

EXECUTIVE SUMMARY

In the year since ERDA's formation, domestic production of natural gas declined 6.9 percent and crude oil 4.5 percent. At the same time, petroleum imports accounted for 37 percent of the Nation's total petroleum consumption in 1975 and are now approaching 40 percent. Achieving energy independence by 1985 has become all but impossible. Even to hold import dependence to the present levels through 1985 would be a formidable achievement. The energy situation is serious and continues to deteriorate. In addition to Federal action, a sense of urgency, public awareness, and participation is required. These factors affirm the need for a national energy policy and a crucial role for ERDA in the years ahead.

The Office of Technology Assessment, in its 1975 analysis of ERDA's initial plan and program, cited two major areas of weakness. The first was ERDA's pursuit of technological options, while neglecting consideration of the broader aspects of energy production, delivery, and use. In particular, OTA indicated that the realization of technologically established energy options may be prevented by nontechnical constraints such as transportation, resource, manpower and capital availability; public acceptability; and institutional, jurisdictional, economic, and environmental compatibility. ERDA has made significant progress in this area as reflected in the updated Plan and Program (ERDA 76-1). ERDA has more aggressively interpreted its role in meeting the Nation's energy goals by expanding its efforts to deal with non-technological constraints. It is apparent that ERDA has begun to orient its Research, Development, and Demonstration (R, D&D) program more toward solving energy problems rather than just creating technical options.

The second deficiency was found in the emphasis of both the ERDA Plan and Program on options directed toward increased energy supply, relative to the programs in end-use demand reduction. Supply programs were over conservation programs by a ratio of 49 to 1. ERDA has

now increased the role and priority of conservation to the same level as the highest priority supply options in meeting the Nation's near-term energy needs.

Though the updated ERDA Plan and Program represents substantial progress in their approach to achieving the Nation's energy goals, other serious concerns deserve attention.

Of particular importance is the observation that important, potential near- and mid-term sources of domestic energy supply from first-generation technologies are not adequately pursued. The principal focus of ERDA's R, D&D programs in synthetic fuels is on second-generation technologies with mid- and long-term payoffs. A key strategy for commercialization of first-generation technologies in high-Btu gasification, liquefaction, surface retort of oil shale, and other alternative energy source programs is the synthetic fuel-loan guarantee legislation presently before Congress. Whether commercialization strategies involve loan guarantees, price supports, cost sharing, import tariffs or combinations thereof, early resolution is imperative. Presumably, alternate strategies for near- and mid-term commercialization will not be available until congressional action is completed either accepting or rejecting the proposed legislation.

ERDA does not sufficiently convey the urgency required to address the near-term energy problems. The framework for a procedure to accomplish this objective exists within ERDA through its new 5-year forward planning system which focuses on technology available in that period. A set of annual milestones to meet near-term energy objectives and annual reporting of progress in meeting those milestones would be very useful. They would give the Congress and the public the opportunity to evaluate progress in the achievement of the milestones. That evaluation, debate, and resultant action could assist in informing the American public of the serious energy problems and choices facing this Nation in the decade ahead. Executive and legislative support, to achieve these program milestones, would help to establish a sense of urgency and action.

ERDA has made substantial progress in its first year of existence toward the establishment of an effective energy research and development program, which represents a critical component of national energy policy.

ISSUE HIGHLIGHTS

Overview

The Energy Research and Development Administration has taken a number of significant steps in resolving the 16 overview issues set forth in the OTA analysis. The principal changes are summarized as follows. Each point is dealt with in more detail in the Overview chapter.

- ERDA has expanded the interpretation of their role in achieving the national energy goals. These goals are the same as set forth in ERDA-48. ERDA has broadened its approach by increasing emphasis on conservation and on the nonhardware aspects of the energy problem.
- The supply-demand balance in the revised ERDA Plan and Program has improved. ERDA has placed conservation at a priority equal to the highest priority supply options. Conservation is now considered the principal strategy for attacking the near-term (to 1985) energy problem.
- Emphasis on socioeconomic and environmental research has increased. The

revised Plan and Program indicates the importance of including socioeconomic and environmental considerations with technology development. Efforts to incorporate socioeconomic analysis are described in each program area, and environmental review is to be a major part of the ERDA planning process.

