FINANCING ENERGY DEVELOPMENT

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PREFACE

Financing Energy Development analyzes and provides background information on a number of proposed programs to assist the private sector in carrying out new investments in energy production over the next decade. The analysis was performed in response to requests from the Senate and House Budget Committees. In keeping with the Congressional Budget Office's mandate to provide nonpartisan analysis of policy options, the report contains no recommendations. This report was prepared by W. David Montgomery of CBO's Natural Resources and Commerce Division under the direction of Douglas M. Costle and Nicolai Timenes, Jr.

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SUMMARY

Background

Since 1973, when the oil embargo and rising energy prices made energy policy an issue of extreme national importance, there has been concern about the ability of the U.S. economy to achieve those policy goals that imply increased domestic energy production. A central question has been whether capital investment will be forthcoming in quantities sufficient to increase total domestic energy production, to exploit relatively abundant domestic energy sources, and to introduce new energy technologies.

Some have seen a generally inadequate supply of investment capital in the United States as an obstacle to achieving energy policy goals. Others have feared that new risks in energy development, some of which have appeared since the embargo, may make investors wary of energy investment. Some claim that energy prices--domestic and foreign--may be too low to make large increases in energy production profitable.

Such concerns have resulted in proposals for a number of programs to stimulate private investment in energy production. Among the proposals under discussion are an Energy Independence Authority, a National Energy Production Board, a synthetic fuels commercialization program, guarantees associated with the transfer of uranium enrichment responsibility to private industry, and tax incentives for construction of electricity generating facilities.

None of these proposals has been viewed as a complete energy policy. Consequently the decision to pursue one or more of them cannot be made without consideration of what action might be taken in other areas of energy policy--specifically, in import policy and energy conservation.

The Role of Energy Policy Objectives

Achieving energy policy objectives such as reducing reliance on imported oil and mitigating the effects of high world energy prices on the economy will require major changes in patterns of energy production and use.

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Whatever the specific objectives, such changes, which include increased domestic energy production, greater exploitation of relatively abundant energy sources such as coal, and introduction of new technologies, will require substantial new investment between 1975 and 1985. The exact amount of investment "required", while necessarily uncertain, varies with the allowable level of imports, as well as total energy needs and other factors. As one example of "requirements", however, keeping imports in 1985 at or below their current levels could require a total investment in energy production of about $560 billion in constant dollars. If aggressive programs to reduce demand were pursued, import reduction could be achieved with less investment in production.

Potential Causes of Inadequate Investment

Two potential causes have been advanced for the possibility that investment will not be forthcoming in quantities sufficient to achieve energy production and import goals:

- Energy prices may be too low to make the desired amount of investment profitable.
- The risks and large scale of some potentially profitable projects may make them unattractive to investors.

1. Energy prices could be too low to bring forth adequate investment (however adequacy is defined) for two reasons. Domestic energy prices could be held below world levels by government action, or world energy prices could themselves be too low. If the latter eventuality implied substantial world wide energy supply, revision of goals might be appropriate. In either case, there would be certain projects which no enterprise would be willing to carry out even if financing could be arranged on reasonable terms. As an example, if domestic oil prices were controlled at $9 per barrel, natural gas prices were regulated at $1 per thousand cubic feet, and electricity prices were not allowed to rise in pace with costs, then only $450 billion in investment might be forthcoming. Oil and gas imports could reach 16 million barrels per day equivalent in 1985, or 40 percent of consumption in that year--a level many would consider to pose unacceptable risks.

2. Even if energy prices were high enough to make energy projects earn profits comparable to those earned in less risky ventures, the risks and scale of some energy projects could make them unattractive to investors. If financial arrangements that have been adopted in the past to deal with risk, such as joint ventures, were still effective, such a situation would be unlikely. However, it might be difficult for investors to find adequate protection against the risks of projects involving large (more than $1 billion) initial investments. If such investments were excluded, only about $520 billion investment in energy might take place between 1975 and 1985. In this case, oil and gas imports could reach 10 million barrels per day or almost 30 percent of consumption.

The actual situation is unlikely to fall neatly into one simple category. Some projects will go forward regardless; some few will be unprofitable under almost any foreseeable circumstance, others will be unable to obtain financing because of size and risk, and some may face a variety of difficulties. An assessment of the extent of such difficulties is central to the design of an efficient set of incentives--and to a determination of whether any are needed.

Options Available to Congress

The two causes of inadequate investment stated above are relevant to the choices among programs to stimulate investment. If low energy prices were the primary restraint on investment, private investment could be increased mainly by measures which increased expected revenues or lowered costs. Such measures would require net government outlays. If, on the other hand, imperfections in financial markets made it difficult to raise capital for risky ventures, government guarantees or direct loans at market interest rates could provide an impetus to ventures expected to be profitable. In these cases, anticipated net government outlays might be very small, although contingent liabilities (as a result of loan guarantees for example), might be large. Direct loans could entail initial outlays, which would be repaid with interest in later years if projects assisted were successful.

Effects on the federal budget also depend on whether assistance to energy financing is placed off budget, as in the case of EIA and loan guarantees, or on budget. Off budget financing would limit budget impact to net gains or losses, which would probably be large only if subsidies to unprofitable ventures were anticipated. In general, compensation for effects of low energy prices requires budget expenditures, while compensation for risks could limit budget impact to administrative costs. Problems of risk may also be relieved by programs which do have significant budget impacts.

As an alternative remedying energy or financial market conditions, for example, Congress could bypass energy and financial markets entirely by giving direct grants or interest subsidies to chosen projects or by initiating government-owned energy projects.

Likelihood of Inadequate Investment

The two cases in which energy investment is inadequate to keep imports at or below their current level are by no means inevitable.

Since 1974, there have been several studies of energy financing. Although they differ in exact projections of investment requirements, all the recent studies agree that there are certain conditions under which the aggregate investment required will be within the capacity of U.S. financial markets without special federal action.* The first of these conditions is relatively high but attainable rates of growth in the economy. If, in addition, all domestic energy prices were allowed to rise from their present level of around $8 per barrel to the level of current world oil prices (around $13.50 per barrel) and if the existence of risk did not deter investors, private financing would be available for substantial increases in private investment,

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*Federal Energy Administration, 1976 National Energy Outlook, February 1976; Banker's Trust Company, "Capital Resources for Energy through the Year 1990", New York, 1976, and J. Hass, E. Mitchell, and B. Stone, Financing the Energy Industry, Ballinger, Cambridge, Massachusetts, 1974.

totaling about $560 billion over the decade. The resulting production is estimated to be sufficient to keep 1985 oil imports at or perhaps well below their current levels of six million barrels per day. Oil and gas imports in that case would equal 20 percent of consumption. Such levels have been suggested by some as acceptable for 1985; in that case, energy investment might be adequate to attain national energy goals without further incentives.

Proposals Before the Congress

Each of the proposed programs of federal assistance to energy investment would use a specific combination of measures.

Some--such as loan guarantees--would be effective if investors deterred by risks of energy investments but might be ineffective if energy prices were very low. Others--such as subsidies--would be effective if profitability were a problem, but might be excessive if investors were averse to the risks associated with investment bearing adequate expected profits.

1. The $100 billion Energy Independence Authority appears designed to remedy financing difficulties with minimal budget impact. Only net gains or losses of the EIA would appear in the federal budget. If EIA acted exclusively to remedy risk difficulties, the net gains or losses reported in the budget would probably be very small. If, on the other hand, EIA were to support investments (such as synthetic fuels) likely to be unprofitable at prevailing energy prices, it could be effective only by incurring losses on those activities; after 1986, annual outlays to support synthetic fuel prices might exceed $1 billion per year. The EIA's Board of Directors would choose between the two strategies.

2. Separate programs of incentives for synthetic fuel production, to be administered through the Energy Research and Development Administration (ERDA), have also been proposed. In the absence of some synfuels commercialization program almost no synthetic fuel production is expected before 1985. The choice of programs and their budget impacts may again depend on

whether energy prices (profitability) or risk is the obstacle. A program of loan guarantees, limited to a total of $2 billion and including other energy projects as well as synthetic fuels, might be effective in countering risks that stand in the way of production of some of the less costly forms of synthetic fuels while entailing minimal outlays.

However, many synthetic fuel processes cannot compete in price with imported oil. The Administration has argued that, to achieve even a target of 350,000 barrels per day by 1985, price guarantees--which are likely to result in substantial price support payments--would be required. Over the life of a program with that target (1975-2005) the support payments could range from zero to $6 billion, but the Administration predicts that they would total $1 billion. As much as $6 billion in loan guarantees and $600 million in construction grants might also be issued.

3. Incentives in a form similar to loan guarantees may be required to induce private investment in uranium enrichment facilities because of the scale and risk of such plants. New enrichment capacity would be required to support increases in the rate of growth in nuclear power. Such incentives would create a risk that federal outlays would be required because guarantees totaling $8 billion are contemplated. The alternative to this program is construction of additional enrichment capacity by the government.

4. An alternative to direct financial assistance to electric utilities, a program of tax incentives, has been proposed to increase the attractiveness of building nuclear and coal-fired power plants and to make it easier for utilities to obtain financing. Federal revenue loss in 1977 is estimated at $800 million, increasing to $2 billion by 1980. Such incentives can counter difficulties arising from unprofitability, but may entail unnecessary expenditures if risk alone is a problem.

5. The bill that would establish a National Energy Production Board does not mandate a specific program of assistance to energy investment. The programs the board would be authorized to propose to Congress might include any or all of those included in the other proposals.

CHAPTER I
INTRODUCTION

Background

Since 1973, when the oil embargo and rising energy prices made energy policy an issue of extreme national importance, there has been concern about the ability of the U.S. economy to achieve those policy goals that imply increased domestic energy production. A central question has been whether capital investment will be forthcoming in quantities sufficient to increase total domestic energy production, to exploit relatively abundant domestic energy sources, and to introduce new energy technologies.

Some have seen a generally inadequate supply of investment capital in the United States as an obstacle to achieving energy policy goals. Others have feared that new risks in energy development, some of which have appeared since the embargo, may make investors wary of energy investment. Some claim that energy prices--domestic and foreign--may be too low to make large increases in energy production profitable.

Such concerns have resulted in proposals for a number of programs to stimulate private investment in energy production. Among the proposals under discussion are an Energy Independence Authority, a National Energy Production Board, a synthetic fuels commercialization program, guarantees associated with the transfer of uranium enrichment responsibility to private industry, and tax incentives for construction of electricity generating facilities.

None of these proposals has been viewed as a complete energy policy. Consequently the decision to pursue one or more of them cannot be made without consideration of what action might be taken in other energy policy areas--specifically, in the policies affecting imports and energy conservation. In that comprehensive framework a goal could be set for domestic energy production in 1985 and programs chosen to achieve that goal. As with measures to stimulate investment, other energy initiatives may have important budgetary, economic, and environmental costs. Development of a comprehensive energy strategy would involve balancing all such costs and the expected benefits.

This report focuses narrowly on private investment in domestic energy production, the ability of various proposed programs to affect energy investment, and the budgetary and economic cost of those proposals. However, a point of reference which could allow integration with other studies of energy policy may be useful. To provide this reference a range of production goals, associated with a specific import level and conservation actions, is described. Comparisons between these goals and the production expected with and without the proposed programs could facilitate the simultaneous choice of goal and program.

Energy Production, Consumption and Imports

A range of possible goals can be selected using recent projections of energy balances. This range suggests that any goal for primary domestic energy production in 1985 is likely to fall in the range of 80 to 100 quadrillion BTU* (quads), compared to an actual 60 quads in 1975.

Since much energy is consumed in a form different from that in which it is produced, some care must be taken in defining the components of that 80 to 100 quads. They include oil, gas, and coal production, electricity generated from nuclear, solar, hydroelectric, and geothermal power, and synthetic fuels. They do not include, for example, electricity generated from oil, gas, and coal because those energy sources are already counted in oil, gas and coal production. The treatment of synthetics is somewhat anomalous: some are produced from sources not counted elsewhere, such as urban waste and oil shale. To maintain a single category in the discussion which follows, energy in the form of

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*The BTU is a common measure of the heat energy contained in a fuel. Many analyses convert quads to their equivalent in millions of barrels of oil per day, a common direct measure of imports. One million barrels of oil per day is roughly equivalent to two quads per year.

synthetics produced from coal is allocated to the synthetic category and coal utilized in that process is subtracted from gross coal production to arrive at the coal production estimate.

