D. CONSERVATION ISSUE PAPERS

1. Importance of Conservation

ISSUE

The ERDA Plan should better reflect the urgency and importance of conservation in responding to the national energy problem.

SUMMARY

ERDA-48 states that energy conservation is of "crucial" importance, particularly in the next decade. However, its program priorities and funding requests are inconsistent with the stated importance of conservation. There is little evidence that cost-effectiveness or environmental/economic impacts have been considered in establishing program priorities; moreover, programs to address nontechnological but none-the-less vital issues in developing and implementing conservation activities seem to be missing. A sense of urgency to achieve results (saved energy) seems wanting.

QUESTIONS

1. How does ERDA expect the importance and probable cost-effectiveness of conservation to be reflected in its programs, especially in comparison with supply technology programs?
2. What guidelines are used to decide whether an energy conservation activity should receive ERDA funding rather than funding from some other Federal agency or the private sector?
3. What is ERDA doing to ensure that its program can be rapidly implemented through an adequate, highly responsive procurement system?

BACKGROUND

Studies of ways to respond productively to the problem of energy price and scarcity conclude that most cost-effective options available to us relate to improved utilization rather than to accelerated supply growth. The ERDA enabling act, Public Law 93-577 Sec. 5(a), states that". . . energy conservation shall be a primary consideration in the design and implementation of the . . . program . . ." Opinions differ regarding the extent and rate at which price effects alone will induce "the market" to shift to more efficient energy use. Many observers feel that because of a variety of market imperfections and Government regulations in the energy area, the price response will be far less complete and less rapid than needed to meet national needs.

Most observers feel that the energy problem is so urgent for both economic and national security reasons, that an aggressive campaign must be mounted to:

- Accelerate the rate at which end-use efficiencies are improved;
- Extend improvements from those that have sufficiently fast payoff to attract private investment to those that self-amortize more slowly but are still attractive in terms of public benefit.

In addition, the public benefit of reduced vulnerability to embargoes and price cartels provides justification for Federal incentives that help induce otherwise "no profit" shifts to higher efficiency.

The urgency and cost-effectiveness of a major effort to improve energy utilization is recognized in the general pronouncements of the ERDA Program Plan, but a closer review shows that the pronouncements do not translate into actual program emphasis and budgetary priority:

- Despite the high priority and cost-effectiveness of conservation the proposed budgetary allocation to conservation versus supply development is only about 2 percent. Clearly the ERDA budget decisions accord little weight to relative cost-effectiveness.
- Approximately half of this 2 percent actually is only indirectly related to end-use conservation; rather, it pertains to miscellaneous programs (e.g., electric transmission and distribution) assigned to the Assistant Administrator for Conservation that, however worthy for other reasons, carry low priority in terms of conservation potential, per se.
- Many of ERDA's conservation programs are overly cautious and conservative (e.g., the electrical sector); they are not comprehensive (e.g., the transportation sector), they display little aggressiveness or sense of urgency as well as an unwillingness to make high-risk but promising, high-leverage investments.
- The old Atomic Energy Commission procurement procedures must be modified to match ERDA's new requirements, especially in the area of conservation. In this area, ERDA must deal with a very diverse set of constituents rather than with a small number of large industrial concerns. There is little evidence that these modifications are being made.

2. Program Management and Coordination

ISSUE

ERDA's plans for conservation program management and coordination within the agency, with other involved Federal agencies, with State and local governments, and with other nations need additional attention.

SUMMARY

ERDA has been mandated (Public Law 93-577) as the primary agency in energy R, D&D with responsibility y to integrate and coordinate national efforts. Its mission is to assure that existing ancillary resources (e.g., capital) manpower, materialist and expertise) are utilized to the maximum extent, thereby making available the most promising energy alternatives.

It is not evident in ERDA's plans whether a comprehensive framework is being established to permit ERDA to perform adequately its required coord-ination/integration role. Insufficient attention is given in the Plan to the implementation of formal mechanisms or operating relationships to assure:

- location of programs within ERDA to maximize chances for an integrated systems approach to solving problems;
- coordination of programs with the various Federal agencies, and State and local governments involved in energy conservation work; and
- integration of foreign energy conservation R, D&D into domestic planning.

Lack of programmatic elements to deal with the above responsibilities could seriously impede the effort to achieve the stated objectives within the conservation program.

QUESTIONS

1. As specific examples of problems in definition of responsibilities:
   - What is ERDA's role in the development and implementation of technologies to recover resources and the energy content of municipal garbage? This would appear to bean important function of ERDA and is so stated in the legislations, yet ERDA's budgetary commitment is of a token nature, and other Federal agencies are involved in this area.
   - How are the solar heating and cooling programs to be coordinated with the building conservation programs, since both are intimately related to building design?
   - Why is work in Electric Conversion, Electric Power Transmission and Distribution, and large-scale (powerplant) Energy Storage under the purview of the Assistant Administrator for Conservation?
2. What specific management mechanism, technique(s) or coordination controls will ERDA use to integrate and coordinate its conservation activities with other Federal agencies?
3. In the near term, where direct Government influence and incentives can create energy savings, how is the responsibility for energy conservation divided between ERDA and FEA?

4. How does one separate the policy implementation role of FEA's energy conservation program from the R, D&D activities of ERDA?

5. How does the ERDA Plan to integrate and coordinate its activities with State and local authorities assure that overlap, duplication, and inefficiency in ancillary resource utilization are avoided?

6. What provisions have been made in the ERDA Plan to assure that the agency will utilize, to the fullest possible extent, innovations for energy conservation developed in other countries? Who will be responsible for these cooperative arrangements?

BACKGROUND

ERDA has been mandated (Public Law 93-577) as the primary agency in energy R, D&D with responsibility for coordination and integration of national efforts and for cooperation with other nations. Programs to develop energy supplies have existed for many years. However, only in the recent past with the rise in energy prices and uncertainties in availability, have significant efforts been focused upon energy conservation. As a result, responsibility for energy savings programs is divided within ERDA, among other Federal agencies, and among State and local governments. Although there are varying perceptions about appropriate division of responsibility, there is general agreement that operating relationships must be established in order to coordinate ongoing efforts at all levels. It is not clear from the ERDA Plan that a comprehensive framework has been established which will permit ERDA to adequately perform its required coordination/integration role. These mechanisms need to be resolved early in ERDA's development.

Within ERDA itself, there are questions regarding the assignment of programmatic responsibilities, For example, on the one hand, responsibility for Solar Heating and Cooling of Buildings is located under a different ERDA Assistant Administrator than programs for minimizing energy required to operate buildings even though the two program areas are closely interrelated, More attention needs to be given to the location of programs within ERDA in order to maximize chances for an integrated systems approach to solving conservation problems,

In a similar vein, some means of formal management control must be developed to assure coordination of related programs in various Federal agencies and departments (e.g., the Federal Energy Administration, Environmental Protection Agency, Federal Power Commission, Department of Transportation, Department of Commerce, Housing and Urban Affairs Department, U.S. Department of Agriculture) that impact on energy demand. In many cases ERDA has a program goal that is either identical or implicitly related to some other agency area of concern. Of critical concern is the relationship between ERDA and the Federal Energy Administration in their efforts to coordinate analysis and policy input in R, D&D program design, The lack of a clear statement regarding the way in which the implementation measures managed by the Federal Energy Administration will be integrated with the R, D&D programs of ERDA requires serious attention, An implementation strategy must be initiated at the earliest stage of research planning and setting of priorities and goals, It is encouraging to note that such coordination seems to be already operational in the Buildings and Industrial sectors,

Likewise, an effective link needs to be made between the Federal system and State and local authorities, since they are responsible for some of the most important policies regarding energy use, The integration of State and local activities into the overall process is important since such activities reflect various regional perspectives. It is also essential in providing an effective channel for information transfer and technical assistance to these groups.

