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February 1979

Domestic Policy Review of

# Solar Energy

A Response Memorandum to
The President of the United States

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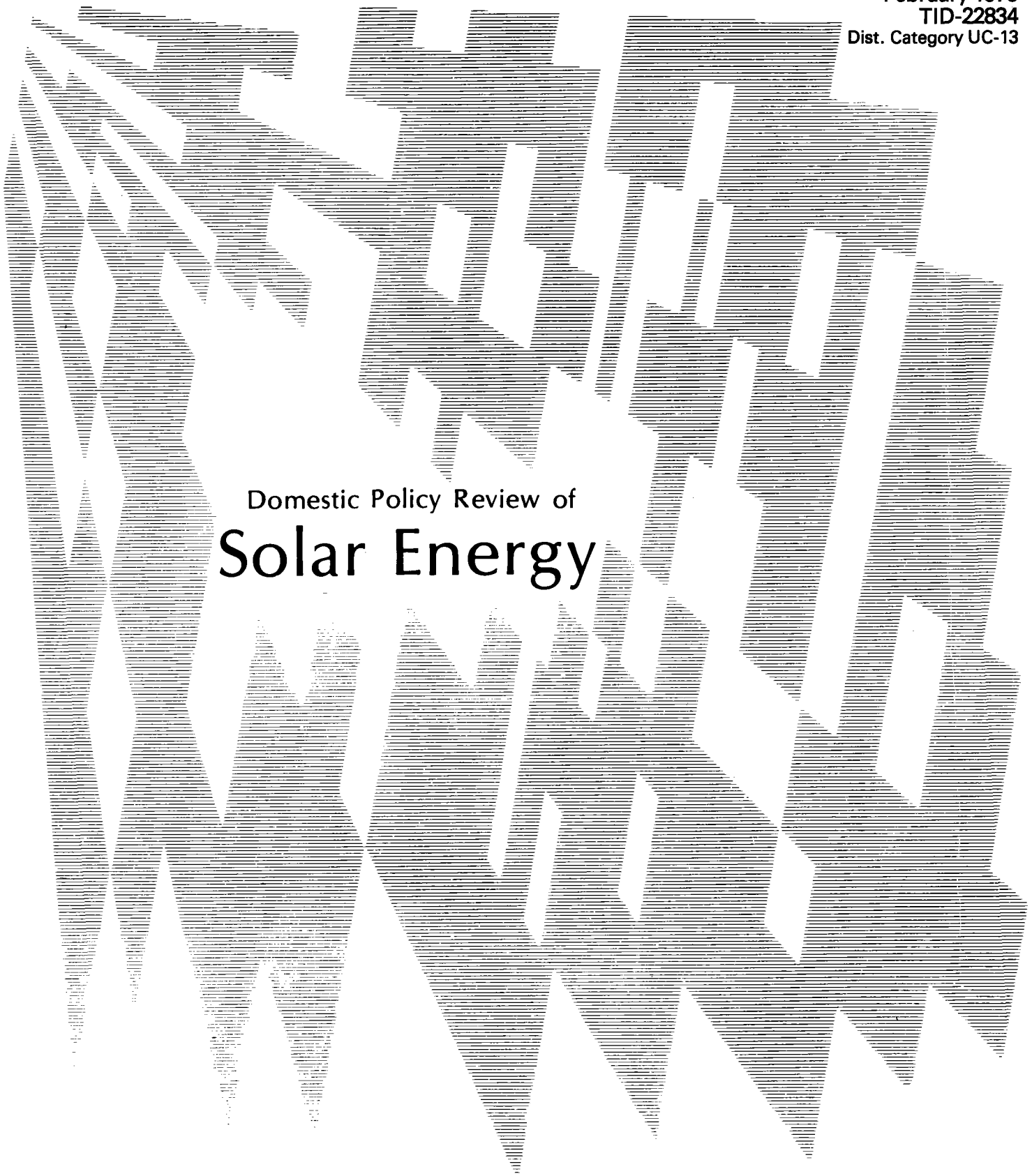

Domestic Policy Review of

# Solar Energy

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The President of the United States

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TABLE OF CONTENTS

PAGE

## LIST OF FIGURES

LIST OF TABLES

# EXECUTIVE SUMMARY

## I. INTRODUCTION

In your May 3, 1978, Sun Day speech, you called for a Domestic Policy Review (DPR) of solar energy.* Stuart Eizenstat followed on May 16 with a memorandum** defining its scope to include:

- a thorough review of the current Federal solar programs to determine whether they, taken as a whole, represent an optimal program for bringing solar technologies into widespread commercial use on an accelerated timetable;
- a sound analysis of the contribution which solar energy can make to U.S. and international energy demand, both in the short and the longer term;
- recommendations for an overall solar strategy to pull together Federal, State and private efforts to accelerate the use of solar technologies.

In response to this memorandum, an interagency Solar Energy Policy Committee under the chairmanship of the Secretary of Energy was formed to conduct the review. Over 100 officials representing more than 30 executive departments and agencies have participated since early June.

This review was conducted with significant public participation. Twelve regional public forums were convened throughout the Nation during June and July to receive public comments and recommendations on the development of national solar energy policy. The response of the public was impressive, and reflected the growing support for solar energy identified by several recent opinion polls. Several thousand people attended the meetings and over 2000 individuals and organizations submitted oral or written comments.

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*For the purpose of this review, solar energy was broadly defined to be energy received from the sun directly in the form of radiant energy, and indirectly in the form of stored radiant energy in biomass (i.e., wood, vegetation and organic solid wastes), heated surface waters, the potential and kinetic energy of water elevated via the hydrological cycle, and the kinetic energy of the wind.

**See Appendix A.

In addition, briefings were given to members of the Domestic Policy Review by representatives of solar advocacy groups, small businesses, state and local government, public interest and consumer groups, utilities, the energy industry and solar equipment manufacturers. This public input was an important part of the Review.*

In large part, themes reflected in the public comments are consistent with the findings of the DPR and the premises of the National Energy Plan. These premises include an emphasis on conservation as a cornerstone of national energy policy, awareness that energy prices should generally reflect the true replacement cost of energy, and recognition of the need to prepare for an orderly transition to an economy based on renewable energy resources. The public forum comments also reflected a deep concern that the poor and the elderly have access to affordable energy.

## II. SUMMARY OF MAJOR FINDINGS

The results of the Domestic Policy Review can be summarized in nine major findings.

1. Significant Potential Exists for Expanding the Nation's Use of Solar Energy. With appropriate private and government support, solar energy could make a significant contribution to U.S. energy supply by the end of this century. Renewable energy sources, principally biomass and hydropower, now contribute about 4.8 quads** or six percent to the U.S. energy supply. Since estimates of future energy supply and demand are imprecise, three generic forecasts of possible solar use were developed. They can be distinguished most readily by the level of effort that would be required to reach them. In the Base Case, where present policies and programs continue, solar energy could displace 10-12 of a total of 95-114 quads in the year 2000 if energy prices rise to the equivalent of $25-32 per barrel of oil in 1977

*Summaries of the public forum comments and the public responses to the DPR status report issued in early September are included in Appendices C and D.

**A quad is one quadrillion British Thermal Units (Btu) of energy.

dollars. A Maximum Practical effort* by Federal, state and local governments could result in solar energy displacing 18 quads of conventional energy by the end of the century. Thus, if one assumes the higher future oil price scenario** and this Maximum Practical effort, solar could provide about 20 percent of the nation's energy by the year 2000. The Technical Limit to solar penetration by the year 2000, imposed primarily by the rates at which changes can be made to existing stocks of buildings and equipment, and rates at which solar techniques can be manufactured and deployed, appears to be 25-30 quads.

2. Solar energy offers numerous important advantages over competing technologies It provides the Nation with a renewable energy source which can have far fewer detrimental environmental effects than conventional sources. To the extent that increased use of solar energy can eventually reduce U.S. dependence on expensive oil imports, it can also improve our balance of payments, alleviate associated economic problems, and contribute to national security.

Widespread use of solar energy can also add diversity and flexibility to the nation's energy supply, providing insurance against the effects of substantial energy price increases or breakdowns in other major energy systems. If oil supplies are sharply curtailed or environmental problems associated with fossil and nuclear fuels cannot be surmounted, solar systems could help reduce the possibility of a major economic disruption.

In addition, because solar systems can be matched to many end-uses more effectively than centralized systems, their use can help reduce a large amount of energy waste. Although the U.S. now consumes about 76 quads of energy a year, less than 43 quads actually are used to provide energy directly in useable form. The rest is consumed in conversion, transmission and end-use losses.

3. Even with today's subsidized energy prices, many solar technologies are already economic and can be used in a

*As defined by the DPR, a Maximum Practical effort would include comprehensive and aggressive initiatives at the Federal, State and local levels, to improve and introduce solar technologies within the framework of traditional Federal intervention.

**Corresponding to 95 quads of total demand in 2000.

wide range of applications. Direct burning of wood has been economic in the private sector for some time, accounting for 1.3 to 1.8 quads of energy use. Combustion of solid wastes or fuels derived from solid wastes is planned for several U.S. cities. Passive solar design can significantly reduce energy use in many structures with little or no increase in building cost. Low head hydroelectric generation is currently economic at favorable sites. Solar hot water systems can compete successfully in many regions against electric resistance heating, and will compete against systems using natural gas in the future. A number of solar systems installed by individual users are cost-effective at today's market prices. In addition, other solar technologies will become economic with further research, demonstration, and market development, and if subsidies to competing fuels are reduced or removed.

4. Limited public awareness of and confidence in solar technologies is a major barrier to accelerated solar energy use. Public testimony continually emphasized the need for more and better solar information. New programs to educate designers, builders, and potential solar users in the residential, commercial and industrial sectors are needed.* Because consumers lack information, they often do not have confidence in solar products. Programs to provide reliable information to consumers, to protect them from defects in the manufacture and installation of solar equipment, and to assure competition in the solar industry can help build consumer confidence in the future.

5. Widespread use of solar energy is also hindered by Federal and state policies and market imperfections that effectively subsidize competing energy sources. These policies include Federal price controls on oil and gas, a wide variety of direct and indirect subsidies, and utility rate structures that are based on average, rather than marginal costs. Also, the market system fails to reflect the full social benefits and costs of competing energy sources, such as the costs of air and water pollution. If solar energy were given economic parity with conventional fuels through the removal of these subsidies, its market position would be enhanced.

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* These concerns are consistent with the findings of a recent study entitled "Citizens Solar Program - State Reports on Barriers and Strategies to Renewable Energy Development", Solar Action Inc., September 1978 (funded by DOE).

6. Financial barriers faced by users and small producers are among the most serious obstacles to increased solar energy use. Most solar technologies cannot compete effectively with conventional fuels at current market prices, in part because of subsidies, price controls, and average-cost utility rate structures for these conventional fuels. The tax credit provisions in the National Energy Act (NEA)* will improve the economics of certain solar technologies, particularly in the residential sector.

Other barriers exist because the high initial costs of solar systems often cannot be spread over their useful lives. Industry and consumers have yet to develop experience in financing and marketing solar systems. Some of the provisions of the National Energy Act will help expand credit for residential/commercial solar systems. In addition, the new Small Business Energy Loan Act** will provide credit assistance to small solar industry firms. Other existing Federal financial programs, that were created for other purposes, could also help finance solar purchases if they were directed toward this end.

7. Although the current Federal solar research, development and demonstration (RD&D) program is substantial, government funding priorities should be linked more closely with national energy goals. Solar RD&D budgets, which have totaled about $1.5 billion in the FY 1974 to FY 1979 period, have not adequately concentrated on systems that have near-term applications and can help displace oil and gas. Electricity from large, centralized technologies has been over-emphasized while near-term technologies for the direct production of heat and fuels, community-scale applications and low-cost systems have not received adequate support. Basic research on advanced solar concepts has also

*The National Energy Act, as passed by Congress and signed into law by the President, is actually five Acts: The Energy Tax Act of 1978 (P.L. 95-618); The Public Utility Regulatory Policies Act of 1978 (P.L. 95-617); The Powerplant and Industrial Fuel Use Act of 1978 (P.L. 95-620); Natural Gas Policy Act of 1978 (P.L. 95-621); and The National Energy Conservation Policy Act (P.L. 95-619).

**Public Law 95-315.

been under-emphasized, limiting the long-term contribution of solar energy to the nation's energy supply.*

8. Solar energy presents the U.S. with an important opportunity to advance its foreign policy and international trade objectives. The United States can demonstrate international leadership by cooperating with other countries in the development of solar technologies, and by assisting developing nations with solar applications. Use of decentralized solar energy can be an important component of development planning in less developed countries which do not have extensive power grids, and cannot afford expensive energy supply systems. In many cases, solar may be the only energy source practically available to improve rural living conditions. Through such efforts, the U.S. could also help to develop new foreign markets for U.S. products and services, thereby increasing opportunities for employment in solar and related industries at home. And, as solar energy eventually begins to displace imported oil and natural gas, the U.S. will enjoy greater flexibility in the conduct of its foreign policy. Insofar as solar energy systems reduce the need for nuclear and petroleum fuels in the long-term, they can help reduce the risk of nuclear proliferation and international tensions arising from competition for increasingly scarce fossil fuels.

9. Although the Federal government can provide a leadership role, Federal actions alone cannot ensure widespread solar use. Many barriers to the use of solar energy, and opportunities to accelerate its use, occur at state and local levels. In order to overcome these barriers and take advantage of these opportunities, a concerted effort at all levels of government and by large segments of the public will be required. Nevertheless, the Federal government can set a pattern of leadership and create a climate conducive to private development and use of solar energy in a competitive market. These efforts must also recognize the wide variation among solar technologies and the resulting need to tailor initiatives to specific solar applications.

*This was also the conclusion of two recent government reports: "Solar Energy Research and Development Program Balance, A Review by the Solar Working Group, DOE" (February 1978); and "Report of the Office of Science and Technology Policy Working Group on Basic Research in the Department of Energy" (June 1978).

## III. THE DPR RESPONSE MEMORANDUM

The DPR Response Memorandum discusses each of these findings in greater detail. The first chapter assesses solar technologies and government policy towards competing fuels, while Chapter 2 evaluates existing Federal solar energy programs. The third chapter identifies solar energy's potential contribution to national and international needs. Chapter 4 presents three options for future government policy and describes specific initiatives which could be adopted to implement each. The three options are to:

1. Continue existing Federal programs but make them more effective.

This option would cost roughly $160 million more between 1980 and 1985 than current and planned programs. No incremental costs would be incurred in 1980 and 1981. Under this option, solar penetration in the year 2000 would increase by 0.3 to 0.7 quads over the level that would result from current and planned programs if world oil prices rise to $25 per barrel in 1977 dollars.

2. Expand the current level of Federal effort with a selection of programs that are targeted to accomplish specific cost-effective objectives.

This option would cost approximately $80 million in 1980, $325 million in 1981, and approximately $2.5 billion more than Option 1 over the period 1980-1985.* The increment in solar penetration over Option 1 is most likely to be between 2 and 3 quads by the year 2000, although it could well be higher.

3. Dramatically increase Federal support with a variety of programs that give solar energy high priority as a national goal.

This option would cost approximately $6 billion in 1980, $10 billion in 1981 and approximately $42 billion more than Option 2 in Federal funds between 1980 and 1985.* The increment in solar penetration in the year 2000 from this option over Option 2 is estimated to be between 15 and 16 quads.

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*This cost would be reduced as a result of Federal subsidies not paid during this period for conventional fuels displaced by solar energy.

These options are not the only possibilities for future government policy. They represent three discrete points on a continuous spectrum. Any number of other options could be formulated, using different combinations of the initiatives contained in these options, or new ones. However, these options do reflect the broad range of proposals received and considered by the DPR. The choice among these options ultimately will depend upon your assessment of the benefits of solar energy compared to its costs in terms of society's competing goals. This memorandum attempts to help you form this judgement by addressing the issues raised in Stuart Eizenstat's memorandum.

# CHAPTER I

# AN ASSESSMENT OF SOLAR TECHNOLOGIES AND GOVERNMENT POLICY TOWARD COMPETING FUELS

## I. INTRODUCTION

Solar energy exists in many forms and can be used in a wide range of applications. Solar energy includes energy from sunlight, wind and water. Numerous technologies are available for capturing the energy in each of these forms.

The contribution that solar energy can make to the nation's energy supply over the next 22 years will depend upon many factors, including the readiness of the technologies themselves, the relative costs of, and subsidies to, competing fuels, and the degree of government support for solar development. This chapter assesses the economic and technical readiness of major solar technologies and examines how government energy policy may affect the level of solar use.

## II. TECHNICAL AND ECONOMIC STATUS OF SOLAR TECHNOLOGIES.*

In discussing the technical and economic status of solar technologies, any generalizations must be qualified in several ways. Technical readiness can vary considerably even for the same basic technology. Where one type of collector is already commercial, another may need further development before it is ready for the market. Costs of solar technologies, as well as competing fuels, can vary considerably among different geographical regions, and between different systems, particularly when individuals supply the labor themselves. Lastly, comparisons between the costs of solar systems and conventional systems do not necessarily reflect total social costs and benefits, including the environmental and national security benefits that arise from the use of solar energy.

### A. Technologies at or Near Economic Competitiveness

In today's subsidized energy markets, a number of solar technologies are economic or nearly so. Many passive solar

* The status of the various solar technologies is discussed in detail in the RD&D Panel Report.

systems are economic today, but inertia and a lack of information on the part of builders and consumers has greatly inhibited their use. Direct burning of wood has been economic in the private sector for some time and already provides 1.3 to 1.8 quads of energy annually. Such use, however, has been mostly at points that are close to the site of biomass production. Major expansion in such uses will require some technological improvements in the efficiencies of collection and transportation.

The relative cost* of hot water from various systems is shown in Figure 1. This Figure, and Figures 2, 3 and 4 which follow, compare the delivered cost** of conventional fuels and solar energy. The figures do not compare true resource costs, but rather the market costs to consumers taking the National Energy Act's tax credits into account.

Figure 1 indicates solar hot water systems can compete successfully against electric resistance heating in most regions of the country, and will compete against systems using natural gas in the future.

Figure 2 shows the effect of regional price differences on the economic competitiveness of such systems.

Low head hydroelectric generators could be used at existing dams, but power marketing problems, complicated licensing procedures and other institutional problems have prevented greater use. Finally, a number of solar technologies which can be produced and installed by individual users (e.g., farmers) are also economically attractive at today's market prices.

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* Estimates for solar technologies reflect differential capital costs. Only energy costs are shown for conventional options.

** The delivered cost means the actual cost to the end-user. These estimates of delivered cost take into account the fact that some forms of energy can be used more efficiently than others.

**Figure 1**

# Domestic Solar Hot Water Heating (National Average)

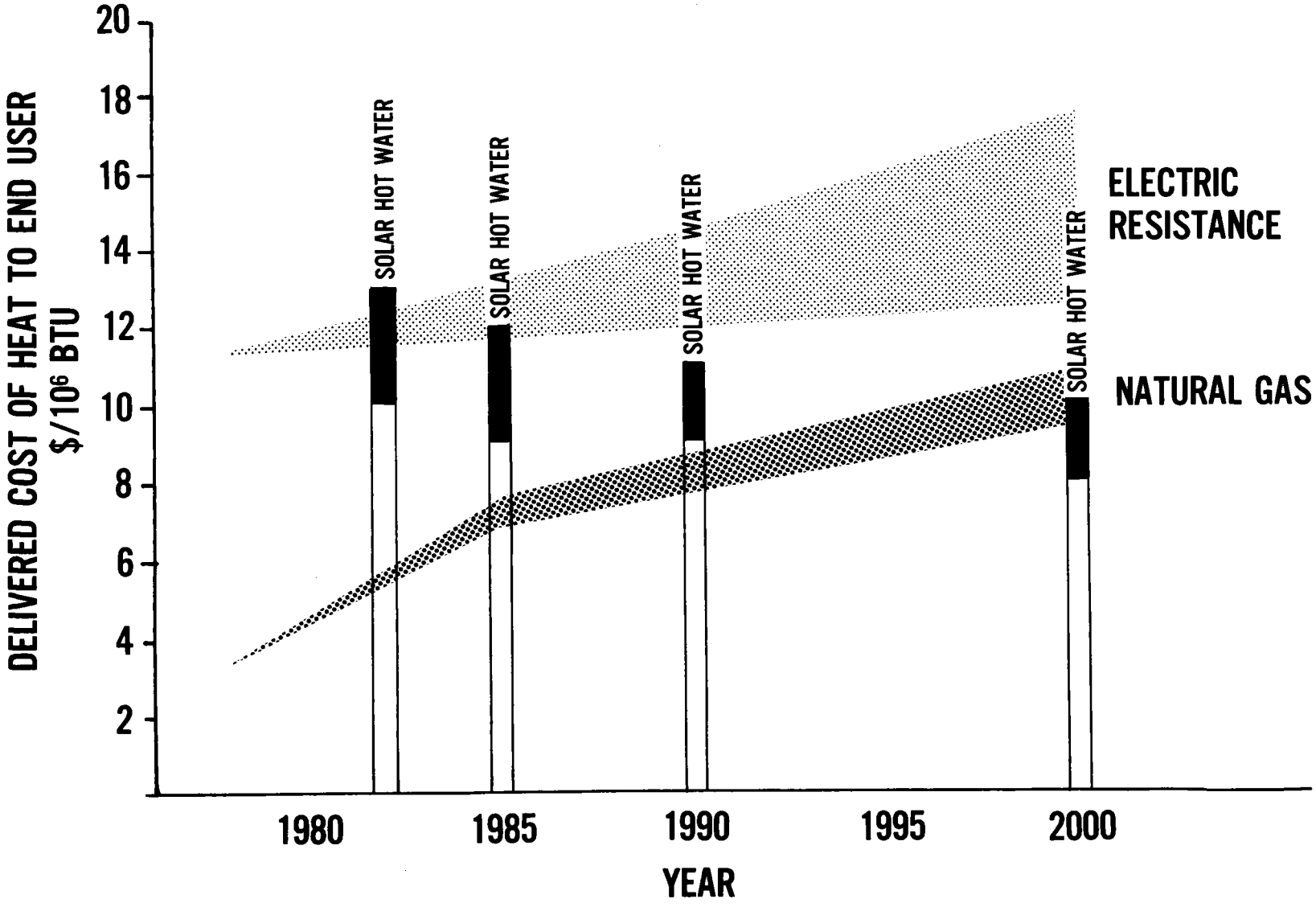
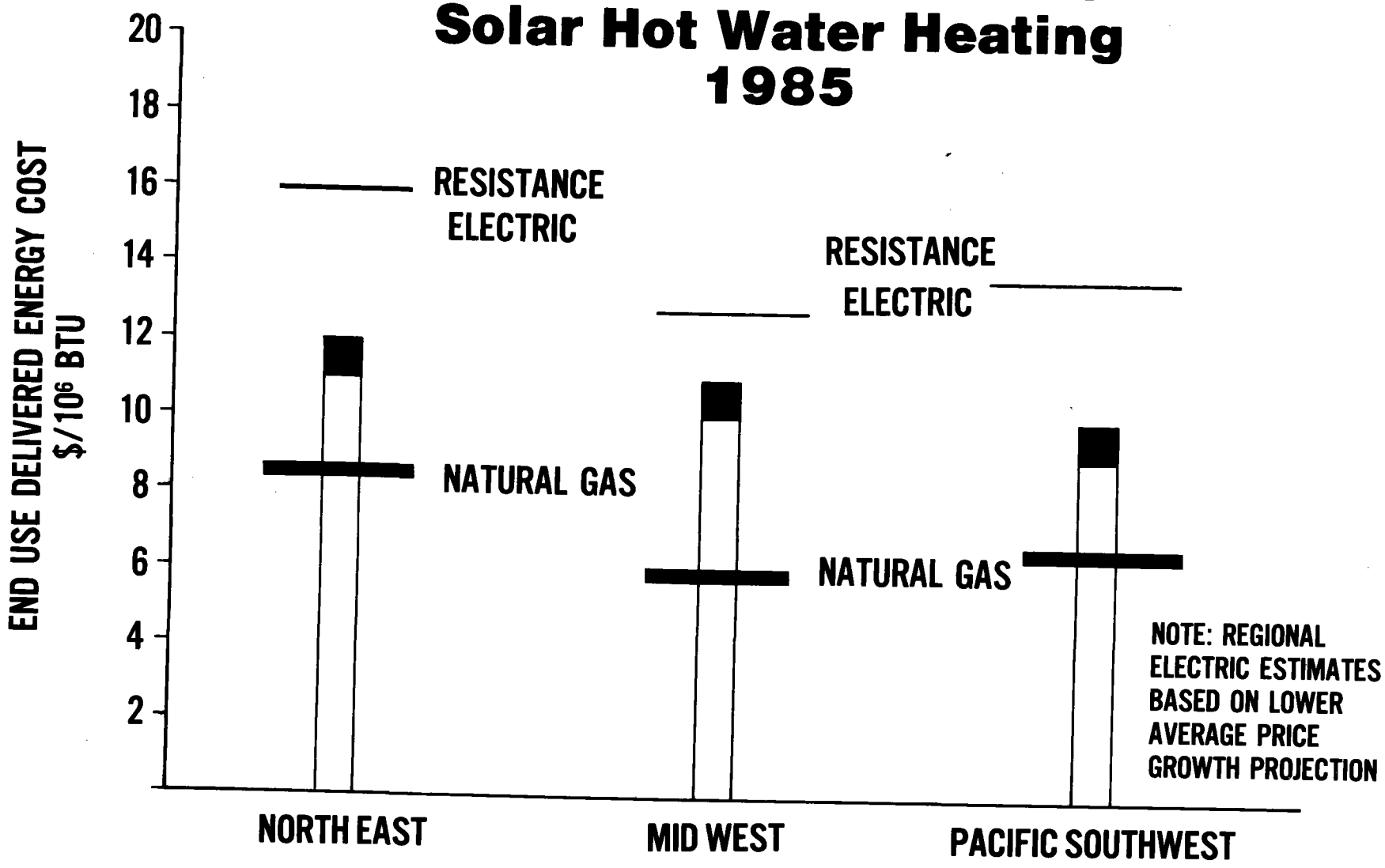


**Figure 2**

# Regional Variations in Solar Hot Water Heating 1985



## B. Technologies that Require Further Research and Development and Product Support

Other solar technologies are more expensive than alternatives available in today's energy market. Penetration of these technologies would be assisted by further research and development to help reduce systems costs and gain acceptance. Active systems for solar space heating, as shown in Figure 3, deliver energy at several times the cost per million BTU of natural gas and oil-fired systems. The difference in the cost of solar space heating compared to the cost of electric resistance heating is smaller. Improved installation procedures, greater contractor experience, the development of lighter-weight, more efficient solar units, and the use of hybrid systems such as solar assisted heat pumps could reduce costs substantially by the year 2000, while prices of oil and natural gas are likely to continue to rise.

