Chapter V

Conservation Issues

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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.

BUDGET SUMMARY

The budget requests for conservation are as follows:

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriation	FY 77 Division Request	FY 77 ERDA Request	FY 77 Request to Congress
Conservation	71.7	209.0	193.9	113.0

The ERDA request is nearly three times the FY 76 budget while the final request to Congress represents a 64-percent increase, one of the largest of any of the offices in ERDA, However, the dollar increase is 80.9 million less than ERDA requested from OMB and represents 3.8 percent of the total ERDA FY 77 budget as against 3.o percent for FY 76. When just those programs which are concerned with the end-use sector are counted (see Issue 4), this becomes 2 percent. This in spite of the fact that conservation is now ranked with the highest R, D&D priorities

in ERDA. While reliable cost-benefit analyses of various conservation options have not been performed (as indeed they are also lacking for supply strategies as well) it is still difficult to justify giving conservation with its low-risk and high short-term potential for payoff such a small fraction of the total ERDA budget. The argument to which some subscribe, that the private sector can be expected to respond more easily in providing us with a cost-effective use of energy than it can in terms of developing additional supplies, neglects the tremendous advantages that accrue to the Nation if we can accelerate the transition to a more efficient energy system.

COMPARATIVE SUMMARY

ERDA has given considerably more emphasis to conservation as a means of achieving the Nation's energy objectives. The increased importance can be seen in the program document for FY 77 which places greater stress on the urgency of conservation and addresses the vital, nontechnological issues in developing and implementing conservation activities.

There are, however, two aspects of ERDA's program on end-use conservation which are still quite troublesome and which appear to seriously handicap the program. First: the conservation program has no apparent overriding sense of direction. A conservation strategy needs to be formulated so the program elements are viewed as parts of a whole. In spite of the value of the research being funded, this lack of a coherent, well articulated, conceptual framework may be responsible for the less than enthusiastic, although unjustified, budget treatment given the ERDA conservation program. Second: ERDA's program does not emphasize that conservation has a major role in solving our long-term energy problem. Activities on new technologies with payoff in the long term have not been identified and commenced. In summary, ERDA should create an imaginative, aggressive, and comprehensive strategy and program for conservation both for the short and long term.

QUESTIONS

1. What plans does ERDA have for establishing an overall strategy for energy conservation so that the various subprograms can be viewed as part of a comprehensive conservation R, D&D program?
2. Does ERDA intend to place more emphasis on the mid- and long-term contribution of energy conservation [1985 and beyond)?
3. Does ERDA feel that the adoption of conservation technologies by the private sector can be measurably accelerated by an aggressive conservation R, D&D program?

z. 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 to integrate and coordinate national efforts. Its mission is to assure that existing ancillary resources (e.g., capital, manpower, materials, 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 coordination / 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,

BUDGET SUMMARY

program management is not identified as a line item and is therefore assumed to be spread across the various subprograms. The portion of each Conservation subprogram which deals with State and local governments is principally contained within the information-dissemination/transfer categories summarized below:

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriation	FY 77 Division Request	FY 77 ERDA Request	FY 77 Request to Congress
Industrial Information Technology Transfer	**0.10**	(Not Available)		2.78
Buildings Dissemination and Transfer	1.05	(Not Available)		0.62

It must be noted that these requests include more than items pertaining to this issue (e.g., see Issue 3). The four remaining Conservation subprograms do not provide separate budget categories related to this issue.

COMPARATIVE SUMMARY

ERDA's plans for coordination with other Federal agencies and other nations have been thoroughly outlined by subprogram under the headings "Federal Role" and "International Cooperation". However, no overall management philosophy for the Federal Conservation Program is apparent and this is inappropriate for the "lead agency" role established for ERDA by Public Law 93-577. In this connection the relationship between ERDA and FEA continues to be of concern.

