N82 22679

Charles E. Bloomquist
PRC Systems Sciences Company

The decision to proceed with SPS will depend on a political determination that commitment of the economic, institutional, and social energies required for its implementation is a worthwhile investment. This determination will be national (and international) in scope and will be based on knowledge of the environmental and societal impacts of the SPS, its projected economics and technological risks, expressed through the influence of contending segments of society.

To assist the decision makers, an assessment of societal issues associated with the SPS has been undertaken as part of the Concept Development and Evaluation Program. Results of the assessment are reported here.

The primary societal assessment objectives are:

(1) to determine if the societal ramifications of an SPS might significantly impede its development, and

(2) to establish an information base regarding these issues.

The approach taken to meet these objectives is oriented to serve the needs of the decision makers. That is, the studies conducted are not intended to be exhaustive treatments of the issues addressed; rather, they are to provide estimates regarding SPS impacts commensurate with its stage of development and the needs of the decision makers.

The four major areas of the societal assessment are: Resources, Institutional Issues, International Implications, and Public Concerns. The rationale for dividing the assessment into these categories is somewhat as follows. Societal issues are created by the interplay between the SPS and its external environment. Those components of the external environment which clearly exert control or influence over SPS and those which are most directly impacted by SPS were given primary considerations.

The SPS requires large inputs of resources, the allocation of which depends on various decision making bodies or institutions. Other institutional mechanisms are required to manage program activities and control interfaces between the SPS and its external environment. International bodies would exert control over SPS because of financial interest, its space-based nature, and the need for agreements to allocate radio frequencies and orbital slots and to set microwave exposure standards. Because of its global significance, the SPS would, in turn, influence international relations. Public concerns over potential social change resulting from the magnitude of the program and the interplay of environmental institutional and international mechanisms is one of the most important components of the external environment.

Having defined the general areas of concern, a two-phase study process was implemented. Key issues in each area were defined and a preliminary assessment was conducted. On the basis of the results, a final assessment was undertaken to pursue the preliminary studies further, where indicated, or to undertake new initiatives which seemed to be indicated. The end result of this process is over two dozen issue-related study reports in addition to a preliminary and

final societal assessment report which attempt to compile the key findings and their implication for SPS. The findings are briefly surveyed below by issue area.

Resources

Based on an initial understanding of system characteristics, the physical resource requirements most likely to present a potential problem were considered to be land, materials, and energy. Therefore, a preliminary study was commissioned to assess the magnitude and impact of these SPS resource requirements. Since determination of land requirements alone is not as important as knowing where rectenna sites can be located, a second study was conducted to identify locational criteria and make a preliminary determination of areas that were eligible for rectenna sites. On the basis of the preliminary studies, three additional activities were undertaken in the final assessment. First, a general methodology for materials assessment of energy systems was refined and applied to the SPS situation to validate and extend the preliminary findings. Preliminary work in the analysis of energy utilization by SPS indicated that no further work was warranted in this area. The preliminary siting and land-use studies, however, indicated the need for a more sophisticated approach to this problem. Two additional studies were, therefore, set in motion. The first of these was essentially a follow-on to the preliminary work in finding eligible and ineligible areas for rectenna sites. The second examined a specific site in great detail to determine the potential environmental impact of installing an SPS rectenna there. These studies are all essentially complete; results are briefly indicated in the following paragraphs.

The preliminary materials analysis compiled a list of required materials for an SPS and then, using a relatively crude screening procedure, evaluated each material in terms of world and domestic supply. Also considered were manufacturing capacity and adequacy of the data base. The refined methodology uses computerized screening of the materials with flags raised at various threshold levels as a function of several parameters: current domestic and world production rates, domestic and world reserves, and so on. Thresholds can be changed and the analysis rapidly run to determine sensitivities. No insurmountable materials problems are evident in either the preliminary or refined analysis. However, materials definition, both quantities and specific kinds, is in a fairly primitive state. Similar analyses will be required as the detailed materials requirements become better defined. Currently, well over half of the elements or compounds required by either design option (silicon or gallium arsenide for the photovoltaic cell material) present no problems. There is a problem in the demand for mercury and tungsten in both options, with silver and gallium becoming problems for the gallium arsenide option. Manufacturing capacity problems are also judged to be more severe for the gallium arsenide option.