Finally, an equally important consideration is the manner in which ERDA intends to participate in international cooperative R, D&D programs, It is important that the agency define more precisely how it will assure that foreign energy conservation work is integrated into domestic planning.

Although it is reasonable that energy conservat ion efforts are ongoing in more than one agency, i t is necessary that these efforts be complementary. The “lead agency” role is at best difficult, but without clearly defined management controls and effective leadership, the result wil1 be duplication and inefficient t use of public resources.

3. Interaction With the Private Sector

ISSUE

A comprehensive plan is needed for interaction between ERDA and the private sector in energy conservation.

SUMMARY

Without close coordination with industry and other private organizations, widespread implement at ion of research results cannot be attained. The problem is complex since various areas of the private sector are organized quite differently and each (e. g., encrgy consuming industry, energy producing industry, the Electric Power Research Institute (EPRI), individuals, public institutions], will require a unique approach to constructive interaction. The ERDA Plan provides few details as to how this interaction is to be accomplished,

QUESTIONS

1. What specific organizational structures has ERDA devised to obtain and utilize input from the industrial, labor and consumer sectors in its basic program planning effort?

2. By what mechanism are ERDA and EPRI program planning activities coordinated?

3. How does ERDA plan to collect, distribute, and implement both public and private conservation research results?

4. What are the criteria used for deciding whether, and to what extent, energy conservat ion activities should be supported with Federal funds?

BACKGROUND

In the area of energy conservation, close coordination between government and private organ i zations, such as industry, professional societies, anti consumer groups, is crucial. While governmcnt may initiate much of the research, u1timate implementation is largely dependent on the privatc sector.

The detailed mechanisms for interact ion will vary great1y from one industry to another, and will even vary somewhat within industries, For e x am ple, the building industry is highly fragmented, involving standards organizations, professional societies, manufacturers, trade groups, and labor organizations, each of which will have a different role to play in utilizing new conservation technology. Many components of this sector have no research capability of their own, and will depend heavily on government for hardware development and policy direction. Others have excellent research and development resources and can be vital contributors to the national program at the planning and development level. The detailed format for ERDA coordination with such diverse components of the private sector must be carefully designed to be effective,

The electric utilities industry is a special case, both because of its central role in energy conversion and distribution and because of its cooperative sponsorship of a wide variety of research and development projects through EPRI. Because of its close connection with the utilities industry and its industry advisory committees, EPRI is both aware of the problems of the industry and well-situated to lead in technology transfer, ERDA, on the other hand, should take the lead on projects with excessively low profit potential, high risk, or high capital requirement.

It is vital that ERDA take affirmative steps to involve all elements of the private sector in the earliest possible stages of program planning. Advisory boards with representatives from industry as well as private citizens can provide important viewpoints to aid in the decision-making process and to support alternative courses of action. Since many energy conservation initiatives may have significant impact on relative competitive positions within industry, government's role must be carefully defined.

Budgeting for research by ERDA should take account, wherever possible, of private expenditures for related efforts. Cooperative programs involving cost-sharing contracts must consider patent and proprietary rights. Even in the development and demonstration stages, ERDA must appreciate and work to eliminate problems that might impede the eventual commercialization of new processes and products,

4. Use of the Term "Conservation"

ISSUE

ERDA's operational definition of energy conservation is too broad.

SUMMARY

ERDA uses the term conservation so broadly hat almost any effort to improve efficiency or cost in either energy supply or energy demand can be subsumed with in it. This has the possible consequence of shifting the emphasis on responsibility for conservation actions away from the consumer toward the suppliers and distributors of energy.

As an example, the Electric Conversion, Energy Storage, and Power Transmission programs can produce large cost savings but, in most instances, their energy savings potential is small in comparison with efforts in the energy demand sector. As important as they are, these cost savings could distort the contribution of these programs in terms of the objective of reducing energy use. This could cause a shift away from end-use conservation priorities to those on the supply side within the overall conservation program. Also to increase their chance of success these programs should be coordinated with research on other components of the electric power system with which they are related synergistically.

QUESTIONS

1. What is ERDA's opera tional definition of conservation ?
2. How can ERDA better structure the diverse activities under its Assistant Administrator for Conservation in order to distinguish their goals more clearly?
3. What level of energy savings can be realized as a result of success in the proposed programs in electric conversion, electric transmission and distribution, and energy storage? How does this compare, in terms of cost, with savings achievable through load management ?
4. How does ERDA propose to integrate the various component programs of the electric power system?

BACKGROUND

The operational definition of conservation is of critical importance, particularly during the period in which the ERDA energy conservation program is being established. Conventional usage defines energy conservation as that array of technologies, techniques, and strategies which results in more "efficient" utilization of fuels to accomplish a given end. Another definition also includes lifestyle and institutional changes which result in a reduced demand for energy consumption.

ERDA's program plan includes the first of these definitions, i.e., more efficient means to achieve given ends, and in some areas, goes

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beyond the latter to include interfuel shifts and measures which might more correctly be termed "economic efficiency" rather than energy efficiency improvements. Too little attention is given, however, to efficiency increases in end-use. This results in an operational definition of energy conservation which permits the rationalization of virtually any efficiency change in the energy supply or demand systems as a conservation measure and can shift the emphasis on responsibility for conservation actions from the consumer to the producer of energy.

The program areas of Electric Conversion, Energy Storage, and Electric Power Transmission and Distribution are examples which meet the "economic efficiency" criteria and are not principally energy efficiency measures. Although these programs are quite worthwhile, there is a very real danger that by their inclusion under the generic term of conservation they could mask a low level of commitment to programs more directly focused on the important task of eliminating wasteful expenditures of energy.

In addition, these programs are principally concerned with various components of electric power systems and should be investigated in coordination with each other and with the other system components rather than as conservation measures. This, too, provides incentive for administrative relocation of these programs.

5. Need for Nontechnological Research

ISSUE

ERDA's role needs clearer definition with respect to research on nontechnological issues associated with energy conservation.

SUMMARY

present inefficient patterns of energy use, characterized by inefficiencies in buildings and consumer products, in transportation, in industrial processes, and in the generation and transmission of electricity, are to a large degree caused by a combination of historical, institutional, governmental, economic, and social forces. Implementation of known methods and technologies to improve energy use efficiency requires an understanding of how these forces operate and how changes in these forces will influence energy consumption patterns and fuel use. The regulatory policies and programs of various agencies need to be critically reexamined to see how they can be modified to promote greater energy efficiency. To accomplish this, identification of a lead agency which will decide on the trade-offs among separate agency interests and establish an overall government posture is a key requirement. Guidelines in (Public Law 93-577, Sec. 5(a), imply a strong ERDA role.

QUESTIONS

1. Has ERDA developed programs to analyze nontechnological issues related to energy use?

z. What fraction of its energy budget will be assigned to analyses of economic, social, institutional, and behavioral issues?

3. What efforts does ERDA anticipate to evaluate the energy impacts of Federal regulatory programs? Will the efforts involve the cooperation and participation of other Federal agencies? If so, how?

4. How can the administrative costs of regulation to the taxpayer, the manufacturer, the businessman, and the consumer be assessed?

BACKGROUND

Energy conservation analysis which focuses solely on the technological issues and neglects the many nontechnological considerations is incomplete and undesirable. Research on the effect of Government regulatory agencies, as well as studies of the social factors which influence energy use patterns, would be particularly timely. For example, the Interstate Commerce Commission regulates all rail and much truck freight traffic in addition to intercity bus travel, The Civil Aeronautics Board regulates commercial aviation, The Federal Highway Administration and the National Highway Traffic Safety Administration regulate truck weight and safety features. The Urban Mass Transit Administration, and a bewildering array of local regulations, control the operation and labor practices of urban transit systems. Almost none of these emphasize energy conservation. Similar examples can be cited for the other areas of concern.