Energy Balances

1. Demand for Energy; Demand for energy depends on policy actions to promote conservation or affect domestic prices and on independent events such as changes in world prices and economic conditions.

Recent projections of maximum energy demand in 1985 range from 100 to 103 quads.[1] Assumptions underlying these projections include no conservation programs and no reduction in demand due to higher prices (in the FEA study, the estimate of 103 quads results from energy prices based on world oil at $8 per barrel).

If, on the other hand, world and domestic oil prices remained at or above current import prices of $13 per barrel and an aggressive conservation program were initiated, energy demand in 1985 could be as low as 93 quads.[2] FEA estimates that conservation measures alone could reduce energy demand in 1985 by as much as 6 quads (3 million barrels per day) below the level it would reach without such measures.[3]

2. Imports; The tolerable level of imports depends on many factors, including the likelihood and estimated consequences of future price changes and embargoes, the cost of increased domestic production, and on policy actions designed to mitigate the consequences of embargoes. Such actions could include

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1. Federal Energy Administration, 1976 National Energy Outlook Appendix G, and U.S. Department of Interior, Bureau of Mines, United States Energy Through the Year 2000 (revised), P. 4.

2. FEA, National Energy Outlook, Appendix G.

3. Ibid., pp. G-3 and G-5.

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formation of an oil stockpile to substitute for imported oil or provision of emergency powers to ration and allocate energy during an embargo.

It is now generally conceded that zero imports is an unnecessarily ambitious goal in light of costs of domestic energy production and the fact that about 3 quads (actually 1.7 million barrels per day) of oil imports, mainly from the Caribbean, are considered secure, as are natural gas imports from Canada of 1 quad.[5] Thus, 4 quads might be considered the lowest level of imports likely to be chosen as tolerable. Reduction of imports to 4 quads would mean that imports in 1985 would be less than one-third of imports in 1975.

In 1975, total oil and gas imports were 13 quads (6 million barrels per day) of oil and 1 trillion cubic feet of gas.[6] These amounts might be considered high estimates of a tolerable level of imports in 1985. However, certain events could lead to tolerating even higher levels. Suppose, for example, that the oil producing cartel (OPEC) were to collapse and the price of imported oil fell to $8 per barrel. Then reduction of imports would become much more costly, because a large part of the potential domestic energy production which could replace imports would cost in excess of $8 per barrel. Simultaneously, the likelihood of an embargo would become more remote, because of the collapse of its potential leadership in OPEC. There is however, little evidence to suggest the possibility of such a collapse.

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4. Creation of such a stockpile is mandated in the Energy Policy and Conservation Act of 1975. A crucial issue in determining the effectiveness of a stockpile is its size relative to the duration and extent of an embargo.

5. Federal Energy Administration, National Energy Outlook, pp. 41 and 127.

6. Ibid, pp. 39 and 127.

3. Energy Production; A high goal for domestic energy production in 1985 might be 100 quads, representing an annual growth rate of 4.7 percent in domestic production.[7] Such a production goal might be chosen if no measures to control demand were adopted and imports in the range of 4 quads (2 million barrels of oil per day) or less were tolerable.

A low production goal for 1985 might be 80 quads, representing an annual growth rate of only 3 percent. Such a goal might be adopted if higher oil prices and strong conservation measures held down the rate of growth in demand, and if 13 quads (equal to the 1975 level) of oil and natural gas imports were tolerable.

The different types of energy produced must vary with the composition of demand. By altering the energy sources, and in particular by changing the technologies used to produce energy, it is possible to alter the cost of energy. Thus, the composition of energy sources and technology of energy production, as well as the level of production, are relevant to energy policy objectives.

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7. In 1975, total domestic energy production was 60 quads and consumption was 73 quads.

CHAPTER II
INVESTMENT DECISIONS AND ENERGY PRODUCTION

With minor exceptions, measures to increase domestic supply, introduce new technologies, or substitute one source of energy for another will require substantial initial investments. These initial investments will result in energy production over many future years. The complexity of the process by which decisions about these investments are made and the number of external factors which can affect the decisions make it difficult to predict levels of investment likely to be forthcoming from the private sector. However, in a broad view of the energy investment process, two features are prominent: expected profits and risk.

Government Policy and Investment

All investment decisions are based on consideration of the profits that a project is expected to provide and the degree of uncertainty which attends those expectations. Any specific project will carry with it some combination of expected profits and uncertainty (which creates risk for investors).[1] If a project is adopted, it will be because its combination of expected profit and uncertainty is more attractive than the combination offered by any rejected project. In general, a risky project will be considered inferior to a relatively safe project unless it offers higher expected profits. The difference in expected profits required to make a risky project as desirable as a relatively safe project is sometimes called a "risk premium."

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1. "Expected profit" and "uncertainty" can be defined precisely for analytical purposes. Expected profits (commonly called the "expected return on investment") are estimated as the mean--a type of weighted average--of the rates of return that would be obtained if specific uncertain events occurred. Uncertainty can be represented by estimates of how likely it is that the actual return will differ (in some specified amount or proportion) from the expected return.

To increase private energy investment, the government would have to induce investors to reconsider projects that they would reject in the absence of governmment action. Actions to increase expected profits by increasing revenues or reducing costs and actions to reduce the risks facing investors could stimulate that reconsideration.

However, if expected profits are so low that they would not make a project attractive even if the profits were certain, then actions to reduce risk will not stimulate investment in that project. On the other hand, if a very large increase in expected profits would be required to make a project attractive in the light of its risks, investment might be stimulated more readily through reduction of risks. Consequently, identification of the role of expected profits and risk in hindering investment in specific projects can contribute to the choice of policy to stimulate investment.

Determinants of Investment

The level of energy prices and the willingness of investors to bear the risks of energy investment are crucial factors in determining whether the comparison between expected profits and risk will result in the realization of a project.

Energy Prices. The price at which energy can now be sold--and expectations of what that price will be in the future--is likely to be the crucial variable affecting the expected rate of return on energy production. Price and price stability are in turn affected by actions of government at many levels: Oil price controls administered by the Federal Energy Administration, natural gas price regulation by the Federal Power Commission, and electricity rate regulation by state regulatory commissions. Actions of OPEC countries in setting the world price of oil can also affect the domestic price of energy.

One cause of a gap between a production goal and the likely level of energy production would be energy prices too low in relation to costs to bring forth the desired production. Although costs of energy production affect expected profits and are sensitive to actions of government--in particular environmental and other types of regulation--the two examples used in the next chapter to illustrate the effects of expected profits (Cases I and II) are based on assumptions regarding energy prices. For simplicity, similar costs are assumed in all the examples: changes in costs would, in principle, have the same effect on expected profits as would changes in prices.

Risk. Certain characteristics of some energy investment opportunities suggest that the risks they involve may be unusually difficult for private investors to bear. Projects that would employ new technologies or require large initial investments (on the order of $1 billion or more) might not be carried out by private investors unless their expected profits were much higher than those obtainable from other investments.

A commitment of $1 billion to a single project with uncertain returns would represent a major undertaking for most industrial corporations. In 1975, only 160 U.S. industrial corporations had total assets in excess of $1 billion.[2] Even those large corporations might consider it likely that the losses they could incur if such a large project failed would cause significant financial upheaval.

However, the taking of risk is an essential part of business. It is often possible to raise capital for projects characterized by a high degree of uncertainty without paying a substantial "risk premium." Even if a project were so large that a single corporation would find it unlikely that disappointment of the large investment would be balanced by the unanticipated success of others, financial markets can facilitate the taking of risk by spreading risk among many investors. For example, forming a consortium can reduce the risk which any single firm takes. If the risk premium associated with some projects were to appear quite large, the likely reason would be some

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2. Fortune, May 1976.

imperfection in financial markets which prevented this spreading of risks. The role of financial markets in promoting willingness to bear risk is discussed in Appendix A.

In the next chapter, Case III provides an example of the possible magnitude of the effect that inability to carry out large risky projects could have on energy production. The investments excluded are those for which specific programs of government risk-sharing have been proposed.

CHAPTER III
THREE CASES OF ENERGY INVESTMENT

In the previous chapter two factors--energy prices and willingness to bear risk--were identified as important determinants of energy investment. In this chapter, three cases, based on assumptions about those two factors, are presented as examples to illustrate how the factors interact in determining the level of investment. The assumptions are compared in Table 1.

Table 1. Comparison Among Cases

Case		Assumptions: Energy Prices	Assumptions: Willingness To Bear Risk
Case I:	Optimistic Outlook	High	High
Case II:	Low Expected Profits	Low	High
Case III:	Problems in Risk-Bearing	High	Low

Case I; An Optimistic Outlook

In constructing this case world oil prices are assumed to remain at their present level in real terms ($13 per barrel) and all domestic energy prices are assumed reach that level in two years. For this to occur, decontrol of oil prices would have to occur at the fastest rate possible under current law; in addition, natural gas prices, which are now held below the equivalent of world oil prices by the Federal Power Commission, would have to rise.

Financial markets are assumed to work efficiently in spreading risk, so that all energy investment projects with expected profits that would be considered adequate in other industries are undertaken. (Specifically, an expected after-tax rate of return of 12 percent is assumed to make the project acceptable.)

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With these assumptions, Case I provides a baseline for the investment potential of the economy. It represents an optimistic projection of energy investment, assuming that both energy and financial markets work very well. In this case, oil imports could be limited to 2 to 6 million barrels per day in 1985 without additional government policy initiatives.[1]

With ideal conditions in energy and financial markets, domestic energy producers would produce all energy--in the form of oil, gas, coal, etc.--with production costs low enough that reasonable profits could be made selling that energy at world prices. To obtain greater production, it would be necessary to turn to energy sources with higher production costs, per barrel equivalent, than the world price of oil. One method of increasing domestic energy production in the case in which world and domestic prices are equal, for example, would be the imposition of tariffs or import quotas. Such action would increase domestic energy prices and the overall cost of energy to the economy (though these actions might reduce anticipated costs of embargoes or impacts of future world oil price increases).

Case II; Low Energy Prices

Case II highlights the consequences of a situation in which energy markets signal investors to hold back on energy investment. Low energy prices (because of falling world prices or government action) in relation to the costs of energy production could bring about this situation. Specifically, Case II estimates are based on the assumption that domestic oil prices are held to $9 per barrel by price controls, that natural gas prices are regulated at $1 per million BTU, and that world oil prices and interest rates remain at Case I levels. Financial markets are assumed to provide capital to any project with expected profits high enough to justify its selection in Case I; that is, no "risk premium" is required.[2] Favorable energy market

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1. The basis for this and subsequent similar calculations is developed in Appendix B.

2. Numerically, an expected 12 percent after tax rate of return is assumed, as in Case I, to result in a projects being undertaken.

conditions, one requirement of the optimistic projections of the Case *I,* are absent in Case II. However the other, high willingness to bear risks, is present.

In Case II, the private sector may not reach energy investment or import goals. Imports, for example, are projected at the equivalent of 16 million barrels of oil per day in 1985. Because lower energy prices cause expected profits for all projects to be lower than they would be in Case I, expected profits for some projects fall below the minimum level investors will accept. Consequently, some energy production that would be profitable at high world prices is foregone because it would be unprofitable at domestic prices. (The relative amounts of energy which would be produced from different sources also would be affected by the relative prices of different forms of energy).

There is an opportunity in Case II to increase domestic energy production and simultaneously to reduce the overall cost of energy to the economy. However, such action could increase costs borne by specific energy users.[3]

Because energy production goals are unlikely to be met if Case II materializes anticipation of Case II would justify changing those goals or adopting programs to stimulate investment. Although direct loans, at the

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3. The total cost of energy is defined as the amount paid for imports plus the cost of producing energy domestically. With high world oil prices and domestic price controls--for example, the $5.25 per barrel ceiling on old oil--no oil producers will market oil which costs more to produce than the ceiling price. Oil costing $7.50 per barrel to produce would be left underground if the selling price were limited to $5.25 per barrel. Instead, oil at $13 per barrel is imported. Decontrol of domestic energy prices would, by encouraging the substitution of lower cost domestic oil for more expensive foreign oil, lower the cost of energy. Because decontrol would result in all domestic prices charged consumers rising to reflect the price of imported oil, the cost-savings would accrue as profits to domestic producers. Cost of energy to consumers would, however, rise.

government borrowing rate, could be of some use in stimulating additional investment by lowering capital cost, only limited increases in investment are possible unless policies are adopted which result in net government expenditures with little prospect of future repayment.