Net energy analysis has been used in the past to compare alternative energy generating systems in terms of the energy produced by each system per unit of energy required. The preliminary assessment indicated that there have been a few analyses of the SPS using some of the widely varying techniques

available. SPS energy ratios were found to be marginally favorable with respect to other energy sources when the system boundaries were drawn so as to exclude fuel ("fuel" in this case being solar radiation). When fuel is included, the SPS energy ratios are very favorable. There are, however, large uncertainties associated with the SPS design and with the energy analysis techniques themselves. Because of these uncertainties, it was considered unwarranted to conduct additional studies in this area for the final assessment. If further studies should be undertaken in the future, it is recommended that such analysis employ a hybrid methodology consisting of: (1) process analysis to identify key initial energy requirements, and, (2) input-output analysis to account for indirect energies. A breakdown of material requirements by system component would facilitate the use of materials energy intensity data and better reveal sensitivity to data uncertainties in the energy analysis. Basically, the energy resource is not considered to be a problem. However, the high initial energy investments of a capital-intensive SPS program make for a long pay-off period. The dynamic consequence of the program mean that, though each individual plant may have a positive energy ratio, initial energy requirements create a protracted energy drain during the initial years of construction and operation.

The approach to the land-use problem, both in the preliminary and final assessments, has been to identify those areas of the contiguous United States that cannot be used for siting rectennas. The remaining areas are then "eligible," pending further analysis. It has also been assumed in both assessments that the required land must be near enough to load centers to represent a reasonable solution to the utility integration problem. Thus, sufficient land is only one requirement; suitably located land is another. The preliminary assessment identified areas of the U.S. that were potentially eligible for SPS rectenna sites. A problem arose, however, in matching potentially eligible areas to power demand areas. The North Central and Northeast regions of the U.S. have the smallest potential area for rectenna siting relative to apparent need. Unfortunately, the uncertainties in the analysis were such that little confidence could be placed in these results. Therefore, a follow-on study was undertaken that refined the data base of exclusion criteria (populated areas, national parks, etc.) and used a finer mapping grid in the eligible area analysis. The preliminary assessment used a 26 X 26 kilometer grid size; the final assessment used the USCG 7.5 minute quad maps which are roughly 13 kilometers on a side. Validation of both eligible and ineligible areas was incorporated in the analysis and sensitivity studies were conducted. In a related but independent analysis, a prototype environmental impact statement was prepared for a specific, although hypothetical rectenna site.

The primary conclusions of the siting studies are that there are suitably located areas for rectenna sites throughout the U.S. Actual acquisition of the specific sites promises to be a difficult problem at best, and location of sites in some of these areas will exact a fairly heavy cost penalty to either prepare the site or modify the rectenna design. The most critical design variable is topography. Sites can be placed in different terrain but only at a substantial cost penalty incurred in site preparation. Migratory bird flyways could have a devastating impact on eligible areas, depending on the (currently unknown) impact of SPS microwave radiation on birds. Sea sites are

available but definition of eligibility is necessarily more crude due to the lack of design parameters for an offshore rectenna. The methodology for determining eligible areas for SPS rectenna sites is highly automated, elegant, and widely applicable.

The prototype environmental impact statement was prepared to see what problems would be uncovered by taking a detailed look at a specific site. The location was chosen because a nearly concurrent EIS was being prepared for the site as a potential location for a geothermal energy resource. Thus, the massive amounts of required background data were essentially free and it was only necessary to hypothesize the placement of a rectenna in the area and redo the analysis. Objectives of the study were: (1) to develop a comprehensive prototype assessment of the non-microwave-related impacts, (2) to assess the impacts of rectenna construction and operations in the context of actual base-line data for a site in the California desert about 250 kilometers north of Los Angeles, and (3) to identify critical rectenna characteristics that are most significant in terms of the natural and human environment. Critical characteristics include: the sheer size and intensity of use of the contiguous land area required by an SPS rectenna; the lack of flexibility in siting individual rectenna structures once the rectenna boundaries are established; the difficulty in finding suitable sites that do not conflict with other societal needs and values; uncertainties relating to reestablishing native ecosystems following total ecosystem modification during construction, and the related need for further research into microclimatic effects near the ground surface beneath the rectenna panels; the proposed two-year construction schedule which has significant implications for socioeconomic impacts, air quality, water supply, and biological resources--all of which could be reduced by extending the construction schedule; and public versus private ownership which has significant implications for rectenna impacts on the local tax base.