R, D&D required to carry out programs in conservation is strongly sector-specific, whether it be in technology, social science, or behavioral science. It is encouraging to note that conservation work is organized along sector lines.

The policies, programs, and regulations of these agencies need to be reexamined to see if recent and projected changes in fuel prices and availability warrant modifications to promote greater energy efficiency, It is likely that these analyses can best be conducted in cooperation with other interested Federal agencies, such as the Federal Energy Administration and the regulatory agencies.

6. Demand Modeling and Conservation Planning

ISSUE

The basic assumptions underlying ERDA's projections of future demands are unrealistic; as a result, the ERDA Plan has not accorded sufficient attention to conservation as a means of reducing energy demand, environmental impact, and financial stress.

SUMMARY

Investment in energy conservation can yield a high rate of return. In addition to lower total cost for a given standard of living, major benefits which result from conservation efforts include:

- Lower energy and natural resource consumption
- Lower capital investment requirements
- Reduced environmental impact,

The Reference Energy System model used in the ERDA Plan as a "baseline" reference for future energy demand growth is unrealistic in that it does not recognize the impact of even current price increases on future demand. As a result, an artificially high demand is projected for 1985 and 2000, and this inflated figure is the basis from which plans for new supply are developed,

Program emphasis and funding may thus be seriously biased toward the supply options. Such an overstatement of need is damaging to future efforts toward energy development in both the supply and demand areas. Since the ERDA Plan is closely tied to numbers generated in the model, we must be careful to keep in mind the assumptions that went into the ERDA calculations.

QUESTIONS

1. ERDA depends rather heavily on the Reference Energy System model to provide estimates of oil and gas imports required under varying assumptions about supply and conservation actions. It is realistic to project that no increases in end-use efficiency will occur (other than with respect to the automobile) over the next 25 years unless the government takes additional actions? In other words, is Scenario 1 more likely to be the "no-action" response?

2. Some industries have already reported gains in energy efficiency (energy use per unit output) that approach the figures projected by the ERDA Plan for 1985. Given present prices plus an (assumed) active Federal program to accelerate conservation, would ERDA expect significantly greater gains in end-use efficiency than assumed in Scenario 1?

3. What plans exist to refine demand projections? How are they related to projected population growth and composition, individual income, and other demographic factors? Is the data available sufficient to describe present energy consumption patterns, let alone project future demand?

4. Has ERDA based its planning and establishment of priorities on consideration of the economic and environmental implications of reduced demand (conservation)?

5. Does the ERDA Plan place too much emphasis on "creating" energy choices and not enough on evaluation of energy options for "trade-off" between options?

6. There are several national energy models at several Federal agencies, notably ERDA and FEA. What continuing coordination arrangements should be made to ensure maximum productivity y and minimum duplication of effort?

BACKGROUND

The ERDA Plan uses a "scenario" approach to calculate national consumption and associated demands for oil and gas imports under various assumptions. Five scenarios are examined, plus a baseline called "no new initiatives" (Scenario O). In Scenario O, ERDA assumes that current consumption patterns continue to the end of the century in all end-use areas with the single exception of a 40-percent improvement in average new car efficiency by 1980, The resulting total energy demand in 1985 and 2000 lies comfortably in the middle between results of "predictions" by others.

Even if current real energy prices remain constant (a very optimistic assumption], consumption patterns will surely continue in the years ahead to shift toward lower demand growth, This is largely due to "lagged response," which means that a consumer's ultimate response to changes in real energy price occurs over a period of up to 10 to 15 years, and that only a small percent of the total response is evident in the first year following a price shift. Therefore, Scenario O does not provide a realistic baseline. If the baseline demand scenario is unrealistically high, the importance of reducing imports and, therefore, the urgency of the need is to increase supplies and reduce demand is inflated.

Conservation Scenario 1 (Improved Efficiencies of End-Use) assumes only very moderate improvements in use. For instance, an average 10-percent improvement in appliance efficiency is assumed by 1985. Such levels of improvement are sufficiently conservative that a very modest national effort can probably achieve the scenario, In fact, it is not unlikely that the shift to higher efficiency assumed in Scenario 1 will occur simply in response to price increases which have already occurred. Similarly, the effect of the high "baseline" in Scenario O is to overstress the urgency of the need to expand domestic supplies in order to hold down imports. Therefore, ERDA should use more realistic parameters for the baseline and conservation scenarios on which to base future program plans and priorities,

In addition, ERDA's projections are based on insufficient data and exclude such factors as the inherent economic and environmental advantages of improved efficiency, The Brookhaven National Laboratories models were used to evaluate the supply/demand picture for 1985 and 2000. Inputs to these models include end-use demands. The model then estimates energy conversation and supply technologies to minimize cost. End-use behavioral and technological changes are not adequately included in the model. For example, the demand assumptions in the conservation scenario of the ERDA Plan project changes in the efficiency of end-use devices but do not consider the effects of design, control, and operational changes, or the influence of the price mechanism. These are significant omissions, particularly in the building sector.

A more useful approach would include the use of a predictive demand model to evaluate the related economic and environmental benefits associated with reduced consumption. These have a significant multiplier effect in reducing supply requirements; a barrel of oil saved will often reduce supply requirements by more than a barrel. A similar situation exists for economic considerations. For example, as conservation is applied to building heating and cooling, capacity requirements are reduced, providing dollar savings. The latter are further increased by operating energy cost savings over the lifetime of the buildings. The direct reduction of environmental impact also provides energy savings.

The development of a data base on energy use patterns as well as improved predictive models is essential to energy demand projections, future program planning, and conservation evaluation, ERDA, in conjunction with other Federal agencies, should undertake the development and refinement of these data and methods.

7. Design Methods and Standards

ISSUE

Energy conservation efforts in the building and consumer products sector require the development and dissemination of analytic design methods and the adoption of reasonable energy standards.

SUMMARY

In order to realize the full potential of energy conservation in the building and consumer product sector, two major tasks must be accomplished. First, the design profession must be provided with improved design methodologies, as traditional design procedures do not place adequate emphasis upon energy considerations. A fundamental reorganization of the design process and the development of new energy-sensitive analytic tools is required. Second, realistic energy standards and/or energy budgets must be established as design guidelines. Data on existing energy use patterns in the buildings and consumer products sector must be analyzed in order to develop a rational basis for new standards. Finally, fundamental questions as to the form energy standards should take must be resolved, The ERDA Plan does not give sufficient emphasis to this need.

QUESTIONS

1. What methods will ERDA employ to establish standards and/or energy budgets and to determine conformance to established standards?

2, Is there a constructive role for ERDA in improving performance evaluation techniques?

3. How will standards be applied to diverse climatic areas and energy use patterns?

4. What role does ERDA intend to play in the educational effort necessary to reorient design toward energy efficiency and conservation?

5. How does ERDA plan to assure a reasonable level of energy accounting in the building and consumer products sector?

BACKGROUND

In most instances, energy use data, improved methods of analysis and design, and the basic elements of realistic standards do exist. However, as the building and consumer products industries are fragmented and have very diverse needs, the data are scattered, and the energy-sensitive methods of analysis and design are frequently not well understood. While many professional societies and manufacturing associations have already adopted standards which, if applied uniformly, would contribute significantly to energy conservation, these efforts have not, in many cases, been coordinated; thus, standards and design procedures within the industries are not consistent, Some standards are prescriptive or specify component performance. Some standards have been proposed for "energy budgets." The General Services Administration has developed a target budget for new office buildings. Standards and guidelines for existing buildings have received even less attention,

A definite role for ERDA exists in this area of concern. Without the development and dissemination of reliable methods of analysis, as well as the adoption of reasonable and uniform standards, energy conservation efforts will be frustrated. Moreover, architects, engineers, and many of the small industrial concerns in this sector are unable to support the major research efforts necessary; thus, a strong lead by ERDA is required.