The cost of solar industrial process heat, shown in Figure 4, is about two to three times as expensive as oil-fired heat today, but is expected to be competitive within a decade. Electricity from wind systems is two to five times as expensive as average price electricity from utility grids, but is expected to come down in cost by a factor of three by 1990 due to improvements in wind machine design and mass production. Conversion of biomass to liquid and gaseous fuels is also less than three times as expensive as competing energy sources.

## C. Technologies that Require Significant Research, Development or Demonstration to Become Economic

Other technologies will require significant research, development or demonstration before they are competitive. These include solar cooling, agricultural process heat*, biomass plantations, photovoltaics, solar thermal power systems, ocean thermal energy conversion systems, and associated energy storage systems. Finally, some advanced technologies, such as satellite power systems and direct photochemical production of fuels are now only in a conceptual state.

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* Some simple forms of crop drying equipment have been in use for several years, and do-it-yourself systems are becoming increasingly popular.

**Figure 3**

# Solar Residential Heat (National Average)

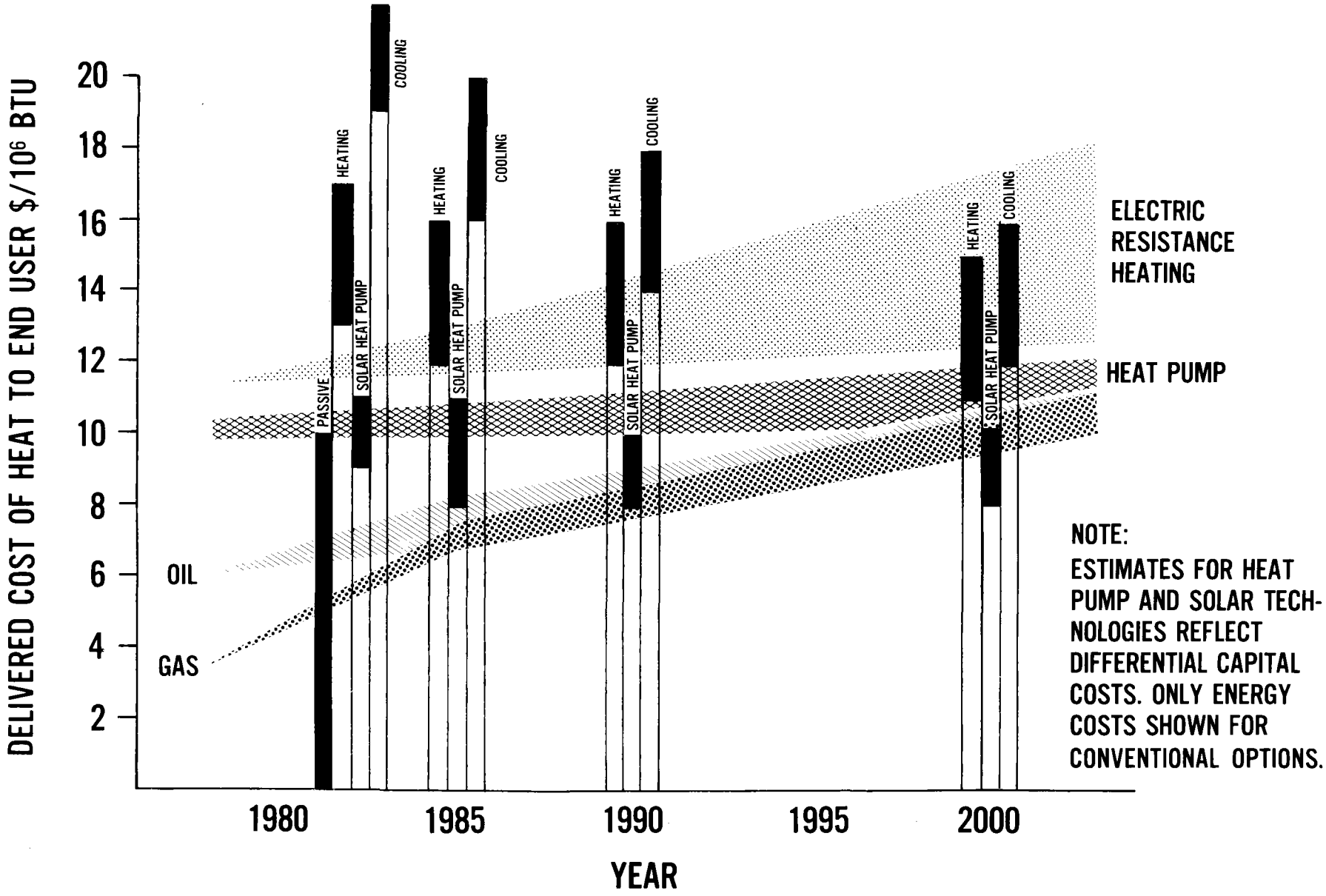
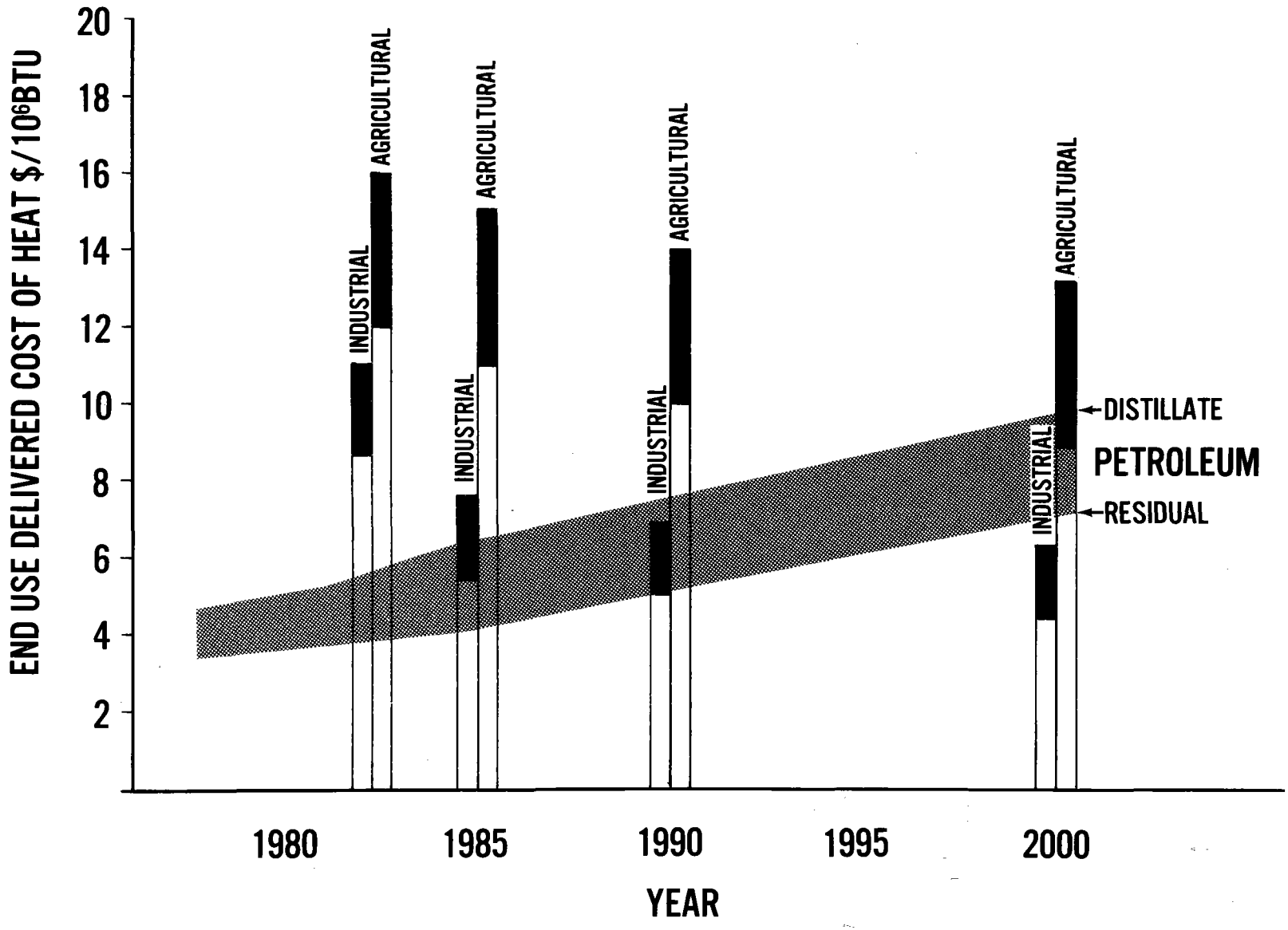


**Figure 4**

# Industrial Process and Agricultural Heating Systems



D. Conclusion

Many solar technologies are already economic and others will be able to compete with conventional energy sources in the near future. Nevertheless, the DPR's estimates of the status of the various solar technologies should not be considered definitive. There are many self-supported firms, inventors and entrepreneurs involved in developing more efficient, less costly solar devices, and it is virtually impossible to keep track of all developments in the field. Although this situation is very healthy for solar development, it does mean that our detailed knowledge and understanding of new developments will necessarily be incomplete and our estimates of projected costs and deployment rates will be imprecise.

## III. SUBSIDIES TO COMPETING FUELS

Government price regulation and subsidies limit the use of solar energy. By keeping the price of competing fuels below what they would otherwise be, they affect purchasing decisions and reduce the demand for solar technologies. These policies include:

Price regulation: Electricity, gas and oil were sold last year substantially below their replacement costs, due in part to Federal price controls on oil and gas, and in part to state-regulated, average-cost utility rate structures.

Table 1 compares the average user prices of oil, gas and electricity with their replacement costs in 1977. This comparison indicates, on an average national basis in 1977,* the extent to which solar technologies were at a competitive disadvantage due to underpricing of conventional energy. It should be noted, however, that this differential is expected to diminish for oil and gas in future years.

* It is important to note that these comparisons do not capture the wide range of regional variability. For example, current gas prices range from $1.71/mmBtu in San Francisco-Oakland to $4.05/mmBtu in New York. In all-electric homes, heating rates range from $3.52/mmBtu in Seattle (the next lowest being $8.55 in Chicago) to $17.80/mmBtu in New York.

TABLE 1

COMPARISON OF REPLACEMENT COSTS AND AVERAGE USER PRICES FOR CONVENTIONAL ENERGY SOURCES--1977 (in 1978 dollars)

| | (1) Replacement Cost ($ /mmBtu) | (2) Average Price ($ /mmBtu) | (1) - (2) Difference ($ /mmBtu) |
|---|---|---|---|
| Natural Gas[a] | | | |
| residential | 2.80 | 2.56 | 0.24 |
| commercial | 2.80 | 2.28 | 0.52 |
| industrial | 2.80 | 1.87 | 0.93 |
| utility | 2.80 | 1.60 | 1.20 |
| Electricity[b] | | | |
| residential | 10.21 | 9.59 | 0.62 |
| commercial | 10.21 | 9.50 | 0.71 |
| Petroleum Products[c] | | | |
| national average | 2.80 | 2.33 | 0.47 |

[a] Replacement cost represents the delivered price of industrial distillate at current world oil prices. Average prices represent 1977 user-prices adjusted to 1978 dollars.

[b] Replacement cost represents in-service costs for a new baseload coal-fired power plant using bituminous coal, scrubbers at 85 percent removal capability. This cost includes all of transmission costs and 25% of distribution costs. Baseload costs were used because solar would, in general, compete with baseload generation. Coal was used here because it represents the most expensive type of baseload plant, thus, providing an upper-bound estimate.

Average electricity prices for 1977 were adjusted to 1978 dollars. In addition, 75% of the average distribution cost was deducted from average prices. This adjustment was made because potential solar users will already be hooked up to the grid for lighting and other uses of electricity. Hence, the price of additional electricity will generally include only a fraction of distribution costs.

[c] Replacement costs represent the averge landed price of imports in 1977 (1978 dollars), converted into mmBtu at 5.8 mmBtu/bbl. Average prices represent refinery acquisition costs.

Subsidies: Depletion allowances and accelerated depreciation in the fossil fuel industries and other subsidies result in price advantages to conventional technologies.** According to one study, the Federal Government has provided on the order of $200 billion in support of conventional energy over the 1918 - 1977 period.*** While issue may be taken with the exact figure, it is clear that conventional energy sources have been substantially subsidized. Price regulation, however, provides a much larger price advantage to conventional fuels.

Unequal access to capital: Centralized energy systems generally have a financial advantage over decentralized units. Since each state guarantees utilities a local monopoly and reduces their risk, these utilities can generally obtain capital on better terms than can individual consumers. Furthermore, a utility can amortize its initial capital cost and repay borrowed funds over long periods of time while individuals and many businesses often do not have this flexibility.

* *

Price controls and other subsidies have provided important benefits to the public in the form of reduced energy prices, and to producers in the form of greater than normal returns. However, they have also led to excessive energy consumption and dependence on foreign fuel supplies.

In the future, new oil and gas prices should gradually increase to a level approximating their replacement cost. Nevertheless, solar energy will still be disadvantaged for a number of reasons. Gas prices will still reflect low-cost gas, rolled-in from existing contracts. Unless current utility pricing policies are changed, consumers will continue to pay average prices for electricity, while solar

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** In FY 1978 alone, depletion allowances and allowances for intangible drilling expenses cost the government approximately $2.8 billion. Source: "Special Analysis: Budget of the United States Government, Fiscal Year 1978".

***"An Analysis of Federal Incentives Used to Stimulate Energy Production", Battelle Pacific Northwest Laboratories (March 1978).

energy systems will generally be priced at the margin. Because today's marginal costs for electricity exceed average costs, there is a bias against solar systems that compete against electricity.* On-going subsidies to other energy sources will also continue to limit the use of solar energy. Unless these handicaps are removed or compensated for, solar energy will not be fully utilized, even where its real economic costs are less than conventional systems.

## IV. COMPETITION

With a large number of firms, the solar energy industry is quite competitive at the present time. In addition, a number of large firms are entering the solar field, thus providing a more diverse industrial and commercial base. The competition in the solar industry can lead to innovation and cost savings. If, however, concern about the reliability of solar systems and marketing practices should lead to restrictions in the number of firms and competition in the industry, the Nation could face less variety in solar applications and higher prices. Federal agencies such as the Department of Justice and the Federal Trade Commission will be monitoring competition in the solar industry.

* This is true unless a utility is making the comparison. Utilities necessarily make their decisions at the margin and many regulatory distortions would not apply to their planning processes for using solar energy.

# CHAPTER II

## REVIEW AND EVALUATION OF FEDERAL SOLAR PROGRAMS

### I. INTRODUCTION

A Federal policy for solar energy must deal with several unique problems. Unlike nuclear power and hydroelectricity, two technologies which the government has developed extensively, solar technologies come in many forms, are varied in scale, and can be applied to a large number of end uses. Federal programs therefore must be designed to support a large and diverse set of new technologies. Moreover, because solar devices will be sold to millions of individuals and small businesses, marketing techniques and delivery systems must be different from those used for conventional technologies that serve only a limited number of utilities and industrial users. Traditional government activities such as financing pilot plants and demonstration projects may have to be supplemented with additional tools, including consumer education programs, product quality standards, and direct financial incentives.

Over the past five years, the Federal government has begun to develop an overall policy designed specifically for solar energy. This policy includes research, development and demonstration; financial incentives; government operations; and special programs aimed at reducing institutional barriers to solar use. Total Federal funding for solar energy programs is summarized in Table 2. Although these programs can be improved, they represent an important beginning in creating an overall Federal solar strategy.

### II. RESEARCH, DEVELOPMENT AND DEMONSTRATION*

Federal programs for research, development and demonstration (RD&D), as shown in Table 3, cover nine different solar technologies and seven government agencies. Funding for Federal RD&D, depicted in Table 4, has increased dramatically in recent years from $14.8 million in FY 1974 to over $500 million in FY 1979.

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*The Federal RD&D program is reviewed in detail in Appendix B.

TABLE 2

FEDERAL SOLAR ENERGY EXPENDITURES
(Budget Authority in Millions of dollars)

| | CUMULATIVE FY 1974 - FY 1978 | BUDGET FY 1979 (estimated) |
|---|---|---|
| Research, Development and Demonstration[1/] | 978 | 554 |
| Federal Buildings | 120[2/] | 20 |
| International Programs | 35 | 50 |
| Tennessee Valley Authority | 1 | 8 |
| TOTAL[3/] | 1,134 | 632 |
| Hydroelectric | 689[4/] | 329 |

1 Sum of expenditures by NSF, AEC, ERDA, DOE, USDA, DOC, EPA, DOI.

2 Total expenditure was $160 million; however, $40 million was funded under the RD&D Program.

3 Excludes some solar expenditures for which information was unavailable to the DPR.

4 Bureau of Reclamation and Corps of Engineers expenditures for multi-purpose facility development, 1977-1978. Total prior (1933-1976) hydro federal incentives estimated at $17.4 billion.

TABLE 3

SUMMARY OF FEDERAL SOLAR RD&D PROGRAMS
(Budget Authority in Millions of Dollars)

| Technology | Organization Responsible | Budget Levels FY '77 | FY '78 | FY '79 |
|---|---|---|---|---|
| Heating and Cooling | DOE/HUD[a] | 86.5 | 95.9 | 96.0 |
| Process Heat | DOE/USDA[a] | 7.8 | 10.3 | 11.0 |
| Biomass | DOE | 12.7 | 20.8 | 42.4 |
| | USDA | 3.7 | 4.1 | 6.7 |
| | DOC | -- | 0.4 | 0.4 |
| | EPA | 4.9 | 4.9 | 5.0 |
| Solar Thermal Power | DOE | 79.1 | 104.1 | 100.1 |
| Photovoltaics | DOE | 59.7 | 76.5 | 118.8 |
| Wind Energy | DOE | 21.9 | 36.7 | 60.7 |
| | DOI | -- | -- | 0.2 |
| Ocean Energy | DOE | 14.2 | 36.0 | 38.2 |
| Satellite Power | DOE/NASA[a] | 3.0 | 4.5 | 4.6 |
| Small Scale Hydro | DOE | -- | 10.0 | 28.0 |
| | DOI | -- | -- | 0.4 |
| Market Development and Training | DOE | 1.6 | 3.5 | 5.5 |
| Federal Buildings Programs | DOE | -- | 20.0 | 25.7 |
| Solar Technical Support and Related Basic Research | DOE | 18.0 | 16.0 | 23.2 |
| TOTAL[b] | | 313.1 | 443.7 | 554.2 |

[a] Joint programs.

[b] The total does not include the substantial expeditures of the U.S. Corps of Engineers and the Bureau of Reclamation for large scale hydro. Budget levels for large scale hydro are $354 million in FY 1977, $335 million in FY 1978, and $329 million in 1979.

The DPR reviewed current Federal programs to determine what improvements could be made. It concluded that Federal efforts in the past have not always concentrated sufficiently on systems which can replace oil and gas. Electricity from large, centralized stations has been over-emphasized while technologies for direct production of heat and fuels, community-scale applications, low-cost systems, and basic research have not received adequate support.

TABLE 4

FEDERAL SOLAR RD&D BUDGET
(Budget Authority in Millions of Dollars)

| Fiscal Year | Solar RD&D |
|---|---|
| 1974 | $ 14.8 |
| 1975 | 54.4 |
| 1976 | 151.6 |
| 1977 | 313.1 |
| 1978 | 443.7 |
| 1979 | 554.2 |
| TOTAL | $1,531.8 |

The DPR also concluded that passive solar heating and cooling technologies should be pursued in conjunction with national energy conservation programs. Increased RD&D on lighter weight, more efficient and lower cost systems should also be conducted if solar space heating and cooling is to receive widespread use. RD&D programs must focus more sharply on the opportunities for using solar energy to produce industrial and agricultural process heat and energy from biomass, and increased emphasis should be given to fundamental research of both a basic and applied nature.

In all areas, increased emphasis should be given to selected field tests to prove the feasibility of a concept and to test promising systems before large-scale demonstration programs are begun. Greater coordination among complementary solar-related programs between DOE and other agencies is needed. The 1980 DOE budget submission, based on the DPR as well as internal analysis, is a move toward implementing these recommendations. DOE is evaluating reprogramming of FY 1979 funds to provide additional momentum toward a more balanced and effective R&D Program.

## III. FINANCIAL ACTIVITIES*

### A. The National Energy Act and the SBA Solar Loan Program

The National Energy Act (NEA) contains tax credits and financial assistance programs for the solar industry. These programs, along with the recently enacted Small Business Energy Loan Act, are the first Federal programs designed specifically to give financial assistance to solar users and to the solar industry.

The NEA tax and lending programs were designed to reduce the costs of solar energy systems and to make credit more available to residential consumers. The Energy Tax Act of 1978, which is a part of the NEA, provides tax credits to residential and industrial purchasers of solar energy systems. Residential purchasers will receive a tax credit of 30 percent of the first $2,000 of investment and 20 percent of the next $8,000 of investment for a maximum credit of $2,200. Approximately 1.2 million solar energy systems are expected to be installed during the life of the credit, which lasts until 1985.** The residential tax credits are expected to cost $567 million through 1985, and lead to an energy savings of 0.03 quads in that year.

The residential credits, targeted at reducing the costs of active and passive solar energy systems, would give greatest emphasis to solar hot water systems. Over ninety percent of the units installed through 1985 under the tax credit are expected to be for solar hot water. In contrast, passive solar systems are only partially covered under the Energy Tax Act's provisions. Those components of

*Financial Incentives are reviewed in detail in Appendix B.

**Estimate of the Joint Committee on Taxation.

passive solar systems that are integral to the structure of the house, for example, thicker walls and storage, are not eligible for the tax credits, due to the difficulty in distinguishing the cost of the solar system from the cost of the house itself. Accordingly, the impact of the tax credits on passive solar is expected to be small.

The Energy Tax Act also provides business purchasers of solar energy systems a 10 percent investment tax credit over and above the regular 10 percent investment credit. When solar energy systems are used for process heat, industrial purchasers will receive a total investment credit of 20 percent (the regular 10 percent investment tax credit plus an additional 10 percent authorized by the Act). When solar systems are used for heating and cooling industrial and commercial buildings, they will receive only a 10 percent credit because heating and cooling systems are ineligible for the regular credit. The business credits under the Energy Tax Act are expected to cost $64 million through 1983 when they expire. The energy savings in that year from the program will be less than 0.001 quads.

The business credits expire too soon to have a large impact on the market for industrial process heat, where cost-reducing technology improvements will take a number of years. Larger credits would be required for a more extended period of time to create the additional demand needed to reduce system costs. The tax credits contained in the Energy Tax Act also do not help industrial and residential consumers in financing the high front-end investment required for solar energy. Nor do they address the fact that solar systems must be financed on credit terms that are often more costly than the incremental utility capacity they replace.

The NEA also contains provisions to encourage the use of solar energy equipment in schools and hospitals. Funds totalling $900 million are authorized through fiscal year 1980 to cover the costs of energy audits and conservation and renewable energy equipment purchases. To be eligible for such funds, states must submit plans showing the extent to which solar energy equipment will be used and the methods to be used to encourage such use.

The National Energy Conservation Policy Act, another part of the NEA, contains a number of financial provisions that fill some of the gaps in the Energy Tax Act. The

Conservation Act increases mortgage limits by 20 percent to cover the costs of solar energy systems for mortgages insured or guaranteed by HUD/FHA and the Farmers Home Administration of USDA. In addition, the Act authorizes the Government National Mortgage Association to purchase loans made for the purpose of purchasing and installing solar energy systems under a 5 year, $100 million revolving fund program. The Federal Home Loan Mortgage Corporation and the Federal National Mortgage Association were also authorized to purchase home improvement loans for solar energy systems.

