "progress" with "economic growth" or "growth in GNP, " and to develop more adequate indicators.

The extent to which a 4.2-percent annual growth figure for GNP, which the Plan contemplates, is designed to provide "full" employment does underscore the need for society to alleviate unemployment. But it assumes that there are no other ways to achieve employment goals. Substitution of labor for capital and energy, shortening the workweek, and lowering artificial barriers to entry in the labor market are among available approaches.

In the long run, the United States can adapt to an economy which uses less energy with greater employment and higher income levels. Some European countries such as Sweden and West Germany have living standards equivalent to or higher than the United States but use less energy. Capital and energy have displaced labor in U.S. manufacturing in the past, and energy-intensive goals have been substituted for labor-intensive goals and services. Labor intensity in the future will differ from labor intensity in the past. However, future growth is likely in activities which employ more labor and have fewer requirements for oil and natural gas. In the long run there will be growth in rail transportation, urban housing, solar power, and energy-saving technologies and appliances. There will also be growth in agricultural and forestry fibers and materials, coal production, and towns and cities in regions with these natural resources. Each of these activities would employ more persons and use less energy than the activities they would displace.

A long-term deficiency in the Plan is associated with the need it acknowledges for replacing energy-wasteful capital stocks. The Plan suggests ways to begin changing some of the capital stocks, but focuses on ones that can be changed relatively quickly (e.g., boilers, engines, buildings, etc.) while ignoring several that can be changed only over much longer periods and that waste even more energy.

Agricultural capital is a case in point. The national energy policy of the last several decades has been to replace human labor as rapidly as possible with petroleum energy, and no sector has applied this policy with more vigor than has agriculture. Machines and chemicals used in agriculture now consume 5 or more calories of oil and gas for every calorie of grain produced. Additional human labor will be required to reduce the energy intensiveness of American agriculture.

Even if continued economic growth were desirable it might not be possible. Prolonged growth will require increased combustion of fossil fuels in the next few decades and new sources of energy from thermonuclear fusion or solar power in the next century. Expansion of the processes we

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generally associate with growth may be limited by the availability of other resources and may not be perceived as desirable from a social or environmental point of view. Two specific problems involve the uncertain impacts of introducing additional volumes of carbon dioxide into the atmosphere through increased combustion of fossil fuels, and the consequences of waste heat generation. While the Plan proposes a study of the carbon dioxide problem, the question of waste heat is not addressed at all.

Issue 19

The Population Factor and Energy Planning

Continued population growth, including natural increase and immigration, makes the goals of the National Energy Plan harder to attain. In the long run, no plan to curb the growth in energy demand can succeed without a parallel policy to curb population growth.

Summary

U.S. energy demand is the product of population size and per capita consumption. Thus population growth, of which immigration is an important component, is a factor that must be considered in the development of an energy plan.

The slowdown in the U.S. fertility rate has already had a marked effect on projected energy demand. This trend, however, is being partly offset by an increasing growth in the rate of immigration, including illegal immigrants, which affects both energy demand and unemployment.

Questions

1. What is the optimum population level for the United States, both as to the number of people who can be supported, given available energy resources, and maintenance of an acceptable quality of life? If it is desirable to stabilize population growth at such a level, what policies and programs would best achieve this?

2. What effect will an influx of illegal aliens have upon the achievement of energy plan goals?

Background

There is a widespread, but erroneous, belief that the United States has solved its population problem. The source of this incorrect impression is as follows: the present (momentary) birth rate in the United States is at replacement level, which in about 50 years would produce zero population growth (ZPC), leveling off at about 270 million (compared with today's 217 million).

population growth, however, proceeds at a faster pace than these statistics imply. In fact, the U.S. population is now growing at about 1.2 percent per year, and if this rate continues, the population will double in 58 years. There are two reasons for this.

First, there is a bulge in the composition of the population in the younger, more fertile years. Even at the replacement rate—one child born for each adult—an increase in population results because parents remain alive for many years after children are born.

The second factor is immigration. Estimates indicate that immigration produces a yearly population increase at least equal to the rate of natural increase of U.S. citizens, and the rate of immigration seems to be increasing.

Of particular concern is illegal immigration. By present estimates there are 6 million to 8 million illegal aliens in the United States, with as many as 1.2 million new illegal aliens arriving yearly. If current rates continue, immigration will add 38 million persons to the U.S. population by the year 2000, of whom at least 25 million will be illegal aliens.

It has been estimated that illegal aliens already living in the United States consume more than 1 million barrels of oil equivalent per day, between 2 and 3 percent of total U.S. energy demand. This and other aspects of the immutable relationship between population and energy demands suggest that U.S. population policies merit careful study and debate as an integral part of any future U.S. energy planning.

Societal Impacts

Issue 20

Impact of a Petroleum-Scarce Future on the Automobile Industry

The National Energy Plan does not address itself to the need for an accelerated search for a substitute for oil, the energy resource that is likely to be exhausted first.

Summary

By the end of the century, the fleet of automobiles and trucks in the United States could total 200 million. Unless adequate liquid fuels are in good supply by that time, the alternatives might well be limited to simply abandoning large parts of that fleet or trying to convert cars to electricity. The loss of mobility that would occur with prolonged sharp reductions in liquid fuel supplies and an enforced shutdown of the U.S. automobile industry and its related businesses would have unprecedented impacts on the U.S. economy.

Questions

1, Should alternative fluid-fuel sources such as alcohols and hydrogen be given higher research and development priorities?

2. How can a full range of transportation services be maintained without fluid fuels?

3. Has the possibility that U.S. transportation could be immobilized by high costs or scarcity of petroleum within 20 years been squarely addressed by industry or the executive branch?

4. What Federal agency has been charged with looking at the long-range implications of and alternatives to our present large petroleum-based transportation fleet? Will this become a function of the Department of Energy?

Background

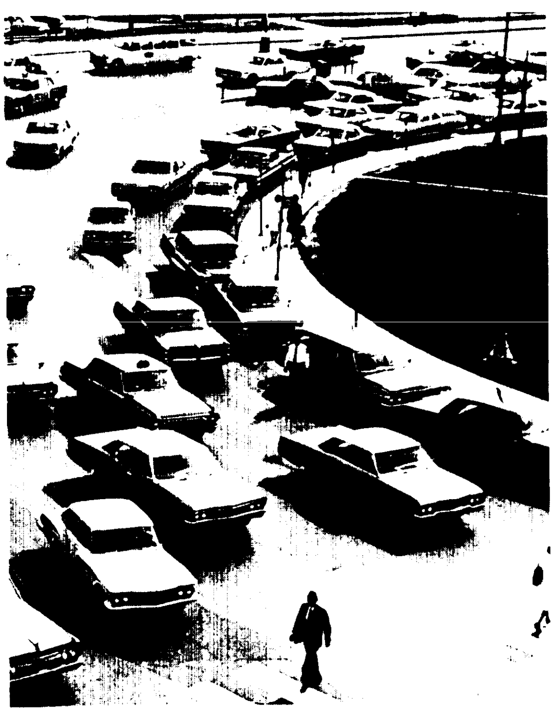
Oil and gas are now burned in applications where coal is available as a substitute. in other applications, particularly in transportation, fluid fuels cannot be replaced on a large scale either by coal or by electricity. There is no evidence to suggest that coal liquefaction can provide enough liquid fuel to provide power for more than a fraction of the Nation's automobile and truck fleet within the next 20 years.

The Plan states that "Government policy has subsidized and protected energy-inefficient . . . transportation. The interstate highway system has encouraged automobile use. Local highways have drawn people, businesses and industry out of central cities into suburbia" (NEP, p. 4). In this process, the United States has become almost totally dependent on the automobile for work, recreation, and the daily tasks of life. Consumers presently pay approximately one-third of their disposable income for mobility, divided roughly 50-50 between personal mobility and the freight costs of consumer products.

As energy becomes more expensive, the United States will have an increasing incentive to shift to public transit and efficient land-use arrangements (Issue #21), This, however, is a slow process. In the meantime, U.S. society and economy would suffer severe disruptions if prolonged and sharp reductions in liquid fuel supplies occurred.

The U.S. dependence on transportation with the vulnerability it conveys underscores the necessity for additional emphasis on development of other liquid fuel technologies, including alcohol. Alcohol can be obtained by fermentation from dispersed biomass and can be used in modern internal-combustion engines.

At a minimum, the National Energy Plan should make provision for a full-scale analysis of the potential for disruption of U.S. transportation as a result of rising oil costs and dwindling oil supplies.



Department of Transportation Photo

Issue 21

Land-Use Patterns

The National Energy Plan acknowledges the opportunities for long-range energy conservation that are inherent in new land-use patterns but offers no proposals to start achieving them.

Summary

Existing patterns of land development, particularly in suburban areas, often **put too much distance between homes and offices or factories, between homes and shops, and between homes and** schools. The development pattern in most areas of the United States makes suburban Americans almost totally dependent on the automobile. It also inhibits installation of the kinds of district heating systems that are common in Europe. Changes in land-use patterns could promote the use of district heating and eventually make it possible to make many trips that now require an automobile by public transportation or by foot. But these changes are long range and fundamental and will take more than one generation to complete. They also will require national guidelines, leadership, and incentives. An example of the kind of first step that could be taken at once is to require a long-range "energy impact statement" for all proposed new transportation programs and for all new urban and suburban construction that involves the use of Federal funds.

Societal Impacts

Questions

1, What steps are being taken to plan for a more energy-efficient distribution of population and industry in the next few decades?

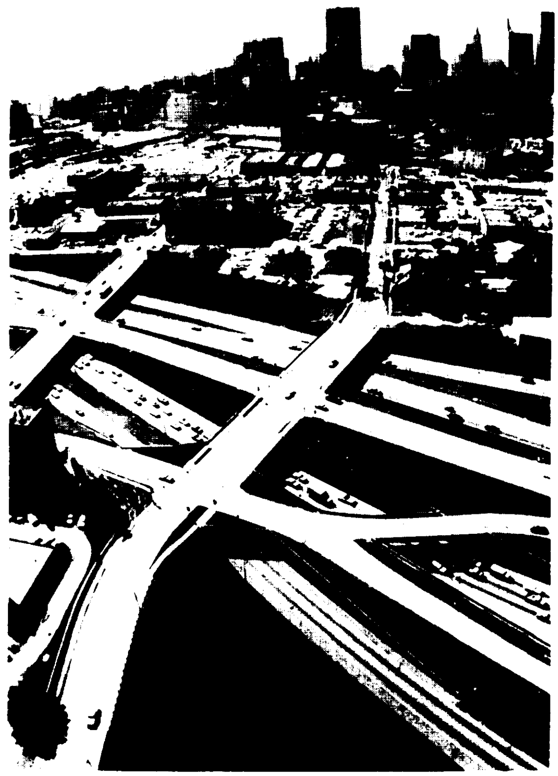
2. What kinds of incentives could encourage people to accept more energy-efficient living and working spatial arrangements ? How can the disincentives which frequently exist at present (e.g., lack of privacy, noise) be eliminated ?

3. What consideration has been given to incorporating a policy-level, land-use office within the Department of Energy?

4. What consideration has been given to coordinating the land-use and transportation functions of the Departments of Housing and Urban Development and Transportation with those of the Department of Energy?

Background

During the post-World War II decades of cheap energy, industrial production was centralized and products were shipped to stores throughout large regions and, in some cases, throughout the Nation. Cheap energy permitted a scattering of jobs, homes, schools, and shops, linked in large part by the automobile. Ninety percent of personal transportation in this country is by passenger car and truck. Nearly 75 percent of all automobile trips cover distances of less than 10 miles. public transportation can provide a substitute for automobile trips only in cases where population densities and geographical relationships are such that relatively large numbers of people are bound for the same destination at about the



