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Volume II — Making Solar Laws Work: A Study of State Solar Incentives

Principal Investigator: J. David Roessner

Project Staff: Craig A. Piernot
Bruce Green
Rob deKieffer
John Ashworth
Jean Neuendorffer

SERI

Solar Energy Research Institute
A Division of Midwest Research Institute

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MAKING SOLAR LAWS WORK: A STUDY OF STATE SOLAR ENERGY INCENTIVES

VOLUME II - TECHNICAL REPORT

PRINCIPAL INVESTIGATOR:

J. DAVID ROESSNER

PROJECT STAFF:

CRAIG PIERNOT
BRUCE GREEN
ROB DEKIEFFER
JOHN ASHWORTH
JEAN NEUENDORFFER

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FOREWORD

This report describes the results of an 18-month study of solar financial incentive and RD&D programs in 18 states. It is part of a series of studies undertaken by SERI and sponsored by the U.S. Department of Energy to identify the problems and issues that have arisen and the results achieved in state efforts to stimulate the application of solar energy. The first of these studies (John Ashworth et al., The Implementation of State Solar Incentives: A Preliminary Assessment, SERI/TR-51-159, January 1979), surveyed the major state solar programs and reached preliminary conclusions about the issues that were important to successful implementation of five types of solar programs: financial incentives, RD&D, testing and certification, land use planning, and education and information.

The research summarized here builds upon the pilot study by focusing in greater depth on state solar financial and RD&D programs. As in the first study, emphasis is upon implementation—the organizational and administrative processes required to convert a law into a functioning program. The third in the series of studies focuses on the mix of programs in selected states to draw preliminary conclusions about how various types of state-supported programs work together to achieve goals such as increased numbers of solar installations and decreased dependence on fossil fuels. The final report of this third study is scheduled for completion in late 1980.

We wish to thank many persons for their contributions to this report. First, dozens of state officials and their staffs gave generously of their time; without their assistance, the study would not have been possible. Second, many reviewers of the research plan and various drafts of the final report improved its quality and accuracy: Paul Berman, Irwin Feller, and Robert Yin; officials in the Regional Solar Energy Centers and the U.S. Department of Energy; SERI staff, particularly Patrick Binns and Peter deLeon. Third, members of the study's technical review committee reviewed the report's structure and content at critical stages during the research: William Osborne, Robert King, Peggy Wrenn, Alec Jenkins, Herbert Wade, and Lynda Connor. The report has benefitted greatly from these persons' criticisms and suggestions, but the authors bear responsibility for the utility and quality of the final product.

Kenneth O. Olsen, Chief,
Buildings Applications and Policy Branch

Approved for

SOLAR ENERGY RESEARCH INSTITUTE

J. Michael Davis, Manager,
Buildings Division

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SUMMARY

This report describes the results of an 18-month study of solar financial incentive and RD&D programs in 18 states. The research focused upon implementation—the organizational and administrative processes required to convert a law into a functioning program. This study is the second of a series of three investigations undertaken by the Solar Energy Research Institute (SERI) and sponsored by the U.S. Department of Energy to identify the problems and issues that have arisen and the results achieved in state efforts to stimulate the application of solar energy. The first study in the series (John Ashworth et al., 1979, The Implementation of State Solar Incentives: A Preliminary Assessment, SERI/TR-51-159), from which the present study was derived, surveyed major solar programs in selected states to identify issues important to successful implementation of those programs. The objective of the third study is to survey a mix of state-supported programs in selected states to determine how those programs work together to achieve state goals for solar energy use and development. This study is scheduled for completion in late 1980.

Eleven financial incentive programs and 12 RD&D programs were investigated to determine the organizational and administrative processes necessary to convert a law into a functioning program. Early sections of the report describe the historical context of state involvement in national energy development and the research approach and study design. Subsequent sections describe and analyze the implementation processes of the two incentive programs. A concluding section summarizes major findings and draws conclusions and implications for state and federal energy policy makers.

Four conditions of importance to implementation were found to be common to both types of incentive programs: attributes of the agency selected to implement the law; involvement of outside groups in the program; specificity of the guidance given for implementing the program; and the opportunity to use solar energy as a heat source in the state. Other conditions of importance to implementation of each type of incentive program are discussed and analyzed.