Institutional Issues

Initial concerns in this area focused on the financing and management of a system as large as SPS, its anticipated difficulties with state and local regulations and its interface with the existing utility industry in the U.S. The utility interface studies were continued in the final assessment period to more definitely explore this critical parameter. The regulation of microwave radiation is in a state of flux and is extremely important for all implementation schemes of SPS which rely on transmission of power by microwave radiation. Therefore, a detailed study was undertaken to establish the state-of-the-art, historical background, and likely future of the regulation of microwave radiation. A survey of federal agency involvement in general for future phases of SPS development was established to assist in program management and perhaps to form the basis for future interagency involvement. The insurability of SPS was investigated by a major broker of spacecraft insurance to get an initial feeling of the special problems involved with respect to SPS and the probable response of the insurance community. Results of these studies are indicated in the following paragraphs.

The financial attractiveness of any project depends on the relationship between anticipated rewards and expected risks. In the case of the SPS, potential problems or downside risk plays a major role in project financing. Risk can be measured through cash flow scenarios or in terms of pay-off periods. The busbar cost of electricity is found to be the single most important factor in cash flow and rate of return. The large capital requirements for SPS through R&D and the initial operational phases tend to favor some form of public sector financing. The federal government or a consortium of governments may be the only available source of financing during start-up operations. Even when the SPS reaches maturity, the private sector would face an extreme challenge to finance the program. A joint venture partnership between government and the private sector is possible where the public interest would be assured by regulation of prices and profits, and government license of the technology. Just how government regulation and the private sector would interface with the SPS requires greater clarification, especially as it regards electricity pricing, industrial relocation, and private sector financing.

Power plant regulation falls primarily under the jurisdictional review of state and local entities. The regulatory framework is in a state of flux, and processes vary by jurisdiction. The role of state Public Utility Commissions in financing and rate regulation is changing. PUCs' approvals of utilities' pre-commitment to the SPS may be conditional on government guarantees regarding electric power pricing. In lieu of the federal government's establishment of a national energy policy, many states are going their own way, creating a de facto decentralized trend in energy policy. States want and are asserting increasing control over power plant planning. This poses a potential problem for the SPS. The inherent characteristics of the SPS will require regional coordination of power plant regulation and transmission interties. No present regulatory framework exists at interstate levels. Land-intensive rectennas may require federally mandated, state-coordinated land use and energy planning. The establishment of a national power grid, currently under study at the federal level, may alleviate or solve many of these problems. Regulatory approvals for current power plant technologies and other delays in regulatory processes now consume a decade or more. This is an indication of the potential time constraints in developing and operating the SPS.

Two categories of concern have been studied with respect to integrating SPS electricity with the then existing utilities. The first has concentrated on questions of ownership, management and other institutional factors remains from the utilities' point of view. The resolution of these factors remains rather nebulous because of the difficulty of predicting future situations. It is fairly clear, however, that while the SPS could be integrated into projected utility networks, the task will not be easy. Technical considerations regarding the location of rectenna sites across the U.S. and providing power to land centers appears to present no great difficulty even under rather severe constraints. There are regional differences but even these are less than might have been anticipated.

There are no federal standards which exist protecting the worker and/or general public from potential hazards of microwave exposure. "Voluntary"