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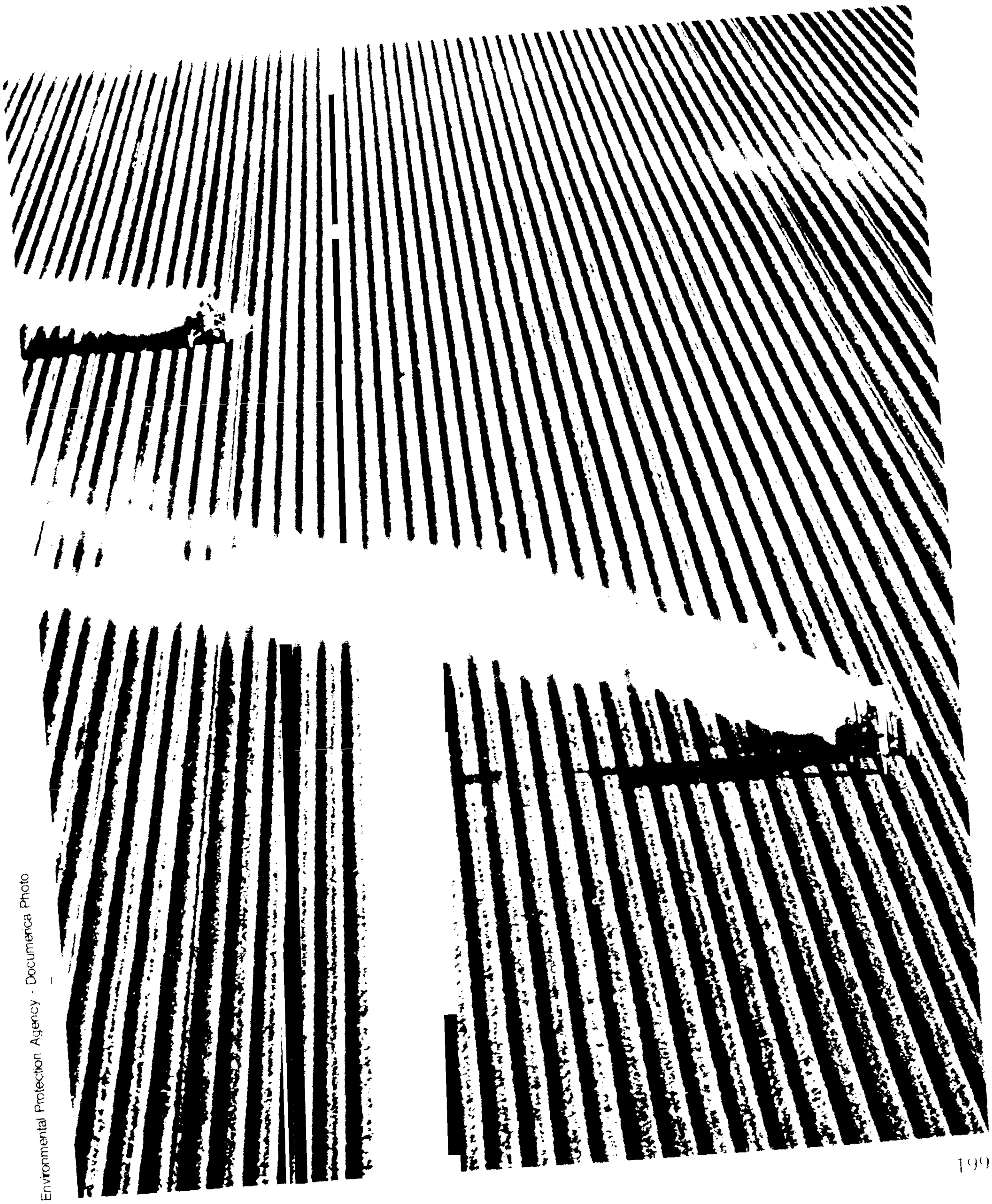
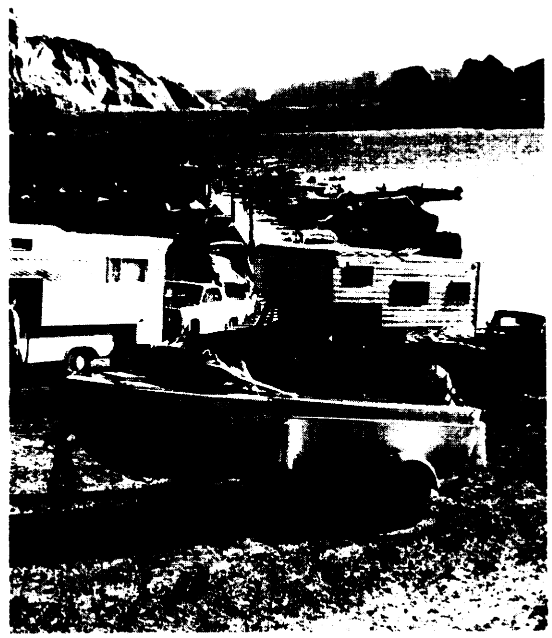


Environmental Protection Agency · Documerica Photo same time. These time and space relationships do not exist in most suburbs today. But as fuels for automobiles become scarce and costly, shoppers and workers will need other means of travel than the car.

One way to reduce dependence on the car is to rearrange urban and suburban development so that work and home or home and shop are more easily linked by public transportation or are close enough together that walking or bicycle riding can substitute for the car. Rearranging land-use patterns is not a short-term solution. it will take over a generation to provide clusters of homes, workplaces, and parks that will reduce the need for transportation as such and still put many amenities within reach of the home. But the new land-use patterns must begin somewhere. Any long-range plan for energy policy should include proposals for beginning such a rearrangement of living and working patterns in the United States.

Department of Transportation Photo



Department of the Interior Photo

Issue 22

In Defense of Amenities

Can cost-benefit analysis justify the sacrifice of irreplaceable national treasures to meet the need for more energy?

Summary

If the American people believe that there are some national treasures that must be regarded as exempt from sacrifice to meet energy or economic goals, then the principle should be explicitly recognized. In addition, such national treasures should be identified so that, if a crisis should occur, panic will not lead the Nation to actions it will later regret.

Although the National Park system was a start in this direction, it is highly selective, focusing on the most popular and obvious types of landscape for preservation. There is a danger that anything not already protected, and perhaps a few things which are, will be destroyed as demands for energy increase.

Questions

1. Can Americans collectively agree that there are national treasures (other than historical shrines) that should be saved for posterity despite energy demands in this generation?

2. Can explicit criteria be worked out, and agreed upon, for identifying national treasures?

3. Can education in the broadest sense, including movies and television, convey a vicarious experience of these treasures to the majority of the people who cannot have the actual experience? Can such vicarious experience be sufficiently keen to elicit support for the preservation of treasures from people who will never enjoy the direct experience ?

Background

In most hard-nosed energy analyses, there is an implied threat that what are called amenities may have to be sacrificed to meet national energy demands. It is implied that the benefits of amenities are soft and cannot be quantified at a high-enough level to justify retaining them in the face of large and easily quantifiable energy needs. This issue should be met head on.

Mount Vernon is generally accepted as a national treasure. The buildings are made largely of wood; their value as fuel, in barrels of oil equivalent, could easily be calculated. As other fuels increase in price will there not finally arrive the time when the increasing value of Mount Vernon as an energy source (which is objectively determinable) must exceed its constant value as an esthetic and historic monument (which cannot be objectively determined)? When this time arrives, do not the principles of cost-benefit analysis dictate that Mount Vernon be converted into firewood?

If the answer to this question is yes, there is no further problem: the pursuit of energy becomes clear sailing—the United States must simply determine the Btu value of all artifacts, treasures or not, and then burn as needed.

But if the answer to this question is no, then the Nation should say so explicitly, because the answer can be, and should be, generalized. If the American people believe that there are some treasures that must be regarded as standing above energy considerations, then these should be explicitly identified in advance of either a crisis or actions taken in panic.

The question of sacrificing a national treasure will not, of course, first be raised with a historic amenity like Mount Vernon: burning this would be unthinkable. But the possibility of sacrifice has already been raised for natural amenities—redwood forests, pristine valleys, and vulnerable species of plants and animals in danger of extinction. Can the Nation—should the Nation-protect these treasures against demands for more energy? Should workmen tear up a beautiful valley to get coal? Should a forest be demolished to get building materials?

The issue of replaceability is relevant. In the case of a landscape which is merely pretty, it is possible to restore its limited beauty after strip mining, if the extractive procedure is properly planned from the outset. The cost of restoration added to the other costs will increase the price of fuel to consumers, but it is generally conceded that justice towards succeeding generations demands that we bear these costs of energy extraction.

There are, however, many works of nature that once lost cannot be restored. The minority who have ever had close contact with a climax hardwood forest or a virgin prairie can speak for the almost indescribable beauty of these complex superorganisms. Once destroyed, neither will be regenerated in a human lifetime: the forest is replaced by a temperate jungle called second growth, and the prairie is followed by an ugly miscellany of weeds. If no further disturbance occurs, ecological succession may eventually restore the original mixture of species, together with the beauty; but in no case will the succession be complete in less than 500 years-a period longer than the lifetime of most nations. For all practical purposes, as far as national policy is concerned, destruction of a beautiful ecological community and the vital information it contains is irreversible.

Can people defend aesthetic goods against utilitarian demands? Those who have experienced the aesthetic delight of them are more likely to rise to their defense, but fortunately it is possible for those who have not had the experience to join in the defense. What percentage of the U.S. population has ever seen, or ever contemplates seeing, Mount Vernon? It surely is less than 10 percent (25 million); yet any proposal to cut up Mount Vernon for firewood would undoubtedly be rejected by the great majority of the electorate. The mere knowledge that this historic shrine is there is an amenity for most Americans-an amenity they will defend against the quantitative onslaught of cost-benefit analysis of the conventional kind.

Appendix I

Appendix I

OTA Background Perspective of Energy Forecasts

Summary

If U.S. energy consumption is allowed to grow at historic rates and if domestic production remains stagnant as it has since 1970, oil-producing nations may not be able to meet world demand in 1985. The gap between world supply and world demand could be as large as 20 percent, and even the threat of a shortage of this magnitude would lead industrial nations to start bidding up prices sharply in the 1980' s." The resulting inflation and the impact of actual shortages would set the stage for recession in strong economies and collapse of weak economies.

Most published forecasts discount the possibility of 'such a crisis because of the assumptions about U.S. consumption and production that are built into their projections. They assume declining rates of growth of demand. They assume rapid expansion of U.S. coal and nuclear-energy production. They assume a reversal of historic declines in domestic production of oil and natural gas.

Based on these assumptions, most forecasters expect the United States to hold its imports to about 10 million barrels a day in 1985, which would keep world supply and demand in balance at close to current world prices. * To achieve this, Saudi Arabian production would increase by about 3 million barrels a day in 1985 to the 12.5 million barrels which the Saudis have said they are willing to produce that year, Other industrial nations would require imports of about 25.3 million barrels a day, roughly equal to or slightly above the anticipated capacity of exporting countries outside of Saudi Arabia.

However, neither declining rates of demand growth or increasing rates of domestic production can be assumed with certainty. A prudent national energy policy must consider the possibility that such changes in historic patterns will not occur rapidly. Energy demand in the United States could grow at historic rates and domestic production could follow present trends. If that were to happen, world oil supply and demand will be thrown sharply out of balance before 1985.

Recent forecasts conclude that the volume of oil produced by the oil exporting nations outside of Saudi Arabia will roughly equal the oil import requirements of nations outside the United States of about 25.3 million barrels per day. If historic demand and supply trends continue, U.S. import requirements would reach about 16.2 million to 19.6 million barrels a day by 1985. If this were to be met along with the rest of the world's demand, a substantial increase in production by Saudi Arabia would be needed. The U.S. import estimate of 16.2 million barrels per day coupled with the expected demand by the rest of the world would require a Saudi production increase to about 16.6 million barrels per day. The high U.S. import estimate and the same non-U.S. demand would mean that Saudi Arabia would have to produce 20 million barrels per day, which is considered the most optimistic estimate of their maximum capacity.

"All projections in this paper assume current world prices

In view of the Saudi political situation, it is not realistic to expect production at either of these high levels. Some factions among Saudi leadership argue that the Nation's long-range interests lie in producing between 2 million and 6 million barrels a day. Current Saudi Arabia production is 9.2 million barrels a day.

Even if Saudi Arabia were willing to produce at the high levels, it would leave the Saudis no reserve capacity to use in moderating pressures among other Organization of Petroleum Exporting Countries (OPEC) nations for price increases.

1. Introduction

The purpose of this paper is to establish a framework on which to base analysis of the proposed National Energy Plan. It will show that this Nation faces the possibility of a substantial gap between demand and domestic supply which may be impossible to close with imported oil.

Two published projections and one draft projection of U.S. energy supply and demand through 1985 are examined. All of these projections make certain assumptions about society's response to higher energy prices, the rate of discovery of new oil, trends in the economy, the impact of environmental constraints such as strip mining regu l at ion, and the rate at which new energy supplies can be introduced. They also estimate the effectiveness of laws that mandate more efficient automobiles and appliances. While these projections differ in detail, they all assume significant shifts from historical rates of growth of supply, demand, or both.

Obviously, if the assumptions are wrong, the forecasts are wrong. If the response to higher prices is weak, if existing conservation measures do not work as anticipated, or if the recent downward trend in energy supply cannot be reversed, U.S. imports could rise to levels that would threaten national security and economic stability. To illustrate how dramatically changes in assumptions can alter forecasts of the gap between U.S. energy demand and domestic supply, 1985 demand and domestic supply are calculated based on continuation of historical trends. It is intended only to estimate the gap that could occur between domestic supply and demand in order to demonstrate the magnitude and importance of the effort that is needed to bring the Nation's energy problem under control.

The projections by the Federal Energy Administration (in draft) * [1 1, the Department of Commerce [2], and EXXON Corporation [3], all conclude that U.S. oil imports will not reach a level that would throw world supply and demand for oil sharply out of balance by 1985 or 1990.

Two other forecasts were evaluated, but are not covered in detail in this paper. One is a Central Intelligence Agency forecast, published in April 1977 [41. The CIA says its forecast "broadly resembles other official and private forecasts, " but is less optimistic about the outlook than most published projections. The pessimism is based in part on a CIA conclusion that the Soviet Union will be a net importer of world oil by 1985, adding to the burden on exporters, and in part on a judgment that supplies from OPEC countries assumed by most other forecasts may not

" The protections in this paper attributed to FEA appear in the draft of the 1977 National Energy Outlook issued January 1977, These figures are subject to change as a result of changes in FEA's assumptions about the effect of various ex - Istlng and future policies.

be available. The possible Soviet import requirements are not considered in this paper. The principal consequence of including them "would be to decrease the likelihood of filling the U.S. domestic supply/demand gap calculated from a "historic trends" analysis.

Another forecast not covered is a report on a 1976 United Nations conference of geologists and economists, which reaches generally optimistic conclusions about world oil supply over a period of 40 to 50 years. The U.N. report focuses on new technologies and oil recovery in the period after 1985, while the time span of this paper is the period between now and the mid-1980's. This paper addresses the important question of production capability within the 1977-85 time frame and not long-term reserve estimates.