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SECTION 1.0

INTRODUCTION AND OUTLINE OF REPORT

1.1 CHANGING FEDERAL-STATE RELATIONSHIPS IN ENERGY

As energy supply and demand are increasingly recognized as public problems, one can expect greater involvement in energy by governments at all levels. While federal legislation such as the Public Utility Regulation and Policy Act (PURPA) introduced the federal presence in areas formerly the province of states, some state public utility commissions are taking new, aggressive stances on regulation, plant siting, and even fuel choice. As energy supply and use become recognized as national problems, state programs and large federal programs of research, development, demonstration; financial subsidies; information; and training should complement one another. National problems need not require national solutions, however, and the natural decentralization of solar technologies now on the market and their localized character (i.e., cost effectiveness is partially a function of local climate conditions and conventional energy costs) suggest the need for effective, well-defined state programs tailored to local conditions.

Many solar technologies are dispersed technologies. Their performance and costs depend heavily on climate, insolation, and type of application (e.g., residential water heating, industrial process heat, remote electricity generation, and water pumping). Accordingly, the type, extent, and timing of government stimulation of solar applications should vary regionally to maximize the efficiency of the expenditure of public funds. The authors of a comprehensive analysis of policy options for commercializing solar heating and cooling systems stated the point emphatically:

> The optimal mix of incentives to apply in any particular region must be strongly dependent upon regional characteristics. It must be recognized that some barriers are best overcome by national strategies, some by state strategies, and some by local tailoring of the various incentive programs (Bezdek et al. 1978, p. 460).

Given the extensive history of state solar incentives relative to federal actions intended to achieve similar objectives and the inherently different consequences that the same incentives will have in different regions of the country, it is important that federal programs encourage and complement, rather than overwhelm and conflict with, state solar incentives.

States with abundant supplies of solar radiation such as California, Arizona, and New Mexico have taken early, significant steps to stimulate the purchase of solar systems by homeowners and businesses. Other states have focused more on the development and demonstration of solar systems, while still others have passed legislation that symbolizes positive attitudes toward solar and renewable energy, rather than directly promoting the development and use of systems. The efficacy and problems of each approach should be the subject of systematic study so that both state and federal officials can benefit. State solar RD&D programs can significantly complement federal research programs in the overall national effort to develop and apply renewable energy sources. Since solar and renewable energy technology performance is rooted in localized climatic and natural resource conditions, states can provide important assistance in developing, adapting, and demonstrating renewable energy technologies designed specifically for local conditions.

Increased application of solar and renewable technologies as a public policy goal began with the states, which are, therefore, a valuable source of information about why various technology development and application programs have worked. State experience should illuminate future energy policy choices by both state and federal officials. The research reported here is an assessment of that experience.

1.2 STATE AND FEDERAL POLICY CONCERNS IN SOLAR AND RENEWABLE ENERGY

Fundamental to solar and renewable energy policy are questions about the cost and efficacy of incentive programs designed to stimulate the application of solar and renewable energy technologies. Program costs include both costs to the treasury and the administration; effectiveness usually is measured by various indicators of the consequences of the program, which will be different for programs with different objectives. Policy officials interested in whether solar financial incentives work will want to know:

- how much sales of solar equipment increased;
- how much money was saved through reduced energy costs;
- how much the consumption of fossil fuels was reduced;
- how many new jobs were created; and
- how many new solar firms were created.

Policy officials interested in the impact of RD&D programs will ask:

- how well the tested solar systems worked;
- whether solar demonstration projects increased solar equipment sales;
- the extent to which development projects increased the performance of systems;
- whether the results of RD&D projects were disseminated and used;
- the proportion of RD&D projects that were successfully commercialized; and
- the quality of research performers supported.

Most, if not all, of these evaluative questions cannot be answered from information now available from either federal or state solar programs. Yet new solar incentive programs are being continually introduced into the Congress and state legislatures, and public officials still ask how existing programs can be improved.