guidelines of 10 mW/cm^2 are a recommended set of values established by the American National Standards Institute (ANSI) in 1966. Events from as early as the 1930's, stimulated by research on "nonthermal" effects of rf radiation as a therapeutic technique, are the roots of the ANSI standard. Currently the lead federal agencies with regulatory responsibilities for microwave radiation are the Department of Health, Education and Welfare (HEW), the Department of Labor (DOL), and Environmental Protection Agency (EPA). Each of these agencies contains specialized subsidiary offices, research, or advisory bureaus to assist a respective agency in establishing and enforcing microwave regulations. The entire federal regulatory process is currently under review, aimed at streamlining and improving the system. Proposed changes include a Committee on Regulatory Evaluation to oversee the regulatory efforts of all agencies. The regulatory changes would also require each new ruling with an economic impact of more than $100 million to consider alternatives to the ruling, including projected costs and benefits of the proposal. For SPS, these regulatory changes would demand an assessment of microwave health effects and a cost and benefit analysis of SPS-derived energy weighed against not having enough energy in the absence of SPS, or any other energy-producing concept. In general, there is a growing trend toward stricter controls on activities perceived harmful to public health. There is also a trend toward the convergence of microwave standards worldwide, characterized by a lowering of Western exposure levels while Eastern countries consider standard relaxation. Cooperative exchange programs and an increasing dialogue between countries and scientists have contributed to a better understanding of methodology and experimental techniques used to develop standards. The need for additional bioeffects research is central to adopting public and workplace standards. Of particular relevance to SPS is the initiation of long-term, low-level microwave exposure programs. Coupled with new developments in instrumentation and dosimetry, the results from chronic exposure programs and population exposure programs and population exposure studies could be expected within the next five to ten years. Public interest in microwave radiation is on the increase. Public concern that rf energy is yet another hazardous environmental agent is sparked by increasing media attention to the topic. In the absence of definitive scientific data on electromagnetic bioeffects, both thermal and nonthermal, discussions of utilizing microwaves may engender all the rhetoric, pro and con, which surrounds the implementation of nuclear power.

Agencies with a purview over the Satellite Power System have been identified including the scope of their responsibility and when and how they can be expected to exercise their authority. The materials are presented in a workbook format. The identification of agencies was accomplished by calling out major SPS functions and activities within the five remaining phases and also within the major issue areas. This list of functions addresses an SPS of international nature as well as one that is limited to a national focus. In either scenario, most of the regulatory functions would continue to be applicable to SPS construction and operation within the United States, but the roles of some agencies, such as the Department of State, would increase dramatically in the international scenario. The SPS concept poses many exposures to both financial loss and liability to third parties. In order to eliminate or minimize these exposures, it is possible that insurance could be provided

to protect against certain risks during both pre-operational and operational phases. The international underwriting community has shown a willingness to insure the sizeable risks affiliated with today's telecommunications satellites, and this precedent could serve as a basis for the acceptance of SPS ground and space-related exposures. The major risks affiliated with the program stem from both the sizeable financial losses that could be incurred and the enormous liability exposures presented by extensive launch and space-construction activities. The possible environmental effects of both the ground and space segments also present a substantial degree of risk. The interrelation of so many participants combined with the need for a continuous flow of resources into space and to launch/rectenna sites forms a dynamic system that can be severely damaged by catastrophic loss at a number of key points. The effects of the overall SPS effort, moreover, will extend into an international realm that today does not provide for the sharing of liability exposures among what could be a consortium of many diverse countries. Even if constructed as a domestic effort, the exposure to international lawsuits are not clear at this time. Underwriters do not presently have a basis for assessing either the possible origins of claims or their severity. However, an effort to develop SPS, combined with a close liaison with the world insurance market, would undoubtedly result in insurance for many SPS exposures. A consistent educational process will both allow underwriters to identify periods of exposure, for which policies could be designed, and would allow increased market capacity for these risks to achieve required levels.

International Considerations

The preliminary assessment identified three important international considerations with respect to SPS. These are: (1) controls expected to be exercised by international organizations through enforcement of treaties governing operations in space and new agreements (e.g., on microwave radiation, geostationary orbit and radio frequency assignment) that may be required because of unique aspects of the SPS; (2) international organizational options to successfully manage the SPS; and (3) military implications of the SPS. A final assessment of the military implications of the SPS was undertaken to more specifically address threats and undertaken by SPS subsystem. In addition, the final assessment has drawn together previously contracted work, melded in foreign appraisals of the SPS, assessed the current international status of SPS, developed strategy guidelines based on case studies of existing international organizations, and derived this from options for an international dialogue within the context of world political/legal realities and agency concerns.