II. The Domestic Picture

The United States depends on oil and natural gas for 75 percent of its energy, but domestic production of both resources peaked early in this decade and oil imports have been rising steadily since then. Unless consumption patterns change, imports will continue to increase through 1985.

In 1970, the United States produced crude oil at an average rate of **9.6** million barrels a day [5]. In October 1976, the United States produced slightly more than 8 million barrels a day [6], Alaska fields onshore will add 2 million barrels a day to domestic supplies when they are producing at capacity, but they will not stop the decline in domestic production. The National Petroleum Council expects primary and secondary production from known reserves, excluding the north slope of Alaska, to drop to 3 million barrels a day by 1985 [7]. The difference between declining supply and increasing demand can be made up only with imports and with enhanced recovery techniques and new discoveries of domestic oil.

The United States will continue to rely on oil and natural gas for more than half of its energy at least through 1985 because large-scale new energy systems cannot be put online before then. Although domestic coal supplies are vast, coal production can, at best, probably only hold fossil-fuel contributions to total energy supplies constant through 1985.

The 1974-75 recession slowed the rate of growth in energy demand and, at one point, produced an absolute decline in demand [51. But the Nation is recovering from the recession and adjusting to a four-fold increase in the cost of energy, and demand is rising again. The growth rate will probably be lower than it was before the 1973-74 oil embargo, but it is likely to remain strong enough to widen the gap between demand and domestic supply.

Growing reliance on imports to bridge the gap could have disastrous consequences for the economy and the pattern of life in the United States. As the president noted on April 18, oil imports cost $3.7 billion 6 years ago and may cost $45 billion this year. In addition to this massive outflow of capital, the United States remains vulnerable to cutoffs of supplies similar to the 1973-74 embargo. The "historic trends" analysis suggests that the most crippling consequence of rising imports may occur in the 1980's when the United States could not buy enough oil to meet demand at an acceptable price.

III. Standard Forecasts

As part of its analysis, OTA reviewed the assumptions in forecasts published by the Department of Commerce, EXXON Corp., and a draft forecast by the Federal Energy Administration.

The first three projections estimate demand in 1985 for the industrial, residential/commercial, and transportation sectors as well as supply of domestic and imported oil and natural gas, coal, nuclear, and other energy. These are shown in table 1-1. Table I-2 shows the annual growth rates for the three forecasts and their components.

Table I-l

DEMAND (in Quadrillion Btus)

Sector	1976 Actual	1985 FEA	1985 DOC	1985 EXXON
Res/Comm	27.40	31.6	30,2	34.3
Industrial.	27.01	40.5	35.5	37.8
Transport	19.36	19.2	21.2	22.2
Total	73.77	91.3	86.9	94.3
Electric	21.37	31.4	32.6	32.5

(Note: Electricity, including conversion losses, has been distributed to the three end-use sectors.)

DOMESTIC SUPPLY (in Quadrillion Btus)

Resource	1976 Actual	1985 FEA	1985 DOC	1985 EXXON
Oil and NGL	19.6	23.9	21.2	21.7
Natural Gas	19.2	16.9	17.4	15.2
Coal	13.7	21.6	18.7	20.0
Nuclear	2.0	7.2	7.9	7.5
Hydro and Other	3.1	4,3	4.7	4.0
Total	57.6	73.9	69.9	68.4

IMPORTS (in Quadrillion Btus)

Resource	1976 Actual	1985 FEA	1985 DOC	1985 EXXON
Oil	15.4	16.0	16.9	23.8
Natural Gas	1.0	2.0	1.4	3.4
Total	16.4	18.0	18.3	27.2
Grand Total	74.0	91.9	88.2	95.6

Table I-2

Assumed Rates of Growth in Energy Demand
(in percents)

	1950-1976	1976-1985 FEA	1976-1985 DOC	1976-1985 EXXON
Total Energy.	3.0	2.4	2.0	2.8
Transportation ..., ...	3.1	1.5	1.0	1.5
Residential/Commercial	4.0	1.6	1.1	2.5
Industry . . . . , ...	2.3	4.5	3.1	3.8

A. Demand

Both the draft FEA and the Commerce forecasts assume rates of growth in energy demand that are about 20 to 30 percent below the rate between 1950 and 1976 [5] The assumed rates of growth in transportation, housing, and commercial activities are about half the historic rate. Only the EXXON forecast assumes a growth rate about equal to the 1950-76 experience. (See table I-2.)

The Commerce and draft FEA projections assume better-insulated buildings, more efficient automobiles, more efficient electrical appliances, and a slower rate of new household formation. Both expect higher fuel prices and new taxes on inefficient equipment to speed up replacement of existing automobiles and appliances with more energy-efficient models.

All three forecasts assume that the growth rate for industry will be close to the preembargo rate because most "easy" conservation measures have been taken and further steps will require larger capital investments than the forecasters believe are likely.

B. Supply

All three forecasts assume that problems associated with development of new energy supplies will be overcome-capital will be available for development and conservation measures, air quality and mining safety problems encountered with the use of coal will be resolved, and nuclear powerplants will be built that satisfy environmental and safety concerns.

The supply forecasts assume increases in domestic energy resources of between 10 and 14 Quads by 1985. This rate of growth means reversing recent trends. Domestic energy production was virtually stagnant at about 59.5 Quads between 1970 and 1976, with an actual drop to 57.6 Quads in 1976.

Electricity: All three forecasts expect utilities to increase supplies of electricity by 4.5 to 4.8 percent a year, and to use about 35 percent of primary energy supplies by 1985, compared with 28 percent in 1976. The forecasts assume 7.5 Quads of nuclear power from new plants generating 92,000 Megawatts (MWe) of electricity at a 60-percent capacity factor and existing plants generating about 43,000 MWe, operating at 53 percent of capacity [8].

Oil: All three forecasts assume an increase in domestic oil production from the present 8 million barrels a day to between 10 million and 11.5 million barrels a day. The increases would come from Alaska production, extensive new discoveries-primarily on the outer Continental Shelf (OCS)-and increased secondary and tertiary recovery from existing reservoirs. The oil production forecasts assume removal of price controls on new and enhanced oil. The OCS projections assume resolution of both environmental and technical problems associated with offshore development and optimistic rates of discovery.

Natural gas: The forecasts assume a slowing of the rate of decline in natural gas supplies as a result of new discoveries, mostly on the OCS. The forecasts expect declines in natural gas production over the 9-year period of 11 to 15 percent and assume decontrol of new gas prices and a resolution of OCS problems.

Other: The forecasts also assume some expansion of hydroelectric capacity, generation of some geothermal electricity, and the use of a small amount of solar heat.

C. Assessment

Although it is possible that the new supplies of nuclear power and coal assumed in the three "standard" forecasts will be available in 1985, it is by no means certain. For example, meeting the implied nuclear power timetable would mean trebling existing rates of plant construction and resolving all safety, environmental, and financial problems that now inhibit the growth of nuclear capacity.

Cutting demand in transportation, housing, and commercial activities to the levels assumed in the FEA and Commerce forecasts will require significant changes in attitudes and habits. Many economists insist that low rates of growth in energy demand cannot sustain the level of economic growth the Nation needs to reduce unemployment [91. But limitations on supply, both foreign and domestic, may drive growth rates to even lower levels than those forecast.

IV. The "Historic Trends" Analysis

With relatively modest changes in the assumptions of the "standard forecasts, " the gap between U.S. demand and domestic supply widens by 1985 to about 33 quads (1 6.5 million barrels per day oil equivalent), more than double 1976 levels. This shortfall in domestic supply would occur if present rates of demand growth do not change and if aggregate domestic energy production does not increase faster than historic trends indicate it will.

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Appendix I

A. OTA Assumptions

The following analysis suggests that the United States may be forced to choose between strong policies to lower the rate of growth in energy demand during the next decade and a severe shrinkage of the economy with its attendant rising unemployment by the end of that period-. Projecting historic trends in U.S. energy use and production gives the following situation [5,101 :

Table I-3

DEMAND (in Quadrillion Btus)

Sector	1976	Historic Trends 1985	FEA*	1985 DOC*	EXXON*
Res/Comm	27.4	39.0	31.6	30.2	34.3
Industrial	27.0	33.1	40.5	35.5	37.8
Transportation	19.4	25.5	19.2	21.2	22.2
Total	73.8	97.6	91.3	86.9	94.3

DOMESTIC SUPPLY (in Quadrillion Btus)

Resource	1976	Historic Trends 1985	FEA	1985 DOC	EXXON
Oil and NGL	19.6	20.3	23.9	21.2	21.7
Natural Gas	19.2	14.4	16.9	17.4	15.2
Coal	13.7	18.8	21.6	18.7	20.0
Nuclear	2.0	6.8	7.2	7.9	7.5
Other	3.1	4.3	4.3	4.7	4.0
Total	57.6	64.6	73.9	69.9	68.4

IMPORTS (in Quadrillion Btus)

Resource	1976	Historic Trends 1985	FEA	1985 DOC	EXXON
Oil	15.4	32.5	16.0	16.9	23.8
Natural Gas	1.0	0.5	2.0	1.4	3.4
Total	16.4	33.0	18.0	18.3	27.2
Grand Total	74.0	97.6	9-1.9	88.2	95.6

*refer to Table 1-1.

In this forecast, the average rate of growth in demand from 1950 to 1976 is assumed to continue to 1985. * This rate, 3 percent, was chosen because it covers a period during which higher-than-normal growth rates of the 1960's are balanced by slower growth and, in some cases, absolute declines in demand, following the 1973-74 embargo. The analysis assumes that the 3 percent figure will reflect recent changes in the economy, such as a slowdown in new household formations, recent energy price increases, and the efficiencies in transportation and appliances mandated by the Energy Policy and Conservation Act of 1975 [21.

The estimate that domestic production of oil and natural gas liquids will be about 10 million barrels a day in 1985 is based on continuation of the 1970-76 rate of decline in domestic production, offset by production of 2 million barrels a day of Alaska crude [51. This implies that the decline in production from existing reservoirs would be great enough that enhanced recovery and new discoveries cannot make up the difference.

The natural gas production estimate is also based on the continuation of its present rate of decline (since 1974). The resulting production in 1985 is about 14.1 trillion cubic feet (Tcf). This is slightly higher than the 13.8 Tcf which is projected by the Federal Power Commission [11], (The FPC projection is based on annual net additions of reserves of 9.5 Tcf, the average since 1968.) In order to reach the natural gas output of 17 Tcf, which is assumed by the draft FEA, Commerce, and Exxon projections, net annual additions to reserves of 14.5 Tcf are required, a level that has not been reached since 1967 [1 O]. The "historic trends" estimates do not take into account Alaska gas, which could total 1.0 Tcf a year but which is not likely to be available before 1985, even under the most optimistic assumptions [11.

Total nuclear generating capacity would be 121,000 MWe in 1985 if all existing plants and plants that already have been granted construction permits are completed and operating. The 1985 calculation assumes a capacity factor of 60 percent, compared with the 1976 average of 53 percent [3,8].**

Coal production is estimated at 950 million tons, 10 percent below the FEA forecast but identical to the projection of the National Coal Association. The lower figure implies that environmental problems which now limit the use of high-sulfur Eastern coal will not be fully resolved by 1985 and that its replacement by low-sulfur Western coal will be held down by production and distribution constraints.

The contributions of hydroelectric, geothermal, and solar power are identical to those projected by the FEA draft. Natural gas import estimates are the volumes of liq-

● The period of 1950-76 was chosen to establish the historic trend in order to minimize the effects of shorter term fluctuations such as the high 1960-73 growth rate of 4.0 percent and the decline occurring from 1973 to 1975. The 1960-73 period was one in which the decline in real energy prices was greatest and the substitution of natural gas and petroleum for coal was at its peak. During that period the annual energy growth rate was slightly higher than the GNP growth rate. For the 1950-59 period the energy growth rate was 3. I percent per year compared to a 3.9 percent per year GNP growth rate. Since real energy prices have risen to levels higher than in 1950, it is very unlikely that the 1960-73 growth rate can be duplicated. It is of Interest to note that a continuation of the 4.0 percent growth rate would lead to a demand figure of 105 Quads by 1985 which would leave a gap of 20 million to 22.5 million barrels per day.

"*The capacity factor for January 1977 was 67 percent, a significant Increase over the yearly average. It is not known whether this will be sustained but it is possible that the assumption of 60 percent will be low. A 70 percent capacity factor would increase the nuclear contribution by 1.1 Quads or 550,000 barrels per day equivalent.

uefied natural gas (LNG) that can be delivered through facilities already licensed [12]. The 1.0 Tcf of imported gas in 1976 comes from Canada and is not likely to be available in 1985.

This analysis, using historic production trends, shows a domestic supply of energy about *5.6* Quads higher than the 1970-76 average because coal and nuclear power would more than offset the decline in oil and natural gas production. If, on the other hand, this were not to occur and domestic energy production remains constant at 59.5 Quads as it has since 1970, then the supply/demand gap would increase to 38.1 Quads. Translated into import requirements this would mean that 18.8 million barrels per day of oil would have to be imported to fill the gap.

B. World Implications

The forecasts of U.S. energy supply and demand through 1985 discussed in section III project that the United States will import between 8 million and 12 million barrels of oil a day in that year. They also forecast domestic production of oil and natural gas liquids for the United States of as much as 12 million barrels a day.