- ERDA has taken steps to develop a commercialization strategy. A key element in this process is the establishment of the Office of Commercialization which has the responsibility of formulating these policies. Details need to be worked out and no judgment as to the effectiveness of the program can be made at this time.
- Greater emphasis is placed on international considerations in the revised Plan and Program. A planning activity is underway in ERDA to establish "courses of action" for international cooperation. Each program area describes international activities related to its various projects.
- ERDA is taking steps to increase the effectiveness of their planning and management structure. ERDA is developing the Planning, Programing, Budgeting, and Review (PPBR) system to establish R, D&D priorities and strategies.

While these represent substantial accomplishments, there remain unresolved points in each of the overview issues. The principal areas of concern can be summarized as follows:

- A sense of urgency is needed in addressing the near-term energy problem. Although enhancing the role of conservation, ERDA has still not adequately addressed the immediate problem of the Nation's increasing dependence on foreign oil. The 5-year planning system being instituted by ERDA, if properly supported by legislative and executive action, can do much to rectify this shortcoming.
- There remain limitations with the conservation program which could seriously reduce its potential contribution. The budget for conservation represents just 3.8 percent of the total ERDA energy overall

R, D&D budget compared to 3.0 percent in FY 76. Further, ERDA has virtually ignored the long-term, lasting potential of energy conservation by excessive concentration on its near-term impact.

- A gap remains between the scope of the basic research program and the needs of the energy technology programs. The basic research program remains weak in a number of important energy-related fields such as heat transfer, thermodynamics, and combustion processes. In addition, very little basic research can be identified in the solar, end-use conservation, fossil, and geothermal programs.
- Alternative energy R, D&D budget strategies have not been defined. ERDA has apparently not investigated the effects of various R, D&D budget levels on achieving the Nation's energy goals.
- Nonelectric energy technology development is still underemphasized. Although OTA does not imply reemphasis of programs directed toward electrification, it does appear desirable for ERDA to place greater emphasis on direct thermal use of solar and nuclear energy sources. This appears to a limited extent with solar and geothermal and is partially responsive to the prior critique.
- Interaction between ERDA and Federal energy related regulatory agencies needs definition. The profound effect that regulatory agencies have on energy resource development, delivery, and use will influence the implementation of ERDA's R, D&D program. An effective coordination effort depends to a large extent on the establishment of a clear national energy policy.

Fossil Fuel

In the fossil-fuel area, the original OTA analysis identified 16 areas of concern. The OTA examination of the FY 1977 ERDA budget and revised program, as reflected in ERDA 76-1, Volume 2, indicates that ERDA is striving to be generally responsive to the concerns through the proper application of funds and intensified efforts. Contingencies have caused certain deficiencies to remain. These are, in large part,

due to the lack of an expected clear national directive to accommodate the commercial development of currently available and future fossil-fuel technologies. The deficiencies are compounded by cuts in the Division and ERDA budget requests before they were submitted to Congress.

The OTA comparative analysis found that ERDA's approach to a number of issues under the fossil-fuel program was substantially improved over last year. These include: (1.) synthetic liquid fuels from coal; (2.) low-Btu and low-Btu, combined cycle systems; and (3.) direct coal utilization. Early transition of these technologies to commercial reality are of major importance for some measure of energy independence and stabilized fuel supply. ERDA has initiated a demonstration plant for coal liquefaction, and it has consolidated the various components of the low-Btu, combined cycle powerplant into an integrated and well-coordinated program. It has reduced its expectations of short-term payoff from fluidized bed combustion and added a program on coal-oil slurry.

