Chapter IV

Solar, Geothermal, and Advanced Systems Issues

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1. Setting Criteria for Program Priorities

ISSUE

Decision-point criteria defining measures for evaluating success within a given solar energy program, choices among programs, and readiness for commercialization need to be established, quantified, and justified.

SUMMARY

The ERDA Plan does not treat the important question of how decisions will be made between solar energy technologies, and between solar and other energy options. Criteria are necessary to evaluate, for each program: (1) the projected rewards upon success, (2) the total costs to the public and private sectors, (3) the relative risks of economic or technical failure, and (4) the potential and projected readiness for commercialization. The decision-point criteria, to be applied at regular intervals in this process, must be predetermined by making a number of specific assumptions concerning the potential of all forms of energy generation, whether conventional or advanced. These assumptions need to be continuously evaluated and revised in the light of changing conditions during the course of the program.

BUDGET SUMMARY

No specific budget allocation for this activity is identifiable in the budget documents. Although this function is being performed (see below), it is impossible to tell whether it is being done in Plans and Analysis, in Technology Support and Utilizations, or the subprograms themselves.

COMPARATIVE SUMMARY

In the revised Plan and Program there is little description of any methods or processes for establishing program priorities and decision-point criteria. There are subprograms where mention is made of evaluation criteria, but with little or no detail as to how they were established.

The Solar Energy Program approval document outlines a basic strategy for establishing the research, development, demonstration, and commercialization plan in the Solar Division. This is an iterative process which is designed to establish priorities through comparative analysis, define programs for technology development, carry out development, and phase over to private industry. The present schedule of projects in the solar program will be put through this process for evaluation. The process has not been in operation long enough to determine its effectiveness but it appears to be a positive step in developing a systematic means of setting criteria for program priorities. In this context, the Solar Division states that the planning process, itself, will be continually updated.

QUESTIONS

1. What specific goals will be set (and when) against which to measure your solar and geothermal programs; that is, how will ERDA define success?
2. In the ERDA estimates of the penetration of solar and geothermal technologies into use by the private sector, what costs and cost relationships were assumed for capital, interest rate, discount rate, fuel, and operations and maintenance for the solar and geothermal systems and the conventional systems that they are to replace?
3. How does ERDA make evaluations of various energy technologies which may have to compete for limited developmental funds, such as solar electric and fusion?
4. Has ERDA conducted cost-benefit and risk analyses which might help implement the decisions to accelerate, abandon, or delay available or near-term options, in the expectation that we can make it to the point where the more advanced technologies can adequately supply our needs?

2. Rationale for Funding of High-Risk Projects

ISSUE

It is important that effective mechanisms be developed by which ERDA can make rational decisions on solar energy projects having great potential as future energy sources, but involving large cost outlays, and being subject to major uncertainties in projected costs and/or technologies.

SUMMARY

The Energy Research and Development Administration is undertaking research and development of long-range solar energy projects which offer much promise in the future, but which, because they involve new and relatively unknown technology, suffer high levels of uncertainty.

Examples of such projects are the ocean thermal energy conversion and satellite solar power station programs in solar energy utilization. Although early-phase funding levels are not necessarily very large for these projects prior to reaching the demonstration phase, it is nevertheless very important that a rational method be established to decide: (a) whether or not to initiate the program, (b) at which level to maintain or accelerate it, and (c) when to implement major and costly undertakings such as demonstration **projects.** There appears to be no effective mechanism now being used to make these decisions.

BUDGET SUMMARY

No specific budget allocation for this activity has been identified nor has consideration by appropriate offices in ERDA been established.

In the two high-risk projects specifically identified by OTA in the issue, there are specific figures available for all analytical studies, as follows:

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriations	FY 77 Division Request	FY 77 ERDA Request	FY 77 Request to Congress
OTEC, Systems Development and Mission Analysis (Budget Outlays)	0	(Not Available)		$0.58
Space Solar Power Systems (SSPS) (Budget Outlays)	0	(Not Available)		0

In FY 76 there was no mention of any ERDA SSPS program. In FY 77 the program is identified, but with zero budget allocation. Also, there was some informal NASA budget in FY 76. NASA is precluded from having any terrestrial energy budget in FY 77.

COMPARATIVE SUMMARY

There is no indication that ERDA is developing mechanisms for making decisions on high-risk solar energy projects. It is also not clear from the budget and program documents that appropriate risk or cost/benefit analysis methodology is being developed or applied.

Within the subprograms, however, there is some evidence that there has been a response to the OTA issue. The OTEC program considers the need to demonstrate cost-effectiveness of critical components before proceeding, although there is no identifiable basis for ERDA's having doubled the OTEC budget authorizations for FY 77. There is also a mention of the need for "minimal risk" in the design of OTEC plants.

With respect to the space-based solar power system, ERDA did respond to the 0TA issue by establishing a formal program for FY 77, but no basis was given for making this decision. The establishment of a program with no budget allocation (and no possibility for NASA funding of terrestrial solar power research) represents a management inconsistency.

There are no identifiable projects underway (or planned) to develop the necessary decision-making guidelines. The basic issue is still unanswered.

QUESTIONS

1. How does ERDA determine the relative 2. founding levels for long-term, high-risk projects?
2. Does ERDA have a definite "plan" for continual review of these technologies and appropriate mechanisms to factor these analyses into its Program Plan?

3. Resource Availability

ISSUE

The ERDA Plan lacks adequate emphasis on the role that critical resources play in selecting energy alternatives.

SUMMARY

The following major resources are likely to be affected by the various solar energy technologies:

. Water • Land • Materials • Energy
• Capital • Manpower • Air quality.

The ERDA Plan does not appear to have addressed adequately the problem of resource requirements of the various solar energy alternatives. It is essential that in our preoccupation with our current energy shortage we do not divert excessive amounts o f our critical resources into energy production. Therefore, it is clear that integration of these impacts across disciplinary lines within ERDA will minimize the chance for oversight.

BUDGET SUMMARY

No specific budget request for this area has been identified.

COMPARATIVE SUMMARY

No specific program area addresses itself to this vital issue. Some mention is made of capital limitations (the high capital cost of solar components has thus far limited that market demand so that large industrial organizations have not entered the field in a major way) but the issues of land, water, materials, and energy are not addressed as such.

The program element of Technology Support and Utilization includes activities concerned with resource assessment. However, this largely deals with solar and meteorological data, and not the items listed in this issue. The latter are only implied within the Environmental and Resource Assessment category.

Under Solar Photovoltaic Conversion, materials and land requirements are mentioned but studies to examine them are not described.