The different assumptions implicit in the "historic trends" analysis, however, give a much bleaker picture. The implications of the substantial increase in import requirements indicated by this analysis are clearly seen when the world oil production capability for that time period is examined. Various estimates for that period indicate that the 1985 import requirements for the non-Communist world outside the United States will be about 25.3 million barrels per day [4,13]. This would be approximately equal to the productive capacity of the OPEC nations outside of Saudi Arabia [4,131. OPEC analysts conclude that, because of internal political pressures, Saudi Arabia may be unwilling to push its production beyond 12.5 million barrels a day before the mid-1980's. Saudi officials also have warned that unless the rate of growth in U.S. demand is reduced in the next few years, Saudi Arabia will make no effort to increase production after 1982.

If the United States were faced with the demand/supply gap projected by the historic trends analysis there would be a shortfall on the world market of 4.5 million barrels per day assuming Saudi production of 12 million barrels per day. In the case discussed above where total U.S. domestic production remained at the 1970-76 levels, this shortfall would reach about 7 million barrels per day under the assumption that non-U.S. world demand remained at the 25 million barrel per day level.

The likely consequences of these developments about potential U.S. imports are one of two options for world producers and consumers in 1985;

- Saudi Arabia will produce between 4 million and 7 million barrels a day more than Saudi officials have said they are willing to produce in 1985;*
- the world's industrial nations will be in a bidding war over 4 million to 7 million barrels of oil a day that will drive prices up and still leave some or all nations short of supplies,

***It should be noted that the maximum productive capacity of Saudi Arabia has been estimated by the Petroleum Industry Research Foundation to be about 20 million barrels per day. This is approximately the volume that would be required if the Saudis were to meet the 7 million barrel per day shortfall. Therefore, not only political limits, but very possibly physical limits, would be exceeded by world demand.**

V. Conclusion

The "historic trends" analysis suggests that international shortages and price rationing are inevitable if U.S. oil import demands are not reduced. The basic question appears not to be whether the economy can continue to grow under more stringent conservation policies but whether conservation measures can take hold fast enough to head off the crippling impact of abrupt oil shortages in 1985. Even if policies designed to maximize domestic oil and natural gas production succeed, extension conservation still will be necessary. Conversely, if domestic energy production does not exceed present levels, conservation measures probably cannot hold import demands at levels which producers would be willing to meet.

The goals of the OTA Energy Policy analysis are to determine, from the perspective of this paper:

- Which set of related energy policies is most likely to keep the gap between domestic supply and demand narrow enough so that it can be bridged in the short term; and
- What kind of policies are needed to expand alternative energy supplies over the long term so that the United States will have a solid energy base after world supplies of oil and natural gas are exhausted.

References

[1] 1977 National Energy Outlook Draft, Federal Energy Administration, Jan. 15, 1977.

[2] Forecast of Likely U.S. Energy Supply/Demand Balances for 1985 and 2000 and Implications for U.S. Energy Policy, Office of Energy Programs, U.S. Department of Commerce, Jan. 20, 1977.

[3] Energy Outlook 1977-90, EXXON Corporation, January 1977.

[4] The International Energy Situation: Outlook to 1985, Central Intelligence Agency, Report No. ER77-10240V, April 1977.

[5] Energy Perspectives 2, U.S. Department of Interior, June 1976.

[6] U.S. Department of Interior News Release, Bureau of Mines, Mar. 14, 1977.

[7] Enhanced Oil Recovery, National Petroleum Council, December 1976.

[8] Monthly Energy Review, Federal Energy Administration, National Energy information Center, March 1977.

[9] CRS Workshop on U.S. Energy Demand and Supply for 1975-90, Feb. 28, 1977.

[10] Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas in the United States and Canada as of December 31, 1975, American Gas Association, American Petroleum Institute, and Canadian Petroleum Association, Volume 30, May 1976.

[11] A Realistic View of U.S. Natural Gas Supply, Bureau of Natural Gas, Federal Power Commission, December 1974.

[12] Gas Supply Review, American Gas Association, Volume 5, February 1977.

[13] D. A. Rustow, Foreign Affairs, Vol. 55, April 1977, p. 494.

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Appendix II

Appendix II

The Presidential Energy Initiatives: Some Policy Considerations

The recent Presidential Energy Message to Congress has raised a number of varied and important issues. The ongoing debate over the proper course for public policy would be enhanced, however, if additional information and quantitative analyses were available. The purpose of this paper is to move toward this end with respect to three diverse, but major, areas of concern. They include:

1. Estimates of the price elasticity of supply (supply response to price changes) for petroleum and natural gas from future discoveries in the Outer Continental Shelf (OCS) and Alaska.
2. Estimates of the impact of deregulated domestic petroleum prices on energy industry profits and capital financing requirements.
3. Estimates of the number and location of future coal mine developments necessary to meet stipulated consumption levels and sulfur constraints.

Price elasticity of supply

Major portions of the undiscovered oil and natural gas resources in this country have been forecast to lie in the public domain, either in the OCS or in Alaska (USGS, 1975). Because energy discoveries in these areas tend to be more expensive to produce than those in traditional areas and because of their potential magnitude, the impact of market prices on their development takes on special significance.

Any forecast of price response must be tentative, given the host of factors which can influence the actual outcome. For that reason, it is valuable to simulate possible impacts using models which require all necessary assumptions to be clearly specified. Results can then be duplicated or recomputed using alternative assumptions and comparisons can be made.

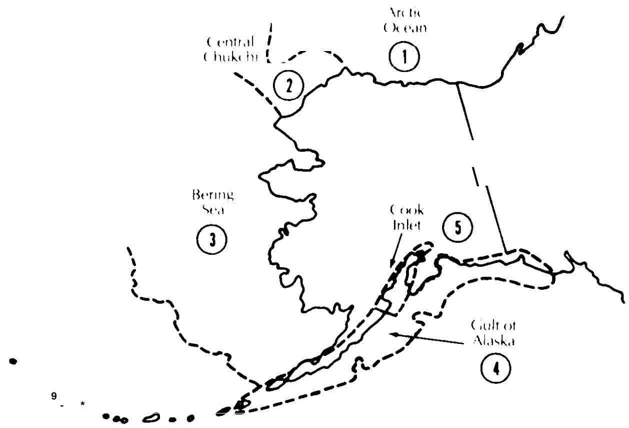
That is the approach used here. A simulation model of private sector behavior under public domain leasing arrangements provides the basis for analysis. Developed over a 4-year period under National Science Foundation funding, the approach has been widely utilized for policy analysis in the past (Kalter and Tyner, 1975a; 1975b; 1975c; Kalter *et al. 1975).* Using concepts of probability theory and Monte Carlo techniques, uncertainty in a number of variables which influence production outcomes can be handled.

For this analysis, potential hydrocarbon discoveries in 13 offshore provinces serve as the focus. [1] Figures II-1 and II-2 outline the areas covered. Appendix A details the input data and assumptions used in the analysis. In general, however, U.S. Geological Survey forecasts of hydrocarbon resources and historical data were used as a basis for deriving field size distributions and the expected number of fields in each OCS subregion. Investment and operating cost data were developed from National petroleum Council information which allowed estimates to be made for individual reservoir sizes in five separate cost regions. Then, the geologic and cost information developed was used in conjunction with

[1] Time was Insufficient to develop the necessary statistical information for an in-depth analysis of the onshore Alaskan situation. However, the results obtained here can be generalized to cover such areas. We will return to this point below.

Figure II-1 Aggregated OCS Provinces Surrounding the Conterminous Lower 48 United States

Figure II-2. Aggregated OCS Provinces Surrounding Alaska



Appendix II

the Monte Carlo simulation model at alternative levels of expected price. The results of these simulations, when coupled with the field number forecasts by size range, provided the basis for the supply price elasticity calculations.

Oil price levels of $11.64 per barrel (the current upper tier regulated price), $13.75 per barrel (approximately the current landed price for imports), $17.00 per barrel, and $22.00 per barrel were simulated. Natural gas prices of $1.40 per thousand cubic feet (Mcf) (approximately the current regulated price for new gas), $1.75 per Mcf (the President's proposed new price level), and $2.25 per Mcf were tested. The current world oil price is equivalent to a $2.43 per Mcf natural gas price.

The results are summarized in table 11-1. Arc elasticity values for various price ranges are displayed for both oil fields (with associated natural gas) and nonassociated natural gas fields (with associated natural gas liquids). The analysis assumed that a competitive leasing system, similar to the current cash bonus approach, would be used to allocate public domain lands to the private sector for development and that development would not occur if the chance of a less than normal profit falls below 50 percent.[2]

The elasticity values calculated are startling but perhaps, on reflection, not surprising. For oil, supply is highly inelastic above $11.64 per barrel in all but the high-cost regions of the OCS.[3] In these regions (Arctic Ocean, Central Chukchi, Bering Sea, and Cook inlet), some price elasticity is exhibited up to a $17.00 per barrel price. But even then, only the highest cost areas (Arctic Ocean and Central Chukchi) require prices of $17.00 per barrel to foster development. Most production in high-cost regions will take place at prices equivalent to current world market prices ($1 3.75 per barrel). Small oil reservoirs (less than 50 million barrels) usually cannot be profitably developed in high-cost areas even at $22.00 per barrel, whereas medium- and large-size reservoirs are developable at prices below $17.00 per barrel. Overall, supply is price elastic in the $11.64 to $13.75 per barrel range only, with moderate inelasticity between $13.75 and $17.00 per barrel and high inelasticity over $17.00 per barrel.

Thus, supply availability from the OCS appears more dependent on the pace of Federal leasing and the size of resource discoveries than on price (assuming that price is allowed to reflect inflationary impacts over time).[4] Higher prices for the produced product would merely be reflected in higher bids for OCS leases if the leasing system were competitive and methods are devised to reduce risk to the private sector developer (such as greater use of contingency payments in lieu of the cash bonus).

[2]NeIther assumption, however, appears critical to the results. Supplemental analysis showed that permitting development whenever after-tax net present values were positive (regardless of the probability of loss) actually lowered the elasticity values in the few situations where development was affected. Using a profit share form of leasing system had little impact on the results.

[3]That is, a given percentage increase in oi1 prices will result in a small percent change in production. An elasticity value of one implies that the percentage change in price equals the percentage change in production. A value greater than one means a greater percentage increase in production (elastic supply) and conversely for a value less than one (inelastic supply),

[4]Note that the results shown assume real prices and relate to total net production. Thus, they give no indication of the sensitivity of production profiles (or timing) to price changes.

Table II-1 .—Supply Price Elasticity Values by OCS Province Based on Monte Carlo Simulation[a]

Province	Oil				Natural Gas		
	$11.64-13.75 bbl.	$13.75-17.00 bbl.	$17.00-22.00 bbl.	$11.64-22.00 bbl.	$1.40-1.75/Mcf	$1.75-2.25/Mcf	$1.40-2.25/Mcf
1. Arctic Ocean	0.68	2.74	0.45	1.81	—	0,29	0.29
2. Central Chukchi	—	2.99	0.24	1.76	—	0.32	0.32
3. Bering Sea	6,23	0.46	0.20	2.60	4.08	0.41	2.60
4. Gulf of Alaska	0.04	0.04	0.18	0.12	0.09	0.02	0.06
5. Cook Inlet	4.28	0.51	0.20	1.92	0.25	4.24	2.7.5
6. North Pacific	0.83	0.24	0.05	0.41	0.00	0.00	0.00
7. Santa Cruz	0.20	0.10	0.02	0.12	0.05	0.06	0.12
8. S. California	0.19	0.05	0.03	0.10	0.08	0.03	0.06
9. Central and Western Gulf	0.33	0,04	0.02	0.13	0.00	0.00	0.00
10. MAFLA	0.20	0,08	0.04	0.12	0.03	0.04	0.04
11. North Atlantic	0.08	0.03	0.48	0.27	0.00	0.00	0,00
12. Central Atlantic	0.04	0.64	0.14	0.35	0.04	0.04	0.04
13. South Atlantic	0.18	0.08	0.04	0.11	0.00	0.69	0.41
Overall	1.85	0.81	0.20	1.17	1.00	0.13	0.62

[a]See Appendix II for input data and assumptions used.

The situation for nonassociated natural gas is similar to that for oil. If anything, supply is even more inelastic to price changes. However, development of gas in high-cost regions will not commence below $1.75 per Mcf. Small- and medium-size finds (below 600 Bcf) in many of these regions would not be developed at prices as high as $2.25 per Mcf. Potential finds in the Bering Sea and Cook Inlet, however, appear price responsive over the range simulated. Overall, a unitary price elasticity is exhibited in the range of $1.40 to $1.75 per Mcf (due to additional reservoirs that would be developed in the Bering Sea), but supply is moderately inelastic between $1.75 and $2.25 per Mcf.