Development of standards should be approached with great care, Prescriptive standards that specify components and systems will tend to freeze the state-of-the-art of the then existing, energy-using mechanical and electrical systems, On the other hand, performance standards which establish broad energy goals within a framework of human needs for comfortable working and living environments will allow design professionals and the building industry the latitude needed to develop innovative and efficient solutions.

The issues relating to the establishment and implementation of energy standards are as follows:

- Are the data on the energy requirements of buildings and various consumer products sufficient to provide a realistic basis for establishing standards?
- What form should such standards take? Should they be prescriptive or performance standards? Will voluntary standards suffice?
- How should these standards be promulgated? They must become an integral part of building codes, conditions for mortgage loans, and so forth, or they will not be effective,
- Once promulgated, how will architects, engineers, and inspectors be trained? What manuals need to be developed to aid implementation?
- Do designers have the analytical tools necessary to assure that their designs meet the intent of energy standards, or is an educational effort required?

8. Development and Demonstration

ISSUE

ERDA's plans for R, D&D of energy conservation technologies in buildings and consumer products should be accelerated and expanded.

SUMMARY

In order to introduce the current technology into society as fast as justifiable by market economics and national need, demonstration projects must be developed for use in all sections of the Nation, ERDA's plans for the implementation of existing technology for energy conservation in buildings and consumer products appear inadequate: in addition, it is evident that ERDA is not spending a sufficient portion of its resources on the research of new energy conservation technology which holds great promise for the future.

QUESTIONS

1. What plans does ERDA have to ensure that the planned major solar heating and cooling demonstration programs place sufficient stress upon insulation and other energy-conserving instruments that must compete for the same capita 1?
2. What plans does ERDA have to study existing buildings for effective energy use?
3. Does ERDA plan any basic research on human factors in order to reevaluate the thermal and visual requirements for comfort, health, and safety ?
4. What potential exists for the application of energy storage to conventional heating and air conditioning systems?
5. If current refrigerants prove to have adverse environmental effects, what are the possibilities for the development of new, effective substitutes'?

BACKGROUND

The ERDA Plan does not appear to give sufficient attention to the need to develop programs designed to demonstrate current energy conservation technology to the public. Congress has legislated a demonstration program for solar heating and cooling, Perhaps that program could be modified to include more explicitly architectural design and thermal engineering, so essential to the economic viability of solar utilization.

Many of the technologies required to enable major conservation in the building and consumer products sector now exist and can be demonstrated and brought into the marketplace more rapidly than solar power systems.

In the near term, the barriers to implementation are primarily nontechnical. However, future national energy goals can best be met only by a program that includes sustained conservation efforts. Great long-term gains may be achieved through an appropriate investment in basic research, The present ERDA plan gives little consideration to basic research relevant to conservation technologies. Examples of areas where new technologies may provide additional energy savings in the building and consumer product sector are (some of them are in ERDA's Plan):

- Thermal energy storage systems compatible with conventional heating and air conditioning equipment.
- Development of more thermally efficient building materials: improved insulation; glass product-s; and selective surf ace materials for solar radiation control.
- Research on human factors, such as people's adaptability to their thermal environment.
- New approaches to high efficiency appliances, including lighting.
- Chemically stable fluids for heating and air conditioning applications, having useful thermal properties.

Until recently, efficiency of energy consumption in buildings was of little concern to the architect, builder, or consumer. The ineffective use of buildings contributes to their inefficient use of energy-based systems. The redesign and replanning of existing buildings (especially the 24 billion square feet of commercial and institutional buildings) poses a major challenge to the Nation's design professionals. R, D&D must be done for both new buildings and retrofitting existing buildings. It is likely that the research which permits the new building contractor to install energy efficient systems will not be directly transferable to the retrofitting of old structures. Therefore, it is good to note that ERDA will initiate research in FY 76 designed to determine how buildings can be retrofitted in a cost-effective manner.

In terms of the specific programs in the ERDA Plan the following observations are made:

- Demonstrations of energy conservation technology in buildings and solar heating and cooling demonstrations, should be more closely coordinated; demonstrations should emphasize the total building system.
- The delay of construction and evaluation of minimum energy buildings until 1978 and novel building design until 1980 seems unnecessary.
- Research into new building materials and systems should be accelerated.
- More emphasis should be placed on research of lighting systems and cost-effective ways to reduce energy use in present lighting systems.
- A program for the evaluation and demonstration of energy storage in buildings as an adjunct to conventional heating and cooling should be developed in the near term as a way to respond to time-of-day electrical rates,
- Research on the energy efficiency of energy-intensive consumer products should be intensified in this fiscal year if possible.

9. Constraints in Building Construction

ISSUE

ERDA does not appear to be devoting sufficient effort to overcoming the nontechnological barriers to energy conservation in building construction.

SUMMARY

The technology to permit substantial reductions in energy expenditures on commercial and residential buildings is currently available. New technologies and designs promise cost-effective reductions of energy to operate buildings of 60 percent or more. However, five primary nontechnological barriers impede this objective and require R, D&D to provide ways to overcome them:

- The minimum first-cost syndrome.
- Antiquated local building codes.
- Poor system design.
- Industry and consumer resistance.
- ERDA's budget control procedures.

QUESTIONS

1. What are the barriers to more rapid implementation of existing technologies in buildings? What is the role of ERDA relative to:
   - Industrial acceptance of technologies designed to foster energy conservation.
   - Financial incentives for design and construct ion of more energy-efficient structures (e.g., life-cycle cost rather than first-cost analyses)?
2. How can building codes be modified to promote energy conservation?
3. How can the design processes be redefined to optimize the building and its energy system as a whole?
4. What research has been done, or is planned, to identify barriers to consumer and industrial acceptance of minimum life-cycle cost decisions in housing and appliances?
5. What incentives will be most effective in gaining consumer acceptance?
   - Must incentives vary with socioeconomic factors?
   - What meaningful incentives can be identified for the commercial sector?
   - Would incentives vary with type and size of commercial organization?
6. What steps are being taken to assure the Nation that the research results of ERDA programs for energy conservation in buildings and community systems can be promptly and effectively utilized by design professionals?

BACKGROUND

The technology which can save substantial (20 to 30 percent) energy in commercial and residential buildings in a cost-effective way is already available. Five major factors are presently inhibiting conservation in buildings:

- First-cost Syndrome, There is still a feeling among many builders that buyers are not willing to pay for the extras that will save them substantial amounts of money in the long run. Under present financing conditions, buyers effectively use a very high discount rate in home purchase decisions regarding mortgage versus operating costs. In the commercial sector, most financial considerations have the net effect of encouraging the landlord to make the lowest possible capital investment. As a result, builders in both the residential and commercial areas tend to use materials and building techniques that cost least in the short run and to ignore operating costs. Therefore, a major ERDA effort should be directed toward undertaking the research and educating the public, lending institutions, and building owners with regard to the opportunities to make cost savings through retrofitting or special measures in new building construction which save energy. Where possible, new construction should be life-cycle costed; that is based on minimum total cost of mortgage plus operations and maintenance. Research should also be done to determine how both builders and buyers can be made aware of the advantages of life-cycle costing.