Case III; Unwillingness to Bear Risk

Case III highlights the consequences of unwillingness of investors to undertake large risky projects despite high energy prices. It is assumed in Case III, as in Case I, that favorable conditions and high prices prevail in energy markets. Thus, one condition of the optimistic case is satisfied, but the other condition is not.

One important function of financial markets is to distribute risks among investors in such a fashion that large projects, which entail risks too large for any single investor to bear, can be financed through relatively small commitments from many investors. If financial markets are unable to perform this function, desirable energy investments; may not be forthcoming. Several proposed energy projects, including production of synthetic fuel, uranium enrichment, and pipeline projects, have been described as suffering from inability to attract financing despite expected profits that would be adequate to justify smaller projects subject to similar uncertainties.[4] That inability is ascribed to the combination of size (an initial investment requirement of about $1 billion) and risk.

In this report, CBO takes no position on whether capital market imperfections are, in fact, responsible for the absence of specific investments. Such a conclusion would require a detailed case-by-case analysis. At a general level only conflicting

4. For example, since each of these projects is included in Case I and Case II projections of energy investment, their expected rate of return after taxes exceeds 12 percent.

evidence is available. A private consortium raised over $6 billion to build the present Trans-Alaska Pipeline without government assistance, which indicates that prospects of substantial size can be supported through private investment.[5] On the other hand, private financial experts have testified on many occasions that other projects could not be financed without government assistance.[6]

In constructing Case III, financial market imperfections alone are assumed to preclude all investments for which specific government actions to reduce financial risks have been proposed. The form such imperfections might take is described in more detail in Appenidx A. The resulting projection is relatively unlikely, but places an upper limit on the need for additional policy to remedy problems of financial market failure.

Government policies which would achieve substantial increases in investment without net government expenditures (on or offbudget) could be implemented only if the financing difficulties were due to market imperfections. When market imperfections are present, the projects to be assisted could promise revenues adequate to repay investments with interest at a rate greater than that paid by the U.S. Government.

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5. FEA, 1976 National Energy Outlook, p. 82.

6. See, for example, testimony included in such Hearings as "Loan Guarantee for Commercial-Size Synthetic Fuel Demonstration Plants," before the Subcommittee on Energy Research, Development and Demonstration, (Fossil Fuels) of the Committee on Science and Technology, U.S. House of Representatives, 94th Congress, First Session, Vols. I and II, Washington, D.C.; and "Future Structure of the Uranium Enrichment Industry," Hearings before the Joint Committee on Atomic Energy, 93rd Congress, Second Session, Part 3: Vol. I-Phase III, Washington, D.C., 1975.

Results of the Three Cases

Quantitative estimates of energy investment, production, and demand likely in the three illustrative cases are constructed from sets of assumptions analyzed in the Federal Energy Administration's 1976 National Energy Outlook, dated February 1976.7 Detailed estimates are provided in Appendix B, together with a description of the methods used to make the estimates. These quantitative estimates should be considered illustrations of effects of some types of obstacles to energy investment. The likelihood of each case depends both on external events and explicit government policies.

Case I can serve as a baseline for the other two illustrations because it involves 1985 energy imports at or below current levels. The two other cases are compared to Case I in Table 2 below. If import levels likely in Case *I* were maintained as the objective for 1985, the difference between investment in Case *I* and Case *II* or III could be a goal for increased energy investment.

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7. CBO has altered some of the FEA estimates and is solely responsible for identifying the resulting projections with the three cases described in this report. FEA has not reviewed or endorsed this use of its projections.

TABLE 2 — RESULTS OF THE THREE CASES

	Case I	Case II	Case III
Investment Required (billions of dollars)	562	449	522
Change from Case I (billions of dollars)	0	-113	-40
Consumption (Quads)	99	101	99
Domestic Production (Quads)	85	71	78
Imports (Quads)	14	30	21
Oil (MMB/D)	5.9	13	9
Gas (TCF/yr)	1.28	6	2.0
Imports with Conservation			
Oil	3.7	9.8	6.8
Gas	1.0	5.75	1.75
Imports with $3 Tariff & Conservation			
Oil	1.1	8.8	4.2
Gas	1.0	5.75	1.75

In Case I, domestic production of 85 quads of energy in 1985 would result from cumulative investment of $562 billion between 1975 and 1984. That level of production would suffice to achieve a low production goal, but not a high goal.

In Case II, energy production would be 14 quads less than in Case I because of low energy prices. Investment would be $113 billion less. In Case 3 risk factors would result in production of 7 quads less energy than in Case I. Investment would be $40 billion less than in Case I.

To restore production and investment to Case I levels, programs could be developed to produce the necessary investments which are eliminated by low energy prices or risks. These programs could also attempt to stimulate other investment, possibly using new technologies. To reduce imports below projected levels either further production stimulus or other measures could be considered.

An aggressive but manageable conservation program examined by FEA,[8] including automobile, appliance and building energy efficiency standards, tax incentives, and electricity load management, could reduce imports below the levels in Table 2. In Case I and Case III a decrease of 2.2 million barrels per day in oil imports and .28 trillion cubic feet per year in natural gas imports would, according to FEA, result from such a program. Because of relatively higher demand in Case II, perhaps 3.2 million barrels per day reduction in oil imports could be achieved in that case.

A $3 per barrel tariff on imported oil could reduce oil imports in Case I or Case III by 2.6 million barrels per day. Because price controls prevent such tariffs from exercising their full restraining effect on demand, only a 1 million barrel per day reduction in oil imports would result from such a tariff in Case II.[9]

The effectiveness of programs designed to stimulate production is assessed in Chapter IV.

Overall Capital Availability

In addition to the specific factors of low energy prices or unwillingness to bear risk, general conditions of capital supply and demand could affect energy investment. If energy investment were to require an expanding share of total business investment or if drastic changes were required in the amount of investment carried out by the different energy industries, some bottlenecks might be expected. Alternatively, an economy-wide "capital-shortage" might raise interest rates and make some energy investments appear relatively unprofitable.

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8. FEA, National Energy Outlook 1976, pp. E-6 and E-7.

9. FEA, National Energy Outlook 1976, Appendix G.

A number of recent studies[10] have concluded that in the absence of a "capital-shortage" energy investment will not demand an increasing share of total business investment.

Although their projections of energy investment differ in detail and to some extent in methodology, the studies reach the common conclusion that between 1975 and 1984, no level of investment likely to be planned by energy producers will demand more financing than can be supplied by the U.S. capital markets at interest rates close to current levels.

FEA, for example, concluded that energy investment of about $580 billion between 1975 and 1984 would be within the capacity of the U.S. financial markets if (currently anticipated) rates of growth in GNP and in private savings continue to accumulate at current levels.[11] Under those assumptions, the share of energy projects in total domestic investment between 1975 and 1985 would never exceed peak levels reached in the past.

The studies cited also do not anticipate substantial changes in the share of the different energy industries--oil and gas, coal, electric utilities, and others--in total energy investment, unless electricity growth is above Case I levels.

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10. Federal Energy Administration, 1976 National Energy Outlook, February 1976; Banker's Trust Company, "Capital Resources for Energy through the year 1990," New York, 1976, J. Hass, E. Mitchell, and B. Stone, Financing the Energy Industry, Ballinger, Cambridge, Mass., 1974, and B. Bosworth, J. Duesenberry and A. Carron, Capital Needs in the Seventies, Brookings Institution, Washington, D.C., 1975.

11. FEA, 1976 National Energy Outlook, Chapter VI.

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As stated above, these conclusions are all predicated on continued growth in personal savings and achievement of a balanced full-employment budget around 1980. If growth in personal saving is inadequate or if large amounts of federal borrowing were to compete with private investment, interest rates could rise and total private investment might decline. In that event it would be unlikely that energy investment could reach Case I levels.

However, energy programs requiring investment would be facing the same hurdles facing all programs requiring private investment. The programs analyzed in the report are designed to direct private investment into energy projects by making those projects more attractive rather than to increase total funds available for investment. Consequently they are not solutions to a "capital shortage."

If energy investment were to fall below projected levels because of inadequate overall capital supply, the need to increase energy investment might appear more pressing. However, the cost of stimulating energy investment and therefore reducing other investment would also be greater, because of the effect of the "capital shortage" on all planned investments. Consequently a shortfall of energy investment due to capital shortage would have to be evaluated in very different terms than the shortfalls projected in Cases II and III of this report. This report does not address that evaluation.

CHAPTER IV
WHAT OPTIONS ARE AVAILABLE TO CONGRESS?

If the most optimistic situation (Case I) prevails, and energy production achieves satisfactory levels relative to demand, then no further Congressional action regarding energy financing might be necessary. If inadequate energy production appears likely, and if that inadequacy results from inadequate investment, Congress could act to stimulate greater private investment, with remedies directed either at problems of low prices or problems of risk. Alternatively, Congress could bypass energy and financial markets entirely by giving direct assistance to chosen projects or by initiating publicly-owned energy projects.

Stimulate Greater Private Investment in Energy Projects

If Congress were to decide to stimulate greater private investment while retaining some reliance on market forces to direct investment into the most appropriate channels, its actions could be tailored to affect the shortfall in investment. Two types of actions are possible: actions to increase the profits expected to be earned in energy production and actions to reduce the risks borne by the private sector.

1. Increased Expected Profits. If low energy prices inhibit investment, as illustrated in Case II, pure risk-sharing may not be a complete solution. Some actions to increase revenues or to reduce costs could be required. Price supports--an agreement by the government to buy energy from a project at a fixed price--or a fixed subsidy per unit of energy produced would directly counter-balance the effects of low energy prices, but only with the expectation that federal outlays would be required.

Other types of subsidy could be directed at reducing costs, rather than increasing revenues. Interest subsidies, low-interest loans, and loan guarantees, for example, can serve to reduce the cost of capital.[1] Because the interest rate paid by the U.S. Government on long-term bonds is lower than the interest rate paid by the least risky corporate bonds of the same maturity, loans at the government borrowing rate would reduce capital cost. If energy investment is insensitive to interest rates, as some FEA sources claim, a strategy of reducing the cost of capital may produce little additional investment. Outlays would be required if interest rates <u>lower</u> than the yield of government bonds were offered.

Moreover, reducing the cost of capital without addressing the level and uncertainty of other costs or prices can lead to inefficient project design. Interest subsidies, for example, can lead recipients to design projects in a way that would create larger investment requirements and lower operating costs than would be the case if choices were made in response to market prices.

It is possible to design measures that would increase expected profits without significantly changing the uncertainty of those profits. However, many measures act on both expected profits and risks. If the government assumed some risks, for example, through loan guarantees, it would also reduce the cost of capital for energy ventures, because guaranteed loans are anticipated to bear interest rates about the same as those associated with U.S. Government bonds.

A strategy of increasing expected revenues or reducing costs could also bring forth investments which are made unattractive by risk; for example, the situation of Case III. A high enough potential profit could outweigh the disadvantages of uncertainty. However, to increase revenues or reduce costs can entail substantial outlays, because investors must be compensated for the risks they are taking. This point is explored further in Appendix A.

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1. "Cost of capital" depends on the interest rate that must be paid to lenders and on the dividends that must be paid to stockholders to obtain capital.

2. Reduce Private Sector Risks. If the primary obstacle to energy investment is an unwillingness to bear risk that makes some projects unattractive even though they promise decent expected profits, government assumption of part of the risks is the direction indicated. By sharing risks with private investors, the government could encourage the pursuit of projects which would promise adequate and relatively certain returns in the long run if the outcomes of all projects could be averaged together. Since the government can utilize the resources of the entire nation, it is in a better position to average out risks than is any private entrepreneur. Options for sharing risks include loan guarantees, price guarantees, and participation as an investor in private ventures. If the projects to be assisted are confined to those that would be carried out except for unwillingness to bear risk, that assistance need not entail net federal outlays if all projects are averaged together, though the government could take a loss on some while earning a profit on others.