With respect to onshore Alaska, the results shown for higher cost OCS regions will probably bracket the actual situation. Geological Survey estimates (1975) indicate that the bulk of Alaska's undiscovered crude oil and natural gas deposits occur in the North Slope region, with small amounts of resources in the south adjacent to the Gulf of Alaska and Cook Inlet. Exploration and production costs on the North Slope are roughly equivalent to those in the Bering Sea and Cook Inlet. For example, exploration costs per well are now approaching 10 million dollars in the NPR-4 area, whereas

Table II-2.—Cumulative Production by OCS Province Based on Monte Carlo Simulation

Province	Oil (million barrels)				Natural Gas (billion cubic feet)		
	$1 1.64/ bbl.	$1 3.75/ bbl.	$1 7.00/ bbl.	$22.00/ bbl.	$1 .40/ Mcf	$1 .75/ Mcf	$2.25/ Mcf
1. Artic Ocean	2167.33	2391.90	3643.27	4018.64	—	4973.57	5293.26
2. Central Chukchi	—	2018.94	3174.43	3349.21	—	3905.40	4185.24
3. Bering Sea	1685.56	3298.11	3589.41	3749.66	3457.22	6278.61	6856.00
4. Gulf of Alaska	1612.46	1623.45	1634.53	1702.92	3415.61	3478.30	3496.61
s. Cook Inlet	327.24	542.01	594.97	622.58	643.62	675.63	1312.70
6. North Pacific	586.43	587.46	614.73	621.26	3124.67	3127.19	3129.24
7. Santa Cruz	273.07	281.47	286.79	288,06	463.12	467.92	474.53
8. S. California	2081.77	2142.32	2161.32	2176.35	1580.30	1607.09	1619,03
9. Central and Western Gulf	2275.37	2391.74	2409.55	2418.00	35494.89	35494.89	35494.89
10. MAFLA	1014.49	1045.46	1061.09	1069.65	1734.94	1746.15	1761.87
11. North Atlantic	916.46	927.13	932.69	1034.80	4430.18	4430.18	4430.18
12. Central Atlantic	1552.15	1560.97	1752.31	1806.55	3773.77	3802.27	3837.34
13. South Atlantic	792.99	815.43	828.14	835.68	1242.84	1243.65	1434.15
overall	15285.32	19626.39	22683.23	23693.36	59361.16	71230.85	73325.04

those in the Bering Sea are estimated at 8.5 million dollars (Kalter et al., 1975). Thus, by analogy, price impacts on supply for similar sized reservoirs in the North Slope can be compared with those of the Bering Sea or Cook Inlet. Similarly, conditions in southern Alaska may be comparable, with regard to costs, to those in the Gulf of Alaska or the North Atlantic.

The results discussed above are basically confirmed by actual experience. Current oil prices are apparently adequate to foster competitive bidding for OCS areas like Cook Inlet, the Gulf of Alaska, and the Atlantic. This is apparent from the results of recent lease sales in those areas. Prudhoe Bay development is occurring on Alaska's North Slope and plans are contemplated to extend this activity offshore. The only issue appears to be what reservoir sizes will be developed once discovery occurs. This analysis suggests that prices between $17.00 and $22.00 per barrel (in real terms) will have little impact on this question.

However, the analysis also suggests (see table II-2) that hydrocarbon resources may be in short supply relative to demands Therefore, if continued price regulation is contemplated as one means of reducing the economic rent (excess profits) resulting from hydrocarbon development, taxes should be substituted to make up the difference between the controlled price and the market clearing level. Only in this manner can a situation of excess demand, like that which has plagued the natural gas market since the 1960's, be avoided.

It must be recognized, however, that unless price elasticity is actually zero, any form of price regulation will lead to some degree of inefficiency. This will occur even with the imposition of an adequate tax to bring consumer prices up to the world price level. Without a tax, inefficiencies will result under all conditions of price elasticity. The question that must be resolved is whether the equity aspects of the problem outweigh any resulting losses in economic efficiency and whether the price regulation-taxation approach is the "best" means of treating the equity problem.

Oil price deregulation impacts

Currently, the wellhead prices for domestic crude oil production are regulated by the Federal Energy Administration. Production is divided into three components—old oil, new oil, and stripper-well production. Old oil is priced at the so-called lower tier ceiling which is the sum of the posted field price on May 15, 1973 and $1.35 per barrel. The national average price for old oil was $5.17 per barrel in December of 1976. New oil was priced at $11.64 per barrel and stripper production (from wells producing less than 10 barrels per day) was priced at $13.30 per barrel (the stripper price has since risen to world oil price levels).

The exact amount of old and new oil being produced is somewhat difficult to determine for a given reservoir or field, In essence, all oil which is not new oil is old oil. New oil, however, has changed definition somewhat over the past several years and its current definition is difficult to apply without historical information on a field's production. Perhaps the best working proxy for purposes of policy analysis is to classify all production which commenced after May 15, 1973 as new oil. Although this definition ignores so-called "released" oil (old oil no longer controlled at the lower tier price due to previous Government action), the bias introduced is in underestimating the amount of oil currently commanding upper tier prices. Overall, approximately 50 percent of domestic crude oil production was sold as old oil in December of 1976, with 36 percent as new and 14 percent as stripper oil.

Aggregate values, such as these, or values applying to one point in time are, however, of little value in ascertaining the impact of a policy which would deregulate domestic crude oil prices. For that purpose, knowledge of future production profiles and the division of those profiles among regulation categories is needed. Only with that level of detail can accurate impacts on industry profits and capital financing requirements be assessed.

'For example, the simulations indicated that a maximum of 15 billion barrels of additional oil could be expected from the OCS at $11.64 pet barrel prices and less than 24 billion barrels at $22.00 per barrel, The value at current world 011 prtces approached 20 billion barrels. This is roughly a 3.2 year's supply for the United States at the consumption rate of 17 million barrels per day (just under the actual rate in 1976).

Similarly, natural gas availability at $1.40 per Mcf just exceeds 59 trillion cubic feet and Increases to 73 trillion cubic feet at $2.25 per Mcf. The President's proposal of $1,75 per Mcf resulted in 71 trillion cubic feet, just about 3.5 year's supply at last year's consumption rate.

Appendix II

Knowledge of production profiles and their division implies the availability of detailed information on a field by field basis so that proper account can be taken of production decline rates, the timing of production changes between regulatory categories (i.e., old or new oil to stripper), and the exhaustion of primary-secondary production in a reservoir. Apparently, information of this type is not publicly available from Government agencies or the industry.

For this evaluation, then, information had to be independently developed. As a basis, a computerized reservoir data file was used, covering **835** oil reservoirs (385 fields) in 19 States. This data base was originally developed, for the Government, by Lewin and Associates, Inc., as part of a study on enhanced oil recovery technology (1 977). From that data base, the following information can be derived for each reservoir:

1. The volume of in-place oil yet to be produced by primary and secondary techniques (the FEA has proposed that tertiary production receive world prices).
2. The actual production in 1974.
3. The reservoir decline rate.
4. The number of producing wells located in the reservoir.
5. The year in which the reservoir was first produced.

The data cover approximately 52 percent of the known remaining oil in place in the United States and 47 percent of actual 1974 domestic production. By 1976, this figure had dropped to 40 percent if the decline rates given are accurate.

Although caution must be used in interpreting the data (due to the use of numerous sources leading to potential inconsistencies and the need to often estimate certain values like decline rates), this file is probably the best available at the present time. Given that qualification, the following steps were taken with the data to analyze the price deregulation issue.

1. For each reservoir, 1974 actual production, the decline rate and remaining primary-secondary reserves were used to derive a future production profile. It was assumed, as is conventional, that field production would decline exponentially (Roe-at) through time (Newendrop, 1975). Cumulative production was constrained so as not to exceed available reserves.
2. Based upon the year when field production commenced, the resulting production profile was then initially assigned to either a new or old oil category.
3. Annual production was then divided by the number of producing wells to ascertain if and when production from the field should be assigned to the stripper category. If this was called for, the assignment was made at the proper point in the production time horizon.
4. Finally, production profiles in the three price categories (old, new, and stripper) were multiplied by assumed values for regulated and deregulated prices in each category. December 1976 price values ($5.1 7 per barrel for old oil and $11.64 per barrel for new oil) were used for the regulation scenario and $13.75 per barrel was used for stripper production and for the case of deregulation.

The results are summarized in tables II-3, II-4, and II-5 for both onshore and offshore

Table n-3.-Annual Oil Production by Price Category from Selected Known 1974 Onshore and Offshore Reservoirs for the Period 1977-94

(million barrels per year)

Year	Onshore Production				Offshore Production				Total Production			
	Old Oil	New Oil	Stripper Oil	Total*	Old Oil	New Oil	Stripper Oil	Total*	Old Oil	New Oil	Stripper	Total
1977	890.8	3.3	105.1	999.2	67.2	3.5	0.1	70.8	958.0	6.8	105.2	1070.0
1978	764.8	2.9	99,9	867.6	55.9	3.1	0.1	59.0	820.7	6.0	100.0	926.7
1979	623.5	2,6	101.7	727.8	46.7	2.7	0.1	49.6	670.2	5.3	101.8	777.3
1980	533.5	2.3	92,4	628.2	35.4	2.3	0.2	37,9	568.9	4.6	92.6	666.1
1981	439.1	2.1	86.4	527.6	26.2	2.0	0.1	28.3	465.3	4.1	86.5	555.9
1982	356.7	1.8	81.7	440.2	20.7	1.7	0.2	22.5	377.4	3.5	81.9	462.8
1983	282.4	1.6	78.1	362,1	14.6	1.5	0,2	16.3	297.0	3.1	78.3	378.4
1984	239.1	1.4	71.2	311.7	12.4	1.4	0.2	13.9	251.5	2.8	71.3	325.6
1985	196.5	1.3	69.4	267.2	9.4	1.2	0.3	10,8	205.9	2.5	69.7	278.1
1986	165.4	1,1	66.0	232.5	8.1	1.1	0.4	9.6	173.5	2.2	66.4	242.1
1987	138.0	1.0	61.6	200.6	7.1	1.0	0.4	8.5	145.1	2.0	62.0	209.1
1988	111.0	0.9	62.5	174,5	6.2	0.9	0.4	7,5	117.2	1.8	62.9	181.9
1989	99.0	0.8	56.3	156.2	5.5	0.8	0.4	6.7	104.5	1.6	56.7	162.8
1990	87.4	0.7	50.0	138.1	4.3	0.7	0.6	5.8	91.7	1.4	50.6	143.7
1991	75.0	0.6	47.1	122,7	3.8	0.7	0.5	5,0	78.8	1.3	47.6	127.7
1992	63.4	0.6	43.7	107,7	2.4	0.6	0,5	3.5	65.8	1.2	44.2	111.2
1993	56.0	0.5	41.0	97,5	2.0	0,6	0.4	3.0	58.0	1.1	41.4	100.5
1994	50.4	0.4	37.5	88.3	1.8	0.5	0.3	2.7	52.2	0.9	37.8	90.9
Total* .. .	5171.9	26.1	1251.5	6449.5	329.7	26.2	5.5	361.3	5501.6	52.3	1257.0	6810.9

"Details may not add to totals due to rounding

fields. Table II-3 displays the resulting production profiles through 1994.[6] Table II-4 shows the gross revenue received by the oil industry under the price regulation assumptions and table II-5 indicates the same information for deregulation.

These values need to be read with several notes of caution, however. First, the production numbers indicate that 90 percent of the reservoir sample output is initially (1 977) classified as old oil, while less than 1 percent is new oil and almost 10 percent is derived from stripper production. Although the sample pertains to less than 40 percent of total 1977 production, this allocation among price categories is substantially different than the December 1976 value for total domestic production of 50 percent old oil, 36 percent new oil, and 14 percent stripper production. Obviously, new oil discoveries since 1974 would account for some of this difference. But major portions may also be due to our inability to distinguish between price categories with complete accuracy given the information in the data base. A portion of the distinction may also

[6] Continued price regulation would actually result in some control well into the next century but the amounts affected would rapidly decline and become inconsequential (relative to the total energy economy).

Appendix II

Table n-4.-Annual Gross Revenue Under Continued Price Regulation by Price Category from Selected Known 1974 Onshore and Offshore Reservoirs for the Period 1977-94

(million dollars)

Year	Onshore Productlon				Offshore Production				Total Production			
	Old Oil	New Oil	Stripper Oil	Total*	Old Oil	New Oil	Stripper Oil	Total.	Old Oil	New Oil	Stripper Oil	Total
1977	4605.6	38.4	1445.0	6089.1	347.4	40.2	1.8	389.4	4953.0	78.6	1446.8	6478.5
1978	3953.9	34.1	1373.1	5361.1	288.8	35.6	1.6	326.0	4242.7	69.7	1374.7	5687.1
1979	3223.3	30.3	1398.8	4652,4	241.5	31.6	1.8	275.0	3464.8	61.9	1400.6	4927.4
1980	2758.3	26.9	1269.8	4055.1	182.8	27.2	3.2	213.2	2941.1	54.1	1273.0	4268.3
1981. , . .	2270.1	23.9	1188.6	3482.6	135.3	22.8	2.0	160.1	2405.4	46.7	1190.6	3642.7
1982	1844.0	21,3	1123.3	2988.6	106.8	-19.3	2.3	128.4	1950.8	40.6	1125.6	3117.0
1983	1460.2	18.9	1073.4	2552.5	75.2	17.4	3.1	95.7	1535.4	36.3	1076.5	2648.2
1984	1236.0	16.8	978.3	2231.1	63.8	15.6	2.3	81.8	1299.8	32.4	980.6	2312.9
1985	1016.1	15.0	954.1	1985.1	48.4	14.1	3.7	66.2	1064.5	29.1	957,8	2051.3
1986	855.1	13.3	907.3	1775.6	41.9	12.8	5.2	59.9	897.0	26.1	912.5	1835.5
1987	713.3	11.8	847.1	1572.2	36.8	11.5	5.3	53.7	750.1	23.3	852.4	1625.9
1988	574.2	10.5	859.5	1444.2	31.8	10.5	5.6	48.0	606.0	21.0	865.1	1492.2
1989	512.0	9.3	774.5	1295.8	28.4	9.5	5.5	43.4	540.4	18.8	780.0	1339.2
1990	452.0	8.3	687.6	1147.8	23.2	8.6	8.3	40.1	475.2	16.9	695.9	1187.9
1991	387.5	7.3	647.8	1042.7	19.6	7.9	7.2	34.7	407.1	15.2	655.0	1077.4
1992	327.8	6.5	600.8	935.1	12.4	7.2	6.7	26,3	340.2	13.7	607.5	961.4
1993	289.3	5.8	564.0	859.0	10.5	6.6	5.0	22.1	299.8	12.4	569.0	881.1
1994 .., .	260.5	5.2	515.0	780.5	9.5	6.0	4.6	20.1	270.0	11.2	519.6	800.6
Total" . ..	26738.9	303.7	17208	.044205.7	1704.5	304.7	75.2	2084.4	28443.4	608.4	17283	.246290.1

'Details may not add to totals due to rounding

be due to the known reservoirs, which are not included in the data file, having a substantially different distribution of production among price categories. For example, the sample includes most major fields and reservoirs. The smaller field not included may therefore contain a greater portion of the stripper production or "released old" oil. In any case, the direction of any analytical bias that results from these data problems appears to be toward overestimating the financial impact of price deregulation for the sample.