The NEA also authorizes $330 million for loans and feasibility studies to aid development of small-scale hydroelectric projects.

The Small Business Energy Loan Act of 1978 authorizes loan guarantees and direct loans for a broad range of conservation and solar energy investments by small businesses. Up to $45 million in loan guarantees would be authorized under this program as well as up to $30 million in direct loans. Manufacturers and distributors of solar energy systems would be eligible for assistance of up to $500,000 of loan guarantees and up to $350,000 of direct loans. It is expected that solar manufacturers will make the greatest use of this program.

Taken together, the NEA and SBA financing assistance programs are not expected to have a great impact on the solar industry. Less than 150,000 residential units are likely to be financed between now and 1985 under the NEA financing assistance programs. Under the SBA programs, it is estimated that fewer than a thousand installations will be financed. Further financial assistance for solar development will be needed in the future if the full potential of solar energy is to be realized.

B. General Purpose Financial Programs

A variety of existing general purpose Federal financial assistance programs could support solar energy if they were directed toward this end. Table 5 summarizes these programs, which include activities in the Departments of Agriculture and Commerce, HUD, the Veteran's Administration and the

TABLE 5

EXISTING FEDERAL FINANCIAL ASSISTANCE
PROGRAMS THAT COULD SUPPORT SOLAR ENERGY

- HUD programs targeted at the residential market:
  - Secondary market operations of GNMA
  - FHA mortgage insurance programs
  - Community Development Block Grant Program
  - Low income housing and rental assistance programs
- Department of Agriculture programs targeted at the rural and agricultural market:
  - Direct loans for improvement of family farms
  - Farmers Home Administration loans and loan insurance
  - Rural Electric Administration loans and loan guarantees
- Veterans Administration financial assistance programs aimed at the residential sector:
  - Guarantees of residential mortgages
  - Direct loans in areas where mortgage credit is short.
- Commerce Department assistance for economic redevelopment through the Economic Development Administration
- Small Business Administration programs aimed at industry:*
  - Loans to small business firms in areas of high unemployment and firms owned by persons with low incomes
  - Small Business Loans Program, loans and guarantees to small businesses unable to obtain credit elsewhere
  - Small Business Investment Company funds available to small, innovative firms with new products

* Not including programs under the Small Business Energy Loan Act of 1978.

Small Business Administration. At present, these programs provide the solar industry little, if any, assistance.*

The DPR has identified several problems with current Federal financing programs. Because solar systems are new and have little resale history, they are often undervalued as an asset. Moreover, most Federal lending programs neither include nor exclude solar energy systems as qualifying for financial assistance. As a result, confusion exists as to the applicability of existing programs to solar energy.

In the residential financing assistance programs, credit risks are evaluated based on the ability of the borrower to meet principal, interest, taxes, and insurance payments (PITI). Energy costs, a significant risk factor in loans to the residential sector, are often not taken into account, although HUD and VA programs do include energy costs in their debt service criteria. The added cost of a solar system increases principal and interest payments, but the reduced energy bills and reduced exposure to rising costs that result from using the system do not get credited in the borrower's favor. If energy costs were added to PITI, the improved risk that results from the borrowers' use of solar energy would be reflected in the terms and conditions of the loan. The Consumer Cooperative Bank, which is being set up pursuant to the National Consumer Cooperative Bank Act (P.L. 95-351), will take a step in this direction by employing criteria in making loans to cooperatives that are more favorable to solar energy than traditional lending criteria.

The current low level of emphasis on solar energy within most Federal financial assistance programs reflects the particular objectives of the programs, which almost always predate national concern with solar energy. The programs are often over-subscribed, and would probably require increased funding to provide substantial direct financial assistance to solar energy. As an alternative, financing agencies could require that applicants for assistance consider solar systems before any funds from these programs are used to purchase conventional energy equipment.

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* The exact level of assistance is impossible to determine because program statistics are not organized to indicate separately the amount of financing for solar projects. A better information base will be needed to evaluate fully the potential of existing Federal financial assistance programs for assisting the solar industry.

## IV. FEDERAL OPERATIONS*

### A. THE FEDERAL GOVERNMENT AS AN ENERGY USER

The Federal government is both a major user and producer of energy. Federal agencies use 740 trillion Btu's of energy a year to operate about 2.8 billion square feet of Federally-owned or leased buildings and facilities. DOD is the largest building owner, accounting for nearly 72 percent of total floor space, with GSA and the VA second and third at 8 percent and 5 percent respectively. Leased buildings amount to 8 percent of total floor space, with GSA and the Postal Service being the two largest holders of Federal leases.

Twelve agencies have installed solar energy systems on their buildings and facilities. More than $150 million has been allocated to 475 solar projects, including 419 solar heating and cooling projects, 45 photovoltaics applications and 8 wind systems. Seventy-five percent of these funds have come from agency mission budgets, the rest has come from DOE demonstration funds. A summary of the systems and funds allocated, on an agency-by-agency basis, is provided in Table 6.

The systems that have been funded to date are expected to supply about 0.2 trillion Btu's annually, or slightly less than 0.03 percent of the total energy required to operate Federal facilities. The total energy that potentially could be displaced, according to DPR calculations, is about 80 trillion Btu's per year, or one-tenth the total now consumed in Federal facilities.

Two new Federal initiatives begin to fill this gap. The Federal Buildings Program in the National Energy Act will provide $100 million over a 3-year period to install solar systems on Federal facilities. It is estimated that this program will reduce fossil fuel demand by about 0.4 trillion Btu's per year after 1981.

The Military Construction Authorization Act (P.L. 95-356) requires all new military housing and 25 percent of other new military facilities to be equipped with solar systems where cost-effective. According to preliminary DOD estimates, these requirements could result in purchases worth $5 to $20 million in FY 1979, and $80 to $120 million

*Federal Operations are reviewed in detail in Appendix B.

TABLE 6

OPERATING AND FUNDED SOLAR ENERGY PROJECTS
FOR FEDERAL BUILDINGS AND FACILITIES*

| | Funds Allocated | | | |
|---|---|---|---|---|
| | Operating | | Funded | |
| Agency | Millions of Dollars | Number of Projects | Millions of Dollars | Number of Projects |
| GSA | $ 1.3 | 5 | $ 2.4 | 4 |
| U.S. Postal Service | 0.2 | 1 | 1.5 | 5 |
| HEW | 0.9 | 2 | 2.3 | 2 |
| NASA | 0.9 | 7 | 3.6 | 13 |
| DOI | 0.7 | 21 | 8.9 | 106 |
| DOE | 1.3 | 10 | 2.9 | 6 |
| USDA | 0.1 | 1 | - | - |
| EPA | 0.01 | 1 | - | - |
| Justice | -- | — | 1.8 | 1 |
| VA | 0.5 | 1 | 16.7 | 49 |
| Transportation | -- | — | 5.5 | 26 |
| Defense | 23.5 | 105 | 82.5 | 109 |
| TOTAL | $29.4 | 154 | $128.1 | 321 |

*A few hundred additional projects are in various planning stages

in FY 1981, the year the full program becomes operational.* When fully operational, the program should save about 0.4 trillion Btu's annually.

In addition, the NEA provides $98 million over three years for the purchase of photovoltaic systems for Federal facilities. The systems are expected to be used in remote sites for communication and other purposes. The program is designed to accelerate development of a photovoltaic industry and the manufacture of lower-cost photovoltaic systems.

The provisions of the NEA and Military Construction Authorization Act provide the basis for a moderate Federal program for using solar energy in government buildings and facilities. Close to two million square feet of collectors will be purchased in 1981. These purchases, which in terms of dollars spent will constitute about 20 percent of projected industry sales in that year, will provide stimulus to the fledgling solar industry. The energy supplied by the purchased equipment should meet about 10 percent of the heating, cooling, and hot water requirements of new Federal buildings. However, the effects of this program after 1981 will be considerably reduced due to the expiration of the NEA Federal Buildings Program in 1981, and the intention of DOD to apply more stringent cost-benefit criteria to solar systems in 1982 and beyond.

Despite the contribution these two programs will make to encouraging solar development, several constraints will limit the increase in Federal solar use. Specific budget provisions and funds for solar installations do not exist except in the NEA Federal Buildings program. Most agencies, including DOD under the Military Construction Authorization Act, must fund solar energy at the expense of agency mission requirements. For agencies other than DOD, current rules for assessing cost-effectiveness favor alternatives other than solar. These rules use a 10 percent discount rate and do not require replacement cost pricing of conventional fuels.

Although the NEA provisions do not require cost-effectiveness criteria to be met for the Federal Buildings Program, and the Military Construction Authorization Act

* The Senate Armed Services Committee has estimated that the full operation cost will be $100 million a year.

redefines cost-effectiveness as repayment of the incremental cost of the solar system over the life of the facility, neither provides the across-the-board change in cost-effectiveness criteria which would be necessary to insure optimal Federal use of solar systems.

Moreover, the Federal effort still lacks overall coordination. At present there is no effort to assure that purchases are made in a systematic manner, so that experience in one Federal facility can benefit another, and so that Federal purchases have a maximum impact in supporting the solar industry.

B. Federal Agencies as Suppliers of Energy

The Federal Power Generation and Marketing (FPGM) agencies supply over 10 percent of the electrical energy used in this country. These agencies include the Tennessee Valley Authority (TVA), the U.S. Army Corps of Engineers, and the Bureau of Reclamation of the Department of the Interior. The Power Marketing agencies within the Department of Energy include the Bonneville Power Administration, the Western Area Power Administration and the Southeastern and Southwestern Power Administrations. The Alaskan Power Administration operates its own dams and markets the power it produces.

The TVA has initiated a comprehensive solar program covering space heating and cooling, agricultural and industrial process heat, biomass and commercial implementation. The agency has installed four solar hot water heaters on its own buildings, and has initiated a program to help finance 1,000 hot water applications in Memphis, Tennessee. It has also supported biomass and agricultural process heat demonstrations. TVA solar applications programs were funded at $200,000 in 1977 and $500,000 in 1978. They are planned to grow to $8.1 million in 1979. These promising programs should make a substantial contribution to the demonstration of solar energy in the TVA service area.

The Bureau of Reclamation in the Department of the Interior has ongoing RD&D programs (mostly facilities development activities) in the hydroelectric energy field amounting to more than $40 million annually. In addition, the Bureau is studying wind-hydropower integration for the Medicine Bow area in Wyoming.

The Army Corps of Engineers is carrying out a national hydroelectric power resources study, which will identify potential hydroelectric sites in cooperation with other Federal agencies. The Corps allocates more than a quarter of a billion dollars annually to hydroelectric power generation.

Finally, the Bonneville Power Authority (BPA) is active in a number of areas. Solar cells have powered hydrometeorological stations for over a decade, and evacuated tube solar collectors are now used in conjunction with an electric heat pump and air conditioning system in a BPA building. The BPA has also installed a temporary aircraft warning beacon powered by solar cells, and the Authority has preliminary plans to install two wind generators in the BPA system.

The programs of the FPGM agencies, many of which are just starting, have a much wider potential. In the future they can play a significant role in promoting solar use, for example by demonstrating how on-site, decentralized renewable energy units can be integrated into large utility grids.

C. International Programs

The Federal government has a growing number of international programs for solar energy. These include bilateral and multilateral cooperative arrangements for research, development and demonstration of solar technologies, energy and related resource assessments, training in energy management, and development of indigenous institutions. Annual expenditures for these programs amount to about $25 million, approximately two-thirds of which is managed by the Agency for International Development (AID).

Existing programs include AID assistance to developing countries, promotional programs by the Department of Commerce to aid U.S. manufacturers in exporting their products, programs under Title V of the Nuclear Non-Proliferation Act to develop non-nuclear energy sources, and activities by Peace Corps volunteers to adapt solar technologies to rural needs.

In addition, DOE has entered into a number of technical cooperation agreements, primarily with other industrial countries, for solar technology information exchange, improvement of analytic techniques, design studies, performance data comparison, and joint hardware development. DOE has two programs already under way for energy assessments with Egypt and Peru with $5 million authorized for FY 1978*, and $1 million for R&D, primarily with industrial countries. Finally, a number of Federal agencies are engaged in cooperative efforts in conjunction with the International Communications Agency, the World Bank, and the United Nations. At

*These are pilot activities, and follow-up activities, if any, have yet to be agreed upon.

the recent Bonn Economic Summit, the President indicated the U.S. intention to intensify its energy assistance programs, especially in the area of renewable energy technologies.

At present, there does not appear to be enough coordination to manage these diverse programs effectively, particularly in view of the multiplicity of international organizations, nations, and private interests that must deal with the Federal agencies involved. As a result, a strategy for developing a comprehensive international solar energy program does not exist. Effective coordination would be enhanced by a clarification of agency responsibilities for implementing bilateral energy programs, particularly with respect to DOE and AID responsibilities for LDC energy programs. In addition, the role of the Federal government in assisting the private sector to market U.S. solar technologies overseas needs to be enhanced as part of the overall U.S. export promotion effort.

## V. INSTITUTIONAL BARRIERS AND INCENTIVES*

The Federal government also has a number of programs to provide incentives and overcome institutional barriers to increased solar energy use. These programs are designed to disseminate information about solar devices and train workers who install solar equipment. In other areas, government programs have been created to help protect consumers who purchase solar products and encourage utilities to promote solar energy. Finally, local governments can turn to other Federal programs for assistance in devising land use policies to facilitate greater solar use.

### A. Information Dissemination and Data Collection

Lack of information about solar energy systems has been a major obstacle to U.S. solar energy development. DOE has primary responsibility for the national solar data collection and dissemination program, with other agencies participating as required to meet their specific constituencies' needs. Existing programs to disseminate solar information include the DOE Technical Information Center, which serves as the national solar information data center, the DOE Energy Extension Service, the National Solar Heating and Cooling Information Center (HUD), the Agricultural Extension System (USDA), the Solar Energy Research Institute and the four Regional Solar Energy Centers that are just now getting under way.

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*Federal Programs to deal with institutional barriers are reviewed in detail in Appendix B.

Despite the existence of several information centers, the public has expressed strong concern in the DPR's public forums that not enough information is available where and in the form it is needed. There is no central clearinghouse to direct people to information sources which do exist on the full range of solar technologies; for example, the National Center deals only with heating and cooling. The DPR also found that information provided by different sources is often contradictory. Builders and other groups complained that the Federal government does not freely distribute all the information that is generated by Federal programs. Moreover, the Federal government has done relatively little to target information to potential users and producers who could benefit from the government's information programs.

B. Labor and Training Programs

Several Federal training programs are designed to assure that a shortage of skilled labor does not hinder increased solar energy use. The Department of Energy administers a program for solar installation classes in post-secondary schools under the Education Act Amendments of 1976. The Commerce Department prepares standard course curricula for solar design and installation, and HUD conducts training programs for installers, builders, and lenders through the National Solar Heating and Cooling Information Center.

The Department of Labor, in conjunction with DOE and the Community Services Administration, has begun a Solar Utilization, Economic Development and Employment (SUEDE) program aimed at training CETA workers to install solar equipment in low income communities. Additional efforts to train instructors who can then train individual workers in techniques for installing solar hot water heating and cooling systems were proposed by DOE during the second session of the 95th Congress but failed to gain Congressional approval.

C. Consumer Protection

Other Federal efforts are designed to enhance consumer confidence in the reliability of new solar devices. The National Bureau of Standards (NBS) has developed interim performance criteria for solar heating and cooling systems and assisted HUD in developing standards for solar heating and hot water systems in Federal demonstrations. HUD and

DOE demonstration programs now require minimum warranties from participating installers and manufacturers. NBS and DOE are also actively working with voluntary standards organizations to develop solar equipment standards and to identify qualified laboratories capable of testing and certifying solar industry products. A hotly debated issue is whether the benefits of warranties to consumers outweigh the possible burdens they place on an infant industry. To date, the Federal effort has largely focused on encouraging and assisting industry rather than on imposing mandatory standards.

D. Utilities

The DPR found that utilities could either significantly assist in the increased utilization of solar energy or serve as major barriers to such use. Utilities can inhibit solar energy use by offering backup energy to users of solar equipment at discriminatory rates or by refusing to buy back system-compatible electric energy at reasonable rates. (Solar backup rates should reflect the true cost of providing that energy, including both the need for peaking power and the contribution solar energy can make to reducing summer peaking loads.) Utilities can assist greater commercialization of solar devices, on the other hand, by giving their customers advice, recommending reliable systems and installers, offering financing, or even owning the systems and leasing them.

The issue of utility involvement in solar energy is highly charged politically with many public participants to the DPR expressing opposition to any utility role in solar development. A question has also been raised as to the impact on competition of involving regulated monopolies in a competitive industry. Clearly, utilities have a role in solar energy in terms of the rates they charge for back-up power and could play a positive role in assisting in the stimulation of greater solar energy use.

Although authority to regulate ultilities has traditionally been firmly held by State public utility commissions, the newly enacted NEA expands the Federal role in ratemaking by prohibiting discriminatory rates for solar energy and authorizing DOE intervention in ratemaking proceedings. In addition, DOE is studying the role utilities can play in promoting solar energy use as part of its institutional barriers and incentives programs.

### E. Land Use

Land use restrictions can have a major impact upon solar energy use. For example, zoning ordinances can restrict access to sunlight and limit installation of solar devices. Because land use has traditionally been a concern of local governments, Federal involvement has been limited to research and information dissemination to the State and local levels. The major Federal program is administered by HUD in conjunction with DOE. Initial efforts have generated some useful data for local jurisdictions that wish to facilitate use of solar energy.

## VI. SUMMARY OF FINDINGS

A broad Federal program for solar energy is already in place, covering most of the appropriate areas of government involvement. There are however, many programs that could be redirected or expanded to accelerate solar energy development and use.

### A. Research, Development and Demonstration

The Federal RD&D program is substantial in size and scope and has already made important contributions to solar development. Nevertheless, Federal efforts have not always concentrated on near term technologies and systems that can replace oil and gas. In the future, more emphasis should be placed upon technologies for direct production of heat, more efficient collectors, biomass, wind, industrial and agricultural process heat, lower cost systems, community systems, and fundamental research of both a basic and applied nature.

### B. Financial Incentives

Federal financial assistance to residential users of solar energy will come largely from the tax credits of the NEA. Although these credits will give valuable assistance, primarily to solar hot water systems, they will do little to encourage passive solar design.

The NEA also gives businesses a ten percent credit for solar investments. However, the size of the credits and their early expiration date will limit their effectiveness; cost-reducing technology improvements for solar process heat, for example, will take a number of years.

Several existing general purpose Federal financial assistance programs might be able to support solar energy if they were directed toward this end. However, solar energy systems will continue to be at a disadvantage until lending criteria are based on the recognition that reduced energy risks are an important element of the credit decision and that solar systems are a valuable asset.

In the future, widespread use of solar energy could have significant impacts on the flow of funds for the energy sector. In the past, the electric utility industry, which has been financed largely by the insurance industry, has been the largest user of capital in the energy sector. In contrast, any substantial capital requirements of solar users will be financed primarily from banks and traditional mortgage sources. New financial mechanisms may be needed to insure that sufficient capital is available for these solar purchases.

C. Federal Operations

A substantial effort to use solar energy in Federal facilities is already underway, and the NEA and the Military Construction Authorization Act will increase this activity. Whether the current Federal effort in this area is adequate depends to a great degree upon the nature of the government's goal. If it is to demonstrate leadership, current efforts with some modification and program expansion will suffice. If it is to stimulate the solar industry, the Federal purchase under current programs of two million square feet of collectors in 1981 represents a sizeable fraction of industry output for that one year. If the goal is to replace fossil fuels with solar energy as much as possible in government buildings and facilities, a major increase in effort and funding would be required.

In other areas, Federal agencies that generate power have not fully utilized their capability to demonstrate how decentralized renewable energy units can be integrated with large generation facilities. And while a number of international programs for promoting solar energy exist, the government lacks an overall international solar strategy.

D. Institutional Barriers and Incentives

The Federal government has already initiated several programs to reduce institutional barriers to solar energy. However, several of these programs could be improved. Solar information programs do not appear to be adequate for

meeting the public's needs. Current training programs could be improved with additional efforts to train instructors who can then train individual workers in solar installation techniques.

Consumers and industry are divided over the issue of providing standards and warranties for solar products. Consumers want assurances that solar units will work, while industry and many solar advocates fear that mandatory warranties will drive out small firms and lead to higher prices. A Federal policy that satisfies both concerns will be difficult to design.

Finally, federal efforts in the area of utility regulation and land use policy have been limited, primarily because these areas have traditionally been reserved for state and local governments.

E. Conclusion

The future course of solar development in this country will depend to some extent upon the quality and scope of government support. Although existing programs are substantial, they can be improved in many ways. The DPR has analyzed a number of initiatives that would carry out the improvements suggested in this chapter. They are described in the discussion of future policy in Chapter 4.

# CHAPTER III

# THE POTENTIAL FOR INCREASING SOLAR ENERGY USE

## I. ESTIMATING FUTURE SOLAR ENERGY USE

### A. Coping with Uncertainty

It is not possible to forecast total energy demand or the future use of specific energy sources beyond the near-term with any certainty. A number of unpredictable factors such as the course of energy prices, the availability of competing fuels, future environmental standards, public attitudes, and the effects of government activity will affect the pattern of future energy use.

Rather than attempt to predict what these factors will be at a future date, the DPR has estimated solar energy penetration in different scenarios, assuming three levels of government support for solar energy at different levels of energy prices. Assumptions were also made about environmental and other government policies.*

### B. The Three Scenarios

The Base Case represents a possible future which could evolve under current energy policies and programs at about the same level of commitment as at present. It takes into account passage of the solar provisions of the National Energy Act, continuation of Federal RD&D programs at present levels (over $500 million per year in 1978 dollars), and a continued effort to identify and overcome institutional barriers to solar energy.

The Maximum Practical Case represents the maximum contribution that solar technologies could reasonably be expected to make by the turn of the century within the framework of traditional Federal intervention. For each solar technology and potential application, the DPR estimated what might be achieved over the Base Case with a set of comprehensive and aggressive initiatives. The amount of solar penetration in the Maximum Practical Case is less sensitive to energy prices than it is to the full range of government policies that would be adopted to achieve a targeted goal.

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*The technical, economic and other assumptions that define each scenario are described in Appendix B.5.

The Technical Limits Case is an attempt to assess the limit to solar penetration by the year 2000 imposed primarily by the rates at which changes can be made to existing stocks and buildings and rates at which solar technologies can be manufactured and deployed. The price of competing fuels and other financial and institutional barriers would play a decidedly secondary role in the Technical Limits Case.

To develop the estimates of the energy impacts associated with the Base, Maximum Practical, and Technical Limits Cases, the DPR estimated the number of solar buildings, windmills, photovoltaic arrays, and other solar equipment that would have to be in place in the year 2000 for solar energy to have the penetration predicted for each scenario. These and other assumptions are discussed in greater detail in Appendix B.5.

C. Results

The DPR estimated future energy supply and demand in the Base Case under three different price assumptions. The low price scenario assumes that depletable fuels will continue to be plentiful and relatively cheap, with world oil prices rising very slowly to $18 per barrel of oil in 1977 dollars by the year 2000. The second path assumes that conventional supplies will be tight and that world oil prices will reach $25 per barrel. The third case assumes that supplies will be even more scarce, with oil prices of $32 per barrel at the end of the century.

Estimated total primary energy demand in the year 2000 under the three price scenarios ranges from 95 to 132 quads. Table 7 shows the estimated Base Case contribution of solar and conventional energy sources at each of the assumed price levels. It also shows the actual contribution of solar energy sources in 1977, as a basis for comparison. As Table 7 indicates, solar energy in the Base Case could displace from 7 to 12 quads depending on energy prices. The DPR also estimated that solar energy could displace 18 quads in the Maximum Practical Case, and as much as 25 to 30 quads in the Technical Limit Case. Table 8 gives a breakdown of the estimated solar contribution in the Base, Maximum Practical, and Technical Limit Cases by solar technology.

In moving from the Base to the Maximum Practical Case, not all solar applications would increase at the same rate. As Table 8 indicates, the energy contribution from passive

Table 7

PRIMARY ENERGY SUPPLY
IN THE BASE CASE
(Quadrillion Btu's)

| | 1977 | 2000 | | |
|---|---|---|---|---|
| | $14.50/bbl[b] | $18/bbl[b] | $25/bbl[b] | $32/bbl[b] |
| Oil | 36.9 | 44.0 | 32.1 | 22.8 |
| Gas | 19.6 | 20.2 | 18.0 | 14.5 |
| Coal | 14.2 | 43.0 | 38.5 | 31.5 |
| Nuclear | 2.7 | 17.0 | 15.0 | 13.0 |
| Solar | 4.2 | 7.3 | 9.9 | 12.7 |
| Other[a] | -- | 0.5 | 0.5 | 0.5 |
| Total | 77.6 | 132.0 | 114.0 | 95.0 |

a Includes geothermal and other non-solar renewable energy sources.

b Landed price of imported oil.