A certain type of price guarantee is an example of an option which reduces risk without disturbing the expected rate of return. Such a guarantee could be provided by a firm contract under which the government agreed to purchase energy at a fixed price. It would operate as an insurance policy, substituting a certain future--of selling at a fixed price--for an uncertain future subject to changes in market prices. All risks due to possible changes in market prices would have been transferred to the government by the fixed price contract. The government would incur losses if market prices fell below the fixed price, or would resell energy at a profit if market prices exceeded the price paid by the government.

Profit sharing when unexpectedly high prices prevail is the key to a strategy of risk-sharing, with minimal expected expenditures, in contrast to a strategy of subsidization. If the government acts only to compensate for events which would reduce private profits (or cause losses), net expenditures can be expected in the long run. Similarly, if the fixed price associated with a price guarantee is set at a level above the expected future market price, net expenditures can be expected.

A loan guarantee provided gratis would protect private investors against losses in some situations, but would not give the government any share in profits when conditions were favorable. Charging a fee for loan guarantees could change the situation by giving the government a revenue which could be adequate to cover expected defaults.[2]

Direct government participation in a project, through loans and equity investment, would constitute pure risk-sharing if all projects selected for assistance were expected to be able to repay the investment with interest at the rate paid by the government when it borrows. In the long run, and on average, all government outlays and interest costs incurred in providing such assistance would be repaid.

In Part B of Appendix A, the cost to government of risk-sharing is compared to the cost of a program that relied on increasing revenues. The Appendix supports the conclusion that when high risk is the primary inhibition to investment, increases in investment could probably be achieved at lower cost through risk-sharing than through increasing expected profits.

However, risk-sharing may have some unintended consequences leading to inefficiencies. The presence of uncertainty can lead to the adoption of desirable

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2. Two energy loan guarantee programs are already in existence. The Geothermal Energy Research, Development and Demonstration Act of 1974 (P.L. 93-410) established a geothermal energy loan guarantee fund and authorized appropriation of $50 million per year to the fund. H.R. 12112 would provide additional authority to guarantee loans for geothermal development. Although ERDA has announced intentions to issue $200 million in such guarantees in 1976, ("Information from ERDA," Vol. 2, No. 20, May 28, 1976, P. 4), no guarantees have yet been issued. The Energy Policy and Conservation Act (P.L. 94-163) authorized $750 million in loan guarantees to small underground coal mines. Regulations regarding such guarantees have not yet been proposed, and no guarantees have been issued.

flexibility to shift from one type of operation to another. Removing uncertainty by government action could reduce the incentives to make such preparations for easy response to future events.

Bypass Markets

The government could attempt to increase investment by going further in reducing the cost of capital, by offering loans at an interest rate lower than even the government's borrowing rate. Such an approach would require net government expenditures over the life of the loans. Alternatively, the government could simply award cash grants to projects deemed desirable but unlikely to be pursued. Both these actions involve less dependency on market forces in determining the course of economic activity. If that is to be done, construction and operation of energy projects by the government itself might also be considered.

CHAPTER V
EFFECTS OF PROPOSED PROGRAMS ON ENERGY PRODUCTION

The proposals described in this report fall within the broad category of options to stimulate private investment while retaining some reliance on the coordinating role of the private marketplace.

They include an Energy Independence Authority (EIA), a National Energy Production Board, two types of commercialization programs, and a set of tax incentives for electric utilities proposed by the Administration. In this chapter each program will be described briefly, and the description followed by an estimate of its impact on energy production and investment. All the estimates are collected for comparison in Table 3. Appendix C provides a detailed description of the EIA and of the methods by which its impact was estimated. The other programs are addressed in companion CBO analyses, and are not described in detail in this paper. Budgetary effects are discussed in the next chapter.

Description of Programs

1. Energy Independence Authority (S. 2532, H.R. 10267): The Energy Independence Authority (EIA) proposed by the President would be an independent government corporation authorized to provide financial assistance to energy projects carried out in the private sector. It would have financial resources of $100 billion, consisting of borrowing authority of $75 billion and a capital stock of $25 billion subscribed by the U.S. Treasury. Only the annual net earnings or losses of the EIA would appear on budget. The life of the EIA would be limited to ten years.

The proposed bill gives EIA broad discretion to choose forms of financial assistance, which could include but are not limited to direct loans, loan guarantees, price guarantees, and purchase of bonds or stocks of private businesses.

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TABLE 3: COMPARISON OF EFFECTS ON PRODUCTION AND INVESTMENT

Program	Increase in Investment 1975-1985 ($ Billions) Case I	Case II	Case III	Increase in Production 1975 (Quads) Case I	Case II	Case III
EIA-Break-Even Policy	0	3	40	0	1	7
EIA-Unlimited Budget Impact	50	62	88	3	7	10
Synfuels President's Proposal						
350,000 barrel per day target	7	7	7	.7	.7	.7
1 million barrel per day target	20	20	20	2	2	2
Synfuels Loan Guarantees	0	0	2	0	0	.2
Uranium Enrichment	0	3.6	3.6	NA	NA	NA
Tax Incentives	0	12	12	0	4	4

NA = Not Applicable

NOTE: Effect of incentives is not additive.

* Total investment impact on electric utilities was not estimated and would be additional to that in the Table.

Two criteria must be applied by the EIA in selecting projects for assistance:

- The project must be unable to obtain financing from the private sector on commercially reasonable terms.

- The project must possess technical characteristics specified in Appendix C.

The kinds of policies that might be adopted by EIA are difficult to predict because of the broad discretion granted by the proposed bill. One general policy the EIA could follow would be refusal of any support beyond risk-sharing. Such a stance could result in no losses being reported in the budget but would enable EIA to affect energy investment only insofar as that investment had been inhibited by unwillingness to bear risk. Limited action otherwise would be possible without affecting the budget if EIA were to subsidize some projects made unprofitable by low energy prices, either by utilizing revenues available from other, more proftiable investments or by offering financing on terms more favorable than would be available from private lenders. These options will be referred to as components of a "break-even policy."

EIA would be able to offer sufficient subsidies to assist all projects made unattractive by low expected profits if additional appropriations were to cover the gap between expenditures and revenues. Such a policy would allow EIA to support projects which would not be carried out even under the most optimistic assumptions regarding private investment. Estimates of what EIA could accomplish by adopting this policy are based on the assumption that Congress will not limit EIA's budget authority.

To illustrate these alternatives for EIA, Table 3 describes the effects of various EIA policies for the three illustrative cases of Chapter III: Case I which assumed optimistic conditions for investment: Case II, which assumed low prices as the primary inhibition; and Case III which stressed high risks. Under a break-even constraint EIA would having nothing to do in Case I. With unlimited subsidies EIA might increase energy investment by $50 billion and production by 3 quads even in Case I. The bulk of this investment would be in synthetic fuels (oil and gas produced from coal, shale, and urban waste) and solar heating and cooling.[1]

With unlimited budget authority to cover losses, EIA could increase Case II investment by $62 billion and production by 7 quads (including the synthetic fuels and solar applications mentioned previously). With a break-even policy EIA action in Case II would be limited to offering lower capital costs to electric utilities (see Appendix C). Although the actual effect has not been estimated, it is unlikely to be sufficient to restore nuclear generation to Case I levels. A possible effect on investment of $3 billion and production of 1 quad is included in Table 3.

In Case III EIA could have a major effect even with the break-even policy because in that case profitable projects are not carried out. EIA could increase investment by $40 billion and production by 7 quads (sufficient to restore all projects eliminated by risk from Case I). With unlimited budget authority to cover losses, EIA could add synthetic fuel and solar projects to those supported under a break-even policy. With this policy EIA could increase investment by $88 billion and energy production by 10 quads.

2. National Energy Production Board (S. 740): The National Energy Production Board (NEPB) would primarily be responsible for utilization of energy resources controlled by the U.S. government (and thus might make optimistic projections of energy supply more likely).

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1. In none of the projections of energy investment described in Appendix A does synthetic fuel investment exceed $2 billion. Up to $20 billion could be invested, but only if synthetic fuels could be sold at prices considerably higher than $13 per barrel of oil (equivalent).

It would also be authorized to propose to Congress a range of programs to accelerate private investment. The net effect of the activities of NEPB on energy production would depend on its choice of programs, and might fall anywhere in the range of programs discussed in this report.

3. Commercialization Programs; Although projects involving the first commercial application of new technologies would be eligible for EIA assistance, they could also be provided with separate, specific support if EIA were not created. Two examples of programs that would provide such support are the proposed Synthetic Fuels Commercialization Program and the plan, embodied in the Nuclear Fuel Assurance Act, for construction of new uranium enrichment facilities by private ventures.

Synthetic Fuels[2] (H.R. 12112, S. 2869). The President has proposed a program to bring synthetic fuels into commercial production in the near future. The program would consist of price supports, loan guarantees, and construction grants designed to achieve an interim synthetic fuel production target equivalent to 350,000 barrels of oil per day, with an option of expanding the program to 1 million barrels per day by 1985 if the initial phase were sucessful.

The President's program addresses conditions of indequate prices and of risk. Price supports would make synfuel production profitable despite low energy prices, and loan guarantees could alleviate problemms of risk. Even in the most optimistic illustration (Case I), an investment in synthetic fuels of only $2 billion is projected, with .2 quads (100,000 barrels per day) production by 1985. In any of the three cases, the President's program could achieve up to 2 quads of increased energy production by 1985 with an investment of $20 billion (see Table 3).

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2. Further information and reference are provided in Commercialization of Synthetic Fuels; Alternative Loan Guarantee and Price Support Programs, CBO Background Paper No. 3, January 16, 1976.

In Case III (risks) the $2 billion synthetic fuel investment and .2 quad production included in Case I does not take place because of the risks involved in commercialization. A recently introduced bill, H.R. 12112, would authorize energy loan guarantees up to $2 billion, some of which could also be extended to other energy sources in addition to synthetic fuels.[3] That program could increase Case III synthetic fuel investment to the level of Case I if loan guarantees were sufficient to remove relevant risks. If uncertainty about the price at which synthetic fuels could be sold were a signficant obstacle, however, price guarantees might also be required to achieve increased synthetic fuel production in Case III.

An alternative approach to synthetic fuels commercialization would be to assist the construction of a small number of facilities, solely for the purpose of technology demonstration. Such a program would have as an objective _information_, rather than the direct increase in energy _production_ on which this report focuses.

Uranium Enrichment (S.5932):[4] Uranium must undergo a process of enrichment before it can be used to fuel nuclear power plants. Very large plants, costing over $3 billion each to construct, are required for enrichment. All such plants are currently owned by the U.S. government and operated by private contractors.

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3. The Committee on Science and Technology of the House of Representatives increased the loan guarantee authority to $4 billion. This analysis is based on the earlier, $2 billion, limit.

4. See a companion staff analysis, _Uranium Enrichment; Alternatives for Meeting the Nation's Needs and Their Implications for the Federal Budget_, CBO Background Paper No. 7, May 18, 1976.

The President has proposed that all new facilities be constructed and owned by private industry. However, the uncertain financial condition of electric utilities that would purchase enrichment services, the uncertain future growth of nuclear power, and the fact that the use of classified technology prevents broad dissemination of information on the investment could present large risks which might prevent private financing. To remedy these difficulties, the Nuclear Fuel Assurance Act (S. 5932) would allow the U.S. government to assume limited risks associated with uranium enrichment. By 1985, one additional plant, costing over $3 billion, could go into operation under these guarantees. With this plant in full operation the 9 quads of nuclear energy production projected in Case I would be possible.

4. Aid to Electric Utilities;[5] The Administration's proposed Electric Power Facilities Construction Incentive Act of 1975 is designed to reduce the cost of construction of electricity generating facilities fueled by sources other than oil and gas. It would increase the investment tax credit for such plants and provide for accelerated amortization and depreciation. Another provision would create inducements to stockholders to invest in electric utilities. However, for utilities to qualify for these tax benefits, state regulatory commissions would be required to make changes in regulatory practices which would increase electricity rates and utilitiy profits.

Taken together the provisions might increase utility profits after taxes sufficiently to remedy shortfalls in electricity utility investment.