On the other hand, the deregulation revenues shown result from the assumption that all oil prices would rise to the current world level (1 3.75) and remain at that *real* value throughout the analytical time period. This is probably a conservative judgment with the probability of higher real prices through time being greater. The result would be an underestimation of deregulation impacts which becomes relatively more severe through the time profile.

With these points in mind, one would like to obtain an aggregate view of the impacts resulting from deregulation. If we restrict our evaluation to known *1974* reservoirs, a range of impacts can be approxi-

Table II-5.—Annua[Gross Revenue Under ‘Price Deregulation by Price Category from Selected Known 1974 Onshore and Offshore Reservoirs for the Period 1977-1994

(million dollars)

Year	Onshore Product Ion				Offshore Production				Total Production			
	Old Oil	New Oil	Stripper	Total*	old Oil	New Oil	Stripper Oil	Total*	Old Oil	New Oil	Stripper Oil	Total
1977	12249.0	45.3	1445.0	13739.4	924.0	47,5	1.8	973.3	13173.0	92.8	1446.8	14712.7
1978	10515.6	40.3	1373.1	11929.0	768.1	42.1	1.6	811.8	11283.7	82.4	1374.7	12740.8
1979	8572.6	35.8	1398.8	10007.2	642.5	37.4	1.8	681.7	9215.1	73.2	1400.6	10688.9
1980	7335.9	31.8	1269,8	8637.6	486.3	32.2	3.2	521.6	7822.2	64.0	1273.0	9159.2
1981	6037.4	28,3	1188.6	7254.3	359.8	26.9	2.0	388.7	6397.2	55.2	1190.6	7643.0
1982	4904.2	25.1	1123.3	6052.6	284.0	22.8	2.3	309.2	5188.2	47.9	1125.6	6361.8
1983	3883.4	22.3	1073.4	4979.2	200.0	20.5	3.1	223.7	4083.4	42.8	1076.5	5202.9
1984	3287.1	19.8	978.3	4285.3	169.7	18.5	2.3	190.5	3456.8	38.3	980.6	4475.8
1985	2702.3	17.6	954.1	3674.0	128.7	16.7	3.7	149.1	2831.0	34.3	957.8	3823.1
1986	2274.1	15.7	907.3	3197.1	111.4	15.1	5.2	131.7	2385.5	30.8	912.5	3328.8
1987	1897.1	13.9	847.1	2758.1	98.0	13.6	5.3	116.9	1995.1	27.5	852.4	2875.0
1988	1527.1	12.4	859.5	2399.0	84.7	12.4	5.6	102.7	1611.8	24.8	865.1	2501.7
1989	1361.7	11.0	774.5	2147.1	75.6	11.2	5.5	92.3	1437.3	22.2	780.0	2239.4
1990	1202.0	9.8	687.6	1899.4	61.8	10.2	8.3	80.3	1263.8	20.0	695.9	1979.7
1991, . . .	1030.6	8.7	647.8	1687.1	52.2	9.3	7.2	68.7	1082.8	18.0	655.0	1755.8
1992	871.8	7.7	600.8	1480.3	32.9	8.5	6.7	48.1	904.7	16.2	607.5	1528.4
1993. , . .	769.4	6.9	563.9	1340.2	27.9	7.8	5.0	40.8	797.3	14.7	568.9	1381.0
1994	692.7	6.1	514.9	1213.7	25.3	7.1	4.6	37.0	718.0	13.2	519.5	1250.7
Total” . . .	71114.2	358.8	17208 .0	88681.0	4533.2	359.9	75.2	4968.3	75647.4	718.1	17283 .2	93649.3

“Details may not add to totals due to rounding

mated.[7] Assuming that the reservoir sample will continue to reflect 47 percent of the production from 1974 reservoirs impacted by price regulation and that the decline rate of the remaining 53 percent is similar to that of the sample, the overall impacted production profile can be approximated.

It is unlikely that the distribution of this additional production among price categories would be more heavily weighted toward old oil than that of the sample. Thus, one extreme of the impact range can be that all production not in the sample is classified as stripper oil.

Table II-6 summarizes these results for two price scenarios. The first assumes a constant deregulated price of *$13.75* per barrel, while the second permits price to compound at *5* percent per year. The total impacted production profile as well as the range in net income (after taxes) to producers is shown for each deregulation situation.[8]

[7] If all discoveries since 1974 were permitted to obtain market price for production, the coverage of the analysis would be complete. To the extent this is not allowed under continued regulation, deregulation impacts would be understated. The extent depends on the price level permitted for this production, the reserves Involved and the associated decline rates.

[8] It was assumed that 48 percent of the gross revenue addition resulting from deregulation would accrue to the Federal Government as taxes, with an additional 4 percent (on average) going to the States. This implies that all producer tax deductions, credits, and exemptions had been used to offset income taxes on the regulated portion of gross revenue,

Table n-6.-Net Revenue Gain to Energy Producers from Oil Price Deregulation of Known 1974 Reservoirs for the Period 1977-94
(million dollars)

Year	Total Production (million barrels)	$13.75 Deregulated Price	Annual 5-Percent Compound Price Growth
1977.	2276.6	$ 3952.3- 8409.2	$ 3952.3- 8409.2
1978	1971.7	3386.4- 7204.4	3656.5- 7784.8
1979	1653.8	2765.0- 5884.1	3216.3- 6856.4
1980.	1417.2	2347.5- 4994.9	2936.1- 6264.4
1981	1182.8	1920.4- 4086.1	2577.8- 5506.6
1982.	984.7	1558.3- 3314.5	2440.4- 4792.3
1983.	805.1	1226.3- 2609.2	1885.3- 4042.4
1984.	692.8	1038.8- 2209.8	1706.1- 3663.6
1985.	591.7	850.8- 1809.6	1489.3- 3206.7
1986.	515.1	716.8- 1525.0	1336.1- 2885.3
1987.	444.9	599.6- 1275.8	1188.7- 2574.8
1988.	387.0	484.3- 1030.9	1017.6- 2217.9
1989.	346.4	431.7- 919.1	964.2- 2104.9
1990. ......,..	305.7	378.2- 806.5	897.8- 1964.4
1991	271.7	325.7- 693.3	818.1- 1795.5
1992.	236.6	272.5- 579.2	723.3- 1594.3
1993.	213.8	240.4- 510.6	674.9- 1492,3
1994. ......,.,	193.4	215,7- 459.3	641.6- 1422.6
Total	14491.3	$22732.7 -48320.8	$32122 .4-68578.4
Present Value Total	—	$15186.3 -32311.4	$19317 .4-41083.2

The annual impacts range as high as $8.4 billion per year in 1977 to a low of $216 million in 1994 for the $13.75 price scenario with all reservoirs not in the sample assumed to be under stripper production. The absolute impact over the 18 year period could range from a low of *$22.7* billion to a high of $68.6 billion, with a present value impact (at a 10 percent discount rate) which ranges from $15.1 billion to $41.1 billion.

These values can be compared to capital requirements of the industry which have been forecast over similar periods of time. The impact of a “plowback” provision as part of any deregulation policy can then be evaluated. For example, the 1976 National Energy outlook (FEA) forecasts the most likely capital requirements of the petroleum industry between 1975 and 1984 as $147.6 billion.[9] This is an average of $15 billion per year. FEA estimated that this could range be-

[9] This forecast is in 1975 dollars, pertains only to the exploration, development and production phases of the industry and exludes lease acqulstion costs. Note that It does not extend to the last 11 years of our analysis.

tween **$9** billion and $19 billion per year. The forecast of *maximum* net revenue gain from deregulation is, therefore, just over 56 percent of the average capital requirement in the best year (1 977). However, for the reference case, deregulation could result in as little as 26* percent of capital requirements in the best year. These values decline to between 7 percent and 24 percent by 1984, Using the $9 billion and $19 billion range for capital requirements, rather than the reference case, results in a 21- to 93-percent value for 1977 and a 5- to 41 -percent value for 1984.

Coal mine developments

A substantial increase in the use of coal by 1985, as called for by the President's plan, will necessitate the establishment of new mining facilities. Moreover, if air quality standards are to be met, low sulfur coal deposits will need to be the object of these new facilities. Such deposits are often located in areas which are not traditionally producers of large quantities of coal. Thus, for both national and regional planning purposes, information on the number, size, and general location of these new facilities would be useful. This type of information is necessary if evaluations of labor force issues, reclamation problems, transportation system adequacy, and the ability to meet air quality standards are to be made.

For this evaluation, a multiperiod spatial allocation model of the United States coal industry (LeBlanc, 1976) was used as the basis for determining future mine developments through 1985, The model uses exogenous forecasts of consumption in 49 regions and determines the least-cost set of coal shipments from 33 supply regions which will satisfy those forecasts given sulfur, resource, transportation, and market constraints, as well as production and transportation economics. More specifically, the effect of the contract-spot market aspects of coal sales on delivery and development patterns over time is considered, along with quality differences among supply regions in coal sulfur and Btu content. Model runs take place in a recursive fashion to permit solutions through time which take account of past contracts and reserve depletion. Both underground and surface mining possibilities (with different resource bases and production costs) are incorporated. Alternative levels of sulfur emission and coal consumption can be investigated. Rail, barge, and mine-mouth electricity generation (and subsequent transportation of electrical energy rather than fossil fuel) are evaluated as possible transportation modes, although coal transshipment and modal capacity limitations resulting in possible transportation bottlenecks are incorporated. Additional detail on the model, the data sources used, and the assumptions specified can be found in LeBlanc (1 976).

Figures II-3 and II-4 display the demand and supply regions, along with their central nodes, used for this analysis. Tables II-7 and II-8 list these regions. For this evaluation, it was assumed that 1.164 billion normal tons.[10] (24 million Btus per ton) of coal would be consumed by 1985. This is slightly less than the President's new goal of 1.279 billion normal tons.[11] We assumed an exponential increase in demand from current

[10] Because a ton of coal trom differlng supply nodes may vary in heat content (ie., Btus per ton), a normaltzatlon of values must occur which places all tons In equivalent units.