In addition to the questions just listed are a series of related issues that concern the design and administration of solar incentive programs:

- Which government agency should be responsible for developing rules and regulations governing eligibility for financial incentives or applications for RD&D awards; and where should it be located within the government structure?
- Should the agency that develops rules and regulations also administer the program?
- What funding arrangements should be employed to support the incentive: annual appropriations, sale of bonds, severence taxes, or other means?

- What kinds of staff should develop rules and regulations or administer the program: scientists and engineers, manager/administrators, or persons with backgrounds in economics and business?
- How specific should rules and regulations be?
- How much documentation should be required of persons submitting claims for a financial incentive?
- What is the appropriate role of nongovernment groups such as industry and trade associations, professional groups, solar activists, and universities?
- How much emphasis should be placed on solar demonstrations as compared to research or development projects?

The research reported here specifically addressed these latter questions and develops very preliminary information on the costs and efficacy of solar financial incentives and RD&D programs. The data were drawn from 23 state solar incentive programs, divided nearly equally between financial incentives (eleven states) and RD&D programs (twelve states).

1.3 OUTLINE OF THE REPORT

The following section describes the historical context of states' roles in energy development generally and solar energy specifically. The third section describes the research approach, study design, data collection procedures, and analytic techniques employed. Sections 4.0 through 7.0 are devoted to describing and analyzing state solar financial incentives: what types of programs exist; what background conditions, administrative procedures, and organizational arrangements are associated with relatively successful programs. Sections 8.0 through 11.0 address state solar RD&D programs in a similar fashion. A concluding section summarizes the findings and draws conclusions and implications for both state and federal energy policy makers. An extensive set of appendices contains tabular presentations of the data and the results of analyses that formed the basis of the findings reported.

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SECTION 2.0

THE STATE ROLE IN SOLAR ENERGY DEVELOPMENT*

2.1 THE TRADITIONAL STATE ROLE IN ENERGY PRIOR TO 1973: TAXATION AND REGULATION

Until the shock of the Arab oil embargo in late 1973, energy issues in the United States were largely a matter of negotiations between individual states and private corporations. The federal role was restricted to five specific areas: the regulation of fuel production, supplies, and prices in time of war and national emergency; the regulation and taxation of energy production on federal lands; the regulation of energy supplies flowing in interstate commerce; the regulation of flows of energy entering and leaving the country in international trade; and the levying of corporate income taxes (which applied to all firms, not just energy producers). All the remaining regulatory and taxing rights were reserved for the states and jealously guarded by the Congressional representatives of energy-producing states. Under their powers, the states regulated the manner in which individuals and corporations could produce, transport, and consume energy. The rules and regulations enacted were designed primarily to minimize the amount of environmental degradation resulting from energy production and to ensure the safety and health of workers. Individual states enacted regulations long before such environmental protection was considered necessary by the federal government or by other states. As early as 1879, New York and Pennsylvania required oil producers to plug abandoned petroleum wells to keep ground water from seeping into oil sands and polluting aquifers (Ise 1928). West Virginia passed legislation in 1939 to limit the adverse environmental impacts of surface mining, nearly forty years before the federal strip mining law was enacted (Cameron, Carter, and Cameron 1976). In 1915, the state of Oklahoma pioneered the concept that a state could regulate the rate of production of an energy source (an oil well) to limit "waste," broadly defined to include the existence of a market for its output at some "proper" price (Ise 1928, p. 254). This concept was gradually expanded in the following forty years to strict state control over every facet of gas and petroleum production. States could (and did) require producers to, under a pooled (unitized) system, reinject natural gas or ground water back into the well to maintain pressure, and to limit discharges into the environment.

Besides being the predominant governmental organizations for the regulation of energy production, the states were also the principal leviers of taxes on energy production. These were taxes specific to extractive industries (severance taxes) and taxes levied on all corporations equally (income, property, sales, and use taxes). The federal role in energy taxation was largely restricted to the energy production on federal lands, taxes on the sale of gasoline, foreign investment tax credits, and income taxes on the profits of energy corporations. The producing states were even able to reduce drastically the federal taxation of oil, gas, coal, and other minerals through the Congressional passage of allowances for resource depletion and for intangible drilling costs. Other than the notable exceptions of the Tennessee Valley Authority and the Atomic Energy Commission's civilian nuclear power programs, governmental intervention was largely restricted to the division of profits of energy output and the amelioration of adverse impacts of production, both of which were issues between state legislatures and regulatory bodies and private corporations. This limited federal governmental role and the strict division of labor between the states and federal government persisted in the field of energy long after the