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5. See a companion staff analysis: "An Analysis of the Proposed Electric Power Facility Construction Incentive Act of 1975," in "Electric Utility Tax Relief Proposals in the President's Fiscal Year 1977 Budget," Hearings before the Task Force on Tax Expenditures and Off Budget Agencies of the Committee on the Budget, U.S. House of Representatives, February 24,1976, pp. 61-77.

However, most of the increased profits for utilities come from higher electricity rates which regulatory commissions must grant so that utilities can qualify for tax benefits. Thus the solution to the Case II problem of low prices due to state regulatory decisions is simply to create conditions leading regulatory commissions to raise prices. This may conflict with other energy policy goals or the aims of regulatory commissions.

In Table 3 the effect of the tax incentives is assumed to be an increase in nuclear energy production of 4 quads. There is, however, some question as to the effectiveness of tax incentives, because the most serious signal of regulatory problems, actual losses, results in a situation in which tax incentives are ineffective. A utility losing money already pays no taxes.

By increasing retained earnings and cash flow, as well as improving profits, the proposed legislation could also remedy some of the financing difficulties of Case III. In particular, it would reduce the high interest rates which prevent some utilities from additional borrowing when earnings are too low in relation to the interest payments. However, tax incentives necessarily reduce government revenues whereas direct programs of risk-sharing need not result in expenditures.

Conclusions

The three examples of energy investment projections constructed in Chapter III provide a perspective on the magnitude of the change in energy investment each program could cause. Table 2 in Chapter III shows that energy prodduction of 85 quads (the level of Case I) would allow oil and gas imports in 1985 to be kept at or reduced much below their current levels.

If energy policy were directed solely at increasing domestic energy production (and no tariffs or measures to reduce demand were initiated), domestic energy production in 1985 would have to be greater than 71 quads (the level projected in Case II) or the Case III level of 78 quads, to keep imports at their current levels (see Table 2). In this context the comparison between the increase in production various programs could cause and the increase required to reach specific production levels such as the levels of Case *I* is of interest.

Because Case II and Case III represent only two of many possible outcomes that would result respectively from low expected profits or unwillingness to bear risk, it is not possible to give a definitive characterization of the effect of EIA under those conditions. However, it is unlikely that problems due to risk alone could reduce energy investment significantly below Case III projections: that case was constructed to include all the large projects for which explicit programs directed at risk have been proposed. Comparison of Tables 2 and 3 indicates that EIA would have ample resources to deal with unwillingness to bear such risks, in that EIA could increase production in Case III by an amount sufficient to reach Case I production. Such an increase could be achieved without incurring losses that would appear on the budget.

Low energy prices or other factors affecting expected profits could result in more or less energy production than in Case II. Even so, the projections indicate that if domestic energy prices were anywhere near the levels assumed in Case II, EIA would be unable to cause energy production to reach the relatively optimistic level of Case I. Even with substantial infusions of funds from the federal budget, EIA's limited authority to increase the profitability of oil and gas exploration would make it difficult for EIA to increase energy production in 1985 by more than 7 quads. That is less than half the production shortfall due to low expected profits that is projected in Table 2.

A large synthetic fuels program and the Administration's proposed tax incentives for utilities could accomplish most of what EIA could accomplish in compensating for unwillingness to bear risk. For example, those programs could restore 6 of the 7 quads difference in energy production between the examples of Case I and Case III. However, government outlays would be required to increase synthetic fuel production and tax revenues would be foregone because of electric utility tax incentives. EIA might achieve greater energy production increases (7 quads) without budget impact in the case of unwillingness to bear risk, and might support investments more likely to be economically desirable than synthetic fuels.

If low expected profits hinder investment (as in Case II), the combination of synthetic fuel commercialization and the proposed electric utility tax incentives could achieve about half the increase in production required to reach Case I production levels (as could EIA). With problems associated with expected profits, all programs would have budget impacts.

Finally, it should be noted again that these estimates assume that the proposed tax incentives for electric utilities would restore any shortfall of nuclear generating capacity, and that there are serious questions as to whether the tax incentives would have that effect.

CHAPTER VI
WHAT IS THEIR BUDGET IMPACT?

Budget impact would depend upon which proposal or proposals were adopted, on whether energy investment reaches a level judged to be adequate in the light of policy goals, and on whether any shortfall of investment is caused by low expected profits (Case II) or by unwillingness to bear risk (Case III).

Energy Independence Authority

The total operations of the EIA would not appear on the budget, since it would be an (off budget) independent government corporation. However, its annual earnings or losses would be reported in each year's budget. It is unlikely that the EIA will produce any net earnings. However, given its broad mandate, it is conceivable that its losses by 1985 could amount to a large portion of its $100 billion in assets. If unwillingness to bear risk restrains investment, as in Case III, such an outcome is unlikely, because EIA is sufficiently large to average risks and net outlays would not be required in the long run to remedy financing problems. If expected profits from energy production are low, annual losses would be necessary to achieve any significant effect.

Even if optimistic projections of investment, associated with high energy prices and tolerance for risk, were to come about the EIA might assist synthetic fuel production or other projects that would remain unprofitable under those conditions. Its losses could then be as large as government outlays required by the synthetic fuels commercialization program itself (discussed below). If EIA did not support unprofitable ventures, both its activities and its budget impact if there were no economic hindrances to investment (Case I) would be minimal.

Commmercialization Programs

Synfuels

Estimates of the most likely budget impact of synthetic fuels commercialization are provided in Table 4. The estimates are based on the assumption

TABLE 4: BUDGET IMPACT OF ALTERNATIVES
(Billions of Dollars)

	1977		1980		1985		CUMULATIVE 1977-2000		CONTINGENT LIABILITIES	
	OUTLAYS	REVENUES	OUTLAYS	REVENUES	OUTLAYS	REVENUES	OUTLAYS	REVENUES	LOAN GUARANTEES	PRICE GUARANTEES
EIA	.04	0	NE	NE	NE	NE	NE	NE	100	
SYNFUELS										
President's Program 350,000 bbl/day	.017	.05	.086	.031	.134	.03	2.8	.8	6	6.5
President's Program 1,000,000 bbl/day	.017	.05	.11	.03	.29	.06	15.7	2	10	30
Loan Guarantees H.R. 12112	.010	.05	.01	.015	.01	.015	.8	.4	2	0
URANIUM ENRICHMENT										
All Private	0	0	0	0	0	.02	0	1.75	8	0
All Government	.12	.03	.79	.26	3.39	.71	47.5	85.8	0	0
ELECTRIC UTILITIES										
Tax Relief		-.8		-2		-2		NE	0	0

NE = Not Estimated

*Changes in tax receipts due to increased utility profits before taxes that might result from this proposal have not been estimated.

that synthetc fuels are sold at the current world price of oil--as was assumed in constructing the cases described earlier. If price controls and regulations or a declining world oil price held down the price of synthetic fuels, larger outlays for price supports could be required.

The President's program would use loan guarantees, price supports, and direct grants to achieve one of two production goals in 1985.

Even with synthetic fuels selling at world energy prices and ample willingness to bear risks, price supports would probably be required to obtain more than the 100,000 barrels per day production by 1985. If world oil prices and synthetic fuel prices remained at $13 per barrel, government outlays would probably reach $500 million annually between 1987 and the year 2000 for a 1 million barrel per day (2 quad) goal.[1] Cumulative outlays could exceed revenues by more than $13 billion over the life of that program.

Low energy prices (resulting from the regulation of synthetic fuel prices or from declining world prices) would require substantial support payments. Annual outlays could exceed revenues by over $250 million from 1982 through 2000 for a small program and could exceed revenues by over $1.4 billion from 1987 to 2000 for a large program. Net expenditures through 2005 of $5.7 to $27 billion could be expected, depending upon program size and on energy prices.

Even under the most optimistic conditions, synthetic fuel production is unlikely to exceed 100,000 barrels per day in 1985. With either the 350,000 or 1 million barrel per day goal the President's program would go well beyond that point. Hence budget impacts of the President's program would be about the same whether or not investors were wary of risks associated with synthetic fuels.

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1. "Synthetic Fuels Commercialization Program," Interagency Task Force on Synthetic Fuels, November 1975, (GPO), p. D-31.

The President's programs include loans guaranteed by the U.S. government: up to $6 billion in guarantees might be issued in the 350,000 barrel per day (.7 quad) program and up to $10 billion in the 1 million barrel per day program. It is unlikely defaults would exceed $2.6 billion between 1975 and 1985 in case the smaller program were adopted, or $6 billion if an immediate commitment were made to the larger program.

If only loan guarantees were extended, little increase in synthetic fuel investment or production would be expected unless unwillingness to bear risk hindered investment. In that case loan guarantees alone, as provided in H.R. 12112, might achieve 100,000 barrels per day production by 1985. Such a program could create contingent liabilities of $2 billion. Even if one project were to fail and default, government outlays would exceed receipts from loan guarantee fees by only $400 million over the life of the program.[2]

Uranium Enrichment

The budget impacts of two alternative strategies for providing new enrichment capacity will be described. Government ownership of all new plants will be compared to private ownership of all new plants. Any mixed option would fall between the two extreme options. In addition, a median projection of required enrichment capacity is used.

It is important to note that, regardless of the option chosen, the federal government is expected to continue to go forward with currently planned additions to capacity, through about 1983.

The budget impacts of the options for ownership of new facilities are in addition to those of currently planned expansion of government facilities. They depend strongly on the number of new plants needed through the end of the century, which could nummber from 2 to 10.

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2. See Commercialization of Synthetic Fuels, CBO Background Paper No. 3, Chapter IV.

For the purpose of these calculations, 6 large plants are assumed. If they were all to be built by the federal government, the early need for additions to capacity would be such as to require an excess of expenditures over receipts until 1988, reaching a peak of over $2.7 billion annually in the early 1980s. These investments would be recouped with interest by 1993, and an annual net income of $5 billion could be expected from 1994 on.

If all new capacity were provided by the private sector, there would be no outlays initially, but contingent liabilities arising from government guarantees. The Administration has requested $8 billion in contract authority, which would be adequate to cover liabilities incurred in supporting construction of four plants. Whether such guarantees would require budget authority and count against the ceiling is an issue. Private entities would pay royalties on government-supplied technology, which could total $150 million annually in the 1990s.

Tax Incentives for Electric Utilities

The proposed tax incentives for construction of electric generating capacity would directly decrease government revenues, by reducing the tax liability of electric utilities claiming the benefits. The reduction is estimated as $.8 billion in the first year the incentives were in effect, rising to about $2 billion in the early 1980s.

Because regulatory commissions are required to alter the way they determine electricity prices in order to qualify utilities under their jurisdiction for the benefits, utility profits and consequently tax liability would increase. The resulting increase in government revenues could be about $1 billion, but much of this increase might not occur. Many utilities which currently do not have sufficient tax liability to utilize fully the tax benefits provided in the proposal would be able to do so because of their increased profits. Thus net revenue impact of the entire proposal cannot be estimated.

Conclusions

In Table 4, the budget impacts of alternative programs are summarized. Estimates of revenues and outlays represent "most likely" outcomes. Zero defaults on direct or guaranteed loans are assumed through 1985, but some defaults are included in the cumulative outlay totals. The contingent liabilities represent the maximum amount the federal government could expect to pay out, if the worst possible conditions affected ventures it supported.

Outlays for 1977 for the EIA are the estimated net loss entered on the federal budget. It would likely include 1977 interest and administrative expenses net of any interest payments or loan guarantee fees received by EIA. All of EIA's assets could be placed at risk, though the likelihood of such large losses being incurred is vanishingly small.

Outlays for synfuels in 1977 are largely administrative costs. In addition, one $7 million grant might be awarded in 1977 under the President's proposed programs. Price support payments are not anticipated until after 1981. ERDA estimates that total outlays of $2.8 billion, including price support payments and redemption of defaulted loans, are likely through the life of the 350,000 barrels per day program. Revenues from synfuels programs are loan guarantee fees. Contingent liabilities include the maximum amount of loan guarantees outstanding at one time, and the largest amount of price support payments which could be required.[3]

If all uranium enrichment capacity were private, the government would receive royalties. If all were constructed by the government, initial capital costs and operating costs would eventually be offset by revenues from the sale of enrichment services.

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3. Source "Synthetic Fuels Commercialization Program Fact Book," October 27, 1976, Tab F (xerox).