A study is presently underway in the ERDA Solar Division which will address many of the points raised in the issue although it is not described in the Program and Plan,

4. Organization of ERDA's Research Program

ISSUE

A major concern with ERDA's research effort is that the management distinction between basic and supporting research formerly used in the AEC continues to polarize the sciences from engineering.

SUMMARY

It appears **(ERDA-48,** volume I, p, VIII-11) that the polarized research management policy is being carried over from the AEC into ERDA. The problem with this management policy is that its tendency to isolate scientific and engineering research has not produced innovative advances in technology comparable to those, for example, produced by the pacesetting electronics laboratories where a continuous spectrum of applied and fundamental research has been carried out under the cooperative leadership of scientists and engineers, Energy-oriented research is even more complex since it involves social and institutional problems in addition to the scientific and engineering aspects of advanced-hardware development. Thus, a nonpolarized institutional mechanism is needed if rapid solutions are to be found for these complex energy problems.

Creation of a Solar Energy Research Institute (SERI) represents one of several institutional mechanisms that can be utilized for this purpose, but there is as yet no indication that it will take the necessary interdisciplinary science/engineering form.

BUDGET SUMMARY

See Issue 9 in the Overview Chapter.

COMPARATIVE SUMMARY

Issue 9, in the Overview Chapter extensively discusses ERDA's response to the general issue of ERDA's basic research effort. Here, comments will be confined to the points raised in the issue reproduced above.

The principal concerns were the undesirable separation of science and engineering functions and the lack of interaction with individuals responsible for commercialization and marketing. The new plan has not responded to any of these points and it still appears that the ERDA basic research program does not adequately support the ERDA energy subprograms in many key areas,

An additional concern, is that the current ERDA program statement defines no goals, no strategy, and no plan for coordinating its basic research activities

with other government agencies, other countries, or the private sector, For example, the ERDA program document shows awareness of only one other Federal agency program (that of the Department of Commerce in materials research), implying that no basic research interaction is planned with the several other agencies performing such work.

QUESTIONS

1. What are some of the specific programs of basic materials research that ERDA is support ing? How do they relate to ERDA's mid-term or long-term goals?
2. Is engineering work toward these goals being done in the same laboratory? If so, are the engineering and scientific programs monitored by the same ERDA manager? Do they have a common laboratory leader? If not, what mechanisms have been established to ensure dialogue between the two managers as well as between the engineering and scientific efforts?

5. ERDA Program Management

ISSUE

The use of outside organizations and Federal laboratories by ERDA for some of its program management functions, particularly in the solar area, could produce an ineffective organization.

SUMMARY

Interposing an additional management level in the development of solar energy technology is not likely to be efficient because some of the organizations used by ERDA for this function have not been constrained by cost considerations. Their management and contractual procedures are highly structural and extremely detailed, an approach which may not be appropriate—or cost effective—for the development of new solar energy forms.

Since the new energy technologies are very sensitive to costs, require innovation, and must interface with commercial energy producers (the utilities), ERDA's current reliance on outside management organizations may cause serious problems with program costs and the cost effectiveness of end products.

Furthermore, when ERDA delegates complete control of an entire program or a large part of a program to one of these organizations, it may be too far removed from the actual research planning to maintain its mandated responsibility for the Nation's energy research and development,

BUDGET SUMMARY

The SERI subprogram is the only budget request applicable to this issue,

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriation	FY 77 Division Request	FY 77 ERDA Request	FY 77 Request to Congress
SERI (Budget Outlays)	1.5	(Not Available)		1.0

COMPARATIVE SUMMARY

This issue has not been addressed in the ERDA program. Specific examples of ERDA's lack of response are as follows:

1. Major program responsibility is still being given to national laboratories, risking a loss of program focus.

2. Increasingly, the program is relying upon highly specific project solicitations which tend to preclude the development of unplanned innovative concepts.

3. The program is substantially understaffed – the present ratio being $3.35 million per professional. This makes it extremely difficult to develop an efficient program in this rapidly expanding technology. It is also largely responsible for the above two items. The ERDA personnel requests for FY 76 and FY 77 were 99 and 130 while ceilings submitted to Congress were 75 and 80.

4. Actions to establish SERI as mandated by Congress have slipped considerably from the schedule submitted last year. This is reflected in the budget request which is 33 percent below the FY 76 figure.

The above points indicate that the dangers raised in the issue are still very real and appear to be increasing.

6. Support for Study of Decentralized Solar Electrical Generation

ISSUE

The study of the decentralized production of electricity has received limited attention, especially because it involves the potential utilization of waste heat.

SUMMARY

One chief advantage of solar energy is its relatively uniform distribution. Extensive electrical distribution systems are thereby rendered unnecessary, or at least can be appreciably smaller. The small distances between generator and user, which are possible with decentralized production, make utilization of the waste heat more feasible than with central station plants. Since future principal energy shortages are predicted mainly in the oil and gas supply areas, which have recently supplied the bulk of the country's thermal energy needs, there is added reason for extensive study of onsite production. The technology for solar onsite systems is at least as well in hand as central station technologies. Fossil-fired total energy systems are in use in many European countries. With photovoltaics especially there are no major economies of scale as larger electrical generating stations are contemplated.

The present ERDA organization establishes the study of decentralized electrical production as a small part of the central station solar thermal branch, A recent (and first) total energy symposium had almost no discussion of photovoltaic total energy systems, and very little on the problems of distributing the waste heat. The major issue of electric utility acceptance has received little attention.

The first major U.S. solar electrical system has recently been installed at Sandia, following an extensive survey under AEC sponsorship. No other electrical-generating facility will be ready for several years according to present ERDA plans, despite the relative simplicity of the technology and the availability y of all components. The reason for this delay in construction is not clear,

BUDGET SUMMARY

There are no explicit budget requests for decentralized solar electric systems. The projects that can be identified are in the following budget categories:

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriation	FY 77 Division Request	FY 77 ERDA Request	FY 77 Request to Congress
Solar Thermal Conversion (Budget Outlays)	3.0	(Not Available)		7,2
Farm & Rural Systems (Budget Outlays)	**0.9**	(Not Available)		1.2

The entire budget for these programs is directed toward hardware development. Total energy projects appear in the Conservation Research and Technology (CONRT) subprogram but no budget requests can be identified. Coordination between them and the Solar Program is discussed in the CONRT program approval document.