Table 8

ENERGY DISPLACED[a] BY SOLAR TECHNOLOGIES IN 1977 AND 2000[b]

| | 1977 | Base Case $25/bbl | Base Case $32/bbl | Maximum Practical | Technical Limit |
|---|---|---|---|---|---|
| Residential/ Commercial Heating, Hot Water, Cooling | Small | 0.9 | 1.3 | 2.0 | 3.8 |
| Passive Design | Small | 0.2 | 0.3 | 1.0 | 1.7 |
| Industrial & Agricultural[c] | -- | 1.0 | 1.4 | 2.6 | 3.5 |
| Hydro | 2.4[d] | 3.9 | 4.0 | 4.3 | 4.5 |
| (High Head) | (2.4) | (3.5) | (3.5) | (3.5) | (3.5) |
| (Low Head) | (Small) | (0.4) | (0.5) | (0.8) | (1.0) |
| Biomass | 1.8 | 3.1 | 4.4 | 5.4 | 7.0 |
| Solar Thermal Electric | -- | 0.1 | 0.2 | 0.4 | 1.5 |
| Wind | -- | 0.6 | 0.9 | 1.7 | 3.0 |
| Photovoltaics[e] | -- | 0.1 | 0.2 | 1.0 | 2.5 |
| OTEC | -- | -- | -- | 0.1 | 1.0 |
| Solar Power Satellite | -- | -- | -- | -- | -- |
| TOTAL | 4.2 | 9.9 | 12.7 | 18.5 | 28.5 |

a The numbers in this table represent the amount of conventional energy that can be displaced by solar energy, rather than the amount of energy actually delivered by solar systems.

b Because predictions about future solar use cannot be precise, the DPR has estimated ranges for solar penetration in the year 2000. The figures in this Table usually represent the midpoints of these ranges.

c Includes process heat, on-site electricity and heating and hot water.

d Energy displaced by existing dams during years of normal rainfall is 3.0 quads.

e Photovoltaics penetration is dependent on substantial cost reductions.

solar design would approximately double while use of hydropower would increase by no more than 10 percent. Increased use of most other solar technologies would fall somewhere between these extremes.

It is important to emphasize that these predictions of solar energy use in the year 2000 are only rough estimates of what might occur. Because the future supply of and demand for energy depend upon a wide variety of unpredictable factors, estimates about future use can only indicate the overall direction of change. For example, any substantial increase in natural gas availability could alter the economics of solar energy, and provide many of the same environmental benefits.

## II. THE IMPACTS OF ACCELERATED SOLAR ENERGY USE

### A. Direct Economic Cost

The DPR estimated the net national energy bill of the Base, Maximum Practical, and Technical Limit cases over the period from 1978 to 2000. This was done by estimating the total cost of installing new solar energy systems in this period and subtracting the cost of an equivalent amount of energy from an appropriate mix of conventional sources.*

In the Maximum Practical Case, this net cost relative to the Base Case appears to range from a small saving to an increase of about one to two percent in the total national energy bill over the next two decades. In the Technical Limit Case, the net energy bill to the Nation could be as high as five to ten percent above that of the Base Case. It should be noted that these estimates do not take into account the benefits of reduced subsidies to conventional fuels that accompany greater use of solar energy, nor do they take into account the government costs of future subsidies to solar energy.

*The $25/bbl price scenario was assumed. Prices of conventional fuels were assumed to escalate at real rates ranging from 1.8 to 4.8 percent per year. Electricity prices were assumed to increase at 1.8 percent per year. Capital costs and projected learning curves for the various technologies were estimated jointly by two of the DPR Interagency Panels.

Because future costs of solar technologies and of conventional fuels are difficult to predict, the net resource cost to the Nation of achieving widespread use of solar energy is highly uncertain. If solar costs decline as rapidly as the optimistic projections, and if the costs of conventional fuel rise rapidly, aggressive solar development could cost no more than use of equivalent conventional resources, and possibly even less. If the reverse proves true (relatively expensive solar and relatively slow increases in costs of conventional fuels), rapid solar expansion would incur net resource costs.

B. Employment Effects

The DPR also estimated cumulative labor requirements for the Base, Maximum Practical and Technical Limits Cases assuming the $25/bbl future. The calculations took into account both the direct and indirect jobs created in supplying solar energy as well as the jobs lost through reduced utilization of conventional fuels. It should be emphasized that the estimates are based on limited data and are therefore very rough approximations.

The results, shown in Table 9, indicate that cumulative labor requirements in the energy sector over the next 22 years could be as much as 3.1 million worker years, or 5 percent, greater in the Maximum Practical Case than in the Base Case, and 9.9 million worker years, or 17 percent, greater in the Technical Limits Case than in the Base Case. Because of the dispersed nature of most solar applications, the jobs created would tend to be fairly evenly distributed across the Nation. Many of the jobs created by an expansion of the solar industry would require low skill levels, thus employing workers subject to the highest rates of unemployment. The effect on unemployment is highly dependent on the specific strategy adopted to accelerate solar energy use.

To the extent that accelerated solar use could result in higher costs than the Base Case, total employment effects could be negative unless offsetting monetary and fiscal policies were implemented. However, if solar systems were no more costly than alternative fuels, then accelerated solar energy use would create somewhat more jobs.

C. The Environment

Solar energy offers several environmental advantages over competing energy sources. Fossil fuel combustion is currently a major cause of air pollution, contributing large

TABLE 9

NET CUMULATIVE
LABOR REQUIREMENTS IN
THE ENERGY SECTOR FROM
1978 TO 2000

(Millions of Worker-Years)

| | Base Case ($25 per Barrel) | Maximum Practical Case | Technical Limits Case |
|---|---|---|---|
| Solar | 4.1 | 10.7 | 22.2 |
| Conventional | 55.7 | 52.2 | 47.5 |
| TOTAL | 59.8 | 62.9 | 69.7 |

quantities of sulfur oxides, nitrogen oxides, hydrocarbons, and carbon monoxide to the atmosphere. These pollutants have been shown to contribute significantly to the incidence of cardiovascular and respiratory diseases as well as the deterioration of crop and property values. Sulfuric acid drainage from coal mines and thermal discharges from electric utilities contaminate the Nation's waters, while oil spills from super tankers and blow-outs from off-shore wells can pollute the oceans. Moreover, coal mining leads to the death of more than a hundred miners and to more than ten thousand mining injuries per year. The Federal Government is now paying compensation of a billion dollars a year to victims of black lung disease.

Nuclear power raises a host of potential environmental problems of its own. These problems arise at every stage of the nuclear process, from extraction, transportation and use of fissionable materials to storage and ultimate disposal of radioactive nuclear waste. These difficulties have led to public concern about the use of nuclear power.

In comparison to conventional fuels, solar energy is relatively clean and pollution-free. Solar energy usually will not contribute to air pollution, except during the production of solar equipment. Increasing solar use from the Base to the Maximum Practical Case will cut emissions of particulates, hydrocarbons, sulfur oxides, carbon monoxide and nitrogen oxides by 8 to 50 percent (see Table 10 for details). At the same time, solar systems will not increase atmospheric carbon dioxide levels which could cause major changes in the global climate.

Some solar processes such as biomass and solar thermal electric with once-through cooling, could have significant water requirements, while leakage and disposal of antifreeze and anti-corrosion fluids from solar heating and hot water systems could produce a minor water pollution problem. However, the widespread use of most decentralized solar systems would be expected to decrease the need for water use in energy supply and reduce the overall potential for water contamination from energy delivery systems.

TABLE 10

NET AIR POLLUTANT SAVINGS IN THE YEAR 2000
Maximum Practical Case vs. Base Case

| | Reductions in Millions of Tons | Percent Change Over Base Case |
|---|---|---|
| Sulfur Oxides | -11.8(savings) | - 8 percent |
| Nitrogen Oxides | - 2.6 | - 8 |
| Carbon Monoxide | - 0.5 | -24 |
| Particulates | - 0.4 | - 9 |
| Hydrocarbons | - 0.4 | -49 |
| TOTAL | -15.7 million tons air pollutants saved | - 8* |

SOURCE: Environmental Protection Agency

Solar technologies will require more land-use per unit of capacity than will conventional energy systems, due to the diffuse nature of the solar resource and the generally low efficiencies of solar devices. However, the potential for serious damage to land resources from activities such as surface mining of coal and shale, and the disposal of uranium wastes does not exist for solar installations.

In sum, while solar energy is not entirely environmentally benign, it does not pose many of the threats to human health and safety and the environment associated with conventional energy technologies.

D. Social Considerations

Use of solar energy avoids some of the types of adverse community impacts that have accompanied the development of conventional energy sources. Disputes between ranchers and coal companies over strip mining in the West, between environmentalists and utilities over the siting of major energy facilities, between energy consuming and energy

*This is the percent change for the five pollutants listed.

producing states over the rate of energy resource development are all inherent in any large increase in most conventional fuels. To the degree that solar energy can substitute for those fuels, it can help reduce the potential for conflict over resource development and facility siting.

Social considerations also play an important role in the public perception of the future benefits of solar development. Many citizens who participated in the public meetings or commented on the DPR Status Report felt that decentralized energy sources would promote the values of individual and community self-reliance and local control over technology development. They felt that other social values such as environmental awareness and willingness to reduce energy consumption would also be promoted by use of solar systems.

E. Foreign Policy and International Trade

In the near and mid term, the United States has an important opportunity to demonstrate international leadership both in assisting developing nations with solar technologies and in cooperating with other countries in technological development and demonstration of solar systems. In addition, the Nation can identify and develop new markets for U.S. products, technology, and services, thereby stimulating domestic employment while contributing to lower costs here and abroad and accelerating global solar use.

In the long term, to the extent that solar energy displaces imported oil and gas, the Nation will enjoy greater flexibility in the conduct of its foreign policy. And, insofar as solar energy systems can substitute for nuclear and petroleum fuels, they can reduce the risk of nuclear proliferation and international tensions arising from competition for increasingly scarce oil supplies. Finally, solar displacement of oil in the year 2000 would reduce annual expenditures for energy imports by approximately $12 billion in the Maximum Practical Case, and by approximately $24 billion in the Technical Limits Case.

# CHAPTER IV

# SELECTING THE APPROPRIATE PACE AND LEVEL OF FEDERAL EFFORT

## I. INTRODUCTION

Several important reasons for supporting solar energy have emerged from the analysis of the first three chapters. Solar energy can reduce the Nation's dependence on increasingly scarce fossil fuels, enhance the quality of the environment, provide employment opportunities, and advance important U.S. foreign policy and balance of trade objectives. Use of solar energy can also reduce depletion of increasingly valuable fossil fuel assets and preserve them for important uses in non-energy sectors of the economy. In the past, price regulations and subsidies to competing energy sources have placed solar energy at a distinct disadvantage, although this gap will narrow in the future. Under any reasonable economic growth scenario, it is clear that supplies of oil and gas will deplete and the Nation and the world will have to rely increasingly upon alternative and renewable energy sources.

The critical question is therefore not whether solar energy should receive support, but rather at what pace and in what form Federal assistance should be extended. This chapter addresses this question, first by identifying the key criteria for making such a decision and then by setting out alternative options for future Federal policy.

## II. DETERMINING THE PROPER PACE FOR FEDERAL SUPPORT

The proper pace of Federal support for solar energy should depend in large part upon the value the Nation attaches to the environmental and other benefits of increasing solar use. In addition, three other factors should play important roles in determining the appropriate level of Federal effort: the availability and cost of alternative energy systems, the future price of oil and other fuels, and the rate of solar technology development.

Unfortunately, the risk that a major energy system will become unavailable, that oil prices will rise rapidly, or that technological development will be delayed cannot be determined with any degree of accuracy. If solar energy is deployed more rapidly than it otherwise would be, in anticipation of events that never occur, the Nation will have wasted resources from accelerated government programs and

investment in more costly energy sources. However, if solar technologies are not available and an alternative system breaks down or oil prices increase dramatically, the cost to the Nation in terms of economic and social disruption could be extremely high.

Major System Breakdown: If major energy systems such as coal or nuclear power fail to achieve current expectations, the widespread availability of solar energy could result in very large savings to the economy. Restrictions on use of conventional systems could occur if it is found that carbon dioxide emissions from fossil fuel combustion interfere with global climate patterns, or if other environmental problems associated with fossil fuel use cannot be surmounted. Similarly, public resistance to nuclear power or a major accident could limit nuclear energy's potential. If any of these systems substantially fail to achieve expected energy contributions, solar energy (along with other energy supply sources and conservation) could help ease the transition.

Rapid Oil Price Rise: If oil prices rise rapidly in the next two decades, a strong solar capability could help protect the Nation against the impacts of such higher prices. However, it is virtually impossible to predict the course that prices will actually take. If depletable resources continue to be plentiful, prices may rise only slowly. For example, substantial increases in natural gas availability could reduce pressures on both foreign and domestic energy price increases and hence slow up the acceleration of solar energy. But if demand rises sharply, if oil supplies are sharply curtailed, or if other fuels become unavailable, the price of oil could increase dramatically within the next decade. To the extent solar technologies could substitute for more expensive fuels and reduce world demand for petroleum products, they could help reduce upward pressures on prices.

If solar technologies do not develop at a relatively rapid pace, they will not be available when oil prices rise or if a major alternative energy system breaks down. Although it is difficult to predict the lead times required for technology development, it is clear that the 22 years between now and the end of the century is not a long time. Many solar applications are most attractive in new installations, yet sixty percent of the buildings, factories and generating plants that will be in use in the year 2000 already exist. Solar units should be introduced soon if they are to provide the basis for rapid deployment in the future.

Apart from these general considerations that affect the appropriate level of Federal support, the government should attempt to take advantage of any opportunities that already exist to promote cost-effective uses of solar energy that are now economic. Given the benefits of increasing solar use, a large number of initiatives for promoting solar energy can be developed that will yield benefits that exceed their cost, and warrant serious consideration.*

## III. OPTIONS FOR FEDERAL POLICY

A wide range of government programs could increase solar energy use. They vary both in the nature of the government activity and the amount of assistance they would provide. The DPR has grouped these programs into three basic policy options representing three different levels of government support:

1. Continue existing Federal programs but make them more effective.

2. Expand the current level of Federal effort with a selection of programs that are targeted to accomplish specific cost-effective objectives.

3. Dramatically increase Federal support with a variety of programs that give accelerated use of solar energy high priority as a National goal.

As noted earlier, existing regulations and subsidies to mature energy technologies result in conventional fuels being priced to the consumer at less than their full cost to the Nation. Progress has been made in correcting these market distortions through reduction of tax subsidies for oil production and enactment of the natural gas provisions of the NEA. However, a precipitous change in existing subsidies and regulations, in an effort to give solar energy parity in the market, could lead to significant economic disruption.

Although the DPR dealt extensively with the subsidy issue, there was insufficient time to conduct an analysis of the full economic and administrative impact of desubsidization. Such a detailed analysis would help to clarify the

*These initiatives are discussed in detail in the Attachment to this Chapter.

distribution of costs and benefits from a policy of across-the-board replacement cost pricing. In the interim, however, efforts to assist the infant solar industry and accelerate national use of solar energy must be considered within the context of existing subsidies and regulations. Within that context, market parity can be approached through compensating subsidies to solar energy. However, if subsidies are used, they should be subject to periodic review so that solar subsidies in the future do not distort energy markets in the same manner as subsidies to conventional fuels do today.

The following discussion assesses each of the three basic options, by examining their impact on solar use and their cost to the Federal government. These cost estimates generally do not include cost reductions from subsidies that would be paid for conventional fuels displaced by use of solar energy.

The DPR has identified five areas of opportunity for Federal action to accelerate solar development. These are:

- Residential and Commercial Applications
- Industrial Applications
- Utility Applications
- Government Operations
- Research, Development and Demonstration.

The Attachment at the end of the chapter describes specific government initiatives which could be adopted to implement each option.

## A. OPTION 1: CONTINUE EXISTING FEDERAL PROGRAMS BUT MAKE THEM MORE EFFECTIVE

### 1. Description

Option 1 takes existing Federal programs and, where possible, redirects them to encourage greater use of solar energy, usually without requiring new expenditures or new legislation. Table 11 summarizes the initiatives for this option. In the residential/commerical sector, for example, more information about passive solar design and construction would be provided to builders, consumers and lending institutions. The Federal National Mortgage Association (FNMA) and

## TABLE 11

## OPTION I INITIATIVES

### Residential/Commercial

Adopt information dissemination and related programs to encourage passive solar.

Assure that Federal lending programs support solar by requiring that goals be established for solar units to be financed and that the criteria for evaluating credit risks be changed.

Extend weatherization programs to include low cost passive and active solar applications.

### Industrial

Make lending assistance available to solar energy under existing Federal general purpose credit programs and establish goals for solar loans.

Permit use of oil and gas under the coal conversion program as a back-up to solar systems. Give back-up use of gas higher priority in case of natural gas curtailments. Give back-up oil priority under crude and product allocation regulations. Allow Clean Air Act non-attainment offsets for solar energy.

### Utility

Use Federal power generation and marketing agencies as models of how utilities can use solar energy.

Expand DOE intervention in public utility commission proceedings.

Allow REA to permit financing of solar facilities.

Provide technical assistance to state agencies to explore use of renewable resources as an alternative to conventional generating stations.

TABLE 11

OPTION 1 INITIATIVES
(Continued)

Government

Federal-Domestic

-- Extend certain Federal purchase programs beyond 1981 at current levels.

-- Revise Federal cost/benefit criteria to include replacement cost pricing and a lower discount rate. Alternatively, DOE funding the difference between the cost satisfying OMB criteria and the actual cost for solar purchases under Military Construction Authorization Act.

Federal - International

-- Coordinate Federal international programs through one agency, with foreign policy guidance from the Department of State.

-- Place increased emphasis on programs for technical cooperation, aid to developing countries for resource development, and export assistance for the U.S. solar industry.

the Federal Home Loan Mortgage Corporation (FHLMC) would be requested to incorporate energy costs in lending criteria, and FNMA, FHLMC, and other agencies would be requested to adopt interim appraisal guidelines for solar energy systems. In addition, increased capital cost ceilings would be proposed where solar energy is used and Federal lending programs directed to establish solar financing goals to assure effective implementation of these changes.

These initiatives, and other proposals for the residential/commercial sector under Option 1, will encourage Federal lending institutions to promote solar development under existing authority.

A variety of regulatory measures would provide incentives for industry to use solar energy. DOE's new coal conversion program would be modified to allow oil and gas back-up for solar facilities. Back-up use of gas would receive higher priority in case of natural gas curtailments. Oil used as a back-up for solar energy would also receive priority under the crude and product allocation regulations, which would be activated in case of an embargo, and Clean Air Act offsets would be allowed for use of solar energy in non-attainment areas. Together with other incentives that might be available, these regulatory measures could provide increased certainty of energy supply, a crucial factor in the economic viability of many industrial operations. Recent industrial conversions from gas to more expensive oil clearly identify the value placed on such certainty.

In the utility sector, Federal power generation and marketing agencies would be used as models to show how utilities can promote solar energy. In addition, DOE would provide technical assistance to state agencies to explore use of renewable resources as an alternative to conventional central generating stations.

Federal leadership through use of solar energy in its own operations can encourage other sectors of the Nation to increase their solar investments. A key initiative in this area will be to revise the Federal cost-benefit criteria for evaluating solar purchases to reflect the replacement costs of conventional fuels and the Federal cost of borrowing. In addition to changing the cost-effectiveness criteria, $40 million per year would be appropriated to DOE to directly fund the difference between the maximum solar cost that satisfies OMB criteria and the actual market cost for solar purchases under the Military Construction Authorization Act. If adopted, either of these modifications should stimulate increased Federal solar purchases in the future.

In the international area, one agency would have responsibility for coordinating all Federal international solar energy programs, under the foreign policy guidance of the Department of State. Increased emphasis would be placed on programs for technical cooperation, aid to developing countries for resource development, and assistance to U.S. industry in assessing and participating in international solar markets.

2. The Cost

Because the initiatives in Option 1 for the most part redirect existing programs, this option does not require substantial new Federal outlays. Cumulative additional expenditures for Option 1 would total about $160 million in the 1980 to 1985 period over current and planned programs. There would be no increase in Federal outlays in 1980 or 1981. An additional $75 million could be reprogrammed for the passive solar information program over the 1980-85 period. Most of the initiatives in Option 1 will not require new legislation. To a large extent they can be accomplished by administrative actions.

3. Energy Impact

It is extremely difficult to quantify the energy impact of individual Option 1 programs. To a large extent, they consist of information dissemination, reallocation of priorities, and better coordination of existing programs. Nevertheless, a rough estimate of the fuels displaced by solar penetration under the first option by the year 2000, taking into account planned increases in current programs, would be between 0.3 and 0.7 quads at a world oil price of $25 per barrel in the year 2000.

## B. OPTION 2: EXPAND THE CURRENT LEVEL OF FEDERAL EFFORT WITH A SELECTION OF PROGRAMS THAT ARE TARGETED TO ACCOMPLISH SPECIFIC COST-EFFECTIVE OBJECTIVES

1. Description

The second option builds on the analysis in Chapter 2 and sets forth program recommendations to fill gaps

in current programs. This option reflects the view that a variety of initiatives can be designed at the present time to meet needs in specific end-use sectors, and that these initiatives can yield benefits to the Nation that exceed their cost. Thus, Option 2 presupposes adoption of most of the initiatives under Option 1, but extends the scope of Federal activity beyond existing programs.

Table 12 lists the initiatives grouped under Option 2. Most of these proposals attempt to address the shortcomings of existing programs. For example, in the residential/commercial sector, tract builders, who build over 60 percent of new homes, have little incentive to take the risks associated with construction and sale of innovative passive solar buildings. Information programs and the NEA tax credits do not sufficiently reduce these risks. Option 2 addresses this problem by providing a tax credit to builders of energy efficient houses and commercial structures. Such structures would emphasize conservation, passive solar design, and use of active solar devices. The credit would be based on the energy efficiency of the building in relation to energy efficiency standards for new buildings, which are to be promulgated in 1979.

Under Option 2, legislation is proposed to enable lessors to qualify for the regular investment tax credit for solar hot water and space heating and cooling investments. This initiative provides a strong incentive for lessors to develop a solar leasing business and, in this way, promotes competition. In addition, it allows the consumer to avoid service, warranty and initial capital cost problems associated with purchasing a solar system. This initiative could also encourage renters to use solar energy systems.

Option 2 would establish a Solar Bank which would initially focus on the financing needs of residential consumers who may be reluctant to make the substantial capital investment required for a solar energy system. Although the monthly payments for such a system are reduced by lower fuel bills, consumers may experience increased payments (net of fuel savings) during the early years of use if the solar equipment has been financed with a relatively short term, home improvement loan at market interest rates. Since the average home is owned for 7 to 10 years, homeowners may be unwilling to finance solar energy systems that do not yield financial benefits in this period. The Bank would

TABLE 12

OPTION 2 INITIATIVES

Residential/Commercial Sector

Tax credit to builders for energy efficient construction

Permit lessors to qualify for the regular investment tax credit for solar hot water and space heating and cooling expenditures.

Adopt a 4 year, $10 million pilot program for 80 percent grants to low income homewoners, condominiums, and cooperatives through the HUD Community Development Block Grant Program and Farmers Home Administration.

Increase Public Housing prototype costs up to 20 percent where solar systems are used; extend FHA increased mortgage limits to all housing subsidy programs; increase appropriations for Section 8 and Public Housing programs by $10 million per year to fund installation of solar energy systems.

Enhance existing voluntary product testing and certification program; require standardized quality and performance information for solar products; develop a warranty reinsurance program if needed.

Establish a Solar Bank to purchase, and commit to purchase, subsidized and unsubsidized residential loans made by private lending institutions, and to guarantee loans and leases.

Industrial Sector

30% tax credit or expensing for solar equipment.

Utility Sector

Where appropriate, require the REA to allocate an increasing percentage of its loans to solar energy systems. Where such loans are precluded by existing law, modify the Rural Electrification Act or establish a Rural Energy Development Fund for solar investments, to be administered by REA. Alternatively, DOE could provide supplemental funding.

TABLE 12

OPTION 2 INITIATIVES
(Continued)

Utility (continued)

The President would request state public utility commissions to encourage or require conservation and solar energy.

Develop plans to maximize hydroelectric generation at existing Federal dam sites, and to allow Federal power generation and marketing agencies to make use of the broad range of solar technologies.

Government Sector

Federal Operations

Require all new civilian Federal facilities* to use passive solar design and the maximum amount of active solar. If OMB criteria are not changed as per Option 1, DOE could fund the difference between the cost satisfying these criteria and the actual cost for selected applications.

Use active solar systems in Postal Service facilities and other high visibility Federal buildings.

State and Local

Provide an additional $15 million per year to give higher priority to solar energy planning in State Energy Management Program.

RD&D

Expand funding and emphasis in FY 1980 RD&D budget on near term technologies and technologies that displace oil and gas. Give consideration to reprogramming of DOE FY 1979 energy RD&D funds, consistent with the FY 1980 budget emphasis.