*This section was drafted by John Ashworth.

beginning of the transformation of state-federal relations in other issue areas. The use of state governments by Congress as implementing bodies for national policies, which expanded so rapidly in the 1960s, did not greatly affect energy production, consumption, and planning until the sudden need to allocate scarce petroleum distillates in the aftermath of the 1973-1974 oil embargo. But the patterns developed in other fields in the 1960s did heavily influence the nature of federal state energy cooperation once it was begun. Therefore, in the next section we briefly survey the changes in the federal system in the post-world-war period with the expansion of federal grants to states and localities, revenue-sharing, and the "New Federalism."

2.2 STATES AS ADMINISTRATORS OF FEDERAL POLICY

Under the U.S. Constitution, the states and federal government have few divided powers and many shared functions. This has been an evolving relationship but, as many authors have noted, there is a continuing overlap of jurisdiction and function between the two levels of government in virtually every phase of national life (Elazar 1972, pp. 47-55). One major transformation that has occurred since the beginning of the New Deal has been the increased use of state governments as implementing agencies for legislation which is national in mandate and broad in scope. The Congress authorizes grants to the states to carry out these mandates, including the writing of the specific rules and regulations for implementation. Initially, most of these were categorical grants, designed to carry out a specific objective in a particular fashion. The Highway Trust Fund, perhaps the best known of such programs, began in the 1950s and has had a major impact on the activities of the states. By 1962, there were 160 categorical grant programs, over 100 of them being relatively small project grants and the others being largely formula-based grants (Walker 1975, pp. 134-135). The expansion of national social legislation in the 1960s greatly increased the number and size of such programs, until they reached nearly 600 by 1974. Categorical grants were joined in the mid-1960s by block grants, which gave the states wide latitude for the choice of means for reaching broad programmatic national goals. Starting with the Partnership in Health Act of 1966 and the Omnibus Crime Control and Safe Streets Act which established the Law Enforcement Assistance Agency (LEAA) in 1968, the Congress has expanded the role of states in planning and implementing programs that seek to meet goals and objectives which are national in scope. Several large additional categorical grant programs were set up in the early 1970s.* General revenue sharing was instituted in 1974, followed by other innovations such as countercyclical grants. As a result, the size of total federal transfers to state and local governments surged from 7.0 billion dollars in 1960 to 43.3 billion dollars in 1974 to over 72 billion dollars in 1977. More importantly, the federal grants as a percentage of the receipts of state and local government from their own sources increased over the same 17-year period from 16.8% to an estimated 35.3% (Intergovernmental Perspective 1977, p. 20).

There has been a great deal of speculation and research on the effects of this infusion of federal funds on the traditional division of state and federal roles, on the autonomy of state officials, and on the provision of goods and services to individual citizens. Analyses have ranged from case studies on the impact of a particular federal initiative on a particular state or locality (Altenstetter and Bjorkman 1976) to broad-scale surveys of

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*The Comprehensive Employment and Training Act of 1973 (CETA), the 1974 (Title XX) to Social Security Act of 1935, and the Community Development and Housing Act of 1974 are the major examples of these new initiatives. For a brief analysis of the impacts of such programs, see Stenberg (1977).

participants on their perception of the overall impact of federal fund transfers to lower level government (Advisory Commission on Intergovernmental Relations 1977a). There are two central issues in the analysis of the implications of the federal grants system on the state and local governments in general and in the area of energy in particular:

- How has the availability of federal funds changed the internal priorities of state and local officials?
- How has this ten-fold increase in federal transfers to the states affected the autonomy of action of the states?

The first question was addressed by the Advisory Commission on Intergovernmental Relations (ACIR) through a 14-volume study entitled The Intergovernmental Grant System: An Assessment and Proposed Policies. One of the volumes examined not only the question of whether federal grants altered state expenditure patterns, but whether the form of the grant was an important determining factor of the magnitude of the response induced. The ACIR researchers found that there was a strong positive correlation between federal grants in a particular area and the rise in state and local expenditures in that same area. Project grants, which require a major initiative by the local government (primarily) or state government, tend to have more of an impact on the level of expenditure than formula-based grants (which are more or less automatic division of a fixed Congressional allocation) (Advisory Commission on Intergovernmental Relations 1977b).