COMPARATIVE SUMMARY

This issue is partly addressed in the context of total energy systems discussed in the Solar Thermal Conversion subprogram, and of rural home and agriculture applications in the Wind Energy Conversion subprogram. Moderate scale photovoltaic, but not small scale, demonstrations are also proposed. Throughout the solar electric programs there is no discussion of studies to investigate the problems and benefits of decentralized systems, or of comparative assessments of central versus decentralized solar electric generation. The one statement dealing with the nontechnical problems of decentralized generation does not indicate any type of comparative analysis. Further, no studies are listed to deal with these suggested institutional problems. This issue is receiving some technical consideration but nontechnological concerns are not being addressed by ERDA.

No program is specifically defined for the “total energy” concept, i.e., use of thermal output as can be achieved in a decentralized system. It must still be concluded that there is not much emphasis placed on decentralized solar electric plants with the potential for both electrical and thermal outputs. The reason for this lack of emphasis may be the absence of a simple program office, and the diversified approach now employed may inhibit completion of a coordinated attack on this approach to solar utilization. It should also be noted that total energy research is now ongoing in the Projects Branch (of the Solar Electric Division) as well as in the Conservation Division of ERDA and at the Department of Housing and Urban Development (HUD).

QUESTIONS

1. Is the present ERDA solar organization (which separates electrical and thermal areas) appropriate for undertaking a project which combines several technologies in a system?
2. What coordination is now occurring with the ERDA Conservation Division which is responsible for fossil-fired total energy systems?
3. Why is no further immediate solar thermal hardware deployment planned, in light of the successful Sandia work, and the rapid cost improvements already obtained?
4. Why has the photovoltaic program not been more active in placing experimental total energy systems into the field (the only one is the very early "Solar One" at the University of Delaware, which was in large part funded locally)?

7. Emphasis on Electric Energy Systems

ISSUE

The program goals of the ERDA Plan appear to emphasize development of electric power systems to the point where the full potential of solar heating is not recognized, and the possibility of obtaining synthetic fuels from solar energy is largely ignored.

SUMMARY

Preoccupation with coal, solar, and nuclear energy for electric power generation has produced too narrow a view of the alternatives for utilizat ion of our energy sources and, in selected areas, would commit the Nation—perhaps prematurely-to a massive change in the infrastructure for energy delivery and utilization. Much of the Nation's thermal end-use energy requirements over the long term may be met by those energy sources, particularly solar and geothermal, that are well suited to supplying thermal energy directly.

BUDGET SUMMARY

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriations	FY 77 Division Request	FY 77 ERDA Request	FY 77 Request to Congress "
Direct Thermal	28.5	87.3	72.3	37.0
Biomass	3.8	6.6	6.6	**3,0**
Total (Nonelectric)	32,3	93,9	78.9	**40,0**
Solar Electric	43,6	112,5	99.3	67.5
Ratio: Electric Nonelectric		1.35	**1,20**	**1,69**

As the figures indicate, in terms of operating expenses ERDA attempted to bring two components of the Solar Program into better balance. However, the request to Congress has reversed this and enhanced the imbalance with respect to FY 76.

COMPARATIVE SUMMARY

The original issue had as its original objective the upgrading of direct solar thermal energy to a status equivalent to that of solar electric as an inexhaustible energy source for the long term. There was no intention to imply a reemphasis of solar electric.

In the revised Program, no programs are described for obtaining synthetic fuels from solar, other than through biomass or electrolysis by way of OTEC to produce hydrogen. Nonelectric uses of wind energy are mentioned and a sizable effort for nonelectric uses of geothermal energy is described (see Issue 16). However, no shift in emphasis is implied. In fact, the original ERDA 48 position that thermal applications were only valid as a mid-term stopgap is still reflected in the FY 77 budget document (page SE/D-1).

QUESTIONS

1. Since the production of heat from electricity is expensive and about half of the end-use energy consumption in the United States is in the form of heat, why hasn't more emphasis been placed on utilizing solar energy sources for direct thermal end-use requirements?

z. What are ERDA's plans for the development of technologies which produce synthetic fuels from solar and nuclear energies? How does ERDA's basic research program reflect these plans?

8. Emphasis on Solar Heating and Cooling of Buildings

ISSUE

The importance of solar heating and cooling relative to other programs is not recognized in the ERDA Plan.

SUMMARY

There is abundant evidence that solar heating and cooling applications offer a larger potential for energy savings in the immediate and near term (to 1985], and beyond this to 2000, than any other solar applications. Indeed, ERDA's figures (ERDA-48, volume I, table 6-1) verify this statement; yet, solar heating and cooling is categorized at the third level of priorities as an "under-used mid-term technology" and one which may "provide an energy 'margin' in the event of R, D&D failure in other areas. " These statements in the ERDA document project a significant potential for solar heating and cooling, yet underemphasize the development and actual impact of solar heating and cooling on our energy economy.

BUDGET SUMMARY

The budget information for this issue is given with Issue 7. It is apparent that ERDA attempted to place greater relative emphasis on solar heating and cooling (both in the buildings and the agriculture and industrial process areas) but was reversed when the budget was submitted to Congress. In particular, ERDA requested an increase of 41 percent in the agriculture and industrial process heat category whereas the budget request to Congress showed a 32-percent decrease from FY 76.

COMPARATIVE SUMMARY

The new program has partially recognized the long-term potential of solar heating and cooling; however in the Budget Estimate for FY 77,, on Page SE/D-1, only electric application of solar is recognized for long-term inexhaustible potential by the statement ". . . the 'Highest Priority Supply' category includes Solar Electric Applications under 'Inexhaustible' sources for the long term". It is further felt that the projections for energy displacement by solar in the solar heating and cooling sector are underestimated in the executive summary for the years 1985 and 2000. Presently approximately 25 percent of our energy is expended in water heating, space heating, and space cooling. By the year 2000 with total energy consumption estimated to be 140 Quads with 25 percent residential/commercial consumption, the projected 2 Quads means that less than 6 percent of the residential/commercial requirements in these areas will be met

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by solar thermal methods. Since it is now economically practical to provide solar water and space heating in many areas, solar heating and cooling projections should be more optimistic. It is felt that the predictions for solar contribution for heating and cooling requirements are pessimistic, while some of the other projections (i.e., ocean thermal, which has doubled since ERDA-48, Volume 2) are overly optimistic,

QUESTIONS

1. How does ERDA reconcile the low projections for solar heating and cooling compared to solar electric in the light of the present relative state of development of direct solar thermal and solar electric applications?
2. How does ERDA justify lower 1985 goals than those put forward by FEA in Project Independence as being attainable with an "accelerated government program"?

9. Purposes of the Solar Heating and Cooling Demonstration Program

ISSUE

The size, scope, and purposes of the solar heating and cooling demonstration program need specific definition.