In the area of coordination within ERDA there are still several unresolved questions. For example there are several projects in the Energy Conversion subprogram which are relevant to subprograms in the Solar, Fossil, and Conservation programs (a. c. to d.c. conversion, fuel cells, etc.). The Energy Storage subprogram has obvious links to solar, transportation, and other conservation activities. While there is discussion within these subprograms of cooperation with other ERDA efforts, there is no apparent systematic approach to coordination. Without such a mechanism from the very start it is likely that some projects will be unnecessarily duplicated and others will not be effectively carried out. This lack of strong, effective intra-program coordination is especially dangerous in the Conservation Program because of the broad range of subprograms and effects they have on other ERDA programs.

QUESTIONS

1. 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?
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. What is the Management Plan for coordination of conservation technologies within ERDA among the various programmatic groups?

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 implementation 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., energy 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,

BUDGET SUMMARY

Interaction with the private sector is encompassed in every subprogram in two forms: 1) As a separate implementation subprogram (technology transfer, information dissemination), and 2) within each of the technology subprograms. The budget requests for the former are given here while those for the latter are not available.

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriation	FY 77 Division Request	FY 77 ERDA Request	FY 77 Request to Congress
Industrial Information Technology Transfer	0.10	(Not Available)		2,78
Buildings Dissemination and Transfer	1.05	(Not Available)		0.62
Transportation Implementation	0.60	(Not Available)		**1.30**

All of these categories include projects in addition to those dealing with the private sector but they are largely oriented toward the latter. The budget increases in all but the buildings subprogram indicate a significant recognition of the need for interaction with the private sector at least in terms of technology transfer and information dissemination.

It should be noted that the ERDA requests for the subprograms in which the above categories fall were higher than the final request to Congress. How this translates to those projects and efforts concerning interaction with the private sector cannot be determined from available data.

COMPARATIVE SUMMARY

ERDA has addressed this issue rather extensively in their program document, All of the subprograms contain projects and efforts to provide information and technology transfer to the private sector. To varying degrees they all have projects underway which coordinate with the private sector including cost-sharing activities.

The principal deficiency in ERDA's attempt to address this issue is the very limited discussion of how they will utilize the private sector to initiate programs and to set priorities. The efforts with the private sector are principally dissemination of information and technology transfer. The buildings and electric energy systems subprograms appear to be more responsive to this concern than the others. This deficiency could lead to R, D&D results that cannot be transferred regardless of how effective the implementation program is.

QUESTIONS

1. What mechanisms has ERDA established to bring in the private sector at the onset of programs and to assist in setting priorities?
2. Has ERDA involved the private sector in developing an overall R, D&D plan for the conservation program?

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 that almost any effort to improve efficiency or cost in either energy supply or energy demand can be subsumed within 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.

BUDGET SUMMARY

The budget implications for this issue can best be seen by looking at the requests of the subprograms grouped as follows:

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriation	FY 77 Division Request	FY 77 ERDA Request	FY 77 Request to Congress
		End-Use Subprograms		
Buildings	12.6	46.9	46.9	21,6
Industry	4.2	35.2	29.2	11,4
Transportation	12.5	36.5	34.0	23.2
TOTAL	29.3	118.6	110.1	56.2
		Non-End-Use Subprograms		
Electric Systems	18.0	35.6	29,0	21.0
Energy Storage	15.6	42.0	42.0	20.8
Energy Conversion	8.9	12.7	12.7	15.0
TOTAL	42.5	90.3	83.7	56.8
TOTAL CONSERVATION	71.8	208.9	193.8	113,0
End-Use Subprograms as percent of total	FY 76	41 percent (Appropriations)		
	(FY 77	57 percent	57 percent	50 percent

ERDA requests are weighted toward the end-use sector which places the emphasis where the greatest energy savings can be achieved. This represents a noticeable shift from FY 76 which appears to respond to some of the concerns raised by this issue. The request to Congress, however, partially reversed this trend by bringing about a 50-50 split between the two groups.