An international organization is strongly indicated for SPS development and commercialization. Four prospective international organizational structure models for the SPS are: (a) a public/private corporation akin to COMSAT, which would evolve into an international corporation akin to INTELSAT; (b) an international organization in which the U.S. would retain substantial control; (c) a quasi-governmental agency like the TVA; (d) a multi-national, private consortium. Any SPS organization must be: responsive to U.S. energy needs, politically feasible, cost-effective, and conducive to international

cooperation and acceptability. The COMSAT/INTELSAT option meets these four conditions. The international scope of the SPS, however, may be better obtained by selling SPS hardware (i.e., satellites, rectennas, etc.) rather than the power, because foreign participants would have a greater stake in the venture than if they were merely passive consumers.

Extensive treaty provisions would be required in order to realize an internationally acceptable SPS. Three existing international organizations most directly concerned with SPS are the: (a) U.N. Committee on the Peaceful Uses of Outer Space (UNCOPUOS), (b) International Telecommunications Union (ITU), (c) Committee on Space Research (COSPAR) of the International Council of Scientific Unions (ICSU). The three existing treaties most applicable to the SPS are the: (a) 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (U.N.), (b) 1972 Convention on International Liability and Damage Caused by Space Objects (U.N.), (c) 1973 Telecommunications Convention and Final Protocol Treaty. Under the 1967 Principles Treaty, the space environment is considered to be open to all who are able to use it. In the case of the SPS, the consideration of space and its environs as part of the "common heritage of mankind" raises the question as to who should benefit from the space resource. The radio frequency spectrum and the geostationary orbit are considered natural resources. As such, they fall within the "province of mankind" pursuant to the 1967 Principles Treaty. The seemingly finite geostationary orbit space and increasing competition for its use will influence slot availability for the SPS. Some nations argue that long-term use of geostationary orbit slot is the same as appropriating it and is, therefore, in violation of the treaty. However, there is some consensus on the first come, first served principle. States with space capabilities have clearly established a customary rule of law whereby outer space exists beyond the sovereignty of any nation-state. This rule has been established in the absence of a formal definition of outer space sovereignty and in the face of the Bogota Declaration, issued by eight equatorial countries asserting sovereignty over the geostationary orbit above their land mass. While international law has not established microwave exposure standards, the 1972 Liability Convention covers the subject of harm caused by orbiting space objects. The Convention is "victim oriented." Clearly, a launching State would be internationally liable for harm produced by microwave radiation emanating from a space object in geostationary orbit. International law prohibits adverse changes in the environment. There is a present lack of knowledge about microwave health and environmental effects. International agreement on microwave exposure standards may be reached much faster if a framework of cooperative bilateral agreements has been established between the U.S. and other countries. The U.S., or any organization operating the SPS, must have general international acceptance of microwave exposure standards in order to be safe from potential negligence suits. The U.S. could take a positive role in calling for an international pool of resources to help in assessing the feasibility, benefits, and impediments of developing a satellite power system. Participation by all countries in such a scheme and distribution of eventual benefits could be determined solely, or in part, on the basis of contributions of human and material resources. It would appear to be more than just a reflection of enlightened

self-interest to spread the R&D costs among the nations of the world. Such policy would further undercut any argument by equatorial countries that the current system is inequitable because the benefits of outer space industrialization would accrue to both space and non-space powers.

The huge power supply that the SPS would develop and the strategic position of the geostationary orbit make the system attractive for some military applications and also vulnerable to attack. Thus, militarily, the SPS becomes a factor in international relations. One has to distinguish between aggressive and supportive military applications to properly assess the impact. There are potential weapons capabilities which would accommodate SPS power output. The SPS could also be used to relay power to other military installations (such as satellites, aircraft, or remote terrestrial stations) or to function as a platform in a manned or unmanned mode for surveillance, repair, etc. Whether or not the SPS serves a military function, it would be attractive as a target. The space segment of the SPS would be vulnerable to an energy with space capabilities but relatively invulnerable to saboteurs or terrorists. The ground segment of the SPS would pose no more attractive a target to saboteurs, terrorists or military attack than other major industrial complexes. However, since the rectenna site would control its assigned satellite to some degree, strong protective measures are indicated. An SPS with offensive or defensive capabilities would have an unsettling impact on international relations. International agreements including resident inspection teams at the satellites would probably be required to minimize vulnerability, and ensure the non-militarization of the SPS.