An issue which may be of interest to the Conress is how, in the context of the Congressional Budget Act of 1974, to provide budget authority for contingent liabilities. Outlays in the full amount of contingent liabilities are extremely unlikely, and the relation between expected and maximum possible outlays varies between programs. If no budget authority is provided, outlays suddenly required by unforeseen events may disrupt the budget process. On the other hand, unused budget authority may give an unrealistic picture of the size of the federal budget.

APPENDIX A

INVESTMENT, DECISION, PROFITS AND RISK

The investment decision involves consideration of the profits which a project is expected to provide and the degree of uncertainty which attends those expectations.

Investment and Financial Markets

In a world of certainty, a standard calculation similar to that used in computing mortgage payments could be used to determine whether an investment would be undertaken. If future revenues were expected to be sufficient to cover future costs and to repay the initial investment (with interest at the rate that must be paid to suppliers of capital) the project would represent a profitable investment. The interest rate that a project is able to pay is referred to as its "rate of return". If a project does not pass this test, it will not be undertaken by a profit-oriented business. Uncertainty about the future revenues or costs of a project creates risk for investors. If a project is risky, suppliers of capital may demand a higher interest rate than they would if the project were completely free of risk. The difference between the interest rate paid in the case of a safe investment and the rate paid on a risky investment is sometimes called "risk premium".

Because the future can never be known completely, all investment projects carry with them some risk. However, one function of financial markets is to facilitate the taking of risk by spreading it among many investors. It is often possible to raise capital for projects characterized by a high degree of uncertainty without paying a substantial risk premium.

This possibility exists whenever an investor can assemble a "diversified portfolio" of investments with the property that disappointment on one investment is very likely to be balanced by the unanticipated success of another. This diversification can make it possible for an investor to eliminate risks unique to a specific project, so that only those risks which affect all investments remain.

Risks associated with the performance of new technologies are in many cases specific to the project involved. Technical failures in exploiting solar energy, for example, would not make unfavorable developments in producing synthetic fuels more or less likely. Some risks, associated with changes in energy prices, would affect all energy investments similarly. However, a decrease in world oil prices could make some investments--in air transportation, for example--more profitable while making energy investment less profitable. Thus diversification might even be able to remove some energy market risks.

Risks associated with the overall condition of the economy, such as recession, rising interest rates or decreased capital availability resulting from high government deficits in conditions of full employment, would affect all investments. Such underlying, "systematic" risks cannot be removed by diversification. The expected return on a project must be sufficient to make investors willing to bear the "systematic" risk associated with the project after diversification has eliminated all "unsystematic" risk. However, that return will be lower than would be required if diversification were not possible.

Diversification can be achieved in three ways: the corporation contemplating a project may also be engaged in other, independent ventures; several corporations may join together to share in the risks of a project; or stockholders, who eventually bear the risks assumed by any corporation of which they own shares, may hold stocks of many independent corporations and thus be able to avoid increase in the riskiness of their portfolio because of a new project being adopted.

Imperfections in Financial Markets

If financial markets worked perfectly, the risks associated with any energy project could be spread among many investors in such a way that capital would flow to energy investment as easily as it would flow to any investment project. If financial markets work imperfectly, however, the risks specific to energy projects may make them unattractive to investors.

An investment of $1 billion or more might be so large relative to the assets and capital budgets of most U.S. industrial corporations (in 1975, only 160 had assets larger than $1 billion)[1] that sufficient diversification within the corporation's investment plan would be impossible.

Some financial theories imply that firms do not need to diversify their investment portfolio, because stockholders can provide any needed diversification by purchasing small amounts of stock in many corporations. If spreading risks among stockholders were made impossible by some imperfection in financial markets, it could be impossible to carry out some projects that promised a rate of return only adequate to compensate for the risk of holding a diversified portfolio of investments ("systematic risk"). Case III provides estimates of the possible magnitude of the effect that inability to carry out such projects could have on energy production. The investments excluded are those for which specific programs of government risk-sharing have been proposed.

To the extent that imperfection in capital markets prevents investment in some otherwise attractive projects, a case for government action to share risks can be made on the basis of economic efficiency. If costs are paid by the government, they are spread among all taxpayers. The resulting sharing of risk reduces the risk faced by any individual taxpayer to a negligible quantity. Consequently, the government could treat energy investment as if the appropriate estimates of prices and costs were certain and support any project judged profitable on that basis. The effect of financial market imperfections could be to keep private investors from undertaking such projects if expected returns were inadequate to compensate for risk.

The analysis which leads to the conclusion that government action is justified to remedy a market failure also suggests the most efficient form that action should take. By reducing risk--for example, by providing a form of insurance--government policies could increase private investment without any expected net government expenditures (on or off budget). Net expenditures would be

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1. Fortune, May 1976.

required to induce private investors to bear all energy investment risks in the presence of financial market imperfections.

If the government were to share in the risks of energy ventures excluded in Case III, it would incur a risk of net outlays that should be nicely balanced by the possibility of net revenues.

The uncertainty of federal outlays may be greater when the government assumes risks associated with energy markets than when it assumes risks associated with new technologies. If technological risks are, as suggested previously, project specific, the cost of a large program of government sharing of technological risks would be relatively predictable in the aggregate, and incentives could be devised which would involve a high probability of zero government costs in the long run.

Market risks, on the other hand, may affect all energy projects similarly. Consequently there may be more uncertainty about the cost to government of sharing market risks. Whether the government should bear such risks, rather than private industry, may depend on how large they appear in the context of the entire federal budget.

APPENDIX B:
CONSTRUCTION OF THE THREE CASES

Case I; An Optimistic Outlook

The 1976 National Energy Outlook published by the Federal Energy Administration projected energy investment which would take place if all domestic energy production could be sold at the equivalent of the world price of oil (about $13 per barrel in 1975 dollars) and if the rates of return required to make energy investments profitable neglecting risk remained at relatively low levels.[1] In addition, certain government actions to increase the availability of domestic energy resources (including opening Naval Petroleum Reserve No. 1 (NPR-1) at Elk Hills, California, and a specific OCS leasing schedule), but not to provide any additional economic incentives, were assumed. Both the price level and the opening of NPR-1 would require Congressional action, because present regulation of oil and gas is unlikely to lead to such price levels, and the Naval Petroleum Reserves cannot be tapped without Congressional authorization.[2]

The report was based on the use of a model of energy supply and demand developed by the FEA (the "Project Independence Evaluation System"). That model determines energy production by comparing estimated prices and costs and selecting only those projects which are profitable at the assumed interest rate. Total capital investment

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1. The rate of return FEA used as a cut-off was equivalent to a current interest rate of 12 percent. Because their analysis assumed zero inflation, they used a "real" interest rate of 8 percent. No project promising a lower return was accepted. Oral communications from participants in the FEA study conveyed their belief that moderate changes in the interest rate would have only a small effect on investment.

2. Authorization was given in April, 1976, with the passage of H.R. 49 by both Houses.

was estimated as the amount required to achieve the predicted level of energy production. The FEA model did not take into account the relative riskiness of energy investments. Accordingly, FEA estimates are treated as including the assumption that investors behave as if none but ordinary business risks were present in energy production.

The projection of energy investment and production chosen as Case I is FEA's "Reference" scenario. This scenario projects cumulative energy investment between 1975 and 1985 as $562 billion, supporting domestic energy production of 85 quads in 1985. A detailed breakdown of investment and production is provided in Table B-1.

In this case the petroleum industry could be expected to invest a total of $234 billion in gas and oil production by 1985[3] resulting in 52 quads of domestic oil and gas output by 1985. Oil production would be 14 million barrels per day, 70 percent of domestic demand. The investment total includes $9 billion to construct a new Arctic gas pipeline as well as more conventional investments, and over $45 billion in lease bonus payments.

The electric utility industry is expected to build up to 785,000 megawatts of electricity capacity with 13 quads of primary energy (35 percent of energy inputs to electricity production) being supplied from sources other than fossil fuels. Investment in generation, transmission, and distribution of electricity would total $277 billion by 1985. Over 20 quads of energy could be produced from

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3. An investment of $19 billion in synthetic fuels, which would require government assistance to be profitable when world oil prices are at $13 per barrel, is excluded from these and all other FEA investment totals. All estimates of cumulative investment include progress payments on capacity still under construction in 1985 which will not result in actual production of energy until after 1985.

TABLE B-1: ENERGY INVESTMENT, CONSUMPTION, AND PRODUCTION

Case I: Optimistic Projection

INDUSTRY	INVESTMENT REQUIRED 1975 - 1985 (Billions)	1985 ENERGY BALANCE[a] (Quads) Production	Consumption
Oil and Gas	234	52	66
Coal	18	20	20
Synthetic Fuels	2	*	*
Electric Utilities	277		
Nuclear Energy		9	9
Solar, Geothermal, and Hydroelectric Energy		4	4
Other Support Industries[b]	31	-	-
TOTAL	562	85	99

Required Imports

Total (Quads)	14
Oil (Million barrels per day)	5.9
Gas (TCF per year)	1.28

NOTES: a Detail may not add to totals due to rounding.
b Includes oil and gas transport and uranium fuel cycle.
* =less than .5 quad.

coal with an investment of about $18 billion through 1985.[4] No more than 0.2 quads (100,000 barrels per day) of synthetic fuels would be produced even under these conditions since larger quantities would cost in excess of $16 per barrel equivalent.

With all energy prices based on world oil at $13 per barrel, demand for energy could range from 93 to 99 quads in 1985, depending on whether conservation measures are initiated. As a result, import levels might range from 8 to 14 quads--including oil imports of 3.7 to 5.9 million barrels per day (20 to 30 percent of consumption). Additional natural gas imports of 1.28 quads include .9 quads of gas from Canada, considered to be a secure source. (About 1.7 million barrels per day of the oil imports would also be secure.)[5] To achieve a greater reduction in imports it would be necessary to stimulate supplies of energy, such as synthetic fuels, which cost more to produce (per unit of energy) than the world price of oil. Or, if the delivered price of world oil were raised to $16 by a $3 tariff, an additional two quads of oil production might be forthcoming in 1985. Such actions would inevitably increase the domestic cost of energy, though who would pay the cost naturally depends on how energy supply is stimulated.

Case II; Low Energy Prices

Reductions in energy production due to causes related to energy markets result from an unwillingness of promoters to pursue certain projects even if risk is not an issue and financing can be arranged on the same terms which would apply to any credit-worthy borrower. Either lower energy prices or higher capital costs than assumed in Case I could reduce energy investment in this fashion. An estimate of energy production which would take place if domestic oil prices equalled $9 per barrel (in 1975 dollars) and natural gas prices were regulated at $1 per million BTU

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4. One million tons of coal contain about .02 quads of energy.

5. FEA, National Energy Outlook, 1976 pp. 41 and 127.

but interest rates and world oil prices remained at Case I levels is provided by the "$9.00 regulation scenario" of the 1976 *National Energy Outlook*.[6] According to FEA, increased interest rates would have little effect on forthcoming production.

CBO has modified the FEA scenario to include failure of regulatory commissions to grant rate increases as large as those assumed in Case I. Rates that were inadequate to provide historic profit levels could reduce electric utility investment, resulting in less primary energy production from nuclear power plants. However, the managements of electric utilities are not completely free to cut back on construction plans, since regulatory commissions are likely to insist that capacity be constructed sufficient to prevent service interruptions. Hence the reduction in generating capacity is likely to be less than the reduction in nuclear power growth, since when their rate of return is inadequate utilities may turn to alternatives to nuclear power with lower capital costs but higher operating costs per kilowatt capacity.

If this resulted in cancellation of half of the new nuclear capacity predicted in Case I to be constructed by 1985 energy production would be decreased by an additional four quads in 1985. This decrease is over and above those included in the FEA projection. Electric utilities might save $12 billion in cumulative investment by shifting to plants with lower capital costs (but possibly higher operating costs).

Under these conditions, domestic energy production would reach 71 quads by 1985, and only $449 billion would be invested in energy production by 1985. Oil and gas production together total only 43 quads, 9 quads less than in Case I. These changes in production result from a decline in petroleum industry investment to about $150 billion.

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6. Similar projections result from the assumption that world oil prices were $9 per barrel through the decade, but in that case revision of the import and production goal might be warranted.