COMPARATIVE SUMMARY

This issue remains unresolved in the present ERDA program document and budget. ERDA 76-1 (Volume II) states “Conservation can be viewed, succinctly, as the use of energy in a cost-effective manner.*’ (emphasis added). Yet the ERDA Conservation budget is equally weighted toward technologies relating to electric energy systems (incorrectly called Power Transmission in the original issue

summary) and energy storage and conversion. These programs, while important, are not consistent with ERDA's own definition.

This is not to say that these other programs are overfunded. There is the danger that they may have insufficient funds since they may not be able to compete with end-use subprograms in terms of reduced energy use. Indeed these subprograms are extremely important in themselves and will directly effect the utilization and integration of solar, geothermal, fusion, and other new energy technologies into the U.S. energy infrastructure. Specifically these subprograms will have a great influence on the structure of the electric power grid as these new supply technologies are introduced. Whether the grid will be oriented virtually exclusively toward large central power generation systems or whether it will be flexible enough to permit both large, bulk systems and small, decentralized systems depends to a large part on the direction the Electric Energy Systems and Conservation Research and Technology subprograms take in their R, D&D programs. The combined influence of these subprograms will serve to establish the flexibility and rate of integration of all new energy sources into the Nation's energy economy. This role is as important to the supply sector as the end-use conservation program is to the demand sector in achieving national goals.

ERDA's broad definition of conservation could distort the situation to the detriment of both sets of programs and of developing solutions to the energy problem. This could be mitigated by either moving the Electric Energy Systems and Conservation Research and Technology (storage and conversion) subprograms out of the Conservation Program and integrating them within their related programs or establishing an effective management structure to ensure that non-end-use subprograms are evaluated on their own terms.

There is also a time-scale issue. Virtually all long-range programs are in the Electric Energy Systems and Conservation Research and Technology subprograms while the end-use subprograms have payoff beginning in the short-term. ERDA has yet to develop a long-term plan for end-use conservation. Despite the very large projected long-term impact of energy conservation, there are virtually no program elements which might contribute to this objective.

QUESTIONS

1. Why has the Conservation Program not made its program consistent with its definition of conservation?
2. What mechanisms has ERDA established to ensure that the funding levels of each set of subprograms, as defined above, are not distorted because they are all lumped within the Conservation Program?
3. What procedures is the Conservation Program using to identify ideas for energy conservation R, D&D for the long term (2000 and beyond)?

5. Need for Nontechnological Research

ISSUE

ERDA's role needs clearer definition with respect to research on non-technological 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.

BUDGET SUMMARY

No budget information concerning this issue could be determined.

COMPARATIVE SUMMARY

Throughout ERDA 76-1 extensive reference is made to research in non-technical problems which deal with the points raised in this issue. However, notwithstanding this recognition, no budget request appears explicitly within the conservation program for such research. Possibly these problems have become integral parts of other subprograms and, therefore, no specific allocations are requested. But research projects on nontechnological impediments to implementation of conservation measures are difficult to find within the discussion of the FY 77 Budget Estimate.

There are some areas of study not discussed in the ERDA Program and Plan which should be included in this issue discussion. Specifically, studies of the economic, labor, and other impacts of energy conservation technology should be performed. In this context it is quite important to examine the various supply and demand options with the objective of optimum use of R, D&D funds within ERDA.

QUESTIONS

1. Why does the Energy Conservation Program appear to place low emphasis on planning and analytical activities?
2. What role does economic analysis play in the ERDA process for establishing priorities?

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.

BUDGET SUMMARY

No budget information concerning this issue could be determined.

COMPARATIVE SUMMARY

ERDA has recognized the impact of price on demand projections. Various models were utilized including one which looked at a demand policy based on rising energy prices. These were compared to a reference case which assumed decontrol of oil and gas prices. It is encouraging to note, in this context, the collaboration between ERDA and FEA through formal agreement for ERDA to use the Project Independence Evaluation System (PIES) model for projections to 1985. It is not clear, yet, how consideration of the impact of rising prices on energy projections will affect ERDA's planning. It should be pointed out here that these analyses should be carefully evaluated. For just as too little emphasis on price could overstate the need for enhanced supply options, too much emphasis could understate the need for both supply and conservation technologies.