Four concerns identified in the previous OTA analysis still remain and are particularly worth citing:

- In the area of primary oil and gas recovery, ERDA's program identified an intention to initiate advanced exploration and extractive techniques both onshore and offshore. However, there is no indication of work designed to improve oil spill clean-up for Outer Continental Shelf operations, or to provide satisfactory answers to other environmental and institutional issues that have the tendency of holding up adequate development.
- Enhanced oil and gas recovery could contribute significant quantities of oil and gas in the short run. ERDA in its original request for increased funds recognized the need identified by OTA for a program of 80 to 150 field tests and demonstrations. The reduction of ERDA's request before submission to Congress will limit the number of tests to the 33 now planned by ERDA.
- In the area of oil shale processing, the ERDA program has been partly responsive to needs. OTA identified in ERDA's earlier

program an excessive concentration on the Bureau of Mines, in-situ, horizontal process and also indicated that there was no program at all for mining plus above-ground retorting. The FY 1977 budget appears to have broadened the scope of the in-situ work to include other processes. The budget was not responsive to the mining plus the above-ground retorting issue probably due to the failure to pass commercialization legislation in 1975.

- In the field of high-Btu coal gasification, OTA initially identified a need for a first-generation, commercial-size plant. The ERDA program and budget remain focused solely on the development of second-generation technologies that can provide mid-term gas supply. The budget reduction in ERDA's budget request before submission to Congress does nothing to meet the concerns for first-generation plant development and lessens the support for even second-generation technologies needed for mid-term gas supply.

Nuclear

The nuclear program delineated in ERDA 76-1 is a constructive attempt to deal with many of the problems of the nuclear enterprise. In particular, the critical issues of waste disposal, safeguards, and uranium resource assessments have been accorded a new sense of urgency and substantially increased funding. In other areas such as closing the fuel cycle and developing the Liquid Metal Fast Breeder Reactor, ERDA seems determined to do whatever it has to in order to assure a workable system. In some areas, however, ERDA's efforts seem inadequate to ensure the development of potentially desirable technologies. The High-Temperature Gas Reactor and the Floating Nuclear Powerplant are examples. The following items seem particularly crucial and deserve particular consideration by ERDA:

- Improving Light-Water Reactor (LWR) Technology. Since our entire short-term nuclear option depends on the success of the LWR, a strong effort is warranted to keep this technology healthy. Problems with the LWR energy system have been identified often and in detail. ERDA's interest, as expressed in ERDA 76-1, in improving LWR technology is promising but program definition is only beginning to emerge.

. Siting of Liquid-Metal Fast Breeder Reactor (LMFBR). ERDA has no serious plans to study nuclear energy centers for LMFBR's, yet the decision as to collocation of LMFBR's is possibly the most important single long-range decision in nuclear energy. ERDA must launch a serious examination of LMFBR collocation.

. Cancellation of Molten Salt Breeder. ERDA has dropped the molten salt breeder without giving any clear justification. This action reduces the number of long-range nuclear options available to the United States. In particular, the only thorium cycle breeder still under development is the Light-Water Breeder Reactor, an option which may have very limited application even though near demonstration.

Solar, Geothermal, and Advanced

ERDA has made improvements in their solar program in addressing some of the issues raised in the OTA analysis. There has been increased attention paid to setting program priorities and making decisions on high-risk projects. Further, the revised ERDA Program places greater emphasis on the nontechnological aspects of solar energy development. These improvements are limited in scope. However, it must be noted that, to some extent, ERDA cannot be faulted for this because budget and personnel constraints preclude a more adequate response. Indeed, there are cases (discussed below) where the budget requests submitted to Congress tend to run counter to a more positive response to an issue as described in the ERDA Program.

The principal findings of this comparative analysis are as follows:

- Solar heating and cooling are still under-emphasized relative to solar electric. This appears to be due in part to reductions of ERDA's budget requests in the budget submitted to Congress. The Solar Heating and Cooling and Agriculture and Industrial Process Heat Subprograms' budget as prepared by the Solar Division were increased a greater percentage than for the solar electric subprograms.
- Steps have been taken to develop systematic mechanisms for setting program priorities.
- The ERDA solar program management process has not noticeably changed

since the original OTA analysis. A major reason for the present management structure is the limited number of personnel in the Solar Energy Division. In this connection, the ERDA request for additional staff was reduced from 31 to 5.

- Decisions on high-risk projects appear to be under better scrutiny, Decision methodology has yet to be put into operation.
- The standards and incentives components of the solar heating and cooling programs have received increased emphasis, but there is still no systematic means to integrate them into the program and to assist in their implementation.
- Little change is evident in the structure of ERDA's research program with regard to enhancing the interaction between the basic science functions and the engineering, nontechnological, and commercialization functions of ERDA.