Simultaneously, the low energy prices created by regulation of gas, oil and electricity prices could result in demand as high as 101 quads in 1985. As a result, imports might reach 30 quads, including over 13 million barrels of oil per day (40 percent of consumption) and 6 trillion cubic feet of natural gas (33 percent of consumption).

Detailed estimates of energy production and investment for the case are presented in Table B-2.

Case III; Unwillingness to Bear Risk

Projections of the decrease in energy production in 1985 which might be caused by financing difficulties alone may be made by modifying certain of the assumptions used in the Reference Scenario of the National Energy Outlook. It is assumed in this case that oil and gas prices are deregulated, that the world oil price is $13 per barrel, and that credit-worthy corporations can raise financing at a 12 percent nominal rate; that is, there are no problems of profitability neglecting risk.

Case II is constructed by eliminating from Case I all investments affecting domestic energy production for which specific government programs to reduce risk have been proposed.

Many of the more risky investments do not result immediately in energy production, but are required to make energy production possible or profitable. Such investments include uranium enrichment and additional pipelines and other transportation links to bring gas and oil from the Arctic.

The scale of uranium enrichment plants—a single plant of optimum size now costs over $3 billion--and risks associated with uncertain growth of nuclear power may deter private investors. One such plant was included in Case I "Other" investment, but is excluded in Case III.

Uncertain costs and delays in producing oil and gas in Alaska could make additional pipelines too risky for private investors. A $9 billion investment in an Alaskan gas pipeline and a $3 billion investment in improving the oil pipeline might require government assistance.

TABLE B-2: ENERGY INVESTMENT, CONSUMPTION, AND PRODUCTION

Case II: Low Energy Prices

INDUSTRY	INVESTMENT REQUIRED 1975 - 1985 (Billions)	1985 ENERGY BALANCE[a] (Quads) Production	Consumption
Oil and Gas	154	43	73
Coal	17	19	19
Synthetic Fuels	2	*	*
Electric Utilities	245		
Nuclear Energy		5	5
Solar and Geothermal Energy		4	4
Other Support Industries[b]	31	-	-
TOTAL	449	71	101

Required Imports	
Total (Quads)	30
Oil (Million barrels per day)	13
Gas (TCF per year)	6

NOTES: a Detail may not add to totals due to rounding.
b Includes oil and gas transport and uranium fuel cycle.
*= less than .5 quad.

Excluding electric generating capacity, the investments that might be eliminated by considerations of risk comprise about $18 billion of the total energy investment in Case I. (A detailed description of the breakdown of the adjustments made to Case I in formulating Case III is provided in Table B-3) .

Lack of enrichment services and transportation systems could also cause reductions in other investments in energy production. For example, the lack of additional Arctic pipelines could reduce energy supply from Alaska by about 2 quads; the corollary decrease in investment could be about $10 billion.[7]

Lack of new uranium enrichment facilities would reduce the amount of nuclear power generation possible in 1985. However, even greater cutbacks in nuclear power growth could be caused by financial difficulties of electric utilities.

Financing difficulties could create problems for electric utilities similar to those caused by inadequate electricity rates. The resulting decrease in nuclear generating capacity could be approximately the same as the 4 quads assumed in Case I. (Both entail cancellation of all nuclear plants for which construction permits have not yet been issued).[8] Although inadequate profits are likely to be the fundamental cause of any problems facing the industry, rates which gave profits similar to those historically associated with a healthy industry could be inadequate to attract outside investors in the light of current conditions.

Any financing difficulties of utilities not due to inadequate rates would be in the final analysis due to risk; such risk could stem from uncertainty about the demand for electricity or from practices of regulatory commissions. Historically, the investment in electric utility stocks and bonds has been considered relatively safe. Bonds have been accorded the highest quality

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7. FEA National Energy Outlook, 1976, pp. 82 & 160.

8. Ibid, p. E - 22

TABLE B-3: ADJUSTMENTS TO CASE I FOR RISK

	REFERENCE		ACCELERATED	
	INVESTMENT (Billion $)	PRODUCTION (Quads)	INVESTMENT (Billion $)	PRODUCTION (Quads)
OIL AND GAS				
Additions to Taps	3	NA	3	NA
Second Alaska Oil Pipeline	NI	NA	6	NA
Arctic Gas Pipeline	9	NA	9	NA
Arctic LNG Transport	NI	NA	5	NA
Resulting Development	9.5	2.4	36.5	7.14
Gas from Tight Formations	NI	NI	1	.9
SYNTHETIC FUELS	2	.2	2	.2
ELECTRIC UTILITIES				
Nuclear Capacity	13	4	13	4
Oil Replaces Nuclear				
OTHER				
Solar and Geothermal	1	.15	3	.6
Uranium Fuel Cycle	3	NA	3	NA
TOTAL	39.5	6.75	80.5	12.84

NI=Not Included in Case I projection.
NA=Not Applicable.

rating and have borne the lowest interest rates of any private issue; utility stockholders have similarly been content with relatively high price-earnings ratios. Events of the last decade, including inflation, changes in patterns of growth in electricity demand, and inability to find new technologies that lower the cost of producing electricity, combined with patterns of regulation to create new risks in the industry. Some regulatory commissions failed until 1975 to provide rate increases adequate to maintain dividends at a level which would make sales of new stocks possible. At the same time, sale of new bonds became difficult because of requirements written into bond sale contracts that utility earnings exceed interest charges by a specified margin. Many utilities, because of inadequate earnings, fell to or below the margin. The result was increased cost of capital, above levels available to safer investments, or at times inability to raise new capital at all. These conditions could have prevented expansion even if utility managements had been willing to build new capacity. However, by the end of 1975, electric utility earnings and stock prices had improved greatly, possibly signalling an end to industry-wide financing difficulties.

The maximum decrease in energy production in 1985 which might be caused by financing difficulties alone appears to be about seven quads, resulting from cancellation of $40 billion in cumulative investment. Since financing difficulties, unlike low energy prices, do not increase demand, oil and gas imports in 1985 would be about 20 quads, or roughly 30 percent of oil and gas consumption.

Financing difficulties may, however, create undesirable changes in the pattern of use of different domestic sources of energy or energy production technologies. Inadequate electric generating capacity can cause hardships in the form of service interruptions to customers who have no other source of power, even if the consequences of inadequate capacity for imports may be small. Similarly, although solar and geothermal energy together are expected to generate only as much electricity in 1985 as 2 to 9 large (1000 MW) nuclear power plants (less than .5 quads even in the most optimistic scenario),[9] their future

9. FEA National Energy Outlook, pp. 241 and E29-E30.

potential may make the loss of such new technologies more significant than would appear from the loss in energy by 1985. In Table B-4 solar and geothermal contributions. to energy production disappear due to rounding.[10] It is assumed that foregoing these investments could reduce total utility investment by $1 billion.

Dependency Factors

Actual events are likely to follow a path higher or lower than that projected in the three cases considered thus far. Deviations will occur, for example, as energy reserves are proved to be larger or smaller than assumed. On the basis of more optimistic assumptions about resource availability than those which underlie Case I, FEA constructed an "Accelerated" case in which domestic energy production could exceed 97 quads in 1985. This total may be compared to their "Reference" production of 85 quads. Pessimistic assumptions about reserves combined with the low energy prices of Case II could result in 1985 energy production of less than 67 quads, compared to projected Case II production of 71 quads.

The increased oil and gas production which results from optimistic reserve estimates includes almost 5 quads of Arctic oil and gas production and 1 quad of stimulated natural gas production, over and above the levels of Case I. To bring this increased production down from Alaska in 1985 could require an additional $10 billion investment[11] in tanker facilities and pipelines. Under Case III conditions such investment might not be forthcoming. The technical risks of using advanced recovery techniques to extract natural gas might inhibit introduction of that technology, and further reduce the advantage to be gained from larger reserves. In total,

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10. Existing geothermal loan guarantee programs which could support only a fraction of the foregone investment in geothermal energy are already in existence. Additional guarantee authority for geothermal and solar energy is provided in H.R. 12112.

11. FEA National Energy Outlook, pp. 82, 190, E-21.

TABLE B-4: ENERGY INVESTMENT, CONSUMPTION, AND PRODUCTION

Case III: Unwillingness to Bear Risk

INDUSTRY	INVESTMENT REQUIRED 1975 - 1985 (Billions)	1985 ENERGY BALANCE[a] (Quads)	
		Production	Consumption
Oil and Gas	212	50	70
Coal	18	20	20
Synthetic Fuels	0	0	0
Electric Utilities	264		
Nuclear Energy		5	5
Solar and Geothermal Energy		4	4
Other Support Industries[b]	28	-	-
TOTAL	522	78	99

Required Imports	
Total (Quads)	21
Oil (Million Barrels per day)	9
Gas (TCF per year)	2

NOTES: a Detail may not add to totals due to rounding.
b Includes oil and gas transport and uranium fuel cycle.

*= less than .5 quad.

it appears that if optimistic predictions of energy reserves were correct, half of the increased production projected by FEA might not be forthcoming because of unwillingness to bear risk.

The estimate in Case III of the effect of risk on energy investment may be low in two other areas, the uranium fuel cycle and solar and geothermal energy. ERDA projects 1975 to 1985 investment requirements in the neighborhood of $25 billion for each of those areas.[12]

A fuel cycle investment of $25 billion would comprise several new uranium enrichment facilities and large expansion in uranium mining and processing. Although unlikely to be needed unless growth in nuclear capacity exceeds Case I levels, this investment could also require government action to reduce risks.

The estimate of $25 billion investment in solar facilities is frankly speculative: it represents installation of solar heating and cooling in 2,500,000 houses by 1985, at a cost of $5,000 each. At current and projected energy prices, solar heating and cooling could not compete with alternative energy sources on this scale. However, some increase in penetration might be possible if uncertainty about future price and cost-saving did not make solar heating and cooling a risky investment or one difficult to finance.

It should also be pointed out that the Case II and Case III estimates of cutbacks in nuclear capacity and the Case III estimate of reduced investment in coal transport are illustrative only. Nuclear energy production could be unaffected by Case II or III, or could be reduced further if plants already issued construction permits were cancelled. Also not estimated are the effects of Case II or Case III on conversion of electric facilities to coal from oil. If that conversion were slowed, demand for and production of coal would fall and oil demand and imports rise. Total utility investment would also be affected.

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12. J.M. Gallagher, M. Carasso, R. Barany, and R.G. Zimmermann, "Direct Requirements of Capital, Manpower, Materials and Equipment for Selected Energy Futures," Bechtel Corp., December, 1975 (Draft).

APPENDIX C:

ENERGY INDEPENDENCE AUTHORITY

On October 10, 1975, a bill to establish an Energy Independence Authority (EIA) was introduced in Congress. The EIA, an independent government corporation, would be authorized to provide a wide range of financial assistance to energy projects carried out in the private sector. It would have financial resources of $100 billion, consisting of a capital stock of $25 billion subscribed by the U.S. Treasury and borrowing authority of $75 billion. Only the annual net earnings or losses of the EIA would appear in the U.S. Budget. Both Treasury borrowing to provide the capital stock and EIA budget authority would be excluded from the budget by the Act. The life of the EIA would be limited to ten years.

Forms of Financial Assistance

The purpose of the EIA is to "supplement and encourage private capital investment to meet the energy needs of the Nation." The bill gives EIA broad discretion to choose forms of financial assistance, which could include but are not limited to direct loans, loan guarantees, price guarantees, purchase and leaseback of facilities, and purchase of bonds or stocks of private businesses. The only specific limitation on forms of assistance is the exclusion of grants-in-aid; EIA also may not provide assistance to public entities, including state and local governments or publicly owned utilities.

Fundamentally all forms of assistance provided by the EIA are intended to be repaid. When EIA assumes risks--for example, when it guarantees prices--it is required to make arrangements to share as well in the profits of the venture it assists. All loans are to be made on terms which offer reasonable hope of repayment. However, no procedures to ensure the EIA will break even are included in the bill. If they chose, the Board of Directors of the EIA might make investments or commitments which resulted in losses that were not made up from profits of other undertakings--for example, by giving extensive price guarantees at levels above market prices.

Eligible Projects

Within broad limits EIA is also given complete discretion to choose the types of projects it would assist. Two general criteria on which projects are to be judged are:

- significant contribution to energy independence or security of energy supplies;
- inability to obtain adequate financing from other sources at reasonable interest rates.