[11] Note that the White House recently increased the actual tonnage requirements under the energy plan to 1.235 billion tons per day from the previously announced 1,070 billion tons (Wall Street Journal, June 2, 1977),

Figure II-3. Model Demand Regions and Central Nodes

Figure II-4. Model Supply Regions and Central Nodes

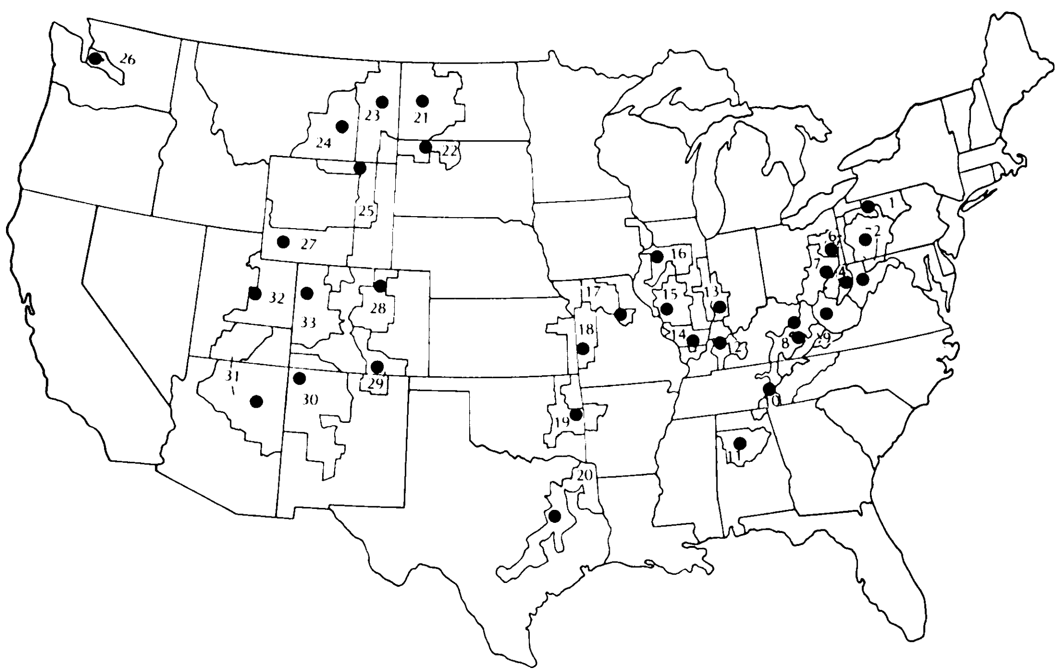


Table II-7.—Demand Regions

State	Region	Centroid Latitude (Degrees)	Location Longitude (Degrees)	State	Region	Centroid Latitude (Degrees)	Location Longitude (Degrees)
Alabama	01	33.23	87.05	Montana	25	46.10	107.22
Arizona	02	36.05	110.59	Nebraska	26	41.17	96.28
Arkansas	03	34.92	92.76	Nevada	27	36.13	115,02
Colorado.	05	39.27	105.20	New Hampshire . .	28	43.09	71.28
Connecticut	06	41.28	72.44	New Jersey	29	40.23	74.29
Delaware ., ...	07	38.37	75.19	New Mexico	30	36.41	108.28
District of Columbia.	08	38.53	77.07	New York	31	42.35	77.08
Florida	09	28.50	83.50	North Carolina . . .	32	35.41	80.12
Georgia	10	33.30	84.10	North Dakota	33	47.15	100.57
Illinois	12	40.07	89.00	Ohio	34	40.00	81.59
Indiana.	13	39.38	86.32	Oklahoma	35	34.40	98.22
Iowa.	14	41.52	92.56	Pennsylvania	37	40.30	78.25
Kansas	15	38.46	95.11	South Carolina . . .	39	33.28	80.37
Kentucky	16	37.41	86.08	South Dakota	40	44.36	99.46
Louisiana	17	30.36	93.06	Tennessee	41	36.04	86.10
Maryland	19	38.55	76.42	Texas	42	31.53	96.14
Massachusetts. . . .	20	42.05	71.22	Utah. ., ...	43	40.04	111.22
Michigan	21	42.39	83.46	Vermont	44	44.29	73.13
Minnesota.	22	45.45	93.35	Virginia	45	37.23	78.12
Mississippi.	23	30.28	89.02	Washington.	46	46.42	122.58
Missouri.	24	38.33	91.39	West Virginia	47	39.10	80.51
				Wisconsin	48	43.22	88.38
				Wyoming.	49	42.23	108.02

levels (using information on likely additions to electrical generating capacity for *1980)* allocated among demand regions in the same ratio as recent forecasts by Johnson (Gordon, 1975). Table II-9 displays these allocations (in normal tons) by demand region for 1980 and 1985. Johnson used commitments of planned electrical utilities as his basis and estimated coal's share of new capacity as a function of price.

The model was then run for *1980* and 1985 under two different sets of supply constraints. First, for States east of the Mississippi (regions 1 through 20), logistical constraints were imposed in each region which limited surface and underground development, separately, to 5 million tons per year or 10 percent of 1973 production, whichever is greater. Only the existing reserve base constrained other regions. The rationale for this scenario is to restrict new mine openings in the smaller Eastern supply regions to practical limits of manpower and land availability. Normally, the 5-million ton

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constraint was the operational restriction. Second, it was assumed that the only constraint on new mine development in a given supply region was the adequacy of reserves to meet long-term (20-year) contracts. Both scenarios considered the entire reserve base, including coking coal, for the analysis. Coking coal is low in ash and sulfur and high in Btu content and usually commands a premium price because of these characteristics. Also, both cases assumed that national standards on the amount of sulfur oxide emissions from the consumption of coal would apply. This standard is now set at 1.2 pounds of SO_2 per million Btus of energy derived and was used for the time period analyzed. [12]

[12]Stack- scrubber technology to remove sulfur after burning was not assumed for this analysis since great technological and logistical uncertainty surround its Introduction.

Table n-8.-Supply Regions

State[a]	Region	Centroid Latitude (Degrees)	Location Longitude (Degrees)
NW Pennsylvania.	01	41.30	78.14
SW Pennsylvania .	02	40.47	79.10
NE West Virginia .	03	39.10	80.03
N West Virginia . .	04	39.02	80.28
S West Virginia. . .	05	38.00	81.30
Ohio-Pennsylvania	06	40.28	80.55
SE Ohio	07	39.45	81.32
E Kentucky.	08	37.28	83.31
Kentucky-Tennessee-Virginia	09	37.06	82.48
Central Tennessee	10	35.45	85.28
Alabama	11	33.30	86.40
W Kentucky-Indiana.	12	37.46	87.07
Central Indiana-Illinois	13	40.00	87.30
S Illinois.	14	37.54	88.55
Central Illinois. . . .	15	39.33	89.18
N Illinois-Indiana. .	16	41.07	90.10
N Missouri.	17	39.25	92.27
Missouri-Kansas. . .	18	37.50	94.22
Oklahoma-Arkansas	19	35.28	94.48
Texas	20	31.45	96.10
W North Dakota. .	21	47.21	102.28
NW South Dakota	22	45,30	102.00
E Montana.	23	46.48	105.20
SE Montana.	24	45.54	106.37
NE Wyoming.	25	44.27	105.22
Washington.	26	47.54	121.32
SW Wyoming-Colorado	27	41.36	109.13
NE Colorado	28	40.25	104.42
SE Colorado-New Mexico	29	37.10	104.30
NW New Mexico-Colorado	30	36.34	108.12
Arizona-Utah.	31	34.54	110.09
NW Utah.	32	39.35	110.48
W Colorado	33	39.32	107.48

‘N W= Northwest, SW= Southwest, NE= Northeast, N= North, S= South, SE= Southeast, E= East, W= West.

Table II-9.—Exogenous Consumption Allocation Among Demanding Regions for 1980 and 1985

Region	1980 Allocation (thousand normal tons)	1985 Allocation (thousand normal tons)	Region	1980 Allocation (thousand normal tons)	1985 Allocation (thousand normal tons)
Alabama	23037	33743	Nebraska	2996	8614
Arizona	5856	8577	Nevada	7916	11595
Arkansas	4200	6285	New Hampshire	1281	1884
Colorado	4572	6425	New Jersey	3486	5114
Connecticut	179	269	New Mexico	13338	19536
Delaware	1557	2288	New York	11019	16148
District of Columbia	638	942	North Carolina	40854	59841
Florida	14758	21617	North Dakota	4255	6232
Georgia	39954	58523	Ohio	92746	135851
Illinois	44000	50000	Oklahoma	5466	8153
Indiana	44895	65760	Pennsylvania	49604	72666
Iowa	6668	15576	South Carolina	10079	15936
Kansas	48722	71512	South Dakota	1186	1737
Kentucky	39787	58278	Tennessee	29696	43497
Louisiana	13568	19874	Texas	44000	64548
Maryland	19931	29201	Utah	8598	12594
Massachusetts	4129	6056	Vermont	50	73
Michigan	44895	65760	Virginia	16378	23989
Minnesota	3939	3939	Washington	10288	15069
Mississippi	5219	7645	West Virginia	46507	68122
Missouri	23717	17114	Wisconsin	8079	5754
Montana	5964	8736	Wyoming	6288	9210
			Total	814295	1164283

As a result of these two scenarios, model runs produced a range of results for the 1980 and 1985 time periods. Table II-10 presents these production values for the various constraints, supply regions, mining conditions (surface and underground), and years. The tonnages shown are in physical rather than normal, tons. The results indicate marked shifts in the location of new production facilities are likely under various constraint levels. This confirms the results of previous analyses (LeBlanc, 1976). For exampie, in LeBianc's study, imposition of national sulfur standards resulted in major production shifts toward the Western States (given the eastern logistical constraint). Here the situation is similar until the logistical constraint is removed. The total cumulative new eastern development (in tons per year) for the case with logistical constraints was only 29 percent of the total, whereas it rose to 76 percent when these constraints

Table 11-10.—Incremental Production Capacity Required by Region, Mine Type, and Year (thousand physical tons)

Region	Eastern Logistical Constraints 1980 Surface	Eastern Logistical Constraints 1980 Underground	Eastern Logistical Constraints 1985 Surface	Eastern Logistical Constraints 1985 Underground	Reserve Constraints 1980 Surface	Reserve Constraints 1980 Underground	Reserve Constraints 1985 Surface	Reserve Constraints 1985 Underground
NW Pennsylvania	5000	88	3821		—	50	—	—
SW Pennsylvania	7000	—	5000	—	28514	—	1	—
NE West Virginia,	5000	4985	5000	5015	39965	—	1	—
N West Virginia. .,	5000	5000	5000	—	20269	—	1	—
S West Virginia	7000	7000	5000	5000	20279	—	147774	—
Ohio-Pennsylvania	5000	—	5000		2000	—	6908	—
SE Ohio	5000	—	—	—	2000	—	—	—
E Kentucky	7000	7000	5000	5000	81918	43897	1	—
Kentucky -Tennessee-Virginia	9000	11000	5000	5000	4000	—	104976	—
Central Tennessee.	4237	—	—	—	2000	—	2338	—
Alabama.	305	7000		5000	729	—	1	—
W Kentucky-Indiana	9600	—		—	4600	—	—	—
Central Indiana-Illmols	5000	—	5000	—	9525	—	22398	—
S Illinois	5000	—	5000	—	2200	—	—	—
Central Illinois	2123	—	1	—	2123	—	—	—
N Illinols-Indiana	5000	—		—	2000	—	—	—
N Missouri	3586	—		—	6783	—	—	—
Missouri-Kansas	2145	—	—	—	2000	—	—	—
Oklahoma-Arkansas	7000	—	5000	—	30289	—	1	—
Texas	22770	—	7011	—	14182	—	3780	—
W North Dakota●	—	—		—	—	—	—	—
NW South Dakota	2091	—	2991	—	2091	—	—	—
E Montana	—	—	14259	—	27	—	3541	—
SE Montana-NE Wyoming	47819	—	244921	—	5140	—	42393	—
Washington	—	—		—	—	—	—	—
SW Wyoming-Colorado	8236	—	1284?	—	8669	—	11159	—
NE Colorado	—	—	—	—	—	—	—	—
SE Colorado-New Mexico		—		—	—	—	—	—
NW New Mexico-Colorado	60213	—	47492	—	7014	—	32593	—
Arizona-Utah	—	—		—	—	—	—	—
NW Utah	1000	—	1	—	1000	—	1	—
W Colorado	1787	—	—	—	1787	—	—	—

● These two supply regions have been combined because of their similar geologic and coal characteristics, as well as the nearly identical production and transportation costs involved.

were removed. In the West, new development is concentrated in Montana, Wyoming, and the Northwest New Mexico-Colorado regions. In the East, however, low-sulfur, high-Btu coal in Eastern Kentucky, Tennessee, Virginia and Southern West Virginia receive the greatest call for new development. It should be noted that these are precisely the deposits whose characteristics make them valuable for coking coal. If these deposits are difficult to burn in utility boilers, expensive to mine, and command a premium price for steel making, as is often argued (Gordon, 1976), the likelihood of achieving the result shown will be remote. However, as indicated above, the two cases should bracket the range of actual results.

With that in mind, we can convert the requirements for new additions in productive capacity for 1980 and 1985 to an estimate of new mining facilities. The model assumed (for production cost purposes) that surface mines would be either 1 million or 5 million ton per year facilities and that underground mines would be 1 million or 3 million ton per year operations. For purposes of analysis, we have assumed that new western surface mines will average 5 million tons per year capacity, while eastern surface mines will average only 1 million tons per year. All underground facilities were sized at 1 million tons per year. Table II-11 displays the cumulative new mine developments, by region, which would be required by 1985 to approximate the President's production goal.

The number of new mine developments required range from 300, in the situation where logistics restrict access to eastern deposits, to 585, when only the availability of reserves restricts new development. In either case, new development is concentrated in surface mining operations (78 to 92 percent of the new facilities). Thus, any increase in the average eastern surface mine size could substantially impact the number of new mines required (but not the total production involved). For example, if all new surface mines average 5 million tons per year capacity, the number of new developments would be reduced to between 180 and 192 (the higher number in the case of the eastern logistical constraint where somewhat more underground production occurs).

Cumulative new development by 1985 must reach approximately 700 million tons (a capacity greater than total 1976 production). Since the bulk of this amount is surface mine development (due to lower production costs), the degree of land disruption involved will heavily depend on the new mine locations. Western areas, with thicker and more contiguous coal seams, could be developed with substantially less disruption and, perhaps, with more easily accomplished reclamation practices. On the other hand, development of hundreds of new strip mines by 1985 may constrain equipment suppliers and prohibit achievement of the Presidential goal. In any case, the number of new developments that would be required in such a short time period has no antecedent in our history.