QUESTIONS

1. To what extent has ERDA's plans for demand modeling and subsequent conservation planning been curtailed by budget limitations?
2. How does ERDA intend to use the results of demand modeling and energy projections in setting priorities for conservation R, D&D?

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.

BUDGET SUMMARY

The budget requests which concern the points in this issue fall in most of the categories of the Buildings subprogram, and, except for the performance standards category, cannot be broken out.

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriations	FY 77 Division Request	FY 77 ERDA Request	FY 77 Request to Congress
Performance Standards	2.6	(Not Available)		1.3

A decrease in funds clearly indicates an underestimate of the money and effort needed to implement satisfactory performance standards in code jurisdictions. The projected energy savings due to activities in this category are much greater relative to the entire program than the budget requests indicate (see Budget Document, CR/U-25). Activities concerned with design methods and new, energy-sensitive analytic tools are not explicitly identified in the budget requests. Finally, information dissemination of standards and design techniques will also

likely be relatively ineffective as a result of the budget request for this category remaining at last year's level (see Issue 3).

COMPARATIVE SUMMARY

The question of energy standards for buildings and consumer products is discussed extensively in the program document. The development of energy standards is an implied goal of the Buildings subprogram and forms an integral part of its strategy and implementation activities. The major difficulty here appears to be budget restrictions which limit the effectiveness of these efforts. With regard to the other major task described in the issue, that of providing new design methods and energy-sensitive analytical tools, there is less said. Design criteria are mentioned in many places in the Buildings subprogram but no comprehensive program is laid out to develop these methods. In this sense the Buildings program appears to emphasize demonstrations of specific technologies (e.g., the annual cycle energy system and the thermally activated heat pumps) and puts less effort on generic design methods to improve energy use efficiency. It is no doubt true that such methods will be developed from the specific technologies, but it is still not clear that a systematic approach toward this goal exists,

QUESTIONS

1. Do budget constraints in the performance standards and dissemination and transfer categories severely limit the effectiveness of the performance standard and design method activities?

2. How is ERDA involving the construction industry in the standard setting and implementation process?

3. What plans does ERDA have to develop a program in design methods and energy-conservation analytic tools which can be used across the buildings and consumer products sector?

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 add it ion, it is evident that ERDA is not spending a sufficient port ion of its resources on the research of new energy conservation technology which holds great promise for the future.

BUDGET SUMMARY

The budget requests for the various categories of the Buildings subprogram which relate to development and demonstration are given here along with a request for construction of a commercial building demonstration project.

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriation	FY 77 Division Request	FY 77 ERDA Request	FY 77 Request to Congress
Commercial Buildings	1.3	(Not Available)		3.9
Residential Buildings	0.9	(Not Available)		3.1
Community Systems	2.6	(Not Available)		6.9
Appliances	0.7	(Not Available)		1.2
Technology	1.8	(Not Available)		3.1
Commercial Building Conservation Demonstration	0	15.3	15.3	0

All of these requests show an increase from FY 76 reflecting an acceleration of demonstration and development of energy conservation technologies in the buildings and consumer products sectors. The elimination of ERDA's request for construction of the demonstration project coupled with the reduction of the division and ERDA's request for the entire Buildings subprograms (see Issue 4) implies that this acceleration is slower than ERDA itself feels is justified. This will slow the rate at which successful energy conservation technologies can be introduced into society.

COMPARATIVE SUMMARY

In the Buildings Conservation subprogram area four specific objectives are stated in the program document: a) to improve the energy utilization efficiency in new and existing buildings, b) to develop energy-saving technologies, c) to improve the energy efficiency of consumer products, and d) to develop "communit$_y$ systems" to improve overall energy efficiency. These objectives indicate that ERDA has responded well to most of the points raised in this issue. There are areas of concern, however, which may reduce the effectiveness of the energy conservation effort.

The expansion of the Commercial and Residential Buildings Programs (particularly demonstration efforts) is somewhat limited. This appears to be due to budget restrictions.