*DOD facilities are addressed by the Military Construction Authorization Act.

address this problem by working with existing financial institutions to purchase and commit to purchase subsidized and unsubsidized mortgage and home improvement loans for solar energy systems, including FHA subsidized home improvement loans specifically targeted to low-income groups. The secondary market operations of the Bank would permit residential consumers to match monthly financing charges with fuel savings.

In the area of consumer protection, the DPR was unable to conclude that private warranty insurance was or was not readily available to solar manufacturers and distributors. This issue merits careful monitoring, and consideration should be given to a Federally-supported program of warranty reinsurance if the need is clearly established.

In the industrial sector, Option 2 calls for legislation providing a 30 percent total investment tax credit for industrial and agricultural solar applications. The existing credits under the NEA are too small and expire too soon to result in widespread industrial use of solar technologies. The proposed change, which would last through 1985, would add 10 percent to the credit already provided in the NEA. Alternatively, a similar level of additional assistance could be provided through direct expensing of solar equipment. The additional incentive provided by either means would reduce solar energy costs through technological improvements sooner than would otherwise be expected.

In the utility sector, the REA would be required to allocate an increasing percentage of its loans to solar energy systems. This would require legislative changes to the Rural Electrification Act. An alternative would be to either authorize a Rural Energy Development Fund under REA, or provide supplemental funding from DOE.

Option II would require Federal power generation and marketing agencies to develop plans to maximize hydroelectric generation at existing Federal dam sites and allow them to make use of the broad range of solar technologies.

Federal use of solar energy would also increase under the second option. Federal purchases of solar energy equipment under Option 1 might not be visible enough to ensure an impact on private sector decisions to use solar energy. Federal solar use would therefore be accelerated and made more visible under Option 2. All new Federal facilities would be required to use passive and active solar

systems when such systems are cost-effective (under the revised criteria proposed under Option 1) and suitable for site and building purposes. In addition, Postal Service and other Federal buildings which are used frequently by the public would be retrofitted with solar heating, cooling and hot water systems.

Federal RD&D activities would be redirected and expanded, and improved coordination would be instituted among complementary solar programs in Federal agencies. Near-term technologies for the direct production of heat and fuels, community-scale applications, low-cost technologies and basic research would receive increased support, while technologies for electricity generation at centralized facilities would be developed at a more moderate pace. The solar RD&D program of the Department of Energy would increase from $554 million in budget authority in FY 1979, to $746 million in FY 1980. These funds would all be within DOE's overall budget ceiling. Reductions in other DOE programs would accommodate this increase. Consideration would also be given to reprogramming of DOE FY 1979 energy RD&D funds, to provide consistency with the FY 1980 budget emphasis.

2. The Cost

The initiatives under Option 2 would increase cumulative Federal outlays for solar energy by $58-$83 million in 1980, $315 to $340 million in 1981, and by approximately $2.5 billion between 1980 and 1985 over the level required by Option 1.* However, this Federal cost would be reduced as a result of subsidies not paid during this period for conventional fuels displaced by solar energy. The largest cost increase would come from the tax credits to stimulate passive solar construction, which would total roughly $1.3 billion over the 1980-1985 period, and the additional credits for industrial and agricultural solar applications, which would total $360-390 million in the same period. Increased use of solar energy in Federal operations and funds to states for solar programs would cost roughly $160 million. The budget outlays for initial capital transferred to the Solar Bank through 1985, are estimated to be $500 million. The Bank will also induce indirect costs of $1.3 billion because tax expenditures for solar equipment eligible for credits under the Energy Tax Act of 1978 will increase.

*This figure does not include DOE's request for increased solar R&D funding in FY 1980 of approximately $200 million. This increase would be within DOE's overall budget ceiling.

Unlike Option 1, many of the initiatives under Option 2 would require new legislation. However, retrofitting of postal facilities and other high visibility government buildings with active solar systems could largely be carried out under existing authority.

3. The Energy Impact

Although predictions of future energy impacts cannot be precise, it is estimated that those Option 2 initiatives most susceptible to analysis would increase the fuels displaced by solar energy in the year 2000 by 1.4 to 2.3 quads over Option 1 if world oil prices rise to $25 per barrel (see Table 13). Other initiatives, whose impacts are more difficult to analyze, could increase this penetration by 0.5 to 1.5 quads. The best estimate of the likely fuel displacement is 2 to 3 quads. Most of this increment would be stimulated by the tax credits for passive solar construction and industrial solar equipment, and by the activities of the Solar Bank.

## C. OPTION 3: DRAMATICALLY INCREASE FEDERAL SUPPORT WITH A VARIETY OF PROGRAMS THAT GIVE ACCELERATED USE OF SOLAR ENERGY HIGH PRIORITY AS A NATIONAL GOAL

1. Description

Option 3, which has been proposed by solar advocates working with national environmental organizations and other public interest groups, calls for a major national commitment to solar energy. A commitment of this magnitude has received support from the solar industry, some labor unions and consumer groups. The option proposes immediate and dramatic efforts to increase the market penetration of renewable energy systems on the basis that current subsidies and price regulations limit the use of solar energy, and because solar energy has significant environmental, safety, and other advantages over conventional fuels. The option presupposes that a dramatic oil price rise or a breakdown in a major alternative energy system is a strong possibility before the end of this century and that solar technologies could be in place in sufficient quantities to reduce the disruptive effects.

Option 3 also assumes that all of the initiatives in Option 1 and many of the initiatives in Option 2 would be adopted. However, in general it recommends larger financial incentives and stronger regulatory measures than Options 1 and 2.

TABLE 13

OPTION 2: ESTIMATES OF COSTS AND QUAD IMPACTS

| | 1985 | | 2000 | |
|---|---|---|---|---|
| | Quads** | Costs (millions) | Quads** | Costs (millions) |
| **Policy Initiatives** | | | | |
| **Residential/Commercial Sector** | | | | |
| Single Family Passive Credits | 0.03 | $ 615 | 0.1-0.3 | $ 615 |
| Multi-Family/commercial Passive Credits | 0.07 | 700 | 0.2-0.6 | 700 |
| Leasing | * | 30-150 | * | 30-150 |
| Low Income | — | 80 | — | 80 |
| Consumer Protection | — | — | — | |
| Finance-Solar Bank*** | 0.05 | 500 | 0.6 | 500 |
| **Industrial Sector** | | | | |
| Process Heat Tax Credits | 0.02 | 360-390 | 0.4-0.7 | 360-390 |
| **Utility Sector** | | | | |
| Presidential Initiatives | — | — | — | — |
| REA | — | — | — | — |
| **Government Sector** | | | | |
| Federal Buildings | — | 82 | — | 82 |
| Postal Service | — | 4 | — | 4 |
| SEMP | — | — | — | — |
| RD&D | — | — | — | — |
| Total | 0.17 | $2440-2600 | 1.4-2.3 | $2440-2600 |

*Minimal impact.
**Primary fuels displaced over Option 1.
***Outlays; includes $500 million initial capital transfer to the Solar Bank from Treasury.

Option 3 presents a series of policies designed to reach a level of solar penetration roughly commensurate with the Technical Limits Case -- 28 quads of solar by 2000. Option 3 goals are achieved by a combination of financial incentives and regulatory measures if the financial incentives fail to achieve prescribed goals.

The initiatives under Option 3 are summarized in Table 14. In the residential/commercial sector, passive solar would be given a major boost by a tax credit of $1000 per building to builders to help defray costs of employing passive solar construction. To qualify for this credit, structures would be required to meet a specified and increasing percentage of the building's heating load by passive solar measures. A national goal would be set to require newly constructed buildings to exceed Building Energy Performance Standards (BEPS)* by 50% by 1987. If, by 1987, 80 percent of new construction did not meet this "50 percent below BEPS" standard, the credit would be replaced by a mandatory program. If program goals were attained, the credit would continue on a declining scale, and be phased out entirely by 2000.

Option 3 sets an ambitious goal of 25 million combined solar systems (both space and hot water heating) in place by 2000. This goal is to be achieved primarily by retrofitting existing buildings. It is conceivable, but highly unlikely, that this goal could be attained by the combination of the NEA tax credits and the information, leasing and financing initiatives under Options 1 and 2. Option 3 provides assurance of meeting this goal in two ways.

First, if 10% of all buildings do not have combined systems installed by 1987, a mandatory program and credit allocation policies, described in the Attachment to Chapter 4, would be invoked. These policies would use the leverage of Federal regulatory authority over the banking industry to require that combined solar systems be installed in a specified percentage of buildings as a prerequisite for loans and loan guarantees.

Second, tax credits for combined systems would be continued after 1985 if the 10 percent goal were not attained. The credits would be reduced to 15% of system costs in 1986, compared to the NEA level of roughly 22 percent. The credits would then gradually be reduced to zero by 2000.

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*Promulgation of Building Energy Performance Standards was mandated by Public Law 94-385.

## TABLE 14

## OPTION 3 INITIATIVES

### Residential/Commercial

$1000 tax credit for builders exceeding BEPS standard by 40-80%. Mandatory passive solar if 80% of new dwelling units do not meet goals by 1987.

A national goal will be established to have 10 percent of all dwelling units have active solar heating and hot water systems by 1987 and to have 25 million combined (hot water and heating and/or cooling) systems by 2000. Mandatory program if program goals not met by 1987; tax credits continued for combined systems under mandatory program if other fuels subsidized.

Federal coordination of private sector standards development testing, and certification; grants for private standard organizations; flexible standards for Federal procurement; certification of on-site systems; warranty insurance program.

Increased funding to states for consumer protection and solar energy planning.

### Industrial

50% tax credit for industrial process heat, phased out beginning in 1985.

30% tax credit plus rapid write-offs for solar manufacturing equipment.

5% mandatory gasohol by 1985; 20% by 2000.

### Utility

Non-discriminatory pricing for solar and renewables; mandatory state rate proceedings for solar energy users; stronger DOE right of intervention; elimination of tax advantages for municipal utilities that do not comply with solar rate reforms.

10% of new electric capacity must be renewable in each load area by 1985; 60% by 2000.

TABLE 14

OPTION 3 INITIATIVES
(Continued)

Utility (Cont.)

15% of all gas through interstate pipelines must be from renewable sources by 2000.

Government

Renewables supply 7.5% of energy needs for existing Federal buildings by 2000.

Expand State commercialization efforts; increase Federal funding for states by $100 million per year.

Expand Federal procurement from photovoltaics to all solar products and use for foreign non-nuclear energy assistance programs.

RD&D

Increase funding to double FY 1980 level by 1982, and spend $18 billion cumulatively through 1985.

Employment

Increase funding for solar job training by $180 million per year.

In the industrial sector, Option 3 would provide substantial stimulus to solar energy above the level provided by Option 2. Legislation would be proposed to increase the tax credit for industrial process heat systems employing solar energy to 50 percent, or 30 percentage points above the NEA. This credit would also be phased out on a declining scale after 1985. However, unless solar systems comprised at least 30 percent of new capacity installed in 1987, mandatory policies, similar to those in the original NEA coal conversion program, would replace the tax credits.

Option 3 would also require that increasing percentages of new electric generation facilities be powered by renewable resources. Legislation would be proposed to require that the equivalent of 10% of all new electric generating capacity installed annually in each utility service area be supplied by renewable sources starting in 1985. The utilities would not have to own or lease the solar systems. However, they would be required to assure that these objectives were met within their service area.

Two other programs presented in Option 3 would have substantial energy impact by 2000. The first would require an increasing percentage of alcohol fuels in the national motor fuel mix -- rising to 20% by 2000. Initially this proposal would rely on the NEA "gasohol" tax exemption to attain program goals. However, the subsidies currently made available for the Department of Agriculture's acreage set-aside program would be transferred to producers of biomass for alcohol fuels, if the NEA programs did not work.

In the utility area, Option 3 would require that an increasing percentage of gas flowing through interstate pipelines be supplied from renewable sources. The national goal would be to supply 15 percent of expected gas use in 2000.

Finally, Option 3 proposes a variety of policies to ensure that major program goals in the residential/commercial, industrial, utility and transportation sectors can be attained. These include more than doubling the RD&D budget proposed in Option 2; establishing a Solar Coordinating Council under the Vice President; an additional 30 percent tax credit for solar equipment manufacturers, and an ambitious plan to make Federal buildings and facilities showcases for solar energy.

2. The Cost

The additional cost to the Federal government of Option 3 over the cost of Option 2 would be $6 billion in 1980, $10 billion in 1981, approximately $40 billion for the period 1980 to 1985, and approximately $110 billion for the period through 2000. The most expensive programs would be the tax credits for industrial applications and for use of passive solar. If the financial incentives are phased out in the mid-1980's and replaced by regulatory measures, Federal costs through the year 2000 would be reduced to about $80 billion. These costs do not take into account subsidies which would not be paid to conventional fuels displaced by Option 3 initiatives, nor other environmental and national security benefits. Analysis is underway to determine the magnitude of these benefits.

Most of the policies proposed in Option 3 that incur significant Federal costs use a combination of financial incentives and regulatory authority. However, if and when mandatory programs are invoked, financial incentives may or may not be continued. This results in two different cost estimates for Option 3.

Table 15 shows costs and quad impacts for the two cases through 1985 and 2000. In column 2 costs are tabulated through 2000 on the assumption that program goals will be fulfilled and incentives continued. Column 3 shows the corresponding costs if mandatory programs come into play and financial incentives other than the Solar Bank are discontinued after 1987.

3. The Energy Impact

Option 3 would increase solar penetration in 2000 by approximately 19 quads above the Base Case, for a total of about 28 quads. This estimate assumes that all of the program goals are attained, either through financial incentives or mandatory policies. Such a program would give solar energy high priority as a national goal, drawing upon the full capacity of manufacturers, contractors, credit institutions and other parts of the economy. Such acceleration would divert resources from other sectors of the economy to an unknown extent.

The largest energy impacts would come from the residential/commercial sector where passive and active systems would displace almost 5 quads by 2000, as shown in Table

TABLE 15

Option 3 Federal Outlays and Net Costs
(in billions of dollars)

| | Costs Through 1985 | Costs Through 2000: Incentives through 2000 | Costs Through 2000: Incentives end in 1987 |
|---|---|---|---|
| Outlays | 44 | 113 | 81 |
| Incremental Quads* (See Table 16) | 2.7 | 18.7 | 18.7 |
| Total Quads** | | 28.6 | 28.6 |

16. The renewable electric policies would contribute 4.6 quads; biomass gas 2.3 quads; industrial process heat 3.6 quads; and alcohol fuels 2.0 quads. Estimates for both the costs and energy impacts of Option 3 have a greater range of uncertainty than those for Option 2.

D. Summary

Table 17 summarizes the initiatives under each option. As mentioned earlier, these options are not the only possibilities for future government policy. Other options could be formulated using different combinations of these initiatives, or new ones. The important point is that a broad range of actions are potentially available to the Federal government, acting in concert with state and local governments and the private sector, to accelerate use of solar energy.

## IV. CONCLUSION - A NATIONAL GOAL FOR SOLAR ENERGY

### A. Should There be a Goal?

A final and important question is whether the President should set a national goal for solar energy use. A national goal has been advocated for several reasons. It would clearly demonstrate a long-term U.S. commitment to use of renewable energy sources both at home and abroad, and would give solar energy more credibility in the public mind as an attractive alternative to conventional energy sources. A goal can also serve as a useful management tool for

* Incremental quads above the Base Case.

** Total quads displaced by solar in the year 2000.

TABLE 16

Option 3: Estimates of Costs and Quad Impacts

| | 1985 | | 2000 | |
|---|---|---|---|---|
| | Quads* | Cost (Billions) | Quads | Cost (Billions) |
| Policy Initiative | | | | |
| Residential/Commercial | | | | |
| Residential | | | | |
| passive | 0.3 | $ 7.4 | 1.7 | $ 17.4 |
| active | 0.2 | 1.0** | 2.1 | 12.1** |
| Commercial | | | | |
| passive | 0.1 | 1.7 | 0.7 | 4.5 |
| active | *** | 1.5 | 0.3 | 5.3 |
| Industrial | | | | |
| process heat tax credits | 0.5 | 6.9 | 3.6 | 18.8 |
| Utilities | | | | |
| renewable electric | 0.5 | - | 4.6 | - |
| biogas | 0.5 | - | 2.3 | - |
| Transportation | | | | |
| gasohol | 0.3 | - | 2.0 | - |
| Government | | | | |
| Federal buildings | *** | 2.5 | 0.1 | 10.0 |
| R&D | - | 18.0 | - | 30.0 |
| Other | 0.2 | 5.3 | 1.4 | 15.0 |
| Total | 2.7 | $44.3 | 18.7 | $113.1 |

*Primary fuels displaced over Base Case.

**Outlays; includes $1.0 billion initial capital transfer to Solar Bank from Treasury.

***Less than 0.01 quads.

TABLE 17

DPR PROPOSED POLICY INITIATIVES

| | OPTION I | OPTION II | OPTION III |
|---|---|---|---|
| Residential | | | |
| Passive Solar | Information dissemination. | Tax credit for energy-efficient construction. | $1,000 tax credit for builders exceeding BEPS standard by 40-80%. Mandatory program if stated goals not met by 1987. |
| Financing | Require each housing lending program to set a goal of solar units financed. | Establish a Solar Development Bank to provide subsidized and unsubsidized residential loans and guarantees. | |
| Low-Income | Extend weatherization programs to include solar applications. | Two 4-year, $10 million programs to enhance solar use by the poor. Set goals for solar use in HUD housing assistance programs. | |
| Consumer Protection | | Enhance existing voluntary testing and certification program; require standardized solar product information; develop warranty reinsurance program, if needed. | Certification of on-site systems. Warranty insurance program. Increased funding to states for consumer protection and solar energy planning. |
| Tax Credit | | Extend investment tax credit to leased property. | NEA residential tax credit phased out gradually rather than dropped after 1985. Mandatory program if reductions in residential energy requirements do not occur by 1985. |

DPR PROPOSED POLICY INITIATIVES (CONTINUED)

| | OPTION I | OPTION II | OPTION III |
|---|---|---|---|
| Industrial | Give priority to solar users under the coal conversion program, natural gas curtailments, and crude and product allocation regulations. Allow Clean Air Act non-attainment offsets for solar energy. Direct existing general purpose credit programs toward solar energy. | 30% tax credit or expensing for solar process heat equipment. | 50% tax credit for industrial process heat, phased out after 1985. 30% tax credit plus rapid write-offs for solar manufacturing equipment. Mandatory program after 1987 if goals are not met. |
| Utility | Use Federal Power Generation and Marketing Agencies as models of how utilities can use solar energy. Expand DOE intervention in public utility commission proceedings. Allow REA to permit financing of solar facilities. Provide technical assistance to state agencies to evaluate renewable alternatives to utility capacity expansion. | Enable REA to allocate loans to solar energy systems by modifying REA Act or establishing a Rural Energy Development Fund. Request state public utility commissions to encourage conservation and solar (Presidential letter). | Non-discriminatory pricing for solar and renewables. Mandatory state rate proceedings for solar energy users. Stronger DOE right of intervention. 15% of all gas through interstate pipelines will be from renewable sources by 2000. 10% of new electric capacity must be renewable in each load area starting in 1985; 60% by 200 |
| Government | | | |
| Federal | Extend current Federal purchase programs beyond 1981 at current levels. Revise Federal cost/benefit criteria to include replacement cost pricing and a lower discount rate, or have DOE provide supplemental funding for expenditures under the Military Construction Authorization Act. | Require all new civilian Federal facilities to use passive solar design and cost effective active solar systems. Have DOE fund solar costs above cost-effectiveness limit. Demonstrate active systems in highly visible Federal buildings. | Renewables supply 7.5% of energy needs for existing Federal buildings by 2000. |

DPR PROPOSED POLICY INITIATIVES (CONTINUED)

| | OPTION I | OPTION II | OPTION III |
|---|---|---|---|
| State and Local | | Give higher priority to energy planning in State Energy Management Programs. | Expand State commercialization efforts; increase Federal funding for states by $100 million per year. |
| International | Redirect programs to emphasize technical cooperation, aid to developing countries and development of an international market. Improve program coordination. | | Expand Federal procurement from photovoltaics to all solar products and use for foreign non-nuclear energy assistance programs. |
| RD&D | | Increase emphasis in FY'80 budget on near-term technologies and those which displace oil and natural gas. Consider 1979 reprogramming consistent with 1980 program thrust. | Increase funding to double FY'80 level by FY'82. |
| Gasohol | | | 5% mandatory gasohol by 1985; 20% by 2000. |
| Employment | | | Increase funding for solar job training by $180 million per year. |

designing and tracking the progress of Federal programs, and can provide some assurance to current and potential manufacturers of solar equipment that there will be a continuing Federal effort to expand solar markets. A national goal would also help to dramatize the importance of solar energy, and galvanize the Nation behind the Administration's plan. Indeed, many individuals and groups might judge the Federal solar effort less on its individual initiatives than on its overall goal.

However, a national goal also has several drawbacks. Selecting a realistic goal can be difficult because predictions about future energy supply, demand and prices are extremely uncertain. A goal set corresponding to the projected impact of the first two policy options may not appear sufficiently ambitious. But a high goal which is unrelated to the estimated impact of government programs will be difficult to justify. Moreover, if the goal raises expectations that cannot be fulfilled, the Federal government will ultimately lose credibility with the public. Any goal that is set would have to be reassessed as new technological developments occur and changes take place in the energy market.

B. What Should the Goal be?

If there is to be a goal, what should it be? Numerical goals have appeal as concrete, understandable targets. But if national efforts are not successful, they become unpleasant reminders of how much we have missed the mark.

If a quantitative goal is set, there are at least three possibilities - 15 or 25 quads of total demand displaced by solar energy in the year 2000, or some number in between. The 15 and 25 quad goals would correspond roughly to Options 2 and 3. A goal based on Option 1 would be close to what would happen even without an expanded Federal effort, and as such would have little practical value as a target for government policy.

15 Quads: A 15 quad goal can be supported by Option 2 programs (and some additional efforts in the future) if oil prices rise to $32 a barrel in the year 2000. At $25 a barrel this figure would be closer to 12-13 quads. The disadvantage of the 15 quad goal is that the interested public may conclude it is too modest to demonstrate a national commitment. Certainly, the Nation's leading solar advocates will probably view it as inadequate and would prefer no goal to one set this low. A goal which is perceived as being too low would probably be counter-productive in terms of gaining public support.

18 to 20 Quads: A goal somewhere in the range of 18 to 20 quads could be supported by a policy which combined programs from Options 2 and 3. Alternatively, such a goal might be justified by selecting Option 2 and indicating that new initiatives will be adopted to the extent they are warranted by future conditions, and that strong support from industry and state and local governments will be essential to achieve this goal. For example, technologies that are not ready for commercialization at this time might be given financial incentives in the future when they are close to being economic. A goal between 18 and 20 quads, corresponding to roughly 20 percent of total energy demand from renewables in the year 2000, would demonstrate a major Federal commitment to solar development, provide strong stimulus to the solar industry, and appeal to a broad spectrum of those concerned with solar energy. Such a goal would not be easy to achieve, and could create pressures for subsequent calls on the budget. Although such pressures will exist in any case, creation of a goal will make it more difficult for the Administration to control budget add-ons.

25 Quads: A 25 quad goal, which corresponds most closely to Option 3, would create the most favorable climate to stimulate accelerated use of solar energy. A 25 quad goal would imply a major national commitment to solar development. As a goal, however, 25 quads is pushing the upper limit of what is achievable, and the Federal role would be far-reaching and costly (approximately $40 billion more than current and planned programs between 1980 and 1985). If this goal cannot be attained by the programs actually selected, the goal will be difficult to justify to Congress and the Nation. Moreover, if the public does not believe the Administration's goal can be achieved, the government's program will have little credibility.

Whatever the Federal goal might ultimately be, it is important that the government reassess the target over the course of time as more information is obtained about the potential of solar energy.

It is also important that the government not deceive itself about the nature of its own role. Federal actions alone cannot ensure widespread solar use. Many barriers and opportunities occur at state and local levels, and actions at all levels of government and by large numbers of individuals and groups will certainly be required to achieve significant solar penetration.

Domestic Policy Review of

# Solar Energy

ATTACHMENT

A Response Memorandum to
The President of the United States

TABLE OF CONTENTS

# Domestic Policy Review For Solar Energy

## Attachment To The Response Memorandum To The President

Introduction: This attachment is divided into three sections, each of which describes specific programs consistent with the level of effort associated with a given policy option. These programs are designed to overcome barriers that hinder the use of solar energy technologies in the residential/commercial, industrial, utility, and government sectors of the economy. The programs in Options I and II and the analysis of their costs and energy impacts are based on detailed DPR analyses contained in the Appendices. The programs in Option III have been suggested by solar advocate groups to address problems which prevent widespread solar energy use and to attain an overall level of solar energy use roughly commensurate with the technical limits case developed by the DPR.

The programs have been grouped by policy option to facilitate a policy decision. Differing combinations of programs could have similar cost and energy impacts and possibly be more effective. The groupings shown here are based on the best judgment of the DPR staff.