SUMMARY

The prime objective of the demonstration program should be **to** accelerate consumer acceptance of solar energy as a heat source so that substantial fuel savings can be achieved at a considerable earlier date than would otherwise result. The plans set forth in ERDA-48 do not appear to be oriented to achieve these purposes. In particular they do not appear to place as much emphasis on demonstration programs as The Solar Heating and Cooling Demonstration Act (Public Law 93-409) does.

The manufacture and sale of solar energy systems for heating buildings and hot water has commenced on a small scale, while solar cooling is still in the development stage. Principal immediate emphasis in solar cooling should be research, development, and testing, whereas the thrust in the solar space and water heating effort should be demonstration.

BUDGET SUMMARY

The trend in funding of the solar heating and cooling demonstration programs can be seen as follows:

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriations	FY 77 Division Request	FY 77 ERDA Request	FY 77 Request to Congress
Commercial Demonstration (Budget Outlays)	12,6	(Not Available)		12.2
Residential Demonstration (Budget Outlays)	**4.0**	(Not Available)		6.3
Development in Support (Budget Outlays)	4.5	(Not Available)		7.8
Total	21.1			26.3

The 25 percent increase in requests for demonstration is less than that for the solar heating and cooling subprogram as a whole. It is likely that this will not permit the increase in emphasis on demonstration suggested in the issue summary. In particular it is still unclear whether the objectives of the Solar Heating and Cooling Demonstration Act (Public Law 93-409) can be met.

COMPARATIVE SUMMARY

The purposes of the Solar Heating and Cooling Demonstration Program have been better formulated in the new program. However, it should be emphasized in the document that the demonstration of solar water and space heating is directed toward the public sector stressing the economic viability and availability of systems and components, rather than the need to prove the practicality of these applications. It is stated that, "The nationwide Federal demonstration program will illustrate the technical feasibility of solar heating and cooling equipment and investigate the economic viability of near-term applications of such equipment. " The differences between heating and cooling should be better delineated. Solar water heating is economical nationwide while solar heating is economical in many regions of the United States. It is stated in the document that additional development of cooling systems is definitely warranted and needs support.

A significant portion of the Solar Heating and Cooling Program deals with the demonstration program. The ERDA Program now recognizes the mandate of PL 93-409 and has increased the number of residential demonstration units from

110 to zoo (see budget, page SE/D4&5). However, this is still considered to be below an adequate number of units. A better awareness of the purpose of the act is given in the implementation section which discusses market development projects (see also budget, page SE/D-Z), including examination of non-technical questions. While ERDA's primary goal in the demonstration program still appears to be hardware demonstration, a noticeable shift toward one of encouraging consumer markets is evident.

10. Role of User Incentives in Solar Heating and Cooling of Buildings

ISSUE

A well-structured user incentive program would accelerate the solar heating and cooling of buildings (SHACOB) and accelerate development of the infrastructure to support large-scale applications.

SUMMARY

Properly structured user incentives are perceived as having the potential to substantially accelerate the growth of solar energy utilization. Although incentive programs should probably not be developed nor administered by ERDA, they have potential impact on ERDA's program. The important interfaces and distinctions between the various Federal agencies with regard to solar incentive responsibilities have not been delineated in ERDA-48.

Incentives may be looked upon as temporary. Economics are less favorable for solar heating and cooling systems now than they will be in the long term because: (a) mass production savings in producing solar equipment have not yet been attained, (b) cost reduction engineering accompanying volume production remains to be done, and (c) it is probable that costs of competing fossil-based energy forms will be higher relative to solar in the near future.

However, there is a clear need for equitable treatment of the solar energy user. The individual user, turned energy producer. does not now receive the benefits of investment tax credits, depreciation allowances, depletion allowances, and other incentives to corporate producers of fossil energy forms. No incentive recognizes his contribution to society in reducing pollution, preserving fossil resources or reducing the Nation's dependence upon imported oil.

BUDGET SUMMARY

No projects dealing with incentives are described in the Solar Heating and Cooling Program. The Technology Utilization and Information Dissemination subprogram calls for a request of $700,000 (Budget Outlay). The budget document

does not indicate that any of these funds will be used for projects concerned with incentives. Reductions of the ERDA budget requests before being submitted to Congress appear to affect these efforts.

According to the Solar Division, the cutbacks could include the elimination of programs which would initiate a regional solar information capability, incentive and barriers programs, a solar code for state implementation and development of comprehensive regional strategies, including cost-shared training and demonstration programs. In addition, publications, conferences, exhibits, films, and newsletters will be cut back.

COMPARATIVE SUMMARY

The issue of incentives is addressed throughout the Solar Heating and Cooling program with several studies on this and related subjects suggested.

The range of these studies is not precisely defined and it is not clear whether ERDA will consider the role of the solar energy user as an energy producer. Although mention of incentives is made in the strategy section in the Solar Heating and Cooling Program, nothing is mentioned in the implementation section about specific projects. It appears that ERDA has only slightly increased its activities dealing with the incentive issue.

In the Federal role section of the Program a "Need for governmental action (including State and local) to encourage use of solar energy" has been indicated. However, no structure is proposed to carry this out. The plan does not indicate ERDA's role nor the extent other agencies (especially FEA) should be involved in providing proper user incentives.

When ERDA mentions "incentives" no specification is made as to whether industrial or consumer incentives or both types are intended. ERDA's emphasis on industrial commercialization makes one think the former is the case. Little mention is made of the possibility of small businesses playing a major role in solar heating and cooling.

QUESTIONS

1. Why, as stated in ERDA-23, does ERDA propose to delay study of incentive programs until 1979?
2. What agency, or agencies, should develop a structured incentive program, and what should be the nature of ERDA's interaction with it?
3. What safeguards can be developed to protect the small business and consumer in his investments — credits or deductions for energy-conserving commercial and residential solar expenditures?

11. Standards for the Measurement of Solar Heating and Cooling Equipment Performance

ISSUE

For consumer protection, standards are needed to provide comparative performance ratings, to allow comparison of durability, and assure proper installation of solar equipment.

SUMMARY

In order for the consumer or builder to intelligently compare solar equipment produced by competing manufacturers, it is necessary that all equipment be rated according to realistic and consistent standards, In order for the owner, builder, or architect to properly size equipment to the load, the equipment performance as determined from a standard measurement procedure must be specified. At present, many equipment manufacturers omit rating data or rate their own equipment in different terms so that it is very difficult to make comparisons or to size installations. Thus, it appears that standards are required not to protect the consumer. It is particularly appropriate that proposed incentive programs be tied to standards so as to discourage fraudulent or mistaken practices.