- Building Codes and Standards. There are two problems with existing building codes in the United States. First, they are inconsistent from community to community, thereby making the introduction of new concepts on a national level difficult. Second, many building codes and construction standards were not developed with energy conservation in mind. ERDA should study this “constraint” upon energy-efficient buildings so that strategies to overcome this problem can be developed,

- System Design. Designers should regard energy conservation as an integral part of the overall building design, While some professional architectural and engineering firms are already active in energy conservation design programs, the great majority have not yet been adequately prepared to undertake the challenges posed by energy conservation in designing new communities and buildings, or redesigning existing communities and buildings. A major program is required to promote the effective utilization of the research results which Federal agencies and ERDA, in particular, will produce.

- Industrial and Consumer Acceptance, Very little research has been done to determine the barriers to industry (producers, builders, and professionals] and consumer acceptance of new conservation techniques and to devise incentives which could be used to overcome these barriers. Some of the barriers to industry acceptance may include: lack of knowledge, lack of proper retraining, capital constraints and improper regulations. In addition, in order for new energy conservation in buildings and consumer products to be fully integrated into society, an effort must be made to understand the barriers to acceptance of these items by the final consumers. It is important that the final consumer understand the implications of energy conservation in the home. In order to overcome these barriers, incentives which should be considered would include retraining programs for industry personnel, tax credits, tax writeoffs, accelerated depreciation, and guaranteed loans. Research is necessary in order to determine precisely which incentives are most effective for the different sectors of the building industry and the various socioeconomic segments of our society.

- ERDA’s Budget Control. The review of ERDA’s program generated a concern regarding the adequacy of AEC-type budget control and contracting procedure when applied to the fragmented, small business components of the building industry. AEC’s control procedures were designed to deal with large corporations capable of carrying the capital outlays required. AEC then reimbursed the firm involved when the equipment, construction, and so forth were completed. Those problems can be overcome by establishing alternate procedures applicable to the segmented building industry, ERDA may wish to establish procedures which would help to eliminate the need for short-term capital as one of the major non-technological barriers to demonstration of energy conservation,

10. Need for Thermodynamic Analysis

ISSUE

The ERDA Plan does not describe how the agency plans to identify areas with the highest theoretical potential for industrial energy conservation and to assess the practical feasibility of implementing programs in these areas.

SUMMARY

Prior to establishing research priorities in industrial energy conservation, a detailed assessment must be made of the amount and form of energy used in industry and the efficiency of industrial energy use. Thermodynamic analysis, which determines the theoretical minimum energy required for a given process, may be used to identify areas having a high theoretical potential for energy savings. Once promising areas have been identified, however, the feasibility of these improvements must be evaluated to determine whether economic, political, or social restraints might render a proposed solution useless, even if it is technologically possible. Such considerations must enter ERDA's program planning activities early in the cycle to assure ultimate utilization of research results.

QUESTIONS

1. What efforts are planned by ERDA to establish priorities for R, D&D programs in industrial processes?
2. What procedures will ERDA establish to evaluate the nontechnical (economic, environmental, etc.) aspects of energy conservation technologies identified by a theoretical minimum energy consumption analysis?
3. How does ERDA propose to utilize existing "minimum energy" analyses (e.g., the FEA studies of Energy Use Data for Nine Industries]?
4. Do adequate methods presently exist to predict accurately the effects that a proposed change in some industrial plant might have on, say, jobs or air quality?

BACKGROUND

For any industrial process, well-established energy accounting procedures can show at what point in the manufacturing sequence energy is consumed, how much is consumed, and in what form. However, such procedures will not indicate the theoretical minimum energy consumption required, thermodynamically, to carry out the process. In evaluating the energy conservation potential of a process, it is therefore necessary to distinguish between the conventional energy losses which occur in process operations and the theoretical energy losses inherent in any process involving thermal energy. For example, conventional energy losses are due to mechanical or fluid friction, to heat losses through the walls of equipment, or to waste steam being exhausted to ambient air or process cooling water. Theoretical losses, on the other hand, are those which are inescapable in any given process even with the best engineering and operating practices. These losses are imposed on the process by the Second Law of Thermodynamics, which deals with the impossibility of the total conversion of heat to work, Thus there is a definable theoretical minimum energy requirement for performing a given process. The potential for energy conservation for that process is a function of that theoretical minimum energy requirement and the energy actually required in manufacturing plants,

In performing a "minimum energy" analysis it must also be recognized that energy loses "quality" or capacity for performing work as it passes from stage to stage in a manufacturing plant. The usefulness of the energy in 30000 F flame is greater than that in a stream of waste cooling water at 100° F, even though the energy release, in terms of Btu per hour, may be the same. The concept of "cascading" energy from stages requiring high grade energy to those requiring lower grade energy is very valuable as a conservation option in many industrial processes.

Once the theoretical potential for energy conservation is established, the problem of implemental ion of energy conservation strategies must then be addressed. While the ERDA Plan cites the identification of energy savings opportunities as a major ERDA role, little is said about the problem of feasibility analysis to determine the acceptability of a proposed solution, For example, "cascading" of heat uses may save a lot of energy but could require a capital investment too large to be economically feasible.

In the near term, energy conservation goals in industry may be met by what might be termed "housekeeping" measures, that is, relatively simple fixes to energy-wasteful equipment and operating procedures, Such measures have already accounted for energy reductions of 10 to 15 percent below levels of a year ago, by many companies, with some companies reporting even better results. In the longer term, however, major process revisions and equipment replacement will be required. These changes will, in most cases, necessitate large capital expenditures, which must be justified in economic as well as energy terms. In some cases, environmental and social factors will also influence these decisions,

ERDA should include the development of tools for feasibility y analysis as a part of its comprehensive plan; these should encompass economic modeling of industrial processes under varying energy cost assumptions, and environmental and social impact assessment methodologies. These tools will be of value not only to industry but also to ERDA itself in the selection of projects with a high probability of success. Furthermore, such models would be useful as policymaking tools, since they would permit policymaking agencies (such as Federal Energy Adminstration, for example) to study possible alternative incentive measures for industrial investment.

11. Oil and Gas Substitution

ISSUE

ERDA's plans for the substitution of other energy sources for oil and gas as part of the industrial conservation "program are not well defined.

SUMMARY

Conservation strategies as defined by ERDA can take two forms:

- Conservation of energy by increasing efficiency of end use.
- Conservation of scarce resources, such as oil and gas, by substituting other energy sources, such as coal, nuclear, or organic wastes. Although ERDA is obviously aware of both of these options, the plans spelled out in the industrial sector do not clearly distinguish between them. ERDA should examine the potential and the impacts of fuel substitution in various key industries, and formulate the specific R, D&D strategies required, Possibilities exist for the production of process heat for industrial users by nuclear- and coal-fired plants. Also the use of synthetic fuels derived from coal, such as low-Btu gas, may prove to be an economical substitute for oil and natural gas in many applications. In the mid-to-long term, as advanced electric generating technologies reach commercialization, industries may shift to electricity for process heat and steam generation. With research and development, high-capacity high-temperature heat pumps may be able to provide process heat with an efficiency comparable to that of direct fuel firing,

Questions

1. What potential does ERDA project for the use of coal as a substitute for oil or gas in the industrial sector? What programs are proposed to achieve this potential?

z. How will the research being performed under the Assistant Administrator for Fossil Fuels be coordinated with the work in conservation?

3. How will ERDA assess the potential of direct nuclear heat and steam generation as a valid option for conserving limited fossil fuels?