2. **ERDA** is still emphasizing the near-term in their R, D&D program (basic and applied) on new energy conservation technology. Very little discussion (both budget and program) is presented of efforts to investigate new, innovative technologies which may have a large long-term payoff (beyond 1985).

Examples of the latter include:

1$_0$ New approaches to high efficiency appliances including lighting.

2. Chemically stable fluids for heating and air-conditioning applications having useful thermal properties.

3. Research on human factors, such as people's adaptability to their thermal environment.

It should be noted that this concern about R, D&D on new technology extends across the entire Conservation Program (see Issue 1). That portion of the program which deals with research appears to lack a strong commitment to basic research on new long-term energy conservation technology such as those quoted above and efforts such as combustion chemistry and innovative industrial processes.

An important new consideration with this issue is the influence of the Energy Policy and Conservation Act of 1975 on ERDA's implementation plans. The provisions of this Act dealing with consumer products and State energy conservation efforts need to be considered by ERDA in formulating its programs.

QUESTIONS

1. Is it feasible to expand the demonstration program in buildings and, if so, to what extent can this accelerate implementation of these technologies?
2. What methods does ERDA have to define broad categories and initiate research into new, innovative conservation technologies for long-term payoff?
3. Has ERDA formulated plans for a basic research program in the conservation area?
4. How will the provisions of the Energy Policy and Conservation Act of 1975 influence ERDA's programs in the consumer products area?

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,

BUDGET SUMMARY

The budget requests which relate to this issue fall within several of the categories of the Buildings subprogram, The dissemination and transfer category (see Issue 3) is the only one for which a significant fraction of funds appears to be related to this issue.

COMPARATIVE SUMMARY

In the Buildings subprogram the issue of constraints in building construction is given high priority in the revised ERDA Program. Also, in the descriptive material associated with the budget emphasis is given to the resistance to conservation measures by the construction industry, problems of adverse building codes, **etc.** Although the issue is discussed in some detail, there is no indication of the budget resources going **to** this effort, and it is not clear that the budget adequately addresses its magnitude.

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.

BUDGET SUMMARY

Funding to implement thermodynamic analyses would be contained within the process analysis and modifications, and unit operations and equipment efficiency categories of the Industry Conservation subprograms. The amounts requested for such analyses are not detailed. However, these categories are presented here.

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriation	FY 77 Division Request	FY 77 ERDA Request	FY 77 Request to Congress
Process Analysis and Modifications	1.4	(Not Available)		1.7
Unit Operations and Equipment Modifications	1.1	(Not Available)		2.2

It cannot be determined, explicitly, whether there is adequate funding to identify targets for industrial energy conservation through thermodynamic analysis, or to assess the feasibility of implementation of these targets. It can be inferred, however, that the program will not accelerate as rapidly as ERDA feels it can, due to the reduction of their requests when submitted to Congress. This is particularly true of the implementation phase which will be addressed primarily by demonstration projects.

COMPARATIVE SUMMARY

The ERDA program document responds to this issue in its discussions concerning identification of 'targets of opportunity' for energy conservation. Although the program document does not specify that this will consist of thermodynamic analysis as described in this issue, the Program Approval Document of the Industry Conservation subprogram does make this point. Further, it charts how such analyses will be integrated into the overall assessment of a particular candidate for energy conservation. The Federal Energy Administration has carried out extensive thermodynamic studies of those industries using the largest amounts of energy. ERDA has noted this. From these discussions, it is clear that ERDA recognizes this issue. With regard to the projects underway or planned in the Industry subprogram, however, there has been little discussion of how thermodynamic analysis has been utilized so far.

The assessment of feasibility will be answered primarily by the comprehensive demonstration projects of energy-intensive processes scheduled from 1976 to 1985 (ERDA program document). The scope of these demonstration programs seems appropriate in light of the budget limitations and the lack of funding for conservation projects.