BUDGET SUMMARY

No specific budget request for this area has been identified,

COMPARATIVE SUMMARY

In the area of heating and cooling, the issue of standards has been considered by ERDA within the residential and commercial demonstration programs (see budget, pg. SE/D-4&5). This deals with the questions of warranty development, system performance standards, system certification processes, performance criteria, manuals of practice, etc. However, no systematic consideration of standards to guide owners, builders, and architects, and to protect consumers is described in the program. Therefore, it is not clear how ERDA will treat this question in promoting commercialization of solar heating and cooling. Further, there is no discussion of the connection between standards and incentives.

ERDA is working closely with the National Bureau of Standards to develop standards in several aspects of solar heating and cooling. These will lead to the development of minimum property standards for solar heating and cooling equipment. In this context NBS is developing collector and storage test codes. Also, NASA/Lewis is providing valuable service in testing collectors.

QUESTIONS

1. What are ERDA and/or other agencies doing to accelerate development of adequate standards?
2. Is it intended that standards be written so that they consciously avoid stifling innovation?
3. Will future standards be so written as to enable the consumer to make his own comparisons on life-cycle cost effectiveness and energy conservation potential?

12. Impact of Solar Energy on Utility Peak Demand

ISSUE

Onsite solar energy sources (most immediately solar heating and cooling), unless developed properly, will cause a significant utility peak demand problem.

SUMMARY

The economics of solar heating and cooling show that much of a building's energy requirements can be met by solar energy. The remainder must be supplied from an auxiliary source—for example, electricity or natural gas from a public utility or a stored onsite source, such as fuel oil. As the use of solar energy becomes more extensive, it may contribute to an increased peak demand problem for the utilities (particularly the electric utilities), because such energy supply systems could need auxiliary power simultaneously. Expensive standby electricity rates for solar energy uses could result. If auxiliary energy is supplied by a public utility, the solar energy systems should be carefully designed to minimize regional standby capacity. An alternative is onsite, selfcontained auxiliary energy storage (such as fuel oil), which makes the consumer independent of the utility or which will ensure his utilization of auxiliary sources at offpeak times.

BUDGET SUMMARY

There is only one explicit request directed to this issue. Under Hybrid Systems (Solar Thermal Conversion) $425,000 (Budget Outlay) has been requested to determine the overall impact on a utility grid.

COMPARATIVE SUMMARY

The potential impact of solar energy on utility peak demand may seriously affect the development and growth of the various solar technologies. The ERDA

program has better reflected the importance of this aspect of solar technology development and implementation under "Status" and "Problems" of the various program areas:

1. Agricultural and Industrial Process Heat — problem recognized;
2. Wind Energy Systems — problem recognized;
3. Solar Photovoltaic — problem recognized;
4. Solar Thermal Conversion — initiated program and problems recognized;
5. Hybrid Power Plants — problem recognized.

In addition, it is stated that ''innovative techniques will be needed to solve the problem of load management and peak demand."

Thus it appears that ERDA is addressing this important problem but in a segmented way. It would be better approached through a structured program which is interfaced with the Electric Energy Systems and Conservation Research and Technology subprograms of the Conservation Division, with an identifiable budget for this area.

QUESTIONS

1. At what levels of implementation (percentage of solar homes) will a peak demand problem for utilities become serious?
2. What standby energy and\or capacity (peak and offpeak) rate structuring can be anticipated or recommended in the future for buildings using onsite solar energy?
3. What methods appear attractive for self-contained onsite supplementary energy storage?
4. How best can an onsite solar energy system be designed to minimize the impact on the utility system while simultaneously maximizing the benefit to the solar consumer?
5. What coordination is planned with the Conservation Division of ERDA for storage schemes uniquely applicable to solar systems?

13. Biomass Energy and Food

ISSUE

Biomass energy generation may conflict with food production.

SUMMARY

In a world in which hunger is an ever-present concern, the use of arable land in the U.S. explicitly for energy production may be seen as irresponsible and may conflict with our own capacity to produce food. For this reason, it is important that the biomass program should not have an adverse effect on the production of food, either in fact or perception.

A variety of development strategies are available to satisfy this requirement, including:

- Improved plant genetics to emphasize biomass production with low water and fertilizer demands
- Changes in cattle-feeding methods and a reduction in the United States demand for beef
- Development of lands unsuitable for food crops
- Integrated food and energy production systems.

Unless such approaches are successful [and are also perceived as being successful), a large-scale biomass energy program will probably be unacceptable.

BUDGET SUMMARY

The biomass subprogram budget is 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
Biomass	4.5	8.1	8.1	4,3

Under the FY 77 Biomass subprogram, work is contemplated in 3 major areas: 1) terrestrial and marine biomass; z) agricultural and forest residue programs; and 3) research and development work directed toward optimizing plant growth for energy yield.

The reduction of ERDA and Division requests delays most of the alternative crop studies as well as the construction of the wood plantation pilot plant. Equipment ordering for the crop residue and feedlot pilot plants will be deferred and R, D&D in optimizing plant growth will be postponed.

COMPARATIVE SUMMARY

The ERDA Program states "These studies will address trade-offs resulting from using land for food or fiber production, recreation purposes, or for energy production in addition to surveying pertinent economic, technical, and environmental issues, " While the general thrust of biomass energy generation conflicting with food production was included in the above statement, the problems of changing cattle-feeding methods, reduced U.S. demand for beef, integration of food and energy production systems, and improved plant genetics to emphasize biomass production with low water and fertilizer demands were not mentioned. One is not certain of the importance of these components in ERDA's Biomass program planning.

QUESTIONS

1. Have studies been made of the comparable economic value of organic materials when used for food, lumber, and energy?
2. What support is ERDA giving to genetic studies for the improvement or development of plants with high energy yield — and with low water and nutrient demands?
3. Is ERDA undertaking studies or research to ensure the long-term productivity of land used for intensive agriculture or tree-farming?

14. Legal and Institutional Constraints in Geothermal Energy

ISSUE

Geothermal energy implementation is not so much constrained by technology as by legal and institutional restraints.

SUMMARY

Federal, State, and local agencies are inexperienced and inconsistent in dealing with leasing, exploration permits, and licensing of geothermal resources. For example, geothermal resources are variously classified as water, minerals, or fossil fuels by regulatory agencies. Furthermore, unlike oil and gas exploration, extensive 1icensing and environmental analyses are required prior to exploratory drilling.