The possible benefits of an SPS program are not just national in scope. It is an inherently international energy concept in that it would utilize resources that are within the international domain (e.g., outer space and the radio frequency spectrum) and would have some impact on the global environment. In this sense foreign involvement is inevitable. But beyond this, the energy potential of the SPS is global in nature. International participation in its development would enhance this potential and contribute to the improvement of international relations. A strategy for international participation in the SPS program has been prepared by (1) assessing the current international status of the SPS in terms of foreign interests, programs and recommendations; (2) integrating the findings of previous investigators who have worked on international SPS issues; (3) developing strategy guidelines based on case studies of existing, large international organizations; and, (4) putting all this information together to develop options within the context of world political/legal climate and agency concerns.

Public Concerns

The preliminary assessment of public concerns focused on two specific and two general issues. The specific issues were relocation and centralization/decentralization. The general issues were public acceptance and student participation. The general studies were intended to develop preliminary public perspectives on the acceptability of the SPS concept and to develop methods for disseminating SPS information to the college community. The issue of centralization is an important topic for investigation on the basis that: (a) there

may be a dichotomy between the SPS design concept and public preferences, and (b) the magnitude of the power output relative to present power-generation facilities have potentially wide sociological ramifications. Implementation of other large energy generation schemes has caused severe relocation of industry and populations. Thus, the preliminary assessment included treatment of this issue from the SPS perspective. The final assessment continued studies of public acceptability, considered the specific problems of the aged and conducted a public outreach experiment, including three public interest groups and thousands of individuals. All studies in this area were summarized in a document which also explored strategy options for the further involvement of the public in the unfolding SPS development process.

The development of a national awareness of the possible environmental impacts of large-scale projects; passage of various laws and regulations for the purpose of controlling environmental degradation; mandatory direct public involvement in project review and approval; and the rise to prominence of public interest organizations have all made the consideration of public acceptability of the SPS very important. Because of the preliminary nature of the SPS concept development and evaluation and the lack of evidence to show any more than a minimal level of public awareness about the SPS, the investigative reports on public acceptance put most of their emphasis on the more general, pre-siting-related issues and the views of knowledgeable organized interests, expressed in the media through personal communication. SPS is not viewed as a highly acceptable energy alternative at this time. A partial listing of major concerns include:

Environmental	Non-Environmental
Microwave effects on health, safety and the environment	Microwave communications effects
	Cost
Launch vehicle emission effects	Internationalization
Land use/rectenna siting	Centralization effects

Positive response focused on the SPS as: a possible solution to the energy crisis, an application of solar energy to meet baseload needs, and a general economic restorative. There is also a perception that the SPS will be a "cleaner" energy source than alternative energy systems. If there is one single point that advocates and opponents can agree on, it is that many of the potential impacts of the SPS program (both environmental and non-environmental) are not well understood and require further study.

As a first step in alleviating public concerns and encouraging general participation in the SPS program, it is desirable to identify and establish a dialogue with important segments of the populace. With particular regard to the student population, several methods have been identified which could encourage or facilitate participation in the SPS discussion. The goals of student and public participation programs should be to create a flexible participation structure for direct involvement of the public in the SPS program development. The following criteria, among others, should guide the selection of appropriate participation techniques: placement of the SPS within a broader energy perspective, making the process multi-disciplinary and informational, and providing feedback to the DOE.

The relocation of industries and population due to SPS implementation is dependent upon choice of site and the cost of electrical transmission, among other factors. The cost of electricity, by itself, may not be a sufficient incentive for industry to relocate. Industries most likely to relocate to rectenna site regions are those which consume a significant amount of electricity and have an uncertain energy supply future. Such energy-intensive industries include iron and steel, chemicals, paper, and aluminum. "Boomtown" phenomena have occurred in recent years with the introduction of coal gasification plants in Wyoming and the construction of other new energy generation technologies in rural areas of the U.S. It is likely that this would occur at SPS rectenna sites, too. Growth-induced effects at these sites through population in-migration following industrial relocation are predictable. One approach which can be used to predict local (at the county level) socioeconomic impacts is based on export base theory, which relates net regional migration to basic (i.e., export) economic activity. Computer models have been developed to perform this type of analysis.