QUESTIONS

1. 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?
2. How does ERDA propose to communicate thermodynamic and economic analysis results to industry so as to aid the technology transfer process?
3. Why was the ERDA budget in the industrial sector cut by OMB so much more severely than other sectors? (30 percent of ERDA's request allowed versus 58 percent for all conservation) ?
4. Has ERDA asked industry to provide documentation of the rationale and potential impact of industrial sector conservation R, D&D?

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.

BUDGET SUMMARY

The budget requests related to this issue fall in the technology categories within the Industry subprogram. The principal category is alternative energy fuels, materials, and process.

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriation	FY 77 Division Request	FY 77 ERDA Request	FY 77 Request to Congress
Alternative Energy Fuels, Materials and Process	0.6	(Not Available) .		2.2

Other efforts, such as an industrial heat pump, are also being funded. In addition, the fossil program contains efforts directed at efforts suggested in this issue. The fragmentation of these projects and the lack of specific budget information makes it difficult to determine how effectively ERDA is responding to this issue through the budget. It is still clear that an overall ERDA program to deal with oil and gas substitution has not been well defined in the sense of the budget.

COMPARATIVE SUMMARY

The ERDA program describes numerous efforts to deal with oil and gas substitution. This occurs in both the Conservation and Fossil programs. In the Industry subprogram by itself, a specific R, D&D strategy for fuel substitution has been developed which responds to the issue. It appears not to have a sufficient budget to implement the effort. The scope of the projects described for FY 77, which is set by budget restrictions, is considerably narrower than the overall program strategy.

ERDA has described efforts to look at high-temperature heat pumps and have budgeted this item for FY 77. There is no description of coordination with efforts in the fossil program on the points discussed in the issue.

There are two other aspects of this issue which deserve ERDA's attention. The first is the need to assist certain hard-hit industries to switch from natural gas to more abundant fuels before 1985. The second is the need to assess the social, economic, and political factors related to oil and gas substitution. Such impacts will be highly regionally dependent and would include changes in employment, inflation, environmental conditions, etc.

The rapid decline in natural gas availability is having a profound effect on industries in the Northeast Central and Atlantic coast regions and requires action on the part of all Federal energy agencies, including ERDA.

QUESTIONS

1. Has **ERDA** developed detailed scenarios as to how each industrial element might switch from its present reliance upon oil and gas to other fuels (on a time scale of 20-30 years)?
2. What plans does ERDA have to assist industries to convert from natural gas in the next 5 years?

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.

BUDGET SUMMARY

No budget information concerning this issue could be determined,

COMPARATIVE SUMMARY

ERDA has given significant recognition in its programs to the establishment of communication with energy use activities in other nations.

Comparative studies of U.S. energy use and energy use in other nations are being undertaken, but have not yet been built into ERDA programs.

QUESTIONS

1. What progress and problems has ERDA encountered in transferring foreign technologies to the United States?
2. What special licensing and patent provisions appear necessary?

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 nuc1ear fuels proceeds, addition a 1 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 direct 1 y the relative benefits and difficulties of the successful development of various candidate technologies.

BUDGET SUMMARY

The budget summary related to this issue is as follows:

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriation	FY 77 Division Request	FY 77 ERDA Request	FY 77 OMB Request
Electric Power Transmission	8.1	(Not Available)		12.9
Distribution	2.5	(Not Available)		3.9

The division of this budget request among the various technologies is not available. Therefore, it is not possible to determine how the budget addresses the issue of setting priorities among the various transmission and distribution technologies. However, no efforts which explicitly evaluate the economic, environmental, and reliability criteria needed to set these priorities are described in the budget document.

COMPARATIVE SUMMARY

The program document places the principal emphasis on a.c. and d.c. overhead transmission followed by compressed-gas-insulated underground systems and finally cryogenic and superconducting systems. ERDA's discussion of priorities is responsive to the issue. ERDA intends to assess the relative technical, environmental and economic merits and disadvantages of these systems but no justification of their choice of priorities appears as yet. Further, support efforts to look at the problems created by each of the systems, environmental (except those caused by high electric fields), material, and land requirements, etc., still appear to be insufficient to allow successful implementation of these technologies.