Projects which may be funded are further limited to those which:

- employ techniques or processes of energy supply or conservation which are not in widespread domestic commercial use.
- relate to nuclear power
- involve generation or transmission of electricity from fuels other than oil or natural gas
- are so large in size as to require assistance
- involve innovative institutional or regulatory arrangements
- deal with environmental protection measures needed in connection with energy activities which EIA is authorized to assist.

EIA may not assist projects involving technology in the research and development phase.

Subsidies

Prediction of what an EIA would do is difficult since the Directors retain substantial discretion within the constraints set down in the proposed bill. One general policy the EIA could follow could be to refuse to give any support to a project beyond risk-sharing. Such a stance would exclude any actions committing EIA to providing net subsidies out of its assets--for example, by guaranteeing prices if the expected level of support is positive. An opposite policy could also be followed--to subsidize projects to the extent of revenues available from other activities while having no budget costs, or to subsidize so heavily that appropriations would be required to cover the excess of expenditures over revenues.

The policy decision regarding subsidies would be the most critical factor in determining the choice of projects. No synthetic fuel process which is expected to have production costs higher than market prices could be supported effectively if subsidies were excluded. Indeed, little effective compensation for effects of high interest rates or price controls (FEA or regulatory) is possible without some subsidy.

The extent of subsidy from retained earnings depends on revenues from other projects--loan guarantee fees, lease payments, interest and dividends from direct investment in stocks and bonds--and can be based only on arbitrary assumptions about EIA behavior.

Potential Candidates for Assistance

The Federal Energy Administration estimated that about $580 billion in 1975 dollars will be required to finance investments in energy supply between 1975 and 1984, the proposed lifespan of EIA. Examination of the composition of this $580 billion worth of potential investments can give some perspective on the kinds of projects EIA would assist.

Almost all of the $580 billion falls in two broad categories: (1) development, production, and transportation of domestic oil and gas, and (2) generation and transmission of electricity. Capital needs of the oil and gas industry are estimated by FEA to equal $234 to $304 billion between 1975 and 1985. Capital needs of electric utilities are estimated by the Federal Energy Administration (FEA) at $215 to $277 billion during that decade.[1] FEA estimates of capital requirements for coal and synthetic fuel production, the uranium fuel cycle, and coal and natural gas transportation total $68 billion.

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1. With an extreme shift to use of electricity, investment in electric utilities could reach $320 billion, according to FEA National Energy Outlooks, p. 297.

To find the share of these projects which EIA might assist, it is necessary to apply the project selection criteria specified in the proposed legislation, which relate to the type of project and need for assistance.

A large share of the investment projects of electric utilities could be assisted by EIA, under the nuclear power or electricity from sources other than oil and gas clauses. About $130 billion investment in nuclear and coal-fired power plants is included in the FEA projections. Another $90 billion investment in transmission facilities for these plants would be eligible.[2]

Almost none of the oil and gas investment projects would be eligible. Only projects applying new techniques, such as fracturing processes to obtain natural gas from "tight" formations, appear to satisfy the selection criteria.

A few projects might be large enough to make a claim to assistance. The FEA estimates include additions to the Alaska oil pipeline costing $3 billion. An Alaska natural gas pipeline could cost $9 billion.

Synthetic fuels, applications of solar energy to domestic heating and cooling and to electricity generation, and geothermal energy development would also be eligible for support. Projects involving coal transportation and production could also be eligible.

EIA is limited to supporting projects which would not otherwise be undertaken. Which projects will satisfy this criterion depends on whether Case I, II, or III obtains. Which EIA could support depends on the extent to which it offers subsidies to projects not profitable neglecting risk.

Possible effects of EIA on energy production are estimated under two assumptions. First, it is assumed that EIA is constrained to break even, so that no losses will be reported in the budget. Under this constraint, the ability of EIA to compensate for Case II conditions is limited. Second, it is assumed that EIA can offer subsidies or price

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2. FEA National Energy Outlook, pp. 243-246.

supports sufficient to attain Case I levels of investment or greater. Possible production and investment increases achievable with EIA are described in Table 6-1.

Effectiveness of EIA with Low Energy Prices

The criteria in the proposed bill governing project selection give EIA only limited authority to compensate for effects of low energy prices or general high interest rates unless EIA incurs substantial outlays which would be reflected in large losses appearing in the Federal budget.

Since the cost of capital to EIA would be lower than that available to private enterprises, EIA could offer lower interest rates than would otherwise be available. Such actions might be helpful to electric utilities and to certain marginal projects for commercializing new technologies, such as the less costly synfuels processes. General assistance to the petroleum industry is unlikely, but some assistance might be provided to the use of advanced recovery techniques. Stimulation of natural gas production from tight formations is an example: an investment of $1 to $2 billion might result in the 1 quad of production projected in FEA's accelerated scenario.[3] Since the viability of these techniques is strongly influenced by energy prices, little increase in use would be expected to result from low interest rates.

If EIA were able to offer assistance likely to result in large losses it could remedy any defect in electric utility financing due to low electricity rates. Under those conditions, however, defaults, capital losses, or operating losses to pay interest subsidies could be substantial.

F. Effectiveness in Remedying Financial Difficulties

The instruments available to EIA could assist any investment prevented by the financing difficulties and risk considerations which underlie Case III. Although EIA may not provide assistance for construction of oil and

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3. FEA 1976 National Energy Outlook, P. E-18, and Project Independence Blueprint, Final Task Force Report - Natural Gas, November, 1974, pp. A-50 to A-73.

TABLE C-1: EFFECTS OF ENERGY INDEPENDENCE AUTHORITY ON ENERGY PRODUCTION

INDUSTRY	CASE I				CASE II				CASE III			
	BREAK-EVEN CONSTRAINT		UNLIMITED SUBSIDIES		BREAK-EVEN CONSTRAINT		UNLIMITED SUBSIDIES		BREAK-EVEN CONSTRAINT		UNLIMITED SUBSIDIES	
	Production (Quads)	Investment (Billions)	Production (Quads)	Investment (Billions)	Production (Quads)	Investment (Billions)	Production (Quads)	Investment (Billions)	Production (Quads)	Investment (Billions)	Production (Quads)	Investment (Billions)
OIL AND GAS	0	0	1	1	0	0	1	1	2	22	3	23
COAL	0	0	0	0	0	0	0	0	2	4	2	4
SYNTHETICS	0	0	2	20	0	0	2	20	*	2	2	20
ELECTRIC UTILITIES[a]												
Fossil & Nuclear	0	0	0	0	1	3	4	12	4	12	4	12
Solar & Geothermal	0	0	*	4	0	0	*	4	*	1	*	5
OTHER												
Uranium Fuel Cycle	-	-	-	-	-	-	-	-	-	3	-	3
Solar Heating & Cooling	-	-	*	25	-	-	*	25	-	-	*	25
Coal Transport	-	-	-	-	-	-	*	1	-	3	-	3
TOTAL[b]	0	0	3	50	1	3	7	63	8	47	12	95

a Effect on electric utility investment in non-nuclear power plant is not estimated.

b Details may not add to totals due to rounding.

* = less than .5 quad.

gas fired power plants, it could assist in financing the investment in coal and nuclear capacity included in Case I but excluded in Case III. However, little new energy production would result. The only effect of cutbacks in construction of new electric generating capacity on imports is to reduce from 9 quads to 4 quads the contributions of nuclear power to primary energy production in 1985. Nevertheless, an adequate supply of generating capacity may also be a goal of energy policy.

Through loan guarantees or direct forms of assistance, such as construction and leasing of power plants, EIA could remove any shortfall in electric generating investment due to financial difficulties, and could (within the limits set by the regulatory process of the Nuclear Regulatory Commission and the Environmental Protection Agency) direct that investment away from oil and gas-fired plants.

If risks and difficulties of arranging financing alone prevent the synfuels ventures producing .2 quad in Case I, uranium enrichment projects, and large pipelines from being constructed, EIA could remedy those problems. By assisting a total of $17 billion investment in these areas EIA could increase energy supply by 2 quads in 1985. (That 2 quads would result from an additional $10 billion investment made profitable by provision of the supporting investment through EIA.) Assistance to electric utilities could restore the 4 quads of nuclear energy production which is eliminated in Case III.

New Technologies

In addition, EIA might encourage the substitution of new technologies for old without increasing aggregate energy investment. Such a strategy, which might be required because of the relatively greater riskiness of new technologies or the difficulties of capturing information benefits, could achieve energy production goals at lower cost than they would be achieved otherwise. However, to the extent that private enterprise cannot capture all the social benefits of introducing new technologies, net subsidies by EIA might be required. FEA estimates that by 1985 the maximum level of electricity generation from solar and geothermal energy would be about .5 quads.

Investment of $5 to $15 billion might be possible in those areas, but is unlikely without some subsidy element in EIA assistance.[4]

If unlimited subsidies were possible EIA might provide support for commercialization of new technologies not economic even in Case I. Some synfuels processes would be uneconomic if world oil prices were $13 per barrel, especially the production of oil from coal. Applications of solar and geothermal energy could also be accelerated, as conceivably could some processes for advanced recovery of oil and gas. A total investment of $20 billion, resulting in annual production of about 2 quads in 1985, would be possible for synfuels alone. ERDA predicts a potential for $25 billion investment in solar heating and cooling, although large subsidies would be required to make such an investment attractive.

Putting all these opportunities together, a picture of what EIA might do emerges. If EIA supports only ventures which appear profitable but cannot raise adequate capital (as in Case III of the report), it could support about $14 billion investment in Alaskan pipelines and synthetic fuel production, $3 billion in the nuclear fuel cycle and perhaps $100 billion in electric utility investment. The need for support to these ventures and the ability of EIA to encourage them without subsidies would depend on whether unprofitability or financing problems caused private investment to be lacking.

If EIA were to pursue a policy of subsidizing projects which cannot earn an adequate profit at current market prices, it could also support up to $20 billion of investment in synthetic fuels and perhaps $25 billion investment in solar and geothermal energy.

In summary, it appears unlikely that financing difficulties will affect more than $20 billion of energy investment (exclusive of investment by electric utilities) which would otherwise be profitable. The remainder of EIA's assets would presumably go to financial support of electric utilities or to subsidize production of energy which could not be sold profitably at prevailing prices.

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4. FEA, National Energy Outlook, pp. E-29 and E-30.

Liquidation of EIA

EIA is designed to liquidate itself at the end of ten years, or, if an extension is granted by the President, thirteen. No new financial commitments are permitted after the first seven years. The Liquidation Plan is to be drawn up by the corporation itself, and no insight into the nature of the liquidation is provided in the bill or fact sheet.

Liquidation can be accomplished by only two means: sale of assets to private investors, or transfer of assets, obligations and functions to the Secretary of the Treasury. Extended life is the essence of an investment: it is a commitment now of resources which will earn income over many future years. If loan guarantees and price supports are to be effective in inducing investment in a project with a life of ten or more years, they must in most cases remain in effect after EIA is liquidated. The agencies which will assume these functions must have budget authority to pay price supports and redeem defaulted loans. To the extent that the often repeated claim that private investors discount loan guarantees which must wait for appropriation to be redeemed, is valid, the termination of EIA and transfers to agencies which do not now have borrowing authority will reduce the effectiveness of loan guarantees.

Purchase and lease-back of facilities also involves physical plant and equipment which will endure beyond the life of the EIA.

Direct loans and stock purchases of EIA can be either transferred to the Secretary of the Treasury or sold back in the private capital markets. In one case, the EIA remains alive in all but name; in the other, financing which EIA supported in 1975 to 1982 will be shouldered by private markets in 1982 and beyond, in addition to investments newly made in those years. The portion of EIA financing which goes into stocks and bonds will, if effective in inducing new investment, simply postpone the time at which that financing must come from private markets--and the government will probably sell its investment at a loss. (Otherwise, private markets would have provided the funds initially.) If the time after 1982 will be a period of easier money, or if 1975 to 1982 is a unique time in the energy sector, this costly shift might be justified.

The choice may be between using EIA to make commitments which will then be assumed by the Secretary of the Treasury, incurring budget costs and imposing large burdens on private capital markets between 1982 and 1988, or choosing only projects which need assistance for seven years or less.