ERDA sponsorship of innovative legal and institutional studies may determine the best methods of resolving these and similar problems to ensure the orderly development of the resource.

BUDGET SUMMARY

These refer to the Environmental Control and Institutional Studies subprogram, The budget requests pertaining to this issue (Economic Policy and Planning Analysis) are within this subprogram.

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriation	FY 77 Division Request	FY 77 ERDA Request	FY 77 Request to Congress
Environmental Control and Institutional Studies	3.9	8.9	7.4	4.8
Economic Policy and Planning Analysis (Budget Outlay)	**1.42**	(Not Available)		1.50

Additional funds are included within the technology subprograms (geopressured resources, advanced technology applications) but cannot be separated.

The $80,000 increase alone appears to be too low to implement the substantially increased effort described by ERDA in its programs.

COMPARATIVE SUMMARY

It is clear that ERDA has taken a major step in addressing this issue in their program document, The points raised by this issue form an important part of the strategy and implementation of the Geothermal Program. It is a part of the overall program strategy, it is considered as a key institutional problem and it is a major portion of the overall program implementation effort. An entire subprogram is devoted to studies in this area along with key environmental problems. The principal problem appears to be whether there are sufficient funds requested within each of the technology programs where this issue is applicable.

QUESTIONS

1. What are the principal institutional and legal impediments ERDA has identified to expedite the leasing and exploration of potential geothermal resources?

2. What policies can ERDA recommend to deal with these constraints?

3. Are there sufficient increases in the budget to continue an effective program in the area of legal and institutional constraints?

15. Environmental Constraints on Geothermal Energy Development

ISSUE

Environmental problems, which have been inadequately stressed by ERDA, can place constraints on the potential development of geothermal energy resources.

SUMMARY

Geothermal energy development will have environmental constraints because of the disposal of gaseous and liquid pollutants, the potential for large-scale subsidence, and the potential for fault movement and earthquake generation, The implemental ion document of ERDA's Energy Plan does not adequately define the necessary environmental evaluation problem for geothermal development.

BUDGET SUMMARY

The requests for funds in environmental matters occur in three subprograms: Environmental Control and Institutional Studies, Hydrothermal Technology Applications, and Advanced Technology Applications. For the latter, specific environmental figures are not available.

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriation	FY 77 Division Request	FY 77 ERDA Request	FY 77 OMB Request
Environmental Studies (Budget Outlay)	**0.9**	(Not Available)		2.8

The above figures represent a substantial increase from FY 76 figures and indicate that ERDA has addressed this issue well, at least within the context of this subprogram. The lack of specific budget information on environmental efforts within the other two subprograms does not permit **any** analysis of their effectiveness,

COMPARATIVE SUMMARY

ERDA has devoted considerable attention to this issue within the program. In both the overall strategy and implementation within the subprograms (Hydrothermal Technology Applications and Advanced Technology Applications), environmental problems and control technologies are considered. The Demonstration Projects subprogram will consider environmental problems as a part of this effort. In addition, the Environmental Control and Institutional Studies subprogram provides for a major effort concerning this issue.

All of the points raised in the issue (subsidence fault movement, disposal of gaseous and liquid pollutants) are specifically considered within the program areas. The principal remaining question is the extent to which each of these points are receiving funding and whether this funding is adequate to deal with the problems.

QUESTIONS

1. What environmental problems has ERDA 2, identified which could seriously hinder geothermal development?
2. Does ERDA have sufficient funding within the final requests to Congress to effectively deal with these problems?

16. Nonelectric Uses of Geothermal Energy and Geothermal Goals

ISSUE

The ability to approach ERDA's presently unrealistic 1985 goal for geothermal utilization will require a substantial increase in emphasis on nonelectric use.

SUMMARY

A realistic maximum prediction for electric generation by 1985 is 4,000 Megawatts of Electric Power (MWe). To reach the objective of 10,000 to 15,000 Megawatts (MW) stated by ERDA, however, will require a large amount of nonelectrical uses, Since a significant portion of the resource base is low temperature, the most important use of geothermal resources in the United States may be for nonelectric applications, Indeed, the principal impact of geothermal resources on worldwide energy needs, to date, has been through nonelectric u t ilizat ion.

The thermal energy from a geothermal reservoir can be used to replace electricity or fossil fuels in low-grade industrial heat applications and space heating. Geothermal water, because of its temperature, can also be used for solution mining, agricultural enhancement, and mariculture.

Of additional consideration in reaching the ERDA goal is the development of the number of wells needed for production and reinfection of 10,000 MW of geothermal fluids. This will require a significant fraction of the drilling rigs, material, and manpower presently being used for oil and gas exploration.

The ERDA Plan may not have assigned enough significance to the potentially important nonelectric uses of geothermal energy. By doing so, ERDA could much more realistically expect to reach their 1985 goals of geothermal utilization.

BUDGET SUMMARY

The requests for funds on development of nonelectric use of geothermal energy occur in two subprograms: Engineering Research and Development (Utilization Technology) and Advanced Technology Applications (Moderate Temperature Resources). In both cases requests which specifically relate to nonelectric use activities are not available. For reference, however, the funding for the total subprograms is given along with that for the areas within the subprogram that concern nonelectric utilization.

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriation	FY 77 Division Request	FY 77 ERDA Request	FY 77 Request to Congress
Engineering Research & Development	10.6	20.8	20.8	11.5
Utilization Technology (Budget Outlay)	6.2	(Not Available)		**7.0**
Advanced Technology	6.9	14.6	10.6	10.1
Moderate Temperature Resources (Budget Outlay)	5.6	(Not Available)		**4.0**

The effectiveness of the nonelectric utilization depends heavily on the funds allocated to this area within each of the subprograms. Again, this determination is not directly possible. In this connection, the Geothermal Program personnel indicate that the reduction of their requests before they were submitted to Congress will have the effect of slowing development of one of the projects which has nonelectric utilization aspects.

COMPARATIVE SUMMARY

In general ERDA has taken significant steps in addressing this issue, although some of the points raised have still not been considered, They have revised their estimates of geothermal's contribution downward to 6000 MW of electricity by 1985 and 0.1 quad per year of nonelectric use. The former is still greater than the limit suggested in the issue but is much closer to that estimate of 4000 MW. ERDA is considering to a greater extent the nonelectric contribution of geothermal resources. Projects are identified within the Hydrothermal Technology subprogram to develop such uses. Studies are to be initiated to identify and assess other nonelectric applications leading to field experiments for industrial use. Further, one of the hydrothermal demonstration projects is being considered for nonelectric use. There are also studies described to investigate the nonelectric use potential of hot dry rock. It is clear ERDA has increased its activities in this area. However, its goal of 0.1 Quad/year is short of that suggested in the issue of 0.3 Quad/year by 1985.