It must be recognized here that the Electric Energy Systems subprogram will play a major role in coordinating compatible access to the electric power grid for solar, geothermal, fusion and other new supply technologies. This requires total system planning including transmission capacity, controls, system interties, and regional development. The objective of this planning is to develop economical reliable, environmentally acceptable, and flexible electric energy systems. The last point is crucial if the future electric systems are not to exclude small, distributed total energy systems from connection. It is not clear that ERDA recognizes this. Although their revised program indicates the need for systems planning, the importance of maintaining flexibility to accommodate a diversity of generation sources, both in size and type, is not spelled out. The budget requests also appear to be inadequate for the task of systems planning. This may be due to the inherited nature of the program which emphasized transmission and distribution R, D&D. Nevertheless an accelerated effort in systems planning, emphasizing flexibility, should be initiated as soon as possible. This requires a strong effort on ERDA's part which must be well coordinated with the energy supply and conservation programs in ERDA.

QUESTIONS

1. Do the priorities in the ERDA program take into account the relative probabilities of success of the various transmission alternatives?

2. 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?

3. How is ERDA intending to coordinate the various electric energy supply technology (nuclear, fusion, solar, geothermal, total energy) programs with the Electric Energy Systems subprogram to ensure adequate systems planning to integrate these supply options into the existing grid?

4. What areas of research does the Electric Energy Systems subprogram intend to emphasize in coming years?

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-use 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.

BUDGET SUMMARY

The budget requests for load management systems are principally located in the Electric Energy Systems subprogram. The Conservation Research and Technology (CONRT) subprogram contains requests for storage technology applicable to load management and the Buildings subprogram discusses load management but no budget data are given.

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriation	FY 77 Division Request	FY 77 ERDA Request	FY 77 Request to Congress
Systems Management Structuring	**4.0**	(Not Available)		6.8

Approximately $300,000 of this amount for FY 77 is designated for technologies and systems studies concerned with load management. No identifiable requests have been made concerning rate incentive questions and other economic and social impacts. This figure allows no more than a modest effort to look at the complex technologies and system development useful for load management.

COMPARATIVE SUMMARY

ERDA has described a broad effort to deal with issues in the program document. They have responded positively to most of the points raised and described coordination with FEA on rate matters. In addition to control over specific loads or customers' use patterns, ERDA is also examining other methods of load management such as storage at the load or generation site and expanded system interconnections. It is not clear, however, how extensive a role ERDA will play in the nontechnological aspects of this issue which are critical to the implementation of effective load management. In addition, there is little discussion concerning coordination of efforts between the end-use subprograms (Buildings, Industry) and Electric Energy Systems subprogram regarding load management.

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 generation?

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. What is the estimated capital tradeoff between investment in new electric utility plant construction and in load management of equivalent capacity?

7. What technical opportunities exist to increase this country's electric utility load factor to those of France and Germany?

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 there fore, it seems doubtful that these technical, economic, or environ mental 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 supporting technologies.

BUDGET SUMMARY

The automotive activities are contained within two budget categories: Heat Engine Highway Systems and Electric and Hybrid Highway Systems. These two categories comprise 83 percent of the entire Transportation subprogram.

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriation	FY 77 Division Request	FY 77 ERDA Request	FY 77 Request to Congress
Heat Engine Higl~way Systems	8.5	(Not Available)		14.8
Electric and Hybrid Highway Systems	1.6	(Not Available)		4.6

Each of these categories has received substantial increases. The principal focus on the Heat Engine category is on the development of prototype gas turbine and Stirling engines which will take the major share of the budget. The Electric

Systems category also is oriented toward prototype development. There is very little R, D&Don basic, long-term support technology indicated in the budget. 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 budget still lacks the appropriate emphasis and balance.