BACKGROUND

Over 80 percent of the energy in the industrial sector is derived from oil and gas. Various possibilities for substitution exist. Coal, for example, can be used to generate process steam, although new technologies, such as fluidized bed combustion, would greatly aid in assuring that environmental standards can be maintained. Conceivably, coal could also be used in process furnaces but not without considerable R, D&D. The use of synthetic fuels from coal for industrial boilers or furnaces is another important possibility as discussed in the fossil section. This option depends on the economics of the various coal conversion processes, such as the production of low-Btu gas for industrial furnaces. While much R, D&D is underway in this general area, specific applications in the industrial sector should be investigated, with appropriate participation by the industries concerned,

A number of studies have been carried out to determine the feasibility of direct use of nuclear heat for process applications. The operating temperature limit of light water reactors restricts their area of potential use to process steam generation. Because of the economic advantage of large scale operation in nuclear plants, it would be necessary to site a number of large customers in close proximity to the nuclear plant, This is the scheme pursued by Consumer's Power and Dow Chemical in Midland, Mich.

Technology is available to utilize organic wastes to generate steam; this, in fact, has been done in the pulp and paper industry, the chemical industry, and others, The principal barriers to further implementation are socioeconomic and should be studied.

Another long-range opportunity for efficient provision of process heat will be the development of high-capacity high-temperature heat pumps to absorb heat from low-temperature process streams and deliver it to higher temperature sections of the process. This concept will require a program of research in thermodynamic properties of potential working fluids, material physical properties, and process optimization, to be carried out via a coordinated government industry effort. The potential gains are significant. For example, a heat pump designed to absorb heat from one stream at 3000 F and deliver it to a stream at 600°F could theoretically transfer more than three times as much heat as the electric energy required to drive it. Realistically, if 60 percent of this theoretical performance were achieved in practice, the heat pump would still provide over twice as much heat input to the process as direct electric heating. With advanced electrical generation systems offering efficiencies in excess of 50 percent, heat pump systems could thus be competitive with direct fossil or nuclear heat sources on an energy-used basis.

12. Use of Foreign Technology

ISSUE

The ERDA program should consider the utilization of foreign technology as an alternative to new conservation research.

SUMMARY

The ERDA Program proposes new research in a number of areas in which technological innovations are already either under development or in operation in foreign countries. The adoption of such innovations should normally take priority over new research initiatives, since the former are cheaper and can impact faster on industry. Successful utilization of certain technologies may eliminate the necessity for research in peripheral areas which bear on the same basic problems.

While adoption of technology developed abroad may simplify the technological research problem, a number of institutional barriers may have to be overcome before successful implementation can be accomplished.

QUESTIONS

1. What provisions have been made in the ERDA Plan to assure that we utilize, to the fullest possible extent, energy conservation innovations developed in other countries?
2. What sorts of institutional restraints might impede the use of foreign technology in attacking some of our own problems? Does the ERDA's Plan include provisions for seeking to ease these restraints?
3. What provisions will ERDA make for the funding of cooperative R, D&D programs with government agencies of foreign countries? What value does ERDA place on such cooperative ventures?

BACKGROUND

While the need for energy conservation may seem new to the United States, where domestic resources have been relatively abundant, conservation in many areas of the world, in particular, Western Europe, has been a way of life for decades, The need to preserve scarce resources has fostered many innovations in energy conservation, and a wealth of experience is available (see Appendix). For example, Germany and France have used municipal refuse as a supplementary fuel source in industrial heating for many years; these installations provided the primary basis for much of the design of the well-known Union Electric/St. Louis project. It is noteworthy that this project has proceeded immediately to commercial scale without requiring expensive and time-consuming pilot operations.

Another example is a system of active load control used by electric utilities in West Germany, in which high-demand appliances may be remotely controlled by signals sent out over the distribution network. If the system is shown to be attractive for use in this country, the im-

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plementation of such an existing technology might be assigned a higher priority than research on new systems designed to fulfill similar objectives.

A vigorous effort to use foreign technology will involve exploratory assessment, investigation of legal factors, and dissemination of the technology, These functions might be carried out either within each ERDA division or in a separate group devoted exclusively to foreign technology.

Some Examples of Foreign Technology Opportunities*

	Item	Examples of Applications (Companies, Locations, etc.)
1.	Cement kiln preheater technology	Japan (developed by Mitsubishi, IHI, etc.) Europe (developed by Polysius, Humboldt, Krupp, F. L. Smidth)
2.	Use of blended cements (with fly ash, blast furnace slags, etc.)	Europe in general (e.g., new blended cement specifications recently introduced by France)
3.	Ceramic recuperators for steel industry applications (soaking pits, etc.)	Developed by British Steel Corporation and installed at Llanwern Steel Works
4.	Oxygen enrichment of copper smelter combustion air	Canada
5.	Dry coke quenching for integrated steel plants	Australia (Wagner-Biro), Switzerland (Sulzer), Russia [through Machine-export)
6.	Energy recovery from blast furnace gases by use of turbines	Japan (IHI)
7.	Use of noncoking coals in blast furnaces	British Steel Corporation
8.	Higher efficiency slab reheating furnaces in steel plants	British Steel Corporation
9.	Ore pelletizing processes for preparation of blast furnace feed	Sweden (COBO process, Glangcold process of the Granges Company)
10.	Agricultural, aquacultural, and district heating applications using industrial waste heat	Germany and U.K.
11.	Cement plant roller mill developments	Lotsche (Germany), Morgardshammer (Sweden)
12.	Improved solvent recovery processes for synthetic rubber precursors and synthetic fiber intermediates	Japan (paraxylene recovery, Japan Gas Co.)
13.	Use of cold in LNG for freezedrying, cold storage, and air separation plants	Japan (Tokyo Gas Co., Japan Super Freeze Co.)
14.	Use of electrical induction heating to replace gas-fired furnaces in heat treating applications	Switzerland (Brown-Boveri)
15.	Techniques for electric utility plant load leveling	Europe in general, such as compressed air storage (Nordwest deutsche Kraftwerke, Germany) and use of offpeak power for cement clinker grinding
16.	Recovery of low-grade waste heat using freon turbine cycles*	Japan (Ishikawajima Harima Heavy Industries]

*Many of these technologies are also being used in American industry.

13. Transmission and Distribution Priorities

ISSUE

The economic, environmental, and reliability criteria underlying ERDA's choice of projects and their relative priorities in the electrical transmission and distribution program need clarification.

SUMMARY

As the demand for electricity increases, and the shift from oil and gas to coal and nuclear fuels proceeds, additional electric transmission and distribution capacities will be needed. This increased capacity must be economically justifiable and environmentally acceptable, The ERDA transmission program does not address directly the relative benefits and difficulties of the successful development of various candidate technologies.

QUESTIONS

1. Do the priorities in the ERDA program take into account the relative probabilities of success of the various transmission alternatives?
2. Has ERDA assessed the economic, reliability y, and maintenance problems associated with commercial utilization of cryogenic and superconducting transmission lines in comparison with less complex alternatives?
3. If superconducting systems prove technologically feasible, has ERDA determined how they may be practically integrated into the power systems?
4. What is the justification for Federal expenditures in electrical transmission and distribution research? Is this area not adequately covered by research in the private domain?

BACKGROUND

As increased transmission capacity is needed within the Nation's electric systems, existing technologies may be unsuitable for satisfying the demands. Additional overhead lines may be unacceptable for environmental and land use reasons. ERDA has, therefore, begun programs on overhead a.c. and d.c. transmission, and underground transmission including superconducting technology, However, the relative emphasis and the likelihood of success of various approaches being pursued are not made clear in the ERDA plan.

A.c. overhead transmission is the method in general use today for delivering large blocks of power over long distances. The expected trend toward large generation parks, large distances from loads, will require higher transmission voltages to accomplish this energy transfer economically using a minimum number of lines.