ERDA makes no mention, however, of the large requirement for drilling rigs needed to reach their goals and the potential conflict with oil and gas exploration needs. Some consideration of this problem may fall within the drilling technology activities but this is not discussed explicitly.

QUESTIONS

1. How did ERDA arrive at its estimate of geothermal's contribution for nonelectric uses of oil-Quad per year by 1985?

2. Does ERDA consider the availability of drilling rigs to be a serious problem in reaching its 1985 utilization goals?

3. Would a person or firm who was interested in using geothermal process heat be eligible for the Federal Geothermal Loan Guarantee Program?

4. Does ERDA feel that as part of its dissemination and implementation function it should encourage the location or relocation of industries using low-grade heat near geothermal resources? Would the loan program apply?

17. Variability of Geothermal Reservoirs

ISSUE

Each geothermal reservoir has its own unique characteristics, which affect the research strategy and demonstration portion of the ERDA program.

SUMMARY

Each geothermal reservoir has unique parameters, such as size, fluid characteristics, and location. Furthermore, the nature of its energy source (heat) requires that it be used at or near where it is found. Thus, the design of equipment and energy conversion technology must be tailored to the characteristics of the fluid in each reservoir; consequently, different power cycles may be used. If the ERDA pilot/demonstration program were to concentrate on a single type of power cycle, multiple demonstrations of the same cycle would not aid the **expansion and** use of this resource. Furthermore, the most useful cycle for a given reservoir may be determined by the availability of cooling water near the well site. Thus, the equip men t and power conversion research strategy will have to consider a wide variety o f possible utilization systems to ensure high efficiency.

BUDGET SUMMARY

Requests for R, D&D funds to account for the variability of Geothermal Reservoirs fall into three subprograms. These include Engineering Research and Development (utilization technology), Resource Exploration and Assessment (reservoir assessment technology), and Hydrothermal Technology Applications (demonstration projects). The amounts in these areas for activities specifically addressing this issue are not given. The budget requests for the entire first and third subprograms have been given previously (Issue 16). Presented here are the requests for the second subprogram.

SUMMARY TABLE

(Dollars in millions)

Budget Category	FY 76 Appropriation	FY 77 Division Request	FY 77 ERDA Request	FY 77 Request to Congress
Resource Exploration and Assessment	3,6	16.0	12,0	10.0
Reservoir Assessment Technology (Budget Outlay)	2.4	(Not Available)		3.5

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The determination of ERDA's effectiveness in treating this issue cannot be precisely made without knowing the specific funds. However, the increase in the ERDA budget in this subprogram should indicate a more intensive approach.

COMPARATIVE SUMMARY

ERDA does not discuss alternative power cycles for different geothermal reservoirs to much extent. Further they do not suggest methods for dealing with possible energy storage requirements in effectively integrating with the existing power grid. However, ERDA appears to have a fair awareness of this issue in their program. It is addressed in the Engineering Research and Development subprogram and is implicitly addressed with regard to hot dry-rock utilization activities. The Demonstration Projects subprogram also has a clear statement of the site-variable problem and intends to deal with it in the second demonstration project. Finally part of the reservoir assessment technology activities concerns utilization options within reservoir model development.

QUESTIONS

1. What cycles has ERDA identified for its pilot/demonstration program in geothermal energy?
2. To what extent will the pilot/demonstration program be concerned with problems associated with integrating a geothermal source with an existing power grid?
3. What portion of the budget requests deal directly with projects concerning the variability of geothermal resources?
4. What priority does ERDA attach to these projects?
5. What plans does the Geothermal Program have to coordinate activities with the Electric Energy Systems subprogram with regard to planning for integrating geothermal electric energy sources into the power grid?

COMMENTARY

In the initial OTA analysis, a number of short issue statements were made, following the 17 more lengthy issues. Repeated here are the original questions with a comparative summary. Many of the concerns have been addressed by **ERDA** (identified by "Adequately addressed"). Other concerns remain as discussed below:

ISSUE	COMPARATIVE SUMMARY
1. Has proper attention been given to the necessary intraagency coordination mechanisms to ensure the cross-fertilization of information and technology between solar programs and necessary auxiliary efforts in other divisions? There are many aspects of the ERDA program which cut across divisional boundaries, and which, although assigned to one division, are of vital concern to the solar-geothermal programs. Examples of such areas are: • Energy storage • Hydrogen generation, distribution, storage, and utilization • Advanced power conversion cycles • Combined storage/conversion systems; e.g., fuel cells or thermal "batteries. " • Super conductivity • Electric power conditioning (e.g., d.c. to a.c. conversion) • Resource availability, particularly fresh water.	1. Intraagency Coordination: ERDA was partially responsive. Although some subprograms describe their cooperative efforts (e.g., wind, agriculture) others which are known to exist are not discussed at all. An example is the total energy activities within the Conservation Branch of ERDA and at HUD, which have many features in common with the solar total energy program. Concern remains that storage may be the most critical solar technology, and that it may not receive the attention deserved. Ten million dollars was requested by the solar division for storage research; none was approved in the request to Congress.
2. Which research programs in the solar and geothermal ares are budget limited? If more funds were provided, what would be done with them, and how would they assist the research effort ?	2. Budget Limitations: Concern was raised initially about the limitations to the budget. No information is provided in the budget on the effects of cutting programs. A statement of assumptions behind the budget is essential for adequate analysis.
3. What are the differences between a test bed facility, a pilot plant, and a demonstration plant? In ERDA language, a test bed is a facility used to test components of and ideas for a total system. A pilot plant is a complete system assembled to show technical feasibility and to gain construction and operating experience. A demonstration plant is a near commercial scale facility used to show economic feasibility y although the plant itself may not be economically competitive at that time. Another but totally different concept of "demonstrations'" is illustrated in connect ion with solar heating and cooling of buildings (see Issue Paper 9), where the objectives are to generate a user market.	3. Definition of Terms: Adequately addressed.