At the same time that "boomtown" phenomena have occurred, there has developed a general shift away from centralizing tendencies in the U.S. A militant new regionalism is likely to emerge in the next decade. Conflicts over energy and environmental issues are increasingly perceived as regional conflicts. State and local entities are assuming increasing influence over energy policy decisions, and general public policy matters. This means that the SPS may have to meet regional energy needs if no single national policy exists at the time of its introduction. The SPS may have to conform to a "de facto" national energy policy which focuses on utilization of geographically diverse fuel sources. There is also a trend for the U.S. to become a multi-option society, rather than an either-or society. This flexibility is reflected in the increasing interest in "appropriate scale" for technological innovations, rather than an emphasis on "economies of scale."

An outreach experiment was initiated in an effort to acquire feedback about the SPS concept from three public interest groups: the Citizen's Energy Project, the Forum for the Advancement of Students in Science and Technology, and the L-5 Society. Each group summarized approximately 20 SPS reports and distributed the summaries to 3000 of their constituents requesting their comments and questions. Responses received were submitted to DOE for comment.

The methods adopted to accomplish their assigned tasks were independently chosen by each group. Therefore, the kinds of feedback information received, both qualitatively and quantatively, are a result of the methods used to obtain this information, and are different for each group. The CEP position is very much in opposition to SPS. This organization advocates decentralized small-scale solar energy systems. Therefore, the two major reasons given for opposing SPS are the trend toward centralization which SPS is indicative of, and the cost of SPS which might extract funds from terrestrial solar alternatives. The FASST position on SPS is relatively neutral. The major focus is on the process of outreach and an effort to include student participation in the development of an advanced technological system. The L-5 position is very much in favor of

SPS. As an organization which is very pro-space and pro-technological development, SPS represents one of many doors into the space frontier. The response to the outreach effort by respondents in all three groups was positive. The opportunity to provide feedback and input in the SPS concept development was appreciated and a pleasant surprise to many. However, there were some questions raised from respondents in all three groups about whether or not public input would actually be utilized.

The U.S. aging population is increasing rapidly. Those "over 65" numbered 3.1 million in 1900 and by 1977 the total climbed to 23.5 million. It can be stated with reasonable certainty that this figure will rise to 31 million in the year 2000 and 43 million in the year 2020. These figures, corresponding to more than 10 percent of our population, are by no means insignificant. This growing constituency is expected to produce substantial social, economic and political influence over the period contemplated for development of alternative energy systems. Energy is used so universally in our daily lives--for lighting, residential comfort, water heating, operating appliances, transportation, etc. --that we seldom think of it for itself, but only for what it can do. It might appear, at first, that age does not play a role in how people demand energy. However, upon further examination, it becomes evident that there are reasons for differing energy demands between age groups. Because the aged generally live on fixed and limited incomes, it follows that their problems have a serious economic aspect. There are also special medical concerns, particularly those related to temperature and lighting, since the aged are particularly vulnerable to situations in which either of these is less than adequate.

A strategy for public involvement is proposed. It is a building-block process which selects components that are compatible with the stage of SPS development, available funds, and the degree of public interest. Several program alternatives are provided, and several options for combining and building programs are offered. The strategy consists of six steps describing a plan of action which can be used repeatedly and periodically throughout the course of SPS development. The six steps are:

(1) Establish goals and objectives,
(2) Identify and select participating actors,
(3) Identify and select SPS issues which should be addressed,
(4) Select the program task which will facilitate attainment of the goals and objectives,
(5) Select appropriate methods and techniques for each program task.
(6) After implementation of methods and techniques, evaluate preceding steps in terms of fulfilling the goals and objectives.

The selection of participating actors, SPS issues of importance, program tasks and methods and techniques are mutually influenced by the selection in each of the others. The selections in all four are influenced by the goals and objectives which have been established. Program evaluation analyzes the results of the implementation of methods and techniques with respect to the goals and objectives. Therefore, all steps in the outreach strategy are interactive.