## Program Descriptions - Policy Option I

Policy Option I assumes the continuation of existing Federal programs and redirects these programs to encourage greater use of solar energy. This Option would ensure that Federal housing, financing, economic development, utility, procurement, and information programs actively support the commercialization of solar technology. It would cost $160 million through 1985. It would involve no budget outlays in 1980 or 1981. Energy impacts will range between .3 and .7 quads in 2000.

### 1. Residential and Commercial Sector

#### a. Passive Solar

(1) Problem Statement: Passive solar designs and construction techniques have not been adopted by the building industry despite apparent cost-effectiveness. In part, this resistance has been because passive solar designs are not well understood by the public or the building industry, in part, because the tax credits contained in the National Energy Act are incomplete with regard to passive solar buildings, and in part, because builders and lenders tend to avoid the risks of non-conventional building designs.

(2) Program: DOE would provide more information about passive solar design and construction techniques to builders, consumers and lending institutions. The current DOE passive solar design competitions would be expanded to include a more comprehensive information program concerning energy efficient buildings. Under the expanded program, expenditures would be increased from the current $5 million per year to $20 million per year. Of the incremental $15 million, $9 million would be spent for improved methodologies for predicting end-use energy consumption from building plans and designs, and $6 million on information programs targeted at architects, builders and engineers, and owners and lenders. State energy offices, community groups, and other professional groups would participate in this information collection and dissemination program. These funds could be reprogrammed from existing DOE resources.

(3) Analysis: While the DOE design competitions will provide examples of passive solar designs, builders and architects need substantially more information in order to predict end-use building energy efficiency prior to construction. This program is designed to augment the programs under the Buildings Energy Performance Standards program (BEPS) and to strengthen the capability for evaluating energy reductions associated with building design features. Such information should expand the use of passive solar designs in the custom-built home market and the commercial building sector, and be useful to builders in meeting the building energy efficiency standards included in the NEA. It is not clear, however, whether additional information on building energy efficiency alone will be sufficient to stimulate tract builders and builders of multifamily housing developments to adopt passive solar building designs.

b. Financing

(1) Problem Statement: Residential use of solar energy has been impeded by several financing problems.

First, the Federal National Mortgage Association (FNMA) and the Federal Home Loan Mortgage Corporation (FHLMC) do not specifically include energy costs in addition to principal, interest, taxes, and insurance (PITI) in their underwriting criteria for conventional mortgages. This omission of energy costs from underwriting criteria is important because many lenders use FNMA or FHLMC forms in processing conventional loan applications, either to permit mortgage sales to secondary markets during periods of tight money or to show that credit risk evaluations are based upon the "market standard." FNMA or FHLMC conventional lending standards could potentially be used in 80 percent of all mortgage originations.

Second, public and private appraisal policies for solar energy systems need further definition. Traditionally, the marketplace has established home appraisal values. However, a home with a solar system has an insufficient resale history to have an established market value. While FHA has initiated procedures for determining a solar

system's value based on a reasonable cost, the Veteran's Administration (VA), the Farmers Home Administration (FmHA), FHLMC, and FNMA have not established appraisal policies for solar energy systems when comparable market values cannot be determined. This lack of appraisal policies is significant because it means that about 90 percent of the mortgage market operates without practical guidelines for appraising solar energy systems.

Capital cost ceilings in FNMA and FHLMC guidelines, in FmHA, in HUD/GNMA Tandem Assistance Programs and certain other HUD programs are a third financing impediment to the wider use of solar energy in single and multifamily homes. Solar energy systems involve a tradeoff between additional capital costs and conventional energy savings. However, these tradeoffs cannot be made by homebuyers when proposed loans are at or near program ceilings.

Finally, while FHA mortgage insurance programs call for including energy costs in underwriting criteria and for appraising solar systems at reasonable costs when market values do not exist, these guidelines are not always implemented effectively. For instance, in some cases, lenders calculate energy costs by using an area's average monthly utility bill and adding to that estimate the first two digits of the home's selling price. Unless the utility bill is adjusted to include the solar system's projected energy savings, there is nothing in such a formula which would benefit the solar home buyer.

(2) Program: Four recommendations are made to improve the effectiveness of existing private and Federal lending programs in the residential sector:

- o request that the Federal Board members of FNMA and FHLMC recommend:

  - that the institutions' underwriting criteria incorporate energy costs in addition to PITI;

  - that these institutions develop interim appraisal guidelines for solar energy which would permit the use of reasonable cost appraisals in the absence of market comparables;

- That these institutions set solar financing goals and report on meeting these goals;

- o recommend legislation to enable FNMA and FHLMC to raise their capital cost ceilings to reflect the increased costs of solar systems;

- o direct the Veteran's Administration and the FmHA to develop interim appraisal guidelines for solar energy which would permit the use of reasonable cost appraisals in the absence of market comparables;

- o extend the increased solar capital cost ceilings enacted as part of the Conservation Policy Act in certain HUD, FHA, and FmHA programs to VA entitlements programs and HUD/GNMA Tandem Assistance programs; and

- o direct FHA, VA, and FmHA to set solar financing goals, to monitor the effectiveness of their underwriting and appraisal policies, and to report on meeting these goals.

(3) Analysis: The primary purpose of these recommendations is to ensure that single and multifamily borrowers who wish to install solar systems will have access to conventional and federally insured financing on the same basis as borrowers who install conventional energy systems. The changes recommended for the FNMA and FHLMC underwriting and appraisal criteria are the most important of these proposals because, while these institutions account for only about 5% of housing finance transactions per year, their underwriting and appraisal criteria are used by a much larger segment of the market. However, because FNMA and FHLMC are corporations not directly controlled by the Federal government, there is no assurance that the Federal members of their boards of directors would be able to effect the changes proposed.

Because it would tap existing programs, this proposal need not entail any incremental cost. It could result in the installation of about 300,000 incremental solar systems with an energy savings of

.03 quads by 1985 and 1.2 million systems by 2000 with an energy savings of .08 quads. Although cost-effective, these programs reach only the limited segment of borrowers eligible for, or interested in, Federal assistance. To the extent that these existing programs were already oversubscribed, it would be difficult to use them for solar purposes. Finally, this program would do little to address the problems of high initial costs or market liquidity.

c. Low Income Households

(1) Problem Statement: Rising energy costs hurt low income groups more than any other segment of the population. These groups are least able to afford the investment required for solar energy systems and benefit least from tax and other financial incentive programs for solar energy. Direct grant and assistance programs for low income groups may be the most effective means of ensuring that low income groups have access to solar energy.

(2) Program: The DOE conservation grant programs for low income homeowners (the DOE Weatherization Program) would be modified to ensure that low-cost, solar energy systems are eligible for grants. Other low income assistance programs, such as those run by CSA, HUD, and CETA, would be directed to establish program goals for solar energy.

(3) Analysis: The DOE Weatherization grant program for low income individuals can be expected to provide insulation for approximately 3.1 million homes by 1985. Although the use of low price solar systems could be as cost-effective as conservation in certain cases, in general, this would not be true. Hence, this proposal would be unlikely to result in a large diversion of conservation funds to solar energy, and its energy impact is likely to be small. Similarly, because of other priorities, the solar goals established by the HUD, CSA, and CETA low income programs might be so small that they would not be meaningful.

d. Information

(1) Problem Statement: In general, users lack adequate information on solar energy. The National Center for Solar Heating and Cooling Information is overloaded with requests, and incapable of distributing its information effectively on a wide scale. Information has not been assembled and distributed at sufficient levels to address the needs of builders, consumers, lenders, and industry. The many existing distribution mechanisms available to move these materials, are largely untapped at the present time.

(2) Program: DOE would develop a coordinated program for providing more meaningful information on solar energy by consulting with industry, public interest groups, builders, and lenders. Existing information distribution resources, such as the Energy Extension Service, Regional Solar Energy Centers, SERI, states, and other Federal agency resources would be used for dissemination purposes.

(3) Analysis: The solar industry believes an effective information program is one of the most important steps that could be taken by the Federal Government. This initiative would offer the first concerted effort to assemble solar energy information and coordinate its distribution through existing channels. The response to the development of this information would be useful to a variety of interest groups. An undetermined budgetary cost would cover preparation and distribution of this information.

2. Industrial Sector

a. Financing

(1) Problem Statement: The industrial sector faces three problems in accelerating its use of solar energy. First, for users, the business tax credits for solar energy contained in the National Energy Act are too small and too short lived to be an effective incentive to increase the use of solar process heat systems. Second, in those applications economic today, financing assistance

may not be available under the general purpose credit programs normally available to industry through the Department of Agriculture, the Small Business Administration (SBA) and the Department of Commerce. It may not be available because lending criteria are vague and inconsistent in the way energy costs are taken into account and the way the values of solar systems are appraised. Third, manufacturers of solar systems receive no financing assistance under the National Energy Act and may have difficulty in using the general purpose credit programs available to more established technologies.

(2) Program: Solar systems would become specifically eligible for Federal financial assistance under the SBA Small Business Economic Opportunity Loan Program, the Small Business Loan Program, and the Small Business Investment Companies Programs; under Department of Agriculture programs, the Farmers Home Administration and the Family Farm Improvement program; and, under the Department of Commerce, Economic Development Administration financing programs. Goals would be set under these programs for solar loans and loan guarantees as a percentage of total loans, with reporting on the extent to which the goals are met. These program changes would be implemented through an Executive Order where possible, and legislatively where necessary.

(3) Analysis: This program would tap existing Federal credit programs by modifying lending criteria for each program and by making solar users and manufacturers specifically eligible for assistance. Energy costs would be considered specifically as an element of credit risk and solar system costs used to appraise market value for lending purposes. It would be likely that the energy impact of the program would be small, however, because many of these programs are already oversubscribed and have program objectives which may not be consistent with their use for solar assistance. The proposal would involve no increase in Federal costs.

b. Regulatory Programs

(1) Problem Statement: Federal fuel allocation and environmental regulations have generally not considered the means by which solar energy systems could be used to achieve program objectives. In many cases, these regulations set priorities for the industrial process heat use of oil, gas, and coal. When conversions or curtailments are ordered under these programs, the possible use of solar energy is not considered. Furthermore, program regulations often are not flexible enough to take into account that solar energy systems in industrial applications require reliable back-up fuel systems.

(2) Program: Four proposals are made to stimulate increased solar use under Federal regulatory programs:

- o allow use of oil and gas as a back-up for facilities using solar energy under DOE's new coal conversion program;
- o provide higher priority in case of curtailments for back-up use of gas for solar facilities;
- o allow Clean Air Act offsets for use of solar energy in non-attainment areas; and
- o allow a higher priority for oil used as a backup for solar energy under the crude oil and product allocation regulations.

These regulatory changes could be accomplished through administrative actions by the Department of Energy and the Environmental Protection Agency and through legislative changes to the Natural Gas Policy Act of 1978.

(3) Analysis: Of these four changes, the first two are the most important, the third difficult to implement, and the fourth of largely symbolic value. In total they would provide an incentive for industry to use solar energy systems either as an option for compliance with Federal law (coal conversion and Clean Air Act requirements) or

because the operating risks of having to shut down a manufacturing plant would be reduced (curtailments or allocations). Overall energy and environmental goals could be achieved at less economic and environmental cost, in many cases, than conversion to coal or installation of costly environmental control systems. The proposals would not involve any Federal costs.

3. Utility Sector

a. Problem Statement: There are divergent opinions about the appropriate role of utilities in accelerating the use of solar energy. On the one hand, some feel competition would be reduced if utilities became actively involved with solar because solar energy competes with energy produced by the regulated gas and electric utilities. If these utilities were reluctant to slow their own growth for the sake of solar energy, they could impede the use of solar energy. However, solar and distributed energy systems would present an opportunity for the utility sector in that increased use of solar energy might enable utilities to reduce the need for costly new capacity additions.

b. Program: Four proposals are presented to address these problems and opportunities.

(1) Federal power marketing agencies would be used as models of how utilities can promote solar energy. This could be accomplished through an Executive Order.

(2) DOE, in conjunction with the Federal power marketing administrations, would provide technical assistance to state agencies to explore renewable resources as an alternative to large central stations.

(3) DOE intervention activities before public utility commission proceedings would be expanded to encourage state policies to promote solar energy.

(4) The REA could be directed to consider using its subsidized and unsubsidized loan and loan guarantee programs for solar energy purposes and to set a goal for lending to solar energy projects. REA financial assistance applications could be required to include analyses of whether

solar energy investments or conservation could meet the needs of the borrower as well as central station power generation, or expanded transmission and distribution facilities.

c. Analysis: This proposal would ensure a Federal leadership role in determining how utilities became involved with solar energy. It would reinforce the Federal information and technical assistance functions. This could be accomplished by having the Federal power marketing administrations encourage solar and conservation alternatives to traditional utility investments in their own investment decisions. It would provide a means of determining a proper rate structure for solar energy considering its intermittent availability. In addition, these efforts could give utilities a broader perspective on the value of solar energy from a national environmental and economic point of view. This proposal would involve little, if any, incremental Federal costs. The energy impact, while difficult to evaluate precisely, could be significant.

4. Government Sector

a. Federal Operations

(1) Problem Statement: Federal Government leadership in making solar energy investments for Federal buildings can encourage the private sector to increase its solar investments and can broaden the market for solar products. However, the high capital costs of solar systems relative to conventional energy sources, the nature of Federal procurement policies and the definitions of cost-effectiveness and the lack of an overall Federal policy with regard to the use of solar energy in Federal buildings have prevented the Federal Government from moving aggressively in this area.

(2) Program: Federal cost-benefit criteria used to evaluate solar purchases would be revised to reflect the replacement costs of conventional sources of energy and a discount rate based on the Federal cost of borrowing. In addition, appropriations would be sought for Federal purchases of solar

systems for selected Federal buildings. Under the National Energy Act $100 million was authorized over a three year period, of which about $25 million per year is expected to be spent in 1979 and 1980. Another $5 to $20 million per year will be spent beginning in 1979 and 1980 under the Military Construction Program which, in effect requires solar energy systems in all new military housing and 25% of non-housing construction. In 1981, these Department of Defense (DOD) expenditures would increase to $80 to $120 million. However, DOD has suggested that the procedures used to evaluate the cost effectiveness of solar project be modified to use OMB cost-effectiveness criteria.

This proposal would adopt those modifications but appropriate funds to DOE to fund the difference between the maximum solar cost which satisfies the OMB cost effectiveness criteria and the actual solar costs incurred by DOD. Appropriations of $40 million per year would be requested for DOE funding of these DOD solar expenditures between 1982 and 1985.

(3) Analysis: These Federal programs could result in a purchase of about two million and four million square feet of solar collectors in 1980 and 1981 respectively. Purchases in 1981 would amount to about 20 percent of expected industry output of collectors. Revision of the cost benefit criteria would establish an important principle and encourage the use of solar devices which are close to cost-effective in the post 1985 period. These programs, although limited in scope, would help develop the infant industry by enabling producers to make necessary manufacturing facility investments to reduce costs and improve system performance.

b. Federal Operations - International

(1) Problem Statement: The Federal Government lacks an integrated program to encourage solar energy on an international scale. Current programs under way at the Departments of Energy, State, and Commerce have different and often inconsistent objectives with the result that Federal efforts to develop solar energy on an international scale are less than optimal.

(2) Program: Federal international programs for solar energy would be coordinated by either the Agency for International Development or the Department of Energy, with foreign policy direction from the Department of State. They would be redirected to emphasize technical cooperation to improve solar energy technologies, to provide aid to developing countries for resource development, and to aid private sector companies to commercialize solar energy products on an international scale. No increase in budget outlays would be required from the within ceiling request of $92 million for FY 1980.

(3) Analysis: The use of solar energy can be effective in the developing countries in which national economic development efforts have been hindered by the escalation of world oil prices. In the rural areas of many of these countries, solar energy is one of the few options available. Support for solar energy in these nations can help them attain a greater degree of energy self-sufficiency, ensure more effective development of indigenous energy resources, and help achieve nuclear, non-proliferation objectives. This program would enhance the U.S. image as an energy leader and possibly lead to increased U.S. exports of solar products. The 1980 projected cost of $92 million and cumulative $500 million cost of this program through 1985 could be provided totally from the redirection of existing program funds and thus have no net incremental cost.

## Program Description - Policy Option II

Policy Option II expands the current level of Federal effort with a selection of programs targeted to accomplish specific cost-effective objectives. The analyses of problems and programs were based on the work of the DPR participants.

These recommendations, the costs and energy impacts of which are shown below, would involve budget outlays of $58 million to $83 million in 1980 and $315 million to $340 million in 1981.

SUMMARY OF FEDERAL COSTS AND ENERGY IMPACTS FOR MAJOR OPTION II PROGRAMS

| Major Programs: | Incremental Federal Cost Through 1985 (Millions of $) | Incremental Solar Energy in 2000 (Quads of Fuels Displaced) |
|---|---|---|
| Passive Solar Tax Credits | | |
| Single Family Buildings | 615 | .1 - .3 |
| Commercial/Multi-family Buildings | 700 | .2 - .6 |
| Solar Bank | 500 1/ | .6 |
| Industrial Credits | 360-390 | .4 - .7 |
| Other 2/ | 270-390 | .1 |
| Total | 2445-2595 | 1.4 - 2.3 |

1/ Represents Treasury outlay for initial Bank capital. The Bank would also incur indirect costs of $1.3 billion through 1985 as a result of an increased number of solar systems eligible for credits under the Energy Tax Act of 1978.

2/ The fuels displaced by some of these programs, the costs of which are included here, are difficult to estimate but could total .5 to 1.5 quads. Taking these savings into account, a best estimate of total savings from this option would be two to three quads.

1. Residential/Commercial Sector

a. Passive Solar

(1) Problem Statement: Tract house and commercial builders have little incentive to take the risks associated with construction and sale of passive solar buildings. Information programs alone, while important, do not reduce possible losses from higher costs or reduced marketability. Under the residential tax credit provisions contained in the Energy Tax Act, passive solar investments are ineligible for tax credits if they serve a major structural function. As a result, those tax credits are not expected to stimulate substantial consumer demand.

(2) Program: Legislation would be proposed to provide a tax credit to builders of energy efficient houses and commercial structures. The tax credit will be computed on an energy use per square foot basis with standards related to building type and climatic region. In all cases, the design level of nonrenewable energy consumption required to qualify for the tax credit would be set at such a low level that substantial use of solar technology, in addition to sound conservation practice, will be needed.

The Federal cost of the credit would amount to about $.40 per million BTU's of energy saved in a residential structure and about $.20 per million BTUs in commercial structures. The credit would be worth about $1000 per dwelling unit to the builder.1/

1/ The value of the credit to the builder would be based on the increased energy efficiency of the building. The builder would be paid $20 per million BTU's of energy saved on an annual basis for residential units and $10 for commercial units. Thus, a residential dwelling unit which saved 50 million BTUs per year would be worth $1000 to the builder.

The credit would offset learning and innovation costs, but pays for only a part of any additional building costs. Thus, it should stimulate cost-effective buildings, and would not subsidize very costly designs. The buildings it helps create would provide working demonstrations of most building types in all parts of the country. These buildings would also provide a solid base of experience and data and increase builder and public acceptance. These would be necessary for effective standards for highly energy efficient buildings to be established during the next ten years.

The energy savings would be measured from building designs which would have to be certified by a professional review group for the structure to be eligible for the credit. The credits would be effective in 1981 and expire in 1985. Building owners would be ineligible for the current, limited NEA tax credits if this credit were used by the builder.

(3) Analysis: This proposal would build upon the information program contained in Option One since information to evaluate building energy efficiency from building plans would be unavailable otherwise. It would be aimed at tract home and commercial builders who are expected to build 60 percent of new homes and 100 percent of new commercial structures accounting for approximately 3.0 quads of incremental energy consumption by the year 2000. A smaller credit is proposed for builders of commercial and multi-family structures because they may be willing to take greater risks than the builders of single family homes. Compensation to the commercial builder would vary with the size of the structure. The credit of $1000 per single family house would compensate the builder for higher construction costs or the risk of carrying the house unsold for up to two months. Credits to the tract builder would cost approximately $615 million through 1985 while the credits to the commercial and multi-family builder would amount to $700 million of Treasury loss. Energy savings in the year 2000 are expected be .3 -.9 quads depending on the effect of the credit after 1985.

b. Leasing

(1) Problem Statement: Many of the barriers to using solar equipment in the residential sector could be overcome through leasing arrangements. Leasing arrangements in which the lessor assumes the responsibility for installation, maintenance, and repairs would allow the consumer to avoid service, warranty and initial capital cost problems associated with purchasing a solar system. In addition, leasing is one of the only options available to renters of residential property. Under current tax law, lessors of solar equipment are ineligible for the regular investment tax credit because solar space heating and cooling property is considered a structural building component. Although lessors are eligible for the business property credit under the Energy Tax Act, a greater incentive is needed for lessors to assume the extra risks of leasing. When the business tax credits under the Energy Tax Act expire in 1982, there will actually be a disincentive for leasing solar heating and cooling equipment under current law.

(2) Program: Legislation would be proposed to enable lessors to qualify for the regular investment tax credit for solar hot water and space heating and cooling investments. This would be accomplished by removing the restriction in the existing 10 percent investment tax credit which limits credit eligibility to property other than a building and its structural components. This change would apply to leased solar property only. Leased solar property would be defined to include equipment that would qualify for the NEA residential solar property tax credit and to business solar property as defined in the NEA. The regular investment tax credit is also limited to property not used in connection with lodging; this restriction would be eliminated in the case of leased solar property. All other restrictions currently applying to the investment tax credit would be retained. The credit would terminate in 1985.

(3) Analysis: This proposal would assist residential consumers with the financing of solar energy systems, give renters greater access to solar energy, and help improve competition in the

energy sector. Under the Energy Tax Act, residential purchasers of solar property qualify for tax credits of between 20 and 30 percent, while lessees of solar property are ineligible for the residential solar tax credit. However, lessors of solar property may depreciate solar property while homeowners may not. The combination of the depreciation and Energy Tax Act business tax credits is approximately equal to the 20 to 30 percent residential credits under the Act. Were lessors eligible for the regular investment tax credit of 10 percent, a strong incentive would exist for lessors to develop a solar leasing business until 1982 when the 10 percent solar credit for business expires. Between 1983 and 1985, lessors would be on an equal footing with residential purchasers of solar equipment. After 1985, when the residential solar credit expires, lessors would again be in an advantageous position vis-a-vis buyers because of depreciation benefits.

This proposal is essentially an alternative to the NEA credits and, as a result, has a relatively small incremental energy impact. However, it is important because it addresses competition, service, and warranty issues in a way direct tax credits cannot.

c. Low Income

(1) Grants

(a) Problem Statement: Expansion of the DOE weatherization program to include solar energy will benefit only a small percentage of low income households. A broader, more visible program would demonstrate the advantages, and optimal use of solar energy for low income groups, and ensure that they benefit from Federal solar energy programs.

(b) Program: Legislation would be proposed to provide 80 percent grants to selected low income homeowners, condominiums and cooperatives for the purchase and installation of solar energy systems. HUD would administer this program and distribute funds through the Community Development Block Grant Program in urban areas, and through the delegation of funds to the Farmers Home Administration in rural areas.

Persons with incomes within the 80 percent of area median income guidelines for the Lower Income Rental Assistance Program would be eligible under this program, and $10 million per year for four years would be requested. To the extent practical, CETA programs would be used to provide training for low income workers in these areas for manufacturing and installation of solar energy systems.

(c) Analysis: A pilot program for direct grants to low income households would enable HUD and DOE to evaluate the effectiveness of solar programs for low income groups and to resolve operational problems which would accompany such programs. Among the unresolved issues are: how to assure system reliability for homeowners with limited resources to deal with unforeseen problems; how to assure that the solar system would be used over its economic life; whether conservation expenditures should be tied to a solar program of this kind; whether to establish prototype costs; and to determine an appropriate level of cost sharing between the Federal Government and the recipient. These grants would be used to purchase 10,000-12,000 solar hot water and combined systems.

(2) Low Income Housing

(a) Problem Statement: Historically, Federal housing subsidy programs have not included allowances for the higher capital costs of solar energy systems but have funded the rising costs of conventional energy through annual appropriations. The recently enacted Energy Conservation Policy Act of 1978 and the Housing and Community Development Amendments of 1978 increased FHA mortgage insurance limits for some single and multi-family housing programs to reflect the capital costs of solar energy systems and made solar energy specifically eligible for assistance under certain HUD programs. Three additional problems remain: (1) public housing prototype costs do not reflect the costs of solar energy systems; (2) not all housing assistance programs had FHA insurance limits changed where solar energy was used; and (3) although solar might be cost effective and reduce

future operating subsidies, its higher initial cost would reduce the number of housing units constructed unless budget ceilings were increased.

(b) Program: Legislation would be proposed to increase public housing prototype costs up to 20 percent where solar energy systems were used; to extend the increased FHA mortgage insurance limits for solar energy to those programs not included in the Energy Conservation Policy Act of 1978; to increase appropriations for the Public Housing and Section 8 programs (lower income rental assistance) by $10 million per year to fund solar energy systems in these federally assisted housing programs. In addition, the Secretary of HUD would be asked to set goals for solar use in Federal housing programs where appropriate.

(c) Analysis: Over one million families live in low income public housing and Section 8 units across the country. These units range from high rise buildings in large cities to small, single-family units in small towns and rural areas (the largest proportionate number of housing authorities are in fact located in the South).