Second, the massive rise in federal transfers to states and localities has meant an increasing dependence on federal grants for the daily operations of state agencies. The effect has been very uneven across states and agencies. One large-scale survey found that 32% of the 1000 state agency heads contacted relied on federal funds for more than 50% of their budgets, while another 47% had less than 25% of their funds provided by federal aid (Advisory Commission on Intergovernmental Relations 1977a). It is clear that winning federal funds and complying with obligatory federal regulations are central to the continued existence and expansion of a large number of state agencies, particularly in the social welfare, environmental protection, community development, and energy conservation fields.

A third issue which has been frequently raised but which is treated only briefly in this initial section is the cost of requesting and administering federal funds. This is particularly true for project funds, which require a continuing committment by the local governments or states including the writing of proposals, the development of detailed implementation plans, the preparation of compliance plans with a large range of federal requirements, and the monitoring of program results. These are issues that are raised later in this report in the context of costs involved in developing and administering energy programs at the state level.

2.3 STATE ROLES IN ENERGY FOLLOWING THE 1973 OIL EMBARGO

2.3.1 The States As Innovators in Energy Policy

As already mentioned, while the federal role in a great many areas was expanding in the 1960s and early 1970s, it was largely dormant in the field of energy. It was the individual states that first recognized the interlocked problems of energy supply to meet rising demand, environmental degradation from energy production, and potential transition from fossil fuels to renewable energy sources. Several states took the initiative in regulating the practices of strip-mining for coal production, starting first with the traditional eastern coal mining states and then in the western states which possess large deposits of low-sulfur coal. State action to lower air pollution from the combustion of energy also preceded and provided models for federal air quality laws. State governments began to create energy offices in the early 1970s in response to growing concerns over the availability of energy supplies. By the time of the Arab oil embargo in October 1973, 32 states had energy offices, energy task forces, or similar units to study alternative strategies of seeking answers to potential shortages of supply (Light 1976). The existence of these state organizations became crucial in sudden crises of supply of petroleum distillates in 1973, as will be discussed in Section 2.3.2.

While most states moved to support increased fossil fuel development or to expedite their electric power generation, a number of states began to develop strategies for the promotion of new sources of energy which would replace or lower dependence on fossil fuels. In keeping with the traditional state role in energy, these initiatives were aimed primarily at the stimulation of an increase in a dependable, environmentally benign, local energy supply rather than at the reduction of demand for particular fuels. The general philosophy was to influence individual consumer choices rather than to mandate changes in consumption patterns or to forbid certain activities. These took the form primarily of state financial incentives for the construction or purchase of solar energy systems and energy conservation equipment, for research and development of new energy systems, and for initiatives to remove barriers to the use of alternative energy sources. The financial mechanisms used by states to encourage alternative energy systems included exemptions from or credits against the same forms of taxation levied on conventional energy sources; personal and corporate income tax, as well as property, sales, and use taxes. Before 1973, there were no state financial incentives for solar energy systems. By November 1978, 37 states had enacted over 135 statutes which dealt with solar energy issues, with 61 of these laws containing provisions for one or more of these financial incentives.* States also provided innovative approaches to the funding of research on new energy sources. Montana and New Mexico use funds drawn from their mineral severance tax proceeds to finance their state solar research programs, while California levies a flat-rate surcharge on all electricity sold in the state. The money generated by the surcharge is used to support all of the activities of the state's energy commission including an active R&D program (Green 1979).