ISSUE	COMPARATIVE SUMMARY
4. Does ERDA's patent policy enhance or impede development and application of solar and/or geothermal energy?	**4-6.** Patent Issues: Not discussed at all.
5. Should ERDA research funding include requirements that access to background proprietary information and patent posit ions be granted to the Federal Government?	
6. How does withholding of "proprietary informat ion" by industry affect ERDA's state-of-the-art reviews and data-bank usefulness?	
7. What should be the nature of incentives to use windpower systems and geothermal heating systems? The issue of incentives related to solar heating and cooling has been discussed previously (see Issue Paper 10]. Many of the same points also apply to wind power and geothermal heat utilization.	**7.** Incentives for Wind Power and Geothermal: It is indicated in the program that wind power incentives are as important as for solar heating and cooling, and it is indicated that wind power incentives are being coordinated through FEA. For geothermal, $4.4 million has been budgeted for FY 77 for loan guarantees.
8. Would it be appropriate for ERDA to fund traineeships in solar and geothermal technology? The discipline requirements for the utiliza - t ion of these resources is such that some incentive, similar to the former NASA traineeships, may be required to encourage pursuit of these specialized educational backgrounds. The need for these hybrid scientists/engineers is immediate.	**8.** Traineeships: There is no discussion of this topic in the solar portions of the plan or budget. ERDA's University Relations Division is reported to have funds for several traineeships, but studies of need are just beginning.
9. What is the reason for the apparent emphasis on the central tower solar electric concept to the exclusion of solar electric approaches?	**9.** Central Tower Emphasis: Adequately addressed, see Issue #6.
10. Should the Plan make a specific commitment of allocating a portion of the solar heating and cooling demonstration projects to the retrofitting o f existing residential and commercial buildings? Although solar heating and cooling systems will be more cost effective in new buildings designed with the systems, the approximately 65 million existing buildings present an immense potential for solar heating and cooling, with a subsequent significant potential fuel savings. This is particularly true in the case of solar-heated domestic water,	**10.** Specific Commitment to Retrofit Projects; The ERDA program and budget do not indicate specifically if and to what extent retrofit projects will be addressed. However, in the first series of "integrated residential project" solicitations, retrofit projects were considered, and a portion (33 of the 143 units, hot water and/or space heating) of the awards were for retrofit projects, However, neither the program nor the budget justification provides specifics or guidelines on the extent to which retrofit projects will be considered.
11. What is the status of the Guaranteed Geothermal Loan Program? The Guaranteed Geothermal Loan Program will be impossible to implement without appropriate ions available to back up the guarantee,	11. Geothermal Loan Guarantee: $4.4 million has been budgeted for FY 77.

ISSUE	COMPARATIVE SUMMARY
12. Why does a solar thermal total-energy system demonstration appear in the plan, but no photovoltaic total energy system? Photovo1taics (at least onsite) would appear to b e at 1east as wel1 suited for total energy systems.	**12.** Photovoltaic Total Energy: , Adequately addressed, see Issue #6.
13. How does ERDA plan to verify and supplement the estimate of geothermal resources indicated in the USGS Assessment Program? USGS cannot drill exploratory geothermal wells, but in order to determine the potential reserves, geothermal exploratory wells must be drilled, Such exploratory drilling will allow for better planning of resource utiliza - tion and determine the resource for which conservation technology should be developed,	**13.** Estimate of Geothermal Resources: See #17, below.
14. Why is little emphasis placed on alternative solar-cell materials (other than silicon) considered in the ERDA Plan? A number of other materials (such as gallium arsenide, cadmium sulfide, and iridium phosphide) are receiving considerable attention from the private sector, and some of them appear quite interesting,	14. Alternative Photovoltaic Materials: The transfer of NSF's solar program to ERDA, without transfer of funding, greatly increases the severity of this problem, although major studies are under way on some new photovoltaic materials. The need for basic research in photovoltaic materials has not been addressed.
15. Does the potential for the export of solar, wind, and geothermal technology and equipment have any impact on R&D strategies?	**15.** Export Potential: See comment 18 below,
16. Will geothermal resources benefit only certain segments of the country? Even though geothermal resources are region al in occurrence and nontransportable, this does not make it a regional resource which will benefit only a small segment of the population. Because of the nature of the resource (heat), it must be used near the well site. However, when geothermal energy is used in one portion of the country to replace fossil fuel heat sources, the fossil fuel saved is available to the country as a whole in the form of high value liquid fuel.	16. National Benefit of Geothermal; The fund allocated to geothermal energy development is indicative that it is recognized to benefit the Nation as a whole.
17. What is the role of ERDA in the development of geothermal exploration methods? The development of advanced geophysical exploration techniques is needed to ensure full and rapid development of geothermal resources. If ERDA agrees that it is within the scope of their mandate to do this type of work, such a statement should be made with details provided.	**17. Estimate of Geothermal** Resources: $9.6 million has been budgeted in FY 77 for Geothermal Exploration Reservoir Assessment and Reservoir Confirmation.

ISSUE	COMPARATIVE SUMMARY
18. Has ERDA given adequate attention to the use of international research efforts to solve common energy problems? The solar energy field is a particularly attractive area for cooperation,	**18.** International Research Efforts: ERDA has identified this as a topic for discussion under each program plan. The differences from the first plan's discussion is impressive.
19. Why hasn't the use of wind energy for nonelectric applications been considered; e.g., water-pumping, with pumped-storage capability? It is possible that significant capital cost and energy savings might be realized by exploiting all possible avenues for these applications.	**19.** Recognition of Other than Electric Uses for Wind: Some but little recognition of other than electric uses for wind are recognized. One area, irrigation: SE/D-19, is referred to under "farm and rural systems" but is placed under the Solar Electric Program.
20, Has ERDA considered establishing test facilities, pilot plants, and demonstration plants on Federally controlled rather than privately controlled lands? This approach, with the assistance of private industry, would allow the rapid testing of technology without many of the long delays associated with licensing and restraints on private land, This approach should be considered for cases where early testing of a resource or technology is mandatory.	**20.** Demonstration on Federal Lands: Adequately addressed. The Department of Defense appears to be taking an increasingly active interest in several phases of solar energy testing. NASA and several ERDA National Laboratories (especially Sandia) have active testing programs.
21. What is the nature of ERDA's interaction with the EPA program in urban waste disposal? How do you integrate the use of agricultural and forest wastes with your program of energy from biomass? The use of organic wastes: urban, agricultural, and tree farming, can make a modest contribution to the fuel supply while reducing an adverse environmental problem.	**21.** Urban Waste Disposal/Utilization: No coordination with the EPA Urban Waste Disposal program is indicated.
22. What ocean areas have you identified that have suitable upwelling conditions for marine biomass cultivation? Is this area large enough to allow a significant impact? What is your estimate of the net energy gain per acre of marine biomass and the cost to harvest?	**22.** Marine Biomass Cultivation: An assessment of prospective marine biomass cultivation sites available as a result of upwelling has not been discussed. However, an assessment of the energy potential from marine biomass has been made.