Overhead d.c, transmission has proved a viable alternate to a.c, in many situations and it is generally more efficient and ecologically more accept able, in that, large ambients electromagnetic fields in the vicinity of the lines do not exist. To take full advantage of d.c, transmission, technology must be advanced beyond the present point-to-point transmission to allow full network advantages as well as transmission at higher voltages,

Underground transmission at higher voltage and capacity levels is virtually nonexistent because of the high cost. Systems must be developed so underground transmission can provide efficient transmission at a reasonable cost from rura1 to urban and city areas in a continuous pattern.

The possibilities now evident for these advances are (1) conventional cables with improved cooling, (z) compressed gas insulated cables, (3) resistive cryogenic cables, and (4) superconducting cables. While several of these possibilities appear very attractive, the cost of research and prototype construction and demonstration is very high, hence this is an important ERDA responsibility,

In general, overhead a.c. transmission technology holds the highest promise for cost effective transmission, but environmental and other constraints, such as land use, demand that new alternatives be developed to provide options for the future.

14. Active Load Management

ISSUE

Active load management in electric power systems is not addressed as a cost-effective way to save energy.

SUMMARY

The problem of meeting large peak demands in electric power systems affects both the fuel consumption and the total capital investment required for generating plants. Energy consumption is affected because peak demands are met with a utility's least efficient generating units (i. e., those units kept off-line until needed for peaking), or by units such as gas turbines which have a low capital cost and low efficiency. Furthermore, large coal and nuclear units are not well-suited for peaking service; hence, peaking service is most commonly accomplished with gas and oil consuming equipment. Equally important, capital, materials, and manpower of the very kind needed for energy resource development, are conserved when the addition of new generating equipment can be slowed down by means of improved load management.

Several options exist for reducing peak load growth. Electrical demand at the end-u se point may be controlled through the use of utility-operated remote controls on large consumption devices, by thermal storage at the use point, and by electrical storage in substations. Peak demand, which is more costly than average demand, may also be controlled through the use of rate incentives to encourage more uniform energy consumption, While some relevant experience exists in the United States and abroad, further technological, economic, and social evaluation is needed to achieve widespread implementation.

QUESTIONS

1. Have alternatives to central station energy storage been considered in the ERDA Plan to reduce power generation requirements in electric power systems?
2. How soon might active load control systems be made available in the United States and when implemented, what impact might such systems have on system load factors, gas and oil demand, and capital requirements for new electric peak power generations?
3. What technological, economic, social, and legal barriers exist which would impede the institution of rate structures designed to encourage better load management by consumers? What incentives do utilities have to improve efficiency through load management?
4. Does ERDA have a well-defined role in studying the feasibility of time-of-day pricing?
5. What are the implications of time-of-day and seasonal pricing on various sectors of the economy?
6. Have public awareness schemes, such as prominent electric meters in homes, been investigated as possible incentive programs for load leveling?

BACKGROUND

Load leveling or "peak shaving" has been used in the United States only for very large industrial customers, while it is practiced on a broader scale in Western Europe, Australia, and some other countries. Because the load characteristics of other countries are sometimes quite different from those in the United States, it is difficult to estimate without careful analysis the total potential savings due to load control. It is clear, however, that present use patterns are costly, in terms of both energy and capital; and furthermore, the form of energy used for peaking is usually gas or oil, our scarcest resources. One approach to the problem is to provide some means of storage, such as batteries, which can be charged during off-peak hours and used as a supplemental power source during peak hours. The alternative approach, and one for which much of the basic knowledge is either available or near at hand, is to control load at the end-use point rather than simply providing the means to meet an uncontrolled load. This may be done by fitting on-off controls to major energy consuming devices, such as large air conditioning compressors and electric water heaters, which can be remotely activated for short periods by the generating utility or by automatic timing devices when total system loads exceed desired levels. This may usually be accomplished with almost negligible effect on the service delivered by such devices.

Another approach to load control is to devise a time-dependent rate structure which encourages users to spread their utilization of energy out over the day (e.g., to avoid use of clothes driers during the afternoon). This can be accomplished by time-of-day pricing to motivate off-peak energy use and flattening of the load curve.

In addition to direct savings in energy, time-of-day and seasonal pricing would save substantial capital cost outlays for the electrical companies. As demand is leveled around the day and year the utility companies will be able to operate with a higher capacity factor. It has been estimated that as much as $50 billion could be saved in the United States over the next decade through active load management* or by reducing the rate of new construction required to meet growing peak loads; but this projection lacks substantive economic analysis.

Both active and passive control strategies need research, testing, and evaluation before broad-scale implementation can be realized. Encoding, metering, and signaling devices must be developed and evaluated; incentives for passive controls will need evaluation through the use of econometric models, which also need further development. Technologies that will enable customers to respond productively to such changes in rates need to be developed.

*Projections of FEA's Task Force on Electric Utilities, 1975.

15. Orientation of Automotive Programs

ISSUE

ERDA's program on highway vehicles is directed more toward prototype development than toward the technological breakthroughs necessary for successful commercialization.

SUMMARY

ERDA's program in automobile, truck, and bus research emphasizes the development and demonstration of major hardware systems (e.g., gas turbine and Stirling engine-powered automobiles, flywheel prototype car, hybrid bus powerplant, 60-mile range electric car, etc.) using state-of-the-art technology. The ERDA Plan gives no indication that payoff is likely to result from such R, D&D through the commercial introduction of more energy efficient vehicles, Obstacles which blocked the commercialization of the proposed systems in the past are not addressed, and therefore, it seems doubtful that these technical, economic, or environmental impediments will be removed by the proposed R, D&D programs. ERDA should focus its attention less on production prototypes and more on long-term, basic supporr ting technologies.

QUESTIONS

1. How does ERDA establish its priorities in advanced automobile technology?
2. Why does ERDA concentrate so much of its effort on the development and demonstration of prototype vehicles?
3. What is the likelihood that these programs will lead to the successful commercialization of alternatives to the internal combustion engine?
4. What impact will ERDA's automotive programs have on the energy problem?

BACKGROUND

The major thrust of ERDA's conservation program on highway vehicles appears directed towards the development and demonstration of hardware. The list of projects on the development of powerplants as possible alternatives to the spark-ignited engine is broad: gas turbine, lightweight diesel, Stirling cycle, battery and flywheel powered vehicles, Most, if not all, of these technologies have been extensively studied in the past, either in this country or abroad, and have been found to possess serious problems that blocked their commercial introduction in this country. While the cost of energy and the seriousness of the present energy problem can change the importance of various options, ERDA has not shown why the likelihood of successful commercialization of any of the projects proposed is appreciably greater now than in the past. The ERDA program does not identify the obstacles which continue to impede their introduction, nor how they propose to address these factors.

Most experts in automobile technology feel that at the present level of funding, ERDA is destined to cover much of the same ground that has already been studied by industry. The market conditions have not changed sufficiently, nor is the depth of research and development sufficient to create a serious competitor to the internal combustion engine.

While a Federal R, D&D program in advanced automobile technology can make a valuable contribution to meeting national objectives in energy conservation, it appears unwise for the program to focus on production prototypes having to compete in the marketplace against the present, highly optimized automobile. A more realistic and useful approach would be to engage in a stable long-term program with an emphasis on supporting, supplementing, and stimulating R, D&D efforts in the private sector. While this is a less glamorous strategy than prototype development, it is more likely to yield significant results in the future, The programs should focus on the early stages of development and on those areas where technological advances could make an important impact on future automotive systems. ERDA is presently engaged in some of these types of projects, such as those on ceramic materials for gas turbines and the sodium-sulfur battery, but, overall, the program lacks the appropriate emphasis and balance.