2.3.2 The States As Implementors of Federal Energy Policy

Several states began to prepare for energy supply shortages before the onset of major petroleum supply dislocation in late 1973. The federal government began to encourage a voluntary petroleum distillate allocation program in early 1973, but the Arab oil embargo forced them to convert this into a mandatory program covering virtually all petroleum products by the end of that year. States were immediately given responsibility for allocating a small amount of the available supplies (normally 3%) but played a far more crucial role in intervening directly with the inexperienced federal allocation officials of the regional and national Federal Energy Office (later the Federal Energy Administration) (Light 1976). In part to deal with the allocation problem and in part to deal with the dislocations caused by the sudden escalation in fossil fuel prices, most states developed an

*For a compilation of state incentives for solar energy as of the end of 1978, see John Ashworth (1979). For updates of legislation since that time, see the Solar Law Reporter, Vol. 1, No. 1, pp. 198-221 and Vol. 1, No. 2, pp. 454-494.

energy office, energy planning group, or State Department of Energy. By October of 1974, 41 of 49 state and territories responding to a National Governors' Conference poll stated that they had developed a "comprehensive state energy office, though many of these offices had little authority or financial support" (Light 1976, pp. 87-88). These organizations served as natural foci for the flood of federal energy initiatives that was to follow. One 1978 study by the Department of Energy located 44 separate "energy programs which involve States, and are administered by eight Federal departments" (U.S. Department of Energy 1978a, p. 2). The authors of that study readily admitted that this was not an exhaustive listing. It did include the major conservation and supply programs administered by the Department of Energy, and some programs that only impinge obliquely on energy, such as the Coastal Zone Management Program and the Federal Water Pollution Control Act.

Several of the early federal energy programs clearly show the extension of procedures developed in other areas to energy planning and management. This is particularly true in energy conservation programs. The Energy Policy and Conservation Act of 1975 (EPCA) provided substantial funds to states that submitted to FEA a program for a 5% reduction of its anticipated 1980 energy use. By January 1978, the plans had to include a host of mandated items, including mandatory lighting efficiencies of public buildings, the promotion of carpooling and public transportation, energy-efficient state procurement policies, and mandatory thermal efficiencies for new buildings. The initial EPCA program was supplemented by the Energy Conservation and Production Act (ECPA) of 1976, which required additional plans outlining the state's programs for conducting educational activities on energy conservation and the encouragement of energy audits for buildings and industrial installations (U.S. Department of Energy 1978a, p. 9).

The EPCA/ECPA program provided a quantum leap in the level of money available to the states for energy-related activites. For fiscal year 1977, the Department of Energy disbursed $22.5 million for the EPCA programs, with another $12 million made available for the additional programs developed in the EPCA programs (U.S. Department of Energy 1978b, pp. 3-5). In FY78 the amount of these grants to the states increased. In addition, new programs such as the Energy Extension Service, which provided $1 million for each of ten pilot states for outreach and conservation programs, were added to the EPCA/ECPA funding. Many state energy offices operate with 100% federal funding, while others have more than 80% of their funding from a variety of federal sources. With the pass-through of federal funds to the Regional Solar Energy Centers, which then subcontract staff services in the states, most states now have at least one person designated to coordinate solar activities.

SERI

SECTION 3.0

OVERVIEW OF RESEARCH APPROACH AND STUDY DESIGN

3.1 INTRODUCTION

This report provides information and analyses intended to improve the design and effectiveness of government programs for stimulating the use of solar energy. The data were derived from systematic study of selected state solar energy incentive programs. More specifically, we identified organizational and administrative factors that affect the successful implementation* of government programs intended to provide incentives for, or reduce barriers to, increased use of solar energy. In subsequent studies SERI will focus on the consequences or outcomes of state solar energy initiatives.

The study is based upon two premises. The first is that lessons can be learned from state efforts to design and implement solar energy incentives and that these lessons will be useful to program managers and policy makers in the states and in the Department of Energy. To the extent that generalizations can be made about the types of programs that work under specified conditions, why they work, and the origin of problems encountered, more effective incentive programs can be designed and existing programs can be improved. The second premise is that how a policy is implemented—the process by which a policy is translated into a program and the nature of the managerial and organizational elements of that program—often is as important for achievement of policy goals as the design of the policy itself. Recent literature on policy implementation provides ample evidence that this is the case (Pressman and Wildavsky 1978; Hargrove 1975; Williams and Elmore 1976; Bardach 1977; Berman 1978).