COMPARATIVE SUMMARY

ERDA has chosen to continue focusing its automotive research activities on prototype development. There has been no significant change in emphasis toward research and development on basic support technology. Although aware of the points raised in the issue it is apparently ERDA's contention that prototype development will result in the highest payoff. However, there is no discussion justifying this choice. In particular, the likelihood of these activities leading to successful commercialization of alternatives to the internal combustion engine is not addressed. It is OTA's contention that this issue remains as valid as when first raised,

QUESTIONS

1. How does ERDA establish its priorities in advanced automobile technology?
2. What is the percentage of funds in the Heat Engine Systems category going to component and support technology development?
3. Does this represent in ERDA's view a reasonable division considering the likelihood of commercialization of prototype engines developed by ERDA?

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 ERDA/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.

BUDGET SUMMARY

The budget item which is principally concerned with this issue is the Implementation category. This request is given in Issue 3. In addition there are elements of the other categories which deal with interaction with the transportation industry although specific budget amounts, if relevant, are undetermined. The available budget requests, however, indicate that ERDA has taken a significant step in addressing this issue.

COMPARATIVE SUMMARY

ERDA has addressed this issue quite extensively in the program document. They intend to make cooperation with the transportation industry a principal component of their strategy and implementation. In the case of high-risk, long-term projects ERDA states that the transportation industry will be involved from the beginning.

The mechanism for this cooperation is not clearly spelled out and it appears unsystematic. Finally, while ERDA considers various constraints, such as antitrust considerations, to joint industry involvement in projects, a strategy for resolving these problems is not spelled out.

QUESTIONS

1. Has ERDA established a formal systematic mechanism for industry involvement in ERDA's Transportation Program?
2. Is ERDA prepared to deal with possible legal constraints to industry involvement in the Transportation Program?

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.

BUDGET SUMMARY

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriation	FY 77 Division Request	FY 77 ERDA Request	FY 77 Request to Congress
Nonhighway Transportation Systems	0.5	(Not Available)		0.5

The amount for FY 77 does not appear to be commensurate with the large quantity of energy used by nonhighway transportation systems (6 percent of the Nation's total). This sum of $500,000 can do no more than initiate studies on technologies to reduce fuel consumption for nonhighway systems. It is inadequate

to deal with problems raised by regulations and legislation on both the State and local level and to examine the impacts of substitution of nonhighway transportation systems for a less efficient highway system.

COMPARATIVE SUMMARY

ERDA 76-1 makes repeated references to the necessity for research in problems associated with nonhighway transportation, Discussion is made of improved technology, regulatory problems, and modal shifts. However, a budget of $500,000 can hardly be an adequate response to the needs for a program in this area. Clearly, only preliminary studies can be initiated with such limited funding. This program level does not evoke confidence that systematic planning of possible energy conservation strategies has been carried out.

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. 11 make no mention of any such activities,

BUDGET SUMMARY

Use of waste, as defined in the issue, falls in the Energy Conservation Program and the Biomass subprogram in Solar Energy. The only budget request that can be determined is in the Buildings subprogram of Energy Conservation.

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriation	FY 77 Division Request	FY 77 ERDA Request	FY 77 Request to Congress
Waste Systems Utilization	1.5	8.0	8.0	1.7

In the ERDA-48 program document, no mention of energy recovery from waste was made, although it is clear funds were appropriated. It is also clear, however, that the FY 77 budget request to Congress does not permit ERDA to expand its efforts to fulfill the mandate of PL 93-577 as outlined in the issue summary. The ERDA and division requests would permit an approach more in keeping with the legislative objectives.

COMPARATIVE SUMMARY

The ERDA document presents a subprogram which deals extensively with this issue. The subprogram contains a description of activities to deal with urban, industrial, agricultural and forestry wastes. It discusses a variety of technological options to utilize these wastes and stresses their substitution potential for oil and gas. These activities would do much to meet the requirements of PL 93-577 in the waste utilization area.

The fact remains, however, that no distinct budget request for this subprogram can be found other than the urban waste category in the Buildings subprogram. Therefore, it is difficult to see how this effort can be conducted at the level that is suggested in the program document.

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?
3. What is the real magnitude of ERDA's subprograms in energy recovery from waste?
4. Why was the budget cut so drastically for the subprogram on urban waste?