16. Cooperation With the Transportation Industry

ISSUE

Successful commercialization of ERDA-sponsored technology in the transportation sector will be achieved more readily with close cooperation between ERDA and industry.

SUMMARY

Industry involvement in the commercialization of ERDA-sponsored technology, such as new and improved automotive powerplants, is critical. While technology transfer within a given organization is difficult, transfer between two different organizations, such as ERDA and the automotive industry, is vastly more difficult. To alleviate this problem, ERDA should solicit industry advice and input during the program planning stage; this input might consist of ERDA contracts with industry in the areas of feasibility, assessment, and systems planning, or of joint 13 RDA/industry advisory groups. Various constraints upon joint interaction exist, such as antitrust considerations in the automotive industry. Nevertheless, early industry commitment to commercialization is essential to the successful transfer of ERDA-sponsored technology to industry,

QUESTIONS

1. How can ERDA encourage private industry to become intimately involved with its energy conservation programs, thereby ensuring maximum utilization of the program's results?

z. Should industry have a financial interest in those ERDA programs which may yield commercially applicable technology?

3. At what point should ERDA funding on a program be stopped and commercialization of the findings left to industry?

BACKGROUND

For ERDA-developed energy conservation technology to receive maximum attention by private industry, ERDA's programs must be planned, monitored, and evaluated with a maximum of industry input. ERDA and private industry have to achieve a mutually satisfactory partnership that recognizes each other's needs and makes the best possible use of the taxpayer's investment. Costly ERDA demonstration projects may not be necessary if industry is given the opportunity to evaluate the commercial viability of newly developed energy conservation technology,

In order to maximize the chances for commercial success, both ERDA and private industry should consider changing some of their past practices. For instance, ERDA must involve industry in the early stages of its major energy conservation research and development program planning. Industry should be asked to outline its major energy conservation research and development needs, to assign priorities and commercialization potential estimates to each of the needs outlined, and to recommend basic research areas that could find widespread utility. In addition, industry should identify programs that it can carry out without ERDA’s assistance. Some of ERDA’s currently planned demonstration programs can and are being done by industry because they are close to or at the commercialization stage.

In those instances where ERDA’s programs are similar to programs previously carried out by industry, ERDA should provide industry with incentives to divulge its previously unreported findings without having to relinquish any vested patent rights. Many industry programs are not carried through to commercialization because of technological difficulties or unrewarding economics. Now that the cost of energy has risen drastically and energy efficiency has become a more important criterion, these programs are receiving renewed attention. However, the originally developed information regarding these programs may not be available in the technical literature because of the stigma associated with negative results and unsuccessful programs, This information may now prove extremely useful to an organization starting a “new” program in one of these areas.

Specific examples of industrial programs which were not commercial successes and were not extensively reported in the technical literature include the continuously variable transmission, heat storage devices, and rotary engines. There are probably many other examples obtainable via careful inquiry into prior industry knowledge of areas now receiving renewed attention because of their energy conservation potential.

Excellent examples of technology transfer from government to industry exist, such as the NACA program, predecessor of the National Aeronautics and Space Administration. The key organizational features of this program were the joint committees, which helped to define the program, and the steering committees, which monitored the progress and output, thereby facilitating rapid technology transfer where appropriate.

The present ERDA program in the transportation sector represents, in effect, the transfer of an existing program from the Environmental Protection Agency (the American Association for the Promotion of Science program), When the program was in the Environmental Protection Agency, industry reviewed its output and concluded that the program had not yielded significant results.

17. Nonhighway Vehicle Transportation Program

ISSUE

ERDA presently has no program for energy conservation in the nonhighway vehicle transportation sector.

SUMMARY

Although railroads, pipelines, waterways, and airplanes carry many of the passengers and much of the freight in this country and use a substantial quantity of petroleum fuel, the ERDA conservation program virtually ignores this sector. There is immediate need for the assembly of an adequate data base and for systems studies to identify the areas of greatest potential fuel savings. In addition to performing this analysis, ERDA must possess the capability to cooperate with and, in some instances, coordinate the efforts of other Federal agencies toward energy conservation in this sector.

QUESTIONS

1. What plans does ERDA have for the assembly of a data base for nonhighway transportation systems?
2. What specific systems studies are under way or contemplated for the evaluation of fuel savings potential in this sector?

BACKGROUND

It is estimated that some 25 percent of the fuel consumed in the United States for transportation is in the form of petroleum used for nonhighway systems, These uses include oil, gas, and slurry pipelines as well as rail, water, and air transport systems, In addition to direct fuel savings from improved efficiency, modal shifts and improved load factors offer economically feasible improvements in energy usage.

In order to identify areas in which substantial fuel savings are possible and to develop implementation strategies, research should begin immediately toward the establishment of an adequate data base and toward the systems analysis of existing transportation networks, Both a cross-sectional and a time-series data base are required to delineate present fuel consumption patterns and to give baseline information against which improvements can be measured.

Systems studies are needed to identify opportunities for significant improvements and to evaluate proposals such as:

- Modal shifts, for example, from highway to water transport for bulk materials, and from highway to rail for passengers
- Advanced technology, for example, highspeed ground transportation for both passengers and freight
- Multimodal terminals for both passengers and freight
- Federal transportation grant programs and other proposed schemes for Federal participation in nonhighway transport R, D&D
- Modifications in transportation regulations to give higher load factors, for example, in passenger airlines and other improvements,

It is important that ERDA avoid duplicating the work of industry and of other agencies, such as industrial locomotive development and the National Aeronautics and Space Administration or the Department of Transportation research and development in air transport. Because of the huge potential for savings, however, it is necessary that ERDA develop the capability to assess fuel usage, determine opportunities for improvement, coordinate its conservation efforts with other programs in industry and government, and stimulate the development of new technology where needed.

18. Energy Recovery From Waste

ISSUE

ERDA has formulated no plans or programs in the productive use of waste although specifically directed to do so by Congress.

SUMMARY

ERDA is mandated by law (PL 93-577, Sec. 6(b)(3)) “to assign program elements. . . to advance energy conservation technologies including but not limited to productive use of waste, including garbage, sewage, agricultural wastes, and industrial waste heat; reuse and recycling of materials and consumer product s,” The ERDA programs in ERDA-48 vol. II make no mention of any such activities.

QUESTIONS

1. Why has ERDA no plans in the productive use of wastes?
2. In relation to other Federal agencies, what is the appropriate ERDA role in the area of R, D&D in energy and resource recovery from municipal solid wastes?

BACKGROUND

ERDA has a statutory requirement to conduct R, D&D for solid waste energy and resource recovery. Principal waste energy sources are municipal solid wastes, biomass waste, and organic sludge. Currently, municipal wastes are being burned with coal to make electricity in one city; in another, these are burned to produce steam and to chill water for district heating and cooling. Authoritative projections indicate that the annual contributions to national energy supply from the burning of municipal wastes could be about 0.5 Quad in 1985 (maximum 0.8 Quad). Although the amount seems relatively small, it equals that of geothermal potential for the near term, Indirect but nonetheless significant additional energy savings can be made from recovery of materials (e.g., aluminum, iron) from the nonfuel fraction.

There exists a question of whether ERDA is giving sufficient attention to solid waste energy and resource recovery R, D&D. While the ERDA FY 76 budget shows token consideration ($300 K) for these activities, ERDA-48, vol. II does not discuss them. Successful R, D&D in this area will expand the amount of resources available for energy production; cause less pollution of land, air, and water; and as an added benefit, help diminish the volume of waste to be discarded, In addition, such a program can also be helpful in improving reuse and recycling systems, producing further savings of energy, and reducing environmental impact, since the collection and separation process for municipal wastes would facilitate aggregation of various kinds of materials. ERDA's program should reflect a higher degree of concern for this area,