Geothermal Program. Substantial strides have been made in treating the issues raised by the OTA analysis. Major subprogram elements are presented in the ERDA Program document which considers nearly all the points raised in the issues relevant to geothermal energy development. This program appears to be very well organized and to treat the entire problem rather than deal solely with the technology.

The only major concern with the Geothermal Program is that the budget request, made by ERDA to OMB, was reduced when submitted to Congress by a higher percentage than the other major programs within ERDA. This is not consistent with the high degree to which the Geothermal Program has responded to the OTA issues.

Conservation

In general, the subprogram elements of the Conservation Program have been responsive to the issues identified in the OTA analysis insofar as the ERDA Plan and Program is concerned. Activities are described which account for most of the points raised in the issues when relevant. The ERDA Plan and Program presents a more vigorous approach to energy conservation and places it with their highest R, D&D priorities. ERDA has also expressed an increase in their efforts to deal with the social, political, economic, and environmental issues associated with the

implementation of energy conservation technologies. Finally there is a greater emphasis placed on interaction with the private sector. This has become a principal component of the strategy outlined in the Program document.

There remain, however, some major concerns with the ERDA Conservation Program as determined by the comparative analysis. Chief among these are as follows:

- In many instances, efforts are described in the various subprograms which resolve points raised in the issues, yet, budget requests delivered to the Congress appear inadequate to effectively carry out these efforts.
- ERDA's use of the term 'conservation' remains too broad. It should be limited to subprograms which are principally oriented toward saving energy in a cost-effective way (Buildings, Industry, Transportation). By also including subprograms that deal principally with the storage and delivery of energy (Electric Energy Systems, Energy Storage), a distortion occurs that is both unnecessary and unfortunate in that it makes the evaluation of each category more difficult and gives the appearance of greater effort in conservation than there actually is.
- The problems of integration of new electric energy sources into the existing grid deserve a higher priority in the Electric Energy Systems and Conservation Research and Technology (Energy Storage) subprograms. There is a need to develop flexible systems which allow the use of small, total energy systems.
- Basic research on innovative energy conservation technologies, which have a high potential for energy savings in the long term, do not appear to be given sufficient emphasis in the ERDA Conservation Program.
- The Conservation Program has no apparent overriding sense of direction. A conservation strategy needs to be articulated so the program elements are viewed as parts of a whole.

Environment and Health

The revised ERDA program for Environmental Research and Safety represents a significant improvement over the planning and implementation programs in ERDA-48. ERDA has made significant progress toward augmenting its environmental efforts and, even more important, toward integrating an awareness of environmental, health, and socioeconomic considerations into its technology groups. In some cases the improvement may simply be a matter of more thorough description of existing programs. The program structure in the area of health effects of atmospheric sulfates is a significant example of this. Most of the many individual studies described either in the program document or in the budget are continuing efforts which existed at the time ERDA-48 was written. These, and other programs relating to health effects and to water contamination, are much more thoroughly defined in ERDA 76-1 than in ERDA-48. New, or at least significantly increased, efforts are evident in the areas of nontechnological research and technological evaluation in modeling, data compilation and characteristics of potential energy-impact regions.

With respect to the remaining issues, ERDA's response has not been adequate. The principal concerns can be described as follows:

- . There is the need for a better definition of the competition between energy and non-

energy sectors imposed by finite water availability in the arid but resource-rich Western States. ERDA has taken only small steps into this area; most of their concern relates to the siting of nuclear facilities, especially nuclear parks.

- The Biomedical and Environmental Research (BER) budget request has increased 4.70/o from 1976 compared to a 320/o increase for ERDA as a whole. The BER budget does not appear to be adequate to meet the problem of U.S. energy self-sufficiency with adequate protection of environmental goals.
- The program of social research in off-shore energy development is structured too coarsely to cover this topic in the detail suggested by the issue. Further, in some cases, background work is not developed enough to provide an adequate attack on problems such as variances on environmental standards for demonstration plants.
- . ERDA's budget for promotion of education and training in critical energy skills sustained an actual reduction. And there is little or no attention to the study of potential climate modification at the national or global scale.