As part of its ongoing activities, HUD has a significant modernization program which includes a major energy conservation component. The National Energy Act includes an additional $10 million per annum authorization for annual contribution contracts (ACC) to increase the energy conservation activities. The $10 million ACC would result in about $100 million in energy conservation modernization. In addition, about 1,500 to 2,000 public housing and Section 8 units have been funded in the HUD Solar Demonstration Program.

This proposal would build on the ongoing modernization program and benefit from the experience gained in the HUD Solar Demonstration Program to benefit low income families. While the additional $10 million per year would be targeted to the on-going modernization program, a portion of these new funds could also be added to the pipeline of new public housing

and Section 8 projects as part of the normal processing mode. In either case, a number of certification and minimum energy conservation standards requirements are already in place and both the HUD field offices and a number of housing authorities have already had experience or training in solar energy systems.

Extension of increased FHA insurance limits to all Federal housing subsidy programs and increasing public housing prototype costs would be consistent with the Energy Conservation Policy Act and would facilitate the use of solar systems in the affected programs. This is likely to be less important than the increased funding described above.

Finally, the establishment of goals for Federal housing subsidy programs would ensure that at least a small percentage of funds from these programs were used for solar energy purposes. It is important to note that the constituents of these programs might object to such a diversion of funds from low income housing. However, to the extent the use of solar energy reduced future subsidies for rising energy costs under these programs, additional funds could be available in future years.

d. Consumer Protection and Confidence

(1) Problem Statement: The issue of consumer protection and confidence involves several elements. Producers of solar equipment have suggested the need for a warranty insurance program for solar products; consumers need additional information about the performance and quality of the products they purchase; and smaller producers may find themselves at a competitive disadvantage due to a lack of capital.

Producers of solar energy equipment have suggested Federal funds for a warranty reinsurance program. While these producers view the voluntary certification efforts currently underway as overcoming consumer doubts about the reliability of solar energy systems, they have suggested that a Federal warranty insurance program would resolve consumer concern about solar products manufactured by modestly capitalized firms.

Consumers need more reliable information about solar products in order to compare their cost-effectiveness. Standardized product information is unavailable at the present time and information which is available may be unreliable.

Competition issues can also be addressed from the point of view of capital availability to small producers. Although the leasing initiative is expected to encourage competition in the solar industry, it too fails to address financial barriers for producers of solar energy products. Specific initiatives in this area are hindered by a general lack of information on the financing needs of small solar businesses and the role of these businesses in the solar energy industry.

(2) Program: The voluntary product testing and laboratory certification program now being coordinated by the National Bureau of Standards and the DOE would be enhanced with grants to expand the development of quality and performance standards and testing procedures to a wider range of solar products. Once the standards and testing procedures are developed, regulations implementing the residential solar tax credits under the Energy Tax Act of 1978 would be modified to make eligible only products which included standardized quality and performance information verified by an independent testing laboratory.

To address competition issues, a detailed analysis would be undertaken to evaluate (1) the financial needs of new and expanding small solar businesses and (2) the role of small business (versus large energy firms) in the solar market.

(3) Analysis: Standardized product information and Federal certification of the testing procedures of independent laboratories would enable consumers to evaluate the effectiveness and reliability of solar energy products. It does not appear appropriate at this time for the Federal Government to enter into a full scale warranty reinsurance program because the industry has not exhausted all possibilities for private insurance. If, however, private insurance efforts are unsuccessful, the Federal Government may want to reconsider the warranty reinsurance program.

The proposed research program will provide an analytical base for developing further initiatives to encourage competition in the solar industry.

e. Solar Bank

(1) Problem Statement: Although solar energy can be cost-effective on a life cycle basis, it requires users to make a capital investment which need not be made for conventional fuel systems. Where retrofit systems must be financed with short-term loans at market interest rates, consumers may experience increased monthly costs because, initially, financing costs exceed energy savings. Savings are realized in later years when the costs of the solar systems decrease and the fuel costs of conventional systems increase. Since houses turn over on an average of every 7 to 10 years, homeowners are reluctant to make investments for which they are unlikely to receive full benefits. Financing mechanisms could assist homeowners to match fuel savings with principal and interest payments.

The use of solar energy at the levels projected in the base case would result in substantial changes in the way energy sector capital requirements are met. About $700 to $800 billion could be required for solar investments under this Option. The capital required to finance the level of solar energy projected under the maximum practical case could amount to $1.5 to $2.0 trillion cumulatively through the year 2000.

The increased funds required for solar energy could cause a change in the flow of funds in the energy sector and could cause liquidity problems for banks and thrift institutions. The electric utility industry, the largest user of capital in the energy sector, has been largely financed with debt from the insurance industry. Residential solar systems, however, will be financed through traditional bank and mortgage sources with the increase in funds required by these institutions offset by a decrease in funds used by the other segments of the energy sector.

The National Energy Act addressed this issue in a limited way by authorizing the Government National Mortgage Association (GNMA) to establish a $100 million revolving fund for the purchase of solar home improvement loans. However, this program and other credit mechanisms now in place within the Federal Government do not appear to be sufficiently broad to address the solar energy financing problem.

(2) Program: Legislation would be proposed to establish a Solar Bank to assure that financing will be available on reasonable credit terms for users of solar energy. The Bank would be established as a Government supported corporation. It would work through existing private sector financial institutions to provide subsidized and unsubsidized loans to the residential sector for solar energy investments. It would also guarantee loans and leases for lessors, and be authorized to guarantee loans for industrial users and manufacturers if such needs develop.

The Bank would accomplish these objectives primarily through secondary market operations. The Bank would commit to purchase and purchase mortgages and home improvement loans for buyers of solar systems. These secondary market operations would include the traditional functions of the GNMA, the Federal National Mortgage Association and the Federal Home Loan Mortgage Corporation as they apply to borrowers for solar energy systems but would be significantly expanded.

Solar Bank programs would reduce the interest rates and extend the maturities on solar loans. The Bank would set a policy of commiting to purchase conventional loans made at specified rates and maturities, to the extent needed. The Bank would also purchase subsidized solar home improvement loans and mortgages. If high interest rates were impeding the financing of solar systems, the Bank would commit to purchase below market rate loans from lenders at the market rate and absorb as a subsidy any difference between its purchase and selling prices. In retrofit applications, the Bank would facilitate the means by which a homeowner could add the cost of a solar system onto

his existing mortgage at an interest rate only slightly greater than that being paid already. This type of financial mechanism is similar to that proposed and used by the San Diego Federal Savings and Loan for solar energy systems. These functions would enable residential purchasers to reduce the financing costs of solar systems to match the energy savings produced.

The Bank would also act as an intermediary between the largest source of funds for the energy sector, the insurance industry, and the projected, largest user of funds, the banking and savings and loan institutions. By purchasing solar loans from these institutions and reselling them to the insurance industry, the Bank can ensure that funds flow from the sources to the users of capital.

(3) Analysis: A solar bank would be a highly visible commitment on the part of the Federal Government to ensure that consumers who wanted to invest in a solar system would have access to financing. This proposal goes well beyond the proposals in Option 1 which would simply modify existing programs so that borrowers under them could be eligible for financial assistance for solar systems. The Bank would finance approximately 12 million incremental solar heating or hot water systems by the year 2000. 1/ These systems would save more than .6 quads of energy in the residential sector at a cost of approximately $.40 per million BTUs. The ultimate costs of the Bank would depend on a variety of factors, including interest rates, default rates, and the level of demand for solar loans. The direct subsidy programs of the Bank would also benefit the low income sector. The table below shows a schedule of estimated budget authorizations and outlays for the Bank.

1/ It is likely that some of these systems will be installed in dwelling units incorporating passive solar designs as well.

| | 1981 | 1982 | 1985 Cum. |
|---|---|---|---|
| | (Millions of 1978 $) | | |
| Total Purchase & Lending Activity | 3,500 | 4,800 | 430,000 |
| Budget Outlays 1/ | 100 | 48 | 500 |

The activities of the Bank would extend beyond 1985. Its lending and purchase activity is estimated at $430 billion cumulatively and total costs at approximately $3.0 billion. 2/ Its mix of loans in the 1985 - 2000 period would include increased numbers of more capital intensive heating and cooling systems. Not included in these forecasts are any lending or guarantee activities the Bank might undertake to assist industrial users, lessors, or manufacturers. The Bank would have authority to provide assistance to these sectors if the needs develop, subject to Congressional approval.

2. Industrial Sector

a. Problem Statement: The Energy Tax Act business credits for solar energy are too small and expire too early to result in widespread commercialization of solar process heat technologies. A major commercialization push for these technologies would accelerate installations, reduce system costs and result in a substantial additional use of solar energy.

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1/ Outlays include only initial capital transferred to the Bank from the Treasury. In addition, increased tax expenditures for solar equipment eligible for credits under the Energy Tax Act of 1978 will increase by $1.3 billion through 1985.

2/ Represents Bank operating costs plus Energy Tax Act credits. To an undetermined extent, Bank operating costs will be offset by income from its secondary market operations.

b. Program: Legislation would be proposed to make investments in solar process heat systems used in industrial and agricultural applications eligible for a 30% total investment tax credit. Alternatively, purchasers of solar industrial process heat systems could be permitted to deduct those expenditures for tax purposes in the year incurred.

This proposal would provide an incremental 10 percent investment tax credit over the level provided in the Energy Tax Act and would terminate in 1985. Qualifying property would not include biomass property.

c. Analysis: Costs of solar process heat systems are expected to decline in the 1980's as energy costs rise and solar costs fall through technological improvements. These cost reductions can be accelerated by an additional incentive through 1985 to stimulate demand, enabling manufacturers to use mass production techniques. Since few of these applications are economic today, and the credit is in effect only during the time period that costs are still high, this proposal involves little windfall. Finally, the credit stimulates system cost reductions and energy savings after its expiration.

Although the tax credits and expensing alternatives have approximately the same present value, expensing is an attractive incentive because it allows more rapid capital recovery than tax credits, where capital is recovered through depreciation. However, taxpayers in higher brackets would benefit more than taxpayers in lower brackets under the expensing proposal and taxpayers with insufficient income to use against the deduction would be helped less than those with high incomes.

The cost to the Federal Government of this proposal would be approximately $360 to $390 million through 1985 with an energy savings of .4 to .7 quads* in 2000 depending upon the rate of technological improvement.

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* This represents a best estimate; quads could range as low as .2 if collector costs do not decline rapidly.

3. Utility Sector

a. Intervention

(1) Problem Statement: Utility regulation varies widely from state to state. It is unlikely that state regulatory bodies, even with technical assistance, intervention, and use of Federal Power Marketing Agencies as models, will adopt consistent policies with regard to solar energy. A stronger Federal role is required to facilitate the use of solar energy in conjunction with the existing utility system.

(2) Program: The President would write to the state regulatory commissions to request that conservation and solar energy be considered in evaluating utility expansion plans. In his letter, the President would suggest that state utility commissions require that utilities analyze all reasonable solar and conservation alternatives before adding new conventional central generating capacity.

(3) Analysis: Under this proposal, the Federal Government would assume a stronger role than in Option 1. Traditionally, regulation of utilities has been a state matter and it is possible that states might resent an attempt by the President to influence what is perceived to be out of the Federal jurisdiction. However, the national economic and environmental importance of solar energy and its diverse technological and resource base may require Federal coordination and leadership if solar energy use is to be accelerated.

b. Rural Electrification Administration

(1) Problem Statement: Under Option I, the REA was directed to evaluate solar energy as a possible alternative to its investments in central station, generating, transmission and distribution systems. The traditional focus of the REA on central station facilities is such that stronger measures would be needed to ensure that solar energy receives a high priority in REA assistance programs.

(2) Program: The REA would be required by administrative action to allocate an increasing percentage of its loans to solar energy systems. If necessary, legislation would be proposed to facilitate such administrative action and to enable the REA to lend directly to homeowners, farmers, and small business for the installation of solar energy or distributed systems whether or not those systems involved the use of electric power. In addition, if using REA funds for solar systems would require extensive legislative changes, an alternative would be to authorize either a separate Rural Energy Development Fund under REA or to provide supplemental funding from DOE.

(3) Analysis: This proposal would put solar on an equal footing with central station electric power systems for REA financing. Since REA loans often include interest subsidies, it could stimulate a number of technologies which are not now economic. By requiring specifically that an increasing percentage of loans be made for renewable energy systems, solar and renewable systems would be proposed as alternatives to conventional electric systems.

c. Expanded Missions for Bureau of Reclamation and Corps of Engineers

(1) Problem Statement: The Bureau of Reclamation and the Corps of Engineers are limited in their ability to support solar energy projects. They can only develop hydroelectric projects which are related to their primary mission of water management and flood control, respectively. Neither can normally install generation capacity beyond their own needs or those of the power marketing authorities.

(2) Program: These agencies would be requested to develop plans, where necessary, for expanding power generation at existing sites. These plans would be used to consider an expansion of the missions of the agencies.

(3) Analysis: This option would not have any direct quad, or Federal cost impacts. As these plans are evaluated and mission changes are translated into actions, there would be impacts which need to be assessed on a case-by-case basis. Estimates indicate approximately 43,000 MWe of new hydroelectric capacity throughout the Nation could be developed at existing dams. This energy would be available to grid as a renewable resource and could displace energy produced by fossil fuels. In addition, this initiative would encourage the utilization of other solar systems, such as wind, by these agencies.

4. Government Sector

a. Federal Operations

(1) Problem Statement: Federal purchases of solar energy equipment and the revision of cost-benefit criteria outlined in Option 1 may not be visible enough to ensure that the Federal leadership role will have an impact on private decision making for solar energy. A larger, more visible Federal program may be needed to accomplish the leadership objective.

(2) Program: The President would direct that all new civilian Federal facilities be required to use passive solar design and construction techniques and to use active solar to the maximum extent practical, based on the revised cost-effectiveness criteria in Option 1. In selected applications, DOE could fund the difference between the maximum solar cost under OMB cost-effectiveness criteria and the actual cost of the solar system. In addition, highly visible Federal buildings would be retrofitted with solar hot water and heating systems to supplement conventional systems. Under this proposal, 500 Postal Service buildings would be retrofitted and a number of other public buildings which experience a high degree of use such as rapid transit transfer stations and national parks, would be retrofitted with solar systems. Precise estimates of the incremental costs for passive solar design and construction are difficult to make because of the difficulty in

distinguishing these costs from costs of conservation. Program costs are estimated at $14 million per year through 1985, Postal Service retrofits would cost about $4 million and other selected buildings $10 million through 1985. Appropriations of $84 million would be requested.

(3) Analysis: The requirement that all new Federal buildings use passive solar energy and active solar systems to the extent practical, and that selected existing buildings be retrofitted, would demonstrate the Federal Government's long-term commitment to solar energy. It would go well beyond the proposal in Option 1 by requiring solar energy use in new Federal construction. In general, active systems would not be economic in new or retrofit situations through 1985 unless evaluated against the alternative of electricity. As a result, this proposal would generate the installation of few active systems. However, DOE could fund the cost difference between the actual costs and maximum costs under OMB criteria to the extent necessary to ensure use of active solar systems in some facilities.

b. State and Local Operations:

(1) Problem Statement: The proposed State Energy Management Planning Act (SEMP) which would consolidate several existing state energy grant programs (EPCA, ECPA, EES) and provide additional resources to states to develop energy planning and management capabilities, does not set specific goals or require specific program activities to develop solar energy within the states.

(2) Program: SEMP legislation to be resubmitted to Congress will be modified to require that states submit plans addressing institutional barriers to solar use. To qualify for the matching grants under SEMP, states would have to (1) set goals for solar use, (2) develop milestone plans for facilities using solar energy, (3) acquire specific data concerning solar energy consumption in the state, (4) prepare plans to remove any regulatory and legal barriers associated with solar access and building codes, (5) address questions concerning utility regulation and solar energy, (6) conduct an

expanded information outreach program to builders, lenders, consumers, and (7) develop programs for consumer protection and information. An additional $15 million appropriation for the SEMP activities will be sought for FY 1980 and continued at that level through 1985.

(3) Analysis: This proposal builds upon traditional Federal/state relationships and would induce increased emphasis on solar at the state level. It adds to the political appeal of the SEMP legislation and would be a cost-effective means of stimulating solar energy use. Its precise energy impact is difficult to predict, however.

b. Research, Development and Demonstration

(1) Problem Statement: Federal research, development and demonstration (RD&D) programs for solar energy technologies have emphasized the demonstration of active heating and cooling and hot water technologies and high cost solar electric technologies. The emphasis on these programs is inconsistent with the DPR findings that more priority should be given to technologies with near-term, commercial possibilities, with wide markets, which replace oil and gas use.

(2) Program: The Federal RD&D effort will be realigned to emphasize passive solar systems and industrial process heat research and development. The change could take place in two phases; first, pending a further review of the 1979 budget, funds may be reprogrammed into the following areas: industrial process heat R&D, solar energy information data bank, small business programs, home and building retrofits, and passive solar; second, the DOE 1980 budget request has been adjusted to reflect DPR recommendations. Over $200 million of increased funding in 1980 was made available for solar energy including process heat (+$19 million), for photovoltaics (+$32 million), wind energy (+$40 million), and biomass (+$34 million). Included in the photovoltaics estimate is $30 million for a Federal buy at a predetermined price substantially below current price levels.

(3) Analysis: The redirected RD&D program in 1979 reflects a greater emphasis on near-term technologies to supply medium- and high-temperature heat and less emphasis on long-term technologies for the centralized production of electricity and residential heating. The increases recommended for these technologies would result in near-term oil and gas savings if these processes become commercially accepted. Table 1, below shows the details of the FY 1980 budget for solar RD&D. The DPR proposed RD&D budget is at about the same level as the fiscal 1980 budget for solar RD&D submitted by DOE, but with a different distribution of funds as shown in Table 1.

TABLE 1

SUMMARY OF DOE SOLAR RD&D PROGRAMS
FY 1980

| Technology | DOE Planned (in millions of dollars) | DPR Recommended (in millions of dollars) |
|---|---|---|
| Heating and Cooling | $108.9 | $108.0 |
| Process Heat | 29.7 | 30.0 |
| Biomass | 61.0 | 70.0 |
| Solar Thermal Power | 121.0 | 137.0 |
| Photovoltaics | 136.7 | 140.0 |
| Wind Energy | 95.0 | 100.0 |
| Ocean Energy | 36.0 | 40.0 |
| Satellite Power | 8.0 | 3.4 |
| Low Head Hydro | 9.2 | 3.0 |
| Solar Commercialization and Market Training and Development | 47.8 | 47.8 |
| Solar Technical Support and Related Basic Research and International | 65.5 | 67.5 |
| TOTAL | $718.8 | $746.7 |

## Program Description - Policy Option III

Option III would increase Federal support for solar energy dramatically. These programs (and others included in Options I and II) have been proposed by solar advocate groups working with national environmental organizations and other public interest groups. Option III presupposes that a significant national commitment to solar energy is justified due to its significant environmental, safety, and social advantages over conventional fuels; that there is a strong possibility of a dramatic oil price rise and/or a breakdown in a major energy supply source before the end of this century; and, that subsidies and price regulation of conventional energy sources will limit the use of solar energy.

Option III also presupposes that all of the initiatives in Option I and many of the initiatives in Option II would be adopted. However, in general, it recommends larger financial incentives and stronger regulatory measures than are proposed in Options I and II. As a result, the problems, programs, and discussion in Option III are not entirely consistent with those in Options I and II. The DPR has not analyzed the likely results of the proposed incentives with the techniques used in Options I and II. Rather the estimates of costs and energy impacts of the main recommendations shown below assume program goals are realized through 2000. The costs of these programs in 1980 are estimated to be $6.0 billion and $10.0 billion in 1982.

### 1. Residential and Commercial Sector

#### a. Passive Solar

(1) Problem Statement: Buildings incorporating passive solar designs are one of the most effective means of using solar energy. The information program outlined in Option I and the tax credit outlined in Option II may not be sufficiently strong to overcome the low level of builders' awareness of passive solar designs, their reluctance to adopt new building and design techniques and the inherently slow rate of change in the building industry. A program to give home buyers the opportunity to buy a passively designed solar house would need to be directed at tract builders since they construct 60 percent of new homes.

SUMMARY OF FEDERAL COSTS AND ENERGY IMPACTS
FOR OPTION III PROGRAMS

| Programs: | Incremental Federal Cost Through 1985[1] (Billions of $) | Incremental Solar Energy in 2000[1] (Quads of fuels displaced) |
|---|---|---|
| **Residential Sector** | | |
| Passive Goal (Builder Credit) | $ 9.1 | 2.4 |
| Active Solar Goal | 2.5 | 2.4 |
| **Industrial Sector** | | |
| Industrial Process Heat Solar Goal (Credits) | 6.9 | 3.6 |
| **Transportation Sector** | | |
| Gasohol | | 2.0 |
| **Utility Sector** | | |
| Renewable Electric | - | 4.6 |
| Biogas | - | 2.3 |
| **Government Sector** | | |
| Federal Buildings Retrofit | 2.5 | .1 |
| RD&D | 18.0 | N/E |
| Other | 5.3 | 1.4 |
| Total | $44.3 | 18.8 |

1/ Because Option III programs do not always assume the programs in the previous Option have been adopted, increments are shown over the Base Case.

(2) Program: Legislation would be proposed to give builders a $1000 tax credit for constructing passively designed, single family dwelling units. Builders of commercial and multifamily buildings would also be eligible for a $1000 credit for each 1500 square feet of space constructed. The credit would be available for qualified passive solar buildings where heating loads were reduced by specified amounts. This credit would be in place of the credit proposed in Option II.

A national goal would be set to require 80 percent of newly constructed buildings to exceed proposed building energy performance standards (BEPS) by 50 percent in 1987 and 80 percent by the year 2000. If, by 1987, 80 percent of new dwelling units constructed in that year did not meet the 50 percent goal, a mandatory program would be implemented to require passive solar construction. The tax credit would be phased out beginning in 1985, according to a predetermined schedule.

The DPR has concluded that buildings using passive solar design and construction techniques can reduce heating and cooling loads significantly with little or no increase in cost. The $1000 limit for the credit for single family dwelling units would give builders an incentive to use the most cost effective solar designs. However, if the costs of achieving the required energy savings were significant, program goals would probably not be met, and the regulatory program would be required. Were this incentive unsuccessful in stimulating the required percentage of new, passive solar buildings, an undetermined level of additional Federal costs would be incurred to administer the regulatory program. While the regulatory program would be aimed at using the most cost-effective designs, in order to limit consumer costs, the economy could incur additional costs if uneconomic designs resulted from the mandatory passive solar program.

After 1985, the tax credit would slowly be phased out, declining to zero by 2000. The reduced incentives would stay in effect if program goals were met. If mandatory programs were invoked in 1987, the incentives could be discontinued entirely, although the political feasibility of discontinuing

a credit of this type in the face of a mandatory program would be open to question.

For purposes of this analysis, it is assumed that the credit is successful in achieving these goals, and, that it is continued after 1987. On that basis, the incremental cost of the credit is estimated to be approximately $9 billion through 1985, and $22 billion through 2000. Were the minimum program goals met, the primary energy savings (compared to the Base Case) would be .4 quads by 1985 and 2.4 quads by 2000. However, the savings through 1985 would not be incremental over Option II because the two credits would be worth approximately the same amount. Either the energy savings under Option II would be higher,or, the savings under Option III below program goals. Incremental savings of 1.6 quads over Option II would be realized through 2000 because this program would incur $17 billion of incremental costs over Option II.

b. Active Solar

(1) Problem Statement: The financing programs under Option II (the Solar Bank and leasing tax credit) will stimulate the installation of approximately 13.0 million active solar energy systems, 7.0 million in existing dwelling units and 6.0 million in newly constructed dwelling units by the year 2000 (some of these are likely to be in dwelling units with passive solar designs as well). By 2000, one-third of all systems in place will be combined heating and hot water systems and two-thirds hot water only systems. Additional energy savings could be achieved from the use of more combined systems and an increase in the total number of systems installed. However, larger financial incentives, although likely to achieve the additional savings, could result in excessive costs to the Federal Government.

(2) Program: A national goal would be established to have 10 percent of all dwelling units install combined solar energy heating and hot water systems by 1987 and to have 25 million combined systems in use by the year 2000. If the 10 percent goal were not met by 1987, a mandatory program would be implemented to require the installation of active

solar energy systems in the required percentage percentage of dwelling units at the time of sale, as a precondition for obtaining credit. The credit allocation program which would implement this requirement is described in section 1(e) (2) below.

If it appears that, by 1986, the goals for 1987 will not be achieved through the financial incentives contained in Option II, the NEA tax credits would be extended for combined systems only. They would be set initially at 15 percent of the cost of the system, up to $6,000, and decline gradually to zero in the year 2000. The credits would be continued under the mandatory program if other fuels were subsidized.