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Table 11-11 .—Number of New Mine Developments Required by Region and Mine Type*

Region	Eastern Logistical Constraints			Reserve Constraints		
	Surtace	Underground	Total	Surface	Underground	Total
N W Pennsylvania	8 8	01	8.9	—	0.1	0.1
S W Pennsylvania	1 2 0	—	12.0	28,5	—	28.5
NE West Virginia ., .,	100	100	200	40,0	—	40.0
N West Virginia ... ., ., .,	10.0	5,0	150	20.3	—	20.3
S West Virginia .,	1 2 0	120	24.0	1681	—	168 1
Ohio-Pennsylvania . .	10.0	—	10.0	8.9	—	8.9
SE Ohio. . . .	5 0	—	50	2.0	—	2.0
E Kentucky	1 2 0	120	24.0	81.9	4 3 . 9	1 25. 8
Ken. -Tenn.-Vlr.. ., ...	14.0	160	300	1 0 9 0	—	109 .0
Central Tennessee	4.2	—	4.2	4.3	—	4.3
Alabama . . . ., .	0.3	12.0	12.3	0 7	—	0.7
W Kentucky -Indiana	9 6	—	9.6	4.6	—	4.6
Central Indiana-IIIlnols.	1 0 0	—	100	31.9	—	31.9
S Illinois . . ,	1 0 0	—	10.0	2.2	—	2.2
Central Illinois	2 1	—	21	2 1	—	2.1
N Illinois-tndiana ,	5 0	—	5.0	2,0	—	2.0
N MIssouri	0,7	—	07	1 4	—	1.4
Missouri-Kansas	0.4	—	04	0.4	—	0.4
Oklahoma-Arkansas.	2.4	—	2.4	6 1	—	6 1
Texas.	6 0	—	60	3.6	—	3.6
W North Dakota, ...	—	—	—	—	—	—
NW South Dakota . . . ., .,	1.0	—	10	0.4	—	0. 4
E Montana	2 9	—	2.9	0 7	—	0 7
SE Montana-NE Wyoming .	58.6	—	58.6	9.5	—	9.5
Washington . . ., .,	—	—	—	—	—	—
SW Wyoming-Colorado	4.2	—	4.2	4.0	—	4.0
NE Colorado....,.,,,.	—	—	—	—	—	—
SE Colorado-New Mexico	—	—	—	—	—	—
NW New Mexico-Colorado	21.5	—	21.5	7.9	—	7.9
Arizona-Utah .,,,,.,, ...,..,,	—	—	—	—	—	—
NW Utah	0 2	—	0.2	0.2	—	0 2
W Colorado	0.4	—	0.4	0,4	—	0.4
Total ., ... , ...	233.3	67.1	300,4	541.1	44.0	585,1

"Assumes 1 million ton per year underground facilities and surface facilities of 5 million tons per year west of the Mississippi and 1 million tons per year east of the Mississippi.

Appendix A
Supply Price Elasticity Analysis: Data Sources and Assumptions

The analytical model used for the Monte Carlo simulation which served as the basis for this evaluation was developed under National Science Foundation funding and is fully detailed in other publications (Tyner and Kalter, 1976). The interested reader should refer to them for further details.

The model, however, requires input data on geologic, cost, and other economic variables. Many of these values must be in the form of probability distributions if the model's full capabilities to consider uncertainty are to be utilized. The basic information on the values used for this analysis were developed by the author in other research (Kalter et al., 1975), A full explanation can be obtained by referring to that publication. What follows will be a summary of the data used.

Input data on assumed field size distributions and the expected number of fields for each OCS subregion are shown in table 11-A-1 for oil and table II-A-2 for natural gas. The information used pertains to water depths out to 200 meters. Exploration, investment and operating cost data were derived from National Petroleum Council (1973) research and modified to reflect 1975 values and our regional format, Cost relationships were then derived which permitted investment costs to be estimated for any size of reserve sample picked by a Monte Carlo iteration. Table II-A-3 displays the five cost regions specified for the analysis and the factors used to determine actual costs in a given region. Table II-A-4 summarizes the oil and natural gas cost values used for selected reservoir sizes. Finally, table II-A-5 displays the values for other geologic, engineering, time, and economic variables assumed for the analysis.

Table 11-A-l .—Oil Field Sizes, Standard Deviations, and Estimated Field Numbers by Field Category and Subregion

Subregion	Category 1 Fields (less than 50 roll. bbls.)			Category 2 Fields (50-100 roll. bbls.)			Category 3 Fields (greater than 100 mil. bbls.)		
	Mean (mil. bbls.)	Std. Dev. (mil. bbls.)	No. of Fields	Mean (mil bbls.)	Std. Dev. (mil. bbls.)	No. of Fields	Mean (mil. bbls.)	Std. Dev. (roil. bbls.)	No. of Fields
1. Arctic Ocean .,	25.8	12.9	80	70.0	49.0	27	158.7	158.7	18
2 Central Chukchi	25.9	12,9	75	69.6	48.7	21	147.3	147.3	17
3. Bering Sea . . . .,	23.0	11.5	106	69.8	48.9	30	147,4	147,4	14
4. Gulf of Alaska	23.9	11.9	3	73.1	51,2	1	577,9	577.9	3
5. Cook Inlet	17.4	8.7	27	69.9	48.9	4	145.2	145.2	3
6. North Pacific . .	17.4	8.7	2	73.9	51.7	1	567.9	567.9	1
7. Santa Cruz .,	16.2	8.1	6	70.1	49.1	1	144.9	144.9	1
8. S. Cal. Basins .,	17.2	8.6	20	71.9	50.3	4	256.6	256.6	7
9. C. and W. Gulf .,	11,7	5.8	88	70.0	49.0	10	155.8	155.8	6
10, MAFLA ...	12.8	6.4	13	70.8	49.6	1	311.8	311,8	3
11, North Atlantic .,	185	9,2	7	70.2	49.1	1	321.3	321,3	3
12. Central Atlantic.	150	75	18	71,0	49,7	2	320.6	320.6	5
13 South Atlantlc	12.2	6.1	13	49.6	49.6	1	225.7	225.7	3

Table 11-A-2.—Nonassociated Natural Gas Field Sizes, Standard Deviations, and Estimated Field Numbers by Field Category and Subregion

Subregion	Category 1 Fields (less than 300 mil. Mcf)			Category 2 Fields (300-600 mil. Mcf)			Category 3 Fields (greater than 600 mil. Mcf)		
	Mean (mil. Mcf)	Std. Dev. (mil. Mcf)	No. of Fields	Mean (mil. Mcf)	Std. Dev. (mil. Mcf)	No, of Fields	Mean (mil. Mcf)	Std. Dev. (mil. Mcf)	No, of Fields
1. Arctic Ocean . .	154.8	77,4	31	420.0	294.0	10	952.2	952.2	7
2. Central Chukchi.	155.4	77.7	26	417.6	292.3	7	883.8	883.8	6
3. Bering Sea. . .	138.0	69.0	34	418.8	293.2	9	884.4	884.4	5
4. Gulf of Alaska	143.4	71,7	1	438.6	307.0	1	3,467.4	3,467.4	1
5. Cook Inlet	104.4	52,2	7	419.4	293.6	2	871.2	871.2	1
6. North Pacific	104.4	52.2	0	443.4	310.4	0	3,407.4	3,407.4	1
7. Santa Cruz	97.2	48.6	1	420.6	294,4	1	869.4	869.4	0
8 S. Cal, Basins	03.2	51.6	3	431.4	302.0	0	1,539,6	,539.6	1
9. C. and W. Gulf.	70.2	35.1	225	420.0	294.0	24	934,8	934.8	14
10 MAFLA . . . . .,	76.8	38.4	1	424.8	297.4	0	1,870.8	,870.8	1
11 North Atlantic	11.0	55.5	5	421.2	294.8	1	1,927.8	,927.8	2
12. Central Atlantic	90.0	45.0	8	426,0	298.2	1	1,923.6	,923.6	2
13, South Atlantic .	73.2	36.6	3	425.4	297.8	0	1,354.2	1,345.2	1

Table n-A-3.-Cost Regions Used in the OCS Analysis

Region Number	Region Name	Area Used	Exploration Cost Factor	Development Cost Factor
1	moderate	Gulf of Mexico South Atlantic South Pacific	1.0	1.0
2	moderate-severe	Central Atlantic North Pacific	1.4	1.9
3	severe	North Atlantic Gulf of Alaska	1.8	2.8
4	ice laden	Bering Sea, Alaska	2.3	3.7
5	severely ice laden	Chukchi Sea Arctic Ocean	4.6	4.6

Table n-A-4.-Exploration, Investment, and Operating Costs for Oil and Nonassociated Natural Gas by Reservoir Size and Cost Region

Reservoir Size	Cost Regions 1	2	3	4	5
			oil		
15	$20.96	$38.85	$57.12	$75.41	$94.02
20	15.60	28.91	42.51	56.12	69.97
65	8.98	16.64	24.46	32.29	40.26
175	5.06	9.38	13.79	18.21	22.70
525	2.68	4.97	7.31	9.65	12.03
1050	1.80	3.33	4.89	6.46	8.05
Exp. Costs per well (in millions)	3.121	4.370	5.618	7.179	14.357
Operating costs (initial)	.40	.52	.64	.76	.88
			Nonassociated Natural Gas		
90	$3.28	$6.48	$9.39	$12.31	$15.47
150	2.46	4.86	7.05	9.24	11.62
390	1.44	2.85	4.12	5.40	6.79
1050	.83	1.63	2.36	3.10	3.90
3150	.45	.88	1.28	1.67	2.10
Exp. Costs Per well (in millions)	3.121	4.370	5.618	7.179	14,357
Operating costs (initial)	.04	.0	.06	.08	.09

Appendix H

Table II-A-5.—Common Input Values for Leasing Policy Analysis

Geologic	
Production decline rate, a	.10
Beta (recovery factor), ß	.50
Reserve distributions	lognormal
Price related	
Original oil price, P_o	$11.65, $13.75, $17.00, $22.00
Original gas price, GP_o	$1.40,$1.75,$2.25
Mean of oil price change distribution, RP1 MN	0
Std. dev. of price change distribution, RP1STD	.04
Mean of gas price change distribution, GP1 MN	0
Std. dev. of price change distribution, GP1 STD	.05
Tax related	
Depreciation method, NDEPR	Sum of Years Digits
Depreciaiton lifetime, N	15 years
Percent investment salvageable, a	1 00/0
nvestment tax credit rate, Ω	1 00/0
Federal corporate tax rate, Ø	480/o
Time related	
Minimum production time, TMIN	9 years
Years of flat production plus production build up, FLATP	5 years
Maximum production period, TMAX	40 years
Development and exploration period, LAG	5 years
Exploration period, LAG1	2 years
Production build up period, IBP	2 years
Production build up factors, BPP	
year 1	.5
year 2	.8
Cost *related*	
Working capital factor, WCF	.1
Triangular investment and operating cost contingency distributions	
BMIN, KMIN	– .05
BMODE, KMODE	0
BMAX, KMAX	.1
Rent per acre, RENT	$3.00
Investment cost allocation during development, F	
year 1	0
year 2	.1
year 3	.3
year 4	.4
year 5	.2

Table II-A-5.—Continued

Percent investment each year that is tangible, YZ	
year 1	0
year 2	.7
year 3	.7
year 4	.8
year 5	.8
Exploration cost allocation during exploration, F1	
year 1	.4
year 2	.6
Percent exploration cost tangible each year, YZ1	
year 1	0
year 2	.3
Other *Factors*	
Discount rate	.10
No. of exploratory wells per 1000 acres	.5
No. of acres per tract, ACRES	5760
Bonus factor, BFAC	.75
No. of M. C. iterations, NLOOP	200

Appendix II

References

Gordon, R. U.S. *Coal and the Electric Power Industry.* Baltimore: Resources for the Future, John Hopkins University Press, 1975.

Cordon, R. "Coal-The Swing Fuel" in *Energy Supply and Government Policy.* Cornell University Press, 1976.

Kalter, R. J. and W. E. Tyner. *An Analysis of Contingency Leasing Options for Outer Continental Shelf Development.* U.S. Congress, House Ad Hoc Select Committee on the Outer Continental Shelf, Outer Continental Shelf Lands Act Amendments of 1975, Hearings Part 3. (94d Congress, 1d session). Washington: Government Printing Office, November 1975.

Kalter, R. J. and W. E. Tyner. An Analysis of federal *Leasing Policy for Oil Shale Lands.* Prepared for the Office of Energy R & D Policy, National Science Foundation, 1975.

Kalter, R. J. and W. E. Tyner. *An Analysis of Advanced Royalty Leasing Systems for Public Domain Coal.* Prepared for the Office of the Secretary, U.S. Department of the Interior, December 1975.

Kalter, R. J., et al. *Alternative Energy Leasing Strategies and Schedules for the Outer Continental She/f.* Cornell University A. E. Res. 75-33, December 1975.

Kalter, R. J. and W. E. Tyner. A *Simulation Mode/ for Resource Policy* Evaluation. Cornell Agricultural Economics Staff Paper 76-35, November 1976.

LeBlanc, M. R. *A Transportation Model for the United States Coal Industry.* Cornell University A. E. Res. 76-10, July 1976.

National Petroleum Council, *Ocean Petroleum Resources, 1975.*

Newendorp, P. D. *Decision Analysis for Petroleum Exploration.* Petroleum Publishing Company, Tulsa, 1975.

Office of Technology Assessment. *An Assessment of Enhanced Oil Recovery Potential in the United States,* June 1976.

U. S. Federal Energy Administration. *National Energy Outlook.* Government Printing Office, 1976.

U.S. Geological Survey. *Geological Estimates of Undiscovered Recoverable Oil and Gas Resources in the United States.* Circular 725, 1975.

Wall Street Journal, "Schlesinger Revises Estimates of Proposals in Carter Energy Plan," June 2, 1977, p. 3.

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