(3) Analysis: The space heating, cooling, and hot water energy requirements for dwelling units in existence in 1975 accounted for approximately 9.7 quads, or two thirds of the total requirements in the residential sector used for these purposes. The programs proposed in Option II will only result in about .7 quads of solar energy used for these purposes principally due to the installation of a large number of hot water heating units. Under this proposal, 25 million combined solar heating and hot water systems would be installed, and an incremental 1.6 quads of solar energy produced compared to Option II. Although it is possible that the program goals through 1987 could be achieved under the Option II proposals, it is likely that the mandatory program would be required and that the NEA credits would be extended.

On that basis, this proposal would have no incremental cost through 1985, and cost $ 17 billion through 2000.

c. Low Income Groups.

(1) Problem Statement: Low income groups are most affected by rising energy costs and are least able to make investments for conservation and solar energy. The proposals outlined in Options I and II may be insufficient to insure that low income groups have access to solar energy.

(2) Program: Legislation would be proposed for a pilot program to retrofit public housing under HUD's housing assistance programs. A level of $100 million per year would be appropriated over five years to demonstrate the most effective use of solar energy in these programs. Through the use of CETA workers, increased training and job opportunities would be available to low income groups. At the termination of the pilot program, existing programs administered by HUD for housing assistance would be in a position to use solar energy more effectively.

(3) Analysis: Federal housing assistance programs involve two cost components, the capital cost of housing assistance and the operating cost for annual subsidies. To the extent that the costs of solar energy systems are included in the capital cost assistance programs, operating cost subsidies can be reduced below what they would have been under conditions of rising energy prices. As a result, the use of these programs to provide assistance for the poor for solar energy systems may not result in any substantial net Federal cost over the life of the programs. Direct outlays however would be $500 million between 1980 and 1985.

d. Lack of Consumer Confidence

(1) Standards for Solar Products.

(a) Problem Statement: The development of standards for solar energy products will build consumer confidence in the use of solar energy systems. Lenders will be more willing to finance solar energy systems which have a demonstrated energy efficiency. However, the development of standards should not stifle innovation, and standards for Federal procurement should be flexible enough to enable the purchase of a variety of solar energy systems.

(b) Program: The development of standards for solar energy systems will be accomplished in coordination with private sector testing laboratories. These laboratories will adopt uniform testing and certification techniques for active and passive solar systems. Federal

grants will be made to standards makers to assist the private testing laboratories. Federal procurement policies will adopt flexible standards for solar energy systems based on the private sector standards developed for the testing laboratories. Finally, procedures will be developed by which the Department of Energy can certify the performance of user or ownerbuilt on-site solar energy systems.

(c) Analysis: The development of standards, testing and certification procedures for active and passive solar energy systems should be broadly based if standards are to build both consumer and lender confidence. Consumers and small business should participate in the standards development process, and standards should be based on real world conditions. Federal procurement policies, which, in the past, have emphasized the quality of materials and construction, should be revised to reflect the overall efficiency of the solar energy system. The cost of this program is likely to be about $100 million through 1985.

(2) Warranties.

(a) Problem Statement: Small solar energy companies lack capital for self-insurance of warranties on solar energy products. Federal procurement policies, however, require a five-year warranty on solar energy systems and this requirement could prevent small producers from competing for Federal purchase contracts for solar energy systems.

(b) Program: Legislation would be proposed to provide an insurance pool for the solar industry. This could be accomplished by a joint contribution from the Federal Government (approximately 20%) and the industry (80%) to the pool. The pool would cover claims by the Federal Government and the private sector. The insurance pool would be guaranteed by the Federal government and claims submitted by consumers would be payed directly out of the pool. The Federal government would have the right to take legal

action against companies manufacturing solar products if negligence or fraud could be proved.

(c) Analysis: Federal warranty reinsurance may stimulate increased sales of solar products by increasing consumer confidence. Approximately $5 - $10 million could be needed for such a pool over each of the next five years. The contribution rate could be adjusted as experience was gained. The ultimate Federal cost of the program would depend upon the extent serious problems with solar products developed. It is difficult to estimate the energy impact of warranties for solar energy products.

(3) Building Codes.

(a) Problem Statement: Local building codes and restrictions on housing design can impede the use of solar energy systems. Local communities charged with setting building codes have too little information about solar construction techniques and about the overall economic and environmental benefits of solar energy systems. Increased information on how solar energy can be incorporated into local building codes is required if solar energy use is to be accelerated.

(b) Program: DOE would develop a model building code to deal with solar energy use. The code would be descriptive in nature and would be adaptable to local community standards. It would be developed in conjunction with the National Governors Association and would involve an outreach effort on an interim basis until the code could be developed. DOE would fund regional workshops on the relationships between building codes and standards and solar energy systems.

(c) Analysis: This proposal would use funds reprogrammed within DOE. The energy impacts cannot be precisely estimated, but, as with warranties, are probably significant because of the importance of local building codes to the building industry. This proposal would be implemented immediately through the regional

workshops. It should be noted, however, that such codes could meet strong local level resistance.

(4) State Programs.

(a) Problem Statement: Full scale solar commercialization requires a strong consumer protection effort at the state level. Currently, consumer protection issues with regard to solar energy are not addressed under the State Energy Management Planning legislation (SEMP) and it is possible that states will be slow in implementing consumer protection programs unless additional funding is made available.

(b) Program: Approximately $30 million per year would be added to the SEMP program to enable states to address consumer protection issues for solar energy. This level would be $15 million a year greater than that proposed under Option II. In order to qualify for these funds, state consumer protection programs would be required to incorporate six elements: (1) citizen participation in the design of the program, (2) an outreach effort to insure maximum participation in consumer protection by all state agencies and private sector organizations, (3) a consumer education program to inform consumers about solar energy systems and their rights to use and have access to solar energy resources, (4) a consumer industry arbitration panel for the resolution of consumer complaints, (5) laws which assure access to solar resources, and (6) training programs for building inspectors.

(c) Analysis: The diversity of state laws and efforts regarding consumer protection require a Federal coordination role to assure that solar energy issues are being addressed in state energy management planning efforts. The SEMP program is the ideal vehicle for implementing consumer protection programs because the diversity of solar resources and technologies require that states actively participate in the acceleration of the use of solar energy.

e. Financing

(1) Information and Training.

(a) Problem Statement: The changes in the Federal financial programs suggested in Options I and II and the financing programs to be implemented by the Solar Bank require that Federal credit managers be well trained and that buyers of solar products be aware of the possibilities of financial assistance.

(b) Program: A Federal training program would be developed to ensure that all persons involved with the administration of Federal credit assistance programs are aware of the environmental and economic benefits of solar energy systems. Loan applications would include detailed information concerning solar energy, as well as statements that loan applications for solar energy would receive a higher priority than other loans in the evaluation process. Finally, seminars and training programs for private sector lending organizations would be developed to make private lending institutions more aware of the benefits of solar energy systems.

(c) Analysis: Funds would be reprogrammed from other Federal training programs and no additional Federal costs would be incurred. This program would supplement the other changes in Federal credit assistance programs which have been outlined in Options I and II. Its energy impact cannot be precisely measured.

(2) Credit Allocation.

(a) Problem Statement: Some lending institutions, such as the San Diego Federal Savings and Loan Association, have developed innovative lending programs for solar energy, but others have been slow to adopt new financial mechanisms to encourage solar energy use. However, if the mandatory programs for passive and active solar are adopted and implemented through the banking system, credit allocation programs would have to be adopted at the same time. These programs might also have to include the use of financial

mechanisms designed to encourage the use of solar energy.

(b) Program: A pilot program would be adopted in 1979 to test how a mandatory credit allocation and interest subsidy program could be developed on a national scale. The program would explore, to the extent consistent with state banking laws, how Federally chartered banks, savings and loan institutions, and others covered by Federal deposit insurance laws could be required to adopt innovative financing programs similar to the San Diego plan outlined in Option II. If, by 1987, the goals for passive and active solar energy use were not met, and the mandatory programs implemented, the Federal government would be in a position to require lending institutions to adopt innovative programs and to maintain a percentage of total assets in solar loans at a level consistent with the overall national objectives for solar energy use. Under such a program, interest rates would be subsidized consistent with the terms and interest rates for the Solar Bank under Option II.

(c) Analysis: Credit allocation programs would only be necessary if the national objectives for solar energy use were not met through the financial incentive mechanisms for passive solar outlined above and the Solar Bank. Under the mandatory programs, financial institutions might be reluctant to extend credit to the extent necessary to assure compliance on the part of users with the regulations for solar use. An effective credit allocation program would require extensive testing. This proposal would begin that testing immediately to assure that a full scale program could be put in place by 1985. The costs of a pilot program are estimated at $100 million through 1987.

2. Industrial Sector

a. Users

(1) Problem Statement: The market segments for industrial solar process heat technology have considerably different economic characteristics. The

incentives contained in Options I and II could result in a market penetration by solar and renewable resources of 1.7 quads out of a potential 13 quads in the year 2000. Larger credits could expand the number of applications for industrial solar process heat technologies.

(2) Program: Legislation would be proposed to increase the tax credit for the business use of solar energy and renewable resources to a total of 50 percent, 30 percent over the level in the Energy Tax Act. The credit would be available for all new, or replacement, industrial equipment for process heat--40% of industrial energy use. The credit would be phased out on a declining scale beginning in 1987.

If, by 1987, 30 percent of new industrial process heat energy capacity added during that year (approximately .3 quads) did not use solar or renewable resources, a mandatory program would be implemented to require the use of solar and renewable resource energy systems. Under the mandatory program, 30 percent of new industrial process heat capacity would be required to be solar in 1987 rising to 55 percent by the year 2000. 1/

The mandatory program would be based on experiences in the coal conversion program, and would be preceded by a two year pilot test in 1986 and 1987. Nevertheless, it would be difficult to administer and it is likely that decisions would be made on a negotiated basis.

(3) Analysis: The 50 percent tax credit for industrial process heat would be a strong incentive and make solar a more attractive source of energy than conventional fuels in many cases. However, technological improvements are required in industrial process heat to make the tax credit effective on a broad scale and these may not occur before the mandatory program comes into effect. To prevent the mandatory program, industry will have to have put .1 quad of delivered solar process heat energy

1/ The incentive would be geared to the costs of delivered energy in order to encourage technological innovation and cost effective systems.

in place in 1987. The mandatory goal would be applied on a nationwide basis rather than a company-by-company, industry-by-industry basis. It would be likely that some industries could meet or exceed the goal but that others could not. The cost of the program would be $ 6.9 billion (depending on the costs of collectors) for an energy saving of .5 quads in 1985 and $18.8 billion for an energy savings of 3.6 quads by 2000 on a primary basis.

b. Manufacturers

(1) Problem Statement: The rapid pace of technological change in the solar industry makes it difficult for solar manufacturing companies to justify large investments in capital equipment to mass produce solar energy products. More rapid capital recovery is required to induce the investments for mass production techniques to reduce costs for solar energy systems.

(2) Program: The regular 10 percent investment tax credit would be expanded to 30 percent for investments in equipment used to produce solar energy systems, subject to a sunset provision in 1985. In addition, manufacturers of solar equipment would qualify for seven year amortization of investments in solar equipment. These tax benefits would be limited to firms deriving at least 50 percent of revenues from solar manufacturing.

(3) Analysis: The combination of the credits contained in this proposal, the rapid amortization, and the financing incentives possibly available through the Solar Bank would be equivalent to a total tax credit of about 50 percent on capital invested. The total cost of these credits is estimated to be $2.4 billion through 1985. No estimate is available for the energy impacts which would result. However, the other programs proposed could not be implemented successfully without adequate manufacturing capacity for solar energy systems. As a result, these proposals should be considered in combination with the other proposals to benefit residential and industrial users of solar energy equipment.

c. Transportation

(1) Problem Statement: The NEA eliminated the four cent per gallon Federal excise tax on gasoline mixed with alcohol if at least 10 percent of the mixture were alcohol. The effect of this incentive was to provide a 40c per gallon incentive for the alcohol contained in the mixture. This incentive, while strong, might not be sufficient to increase alcohol use to 20 percent of total gasoline production.

(2) Program: If it did not appear that, by 1985, 20 percent of total gasoline production would be displaced by alcohol by 2000 as a result of this incentive, a mandatory program would be put into effect to require the use of alcohol in all gasoline production. The exact percentage level in intermediate years would be based on agricultural needs and alcohol fuel production capacity.

In order to assure that the goals of the mandatory program would be met, legislation would be proposed to reallocate the approximately $4 billion per year of funds now used for farm income stabilization to stimulate increased agicultural production. Producers of alcohol fuels would be given the subsidies now given to farmers for set-aside acreage. This reallocation of funds and the mandatory program would only be implemented if the NEA incentives did not stimulate the level of production specified.

(3) Analysis: The effectiveness of the NEA incentives for gasohol should be tested prior to the development of new programs. If, however, this type of financial incentive is ineffective (which in this case is likely), a mandatory program would be used to overcome barriers to increased gasohol use. The combination of the mandatory program and direct subsidies proposed as a contingency here would be used to achieve the goal.

The proposal to shift subsidies from acreage set-aside to alcohol fuel producers would result in no increase in Federal outlays. Farm production would be stimulated through the increased demand for farm products by the producers of alcohol fuels, and farm income might remain at the same level or increase as a result of the increased demand for farm products.

This proposal would result in energy savings of about .1 quad per year for each percent of alcohol required in the gasohol blends based on projected levels of gasoline consumption.

3. Utility Sector

a. Rural Electrification Administration

(1) Problem Statement: Under Option I, the REA was directed to evaluate solar energy as a possible alternative to its investments in central station generation, transmission and distribution systems. Under Option II, it was required to devote an increasing percentage of funds to solar purposes. However, solar energy would still not receive the highest priority claim on REA funds.

(2) Program: The REA Act would be modified to direct that REA could make no loans for central station power facilities unless it could be demonstrated that those needs could not be met by conservation or by distributed energy systems. Second, the REA would be required to allocate an increasing percentage of its loans to solar energy systems. Legislation would also be proposed to enable the REA to lend directly to homeowners, farmers, and small business for the installation of solar energy or distributed systems, whether or not those systems involved the use of electric power.

(3) Analysis: This proposal would give solar a higher priority than central station electric power systems for REA financing. By specifically requiring that solar energy and conservation be analyzed prior to making any loans for conventional electric systems, solar energy and conservation could become the largest user of REA funds.

b. Federal Power and Marketing Authorities

(1) Problem Statement: A stronger Federal leadership role is required for the utility industry to move aggressively in the use of solar and renewable energy sources. While the potential exists for some competitive problems as a result of utility involvement, there will be extensive interrelationships between utilities and the solar user as the solar

industry grows. The Federal power marketing authorities can play an important role as models for utility involvement with solar energy systems.

(2) Program: Under this proposal, new generation facilities constructed by the Federal power marketing authorities would be powered by renewable resources unless not technically feasible or economic. Second, no major supply commitments would be made by the Federal power marketing authorities unless the purchaser demonstrated that the need for power could not be met through conservation or renewable resources. Third, the Federal power marketing authorities would not enter into any purchase contracts unless the needs could not be met through conservation or the use of renewable resources and unless such purchases could not be made from renewable sources. Legislation would be proposed to implement these proposals.

(3) Analysis: Under this proposal, the Federal power marketing authorities would take a much stronger lead in establishing the relationship between the utility sector and the users of renewable and solar energy resources. As both buyers and wholesalers of power, they have a significant influence on utilities. Although the energy impacts cannot be precisely estimated, they could be significant.

c. Utility Rate Reform

(1) Problem Statement: Public utilities have the ability, through their rates, to encourage, discourage, or be neutral to solar energy. Because utility system load patterns, daily and yearly peaks, and mix of customers vary widely, no general national rate is likely to be suitable for every system. However, action taken on a national level to encourage cost-justified rates, to ensure Federal intervention authority, and to make relevant information available to state utility commissions could facilitate optimal use of solar energy in each utility region.

(2) Program: The elements of this option, which would require Federal legislation to implement are:

- Mandatory State Proceedings. Each state would be required to hold rate hearings on a utility-by-utility basis (or, if the service territory were so large that it covered several distinct climate zones, on a zone-by-zone basis), to develop a rate for solar energy users. Such a rate would take into account, at the minimum, the following factors:

  - The actual load pattern (both daily and seasonal) for which the rate is being designed.

  - The actual weather data for the territory or zone for which the rate is being designed.

  - The storage capabilities of various types of solar systems.

  - The degree of market penetration of solar at the time the rate is being put into effect. (It is crucial that rates designed not treat solar systems as if they were a major contributor to system peaks and valleys, if they were in fact only indistinguishable blips on the total system).

- Deadline for Holding Rate Hearings. Each state would be required to hold solar rate hearings within two years following the passage of the legislation.

- Federal Intervention as of Right. The Deparment of Energy would be able to intervene in state hearings as a matter of right. If it did intervene, it would also have the right to appeal the Commission's decision through the state administrative or court system on substantive grounds or through the Federal court system if hearings were not in compliance with the requirements of the legislation.

- Municipally-Owned Utilities and Other Publicly-Owned Systems. Municipal utilities would be required to undertake studies of a similar nature to those required for other regulated utilities concerning the establishment of solar

rates. The tax-exempt eligibility of the utilities would be dependent upon their compliance with the intent of the legislation described above. The Department of Energy would have a right to participate in the study to the extent necessary to ensure that relevant data was brought to the attention of the municipal system and would have the right to appeal to the Federal courts if the study did not meet the standards of the Federal legislation.

(3) Analysis: This legislation would be designed to ensure that public and private utility rates facilitate rather than impede the use of solar energy. It would go beyond proposals in Options I and II in that it would give the Federal government responsibility to intervene in affairs traditionally in the domain of the states. It could be politically difficult to implement for that reason. The cost to the Federal government would be almost zero; the energy impacts are undetermined.

d. Solar Electric

(1) Problem Statement: The electric utility industry is in the process of switching from the use of oil and gas, to the use of coal for electric generation facilities. The regulatory incentives contained in Option I would enable utilities to use oil and gas as a backup fuel where solar and renewable resources were used for electric power generation. However, strong regulatory measures would be required to achieve a goal of 10 percent of new electric capacity in the form of renewable or solar energy resources by 1985.

(2) Program: Legislation would be proposed to require that the equivalent of 10 percent of new electric generation capacity be derived from renewable or solar energy resources in each load area by 1985. The electric utilities would not have to own the solar or renewable resource systems but would have to assure that this objective was met in order to add conventional new capacity. The industrial tax credit would not be available to utilities.

(3) Analysis: This proposal would move the utility industry strongly in the direction of using solar energy and renewable resources in lieu of fossil or nuclear capacity. However, this proposal could be interpreted by states as Federal intrusion on the power of state regulatory commissions. The objectives of this proposal would be to increase solar electric capacity by 4.6 quads through the year 2000, about 30% of new generating capacity. To achieve this objective, DOE cost reduction goals for wind and photovoltaics would have to be met in order for those technologies to have marginal costs no higher than conventional technologies. This proposal would have no Federal cost but could have undetermined costs to the economy.

e. Biomass Gas

(1) Problem Statement: Increased biomass use by industry would be necessary if the goals established for that sector are to be met. Strong regulatory measures directed at gas suppliers would be required if the biomass resource base is to be fully used, since transportation is economic only after conversion of biomass to a liquid or gaseous form.

(2) Program: Legislation would be proposed to require that a percentage of gas input to regulated pipelines be in the form of renewable resources with the percentage increasing to 15% in the year 2000. The industrial tax credit would not be available to pipeline companies or to producers of biomass gas for sale.

(3) Analysis: This proposal, in combination with the other mandatory programs proposed, would move the country to use its biomass resources at very nearly maximum sustainable levels. Almost complete collection of forest residues and intensive silviculture would be required. Although this proposal would have no Federal cost, the environmental and economic costs and uncertainties which would be attached to production of this much gas from biomass would have to be balanced against the environmental and economic costs of synfuels and LNG for example.

4. Government Sector

a. Federal Operations

(1) Problem Statement: Federal procurement practices have emphasized cost-effectiveness on a project-by-project basis, and have not taken into account replacement costs, the value of a Federal purchase program to the solar industry, or the multiplier effect on the economy as a whole which could result from Federal purchases. Federal subsidy programs have also discouraged inventors because of the Federal requirement that patents financed through Federal funds be given to the Federal Government. Finally, there has been little coordination of the overall Federal role with regard to solar energy.

(2) Program: The Federal Government would initiate a program to use active solar energy systems to replace 7.5 percent of the energy requirements of existing Federal buildings and facilities by the year 2000. The initial emphasis of the program would be on solar hot water and space heating systems. Solar space cooling and other renewable resources are not likely contribute to the achievement of the goal until the later years.

(3) Analysis: A stronger Federal commitment to the use of renewable and solar energy resources would demonstrate to the public the value of using solar energy, and, to the industry, that a substantial market exists for solar energy products. It is estimated that the proposed action would cost $500 million a year over a 20-year period. The program would be funded at $2.5 billion from 1981-1985, accomplish a retrofit of 7.5 percent of Federal facilities and an energy savings of 10 trillion BTU per year. Additional retrofits from 1986-2000 would be applied to 22.5 percent of Federal facilities at an energy savings of 30 trillion BTU's and a total cost of $7.5 billion. This program could have significant multiplier effect on the private sector because it would stimulate cost reductions and the use of mass production techniques. It would also represent a Federal commitment to the replacement of fossil fuels rather than the demonstration of solar energy use.

b. State and Local Operations

(1) Problem Statement: The widespread commercialization of solar energy envisioned in the proposals outlined above will require active state involvement in the solar energy industry. Insufficient funds are currently available to the states to implement solar commercialization programs, consumer protection programs, and utility and regulatory programs.

(2) Program: This proposal would expand the funding for state commercialization and consumer protection efforts by $100 million per year. These funds would be provided through the SEMP legislation and appropriations. A level of $30 million per year would be allocated to states for consumer protection efforts, $25 million per year would be allocated to states for revision of local building codes and the training of building inspectors, and the balance, $45 million per year, for other solar energy related programs. These programs would include citizen participation in the use of solar energy, out-reach efforts, consumer education programs, arbitration panels for resolving solar disputes, zoning programs, and training programs for state and local building inspectors, builders, suppliers, and financiers.

(3) Analysis: This proposal is designed to increase state involvement in the planning process for solar energy use over the level of Option II. The total Federal cost of this increase, $500 million through 1985, would be about equal to the currently planned SEMP program.

c. International Operations

(1) Problem Statement: U.S. leadership in advancing the worldwide use of solar energy could reduce energy costs for less developed countries, reduce the world's dependence on oil, gas, and other fossil fuels, reduce world dependence on nuclear energy sources and enhance nuclear non-proliferation objectives. However, current spending levels for international solar activites are too low to achieve these objectives.

(2) Program: The U.S. would provide foreign aid assistance to less developed countries by giving them solar energy equipment through the Agency for International Development, through technical assistance programs and through the establishment of an affirmative role for the Export-Import Bank with regard to exports of solar energy systems. Federal procurement practices would be modified to enable Federal purchases of photovoltaics and all other solar energy products to be used by foreign countries.

(3) Analysis: This proposal would reprogram and expand Federal funds used for foreign aid for energy purposes. It would help U.S. companies establish a leadership position in the export of solar energy systems. The cost of this program would be approximately $ 125 million per year and would result in a worldwide energy savings of .01 quads by the year 2000.

d. Research and Development

(1) Problem Statement: Expenditures for solar research and development are still small in comparison to those for other technologies. Spending on nuclear research for fusion and fission technologies is considerably more than the level expected to be spent for solar in Fiscal Year 1980. Expenditures for solar energy are also small in relation to other programs with high National priorities such as the space effort, Federal highway programs, and the Federal housing programs.

(2) Program: Solar RD&D expenditures would be increased to approximately $2.5 billion per year through 1990 for a cumulative total of $30 billion over 12 years. Expenditures for solar satellites would be excluded from this total. RD&D would focus on hybrid systems, district heating, wind and photovoltaics, pumped storage, low-cost systems and transportation uses of renewable resources.

(3) Analysis: A substantially increased R&D effort would be necessary to achieve the goals for solar energy use outlined in this Option. Solar R&D efforts would concentrate on those technologies which could be commercially used and which could help achieve the nation's solar objectives. Some

solar energy advocates argue that the expenditures proposed are small, even in relation to what has been spent historically for other energy sources and other programs such as NASA. The space program spent approximately $60 billion in the 10-year period from the time that President Kennedy announced efforts to get to the moon to the early 1970's. This RD&D program, in combination with Federal procurement efforts, would give the Federal solar program a much higher National priority than in Option I or II.

e. Employment

(1) Problem Statement: The widespread use of solar energy envisioned by these proposals would increase the demand for skilled labor and require new labor skills. Many of those job skills are not available today and Federal and state training programs may not produce enough trained technicians to implement the programs above.

(2) Program: Federal retraining programs would be directed at creating solar job skills. The ACTION and CETA jobs program would be expanded for this purpose. Joint Federal/state funding of union training programs would also be initiated and labor impact statements required for all future energy developments and energy legislation. Approximately $180 million per year would be devoted to these programs.

(3) Analysis: Solar energy is more labor intensive than many other types of energy systems and it will be important to have a sufficiently trained labor force to achieve the solar goals set out above. Solar energy will have very beneficial impacts on employment and, if properly directed, may substantially increase the employability of workers in economically depressed areas. These programs could create 45,000 more jobs at a cost of $900 million through 1985.

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