Research reported here was restricted to selected research, development, and demonstration (RD&D) programs and financial incentive programs initiated by states in the United States. Information outreach programs were studied in a concurrent research project and the results reported separately. The study therefore covered two major types of incentives—those intended to increase the supply of more cost-effective solar technologies and those intended to increase the demand or market for solar energy technologies.

3.2 RELEVANCE TO THE DEPARTMENT OF ENERGY AND STATE ENERGY POLICY MAKERS

This research project is intended to illuminate decisions in the following three types of activities:

- management of solar technology R&D programs,

*By implementation we mean the process by which broad policy mandates (often embodied in legislation) are interpreted, refined, and executed by administrative agencies. Implementation activities thus include the development of regulations, standards, and codes; the formulation of eligibility criteria; the development of administrative procedures and practices; and the establishment of organizational responsibilities and institutional arrangements.

- design and implementation of solar energy incentives, and
- evaluation of solar incentive programs.

Implementation is a key issue in any research on or assessment of government energy incentive programs because the success of these programs probably will be influenced as much by the way the program is implemented as by the design of the incentive itself. Lack of success in an energy incentive program may be due to bad design or poor (inappropriate) implementation. By studying implementation, one can determine whether one or the other is true. If it is a design problem, the program should be discontinued. If it is an implementation problem, information on implementation is needed to improve program effectiveness. There are additional reasons for studying implementation. First, many energy incentive programs are new, so that monitoring the progress of program development, organization, and administration is a central element of policy interest. Implementation is particularly important to policy makers initiating or implementing a new policy action of their own. Second, a focus on implementation should advance our understanding of a major, but often undocumented, influence on new policy actions; namely, the accommodation of policy objectives to an institutional setting. Third, much of the uncertainty associated with a new policy action arises from uncertainty about how policy objectives will actually be enacted into programs by the responsible administrative agency. Finally, for many policy purposes, information about "ultimate" outcomes is less important than information about implementation outcomes and the implementation process itself.

In most respects, policy processes in state and federal governments are analogous: legislative bodies formulate or react to policy initiatives, assign responsibility for implementing policy initiatives to administrative agencies (public bureaucracies), and exercise oversight to ensure that legislative intent is carried out. Administrative agencies interpret policy mandates, set rules and regulations, and develop administrative routines. State agency functions and political settings are thus similar to those of their federal counterparts, and the experiences of state bureaucracies should be valuable to both levels of government. For example, though there is some differentiation among the types of R&D projects supported at the federal and state levels (e.g., state programs tend to be oriented toward relatively short-term applications), managers at both levels of government face similar issues: how to assign project priorities, plan and manage demonstration programs, disseminate research results, select commercialization strategies, and evaluate program activities.

The project developed measures of "intermediate" program effects and state program activity levels and identified implementation issues that affect the costs (including administrative costs) and benefits of solar incentive and RD&D programs. It also developed conceptual and methodological tools to address these types of questions within the context of solar energy. These products should help federal program evaluators ensure that full program costs are incorporated in evaluations and that causal relationships linking program costs and other inputs to program outputs are better understood and specified.

Analyses presented in this study regard states as experimentors in the solar energy field whose experiences are valuable if systematically documented in a form useful to federal and state officials. In addition, future federal programs, to be fully effective, should complement existing state programs in both design and operation. This study provides detailed information about how variations in the design and operation of representative state programs affected their success. Finally, state and local government cooperation and action are essential to the realization of national energy goals. The understanding of state solar energy programs provided by this study should prove valuable to national policy makers charged with designing or improving national incentive programs that must function in a federal system of government.

3.3 GENERAL FRAMEWORK

The objectives of this project reflect the assumption that the steps taken to execute a policy are as significant for achievement of policy objectives as the design of policy itself. The primary research questions addressed relate to the achievement of what Hargrove (1975) has called the "missing link" between policy and outcomes: an implemented program. The project focuses on measures of "implementation success" and on the relationships between these measures and a variety of implementation conditions that describe the way particular state solar energy initiatives have been executed through administrative action. It seeks to identify (for each type of policy initiative) the factors that account for the extent of program implementation observed. We expected that factors other than the type of initiative or mode of implementation, especially the local political climate, existing state statutes, state energy costs and availability, and state size and growth, would be important. These were explicitly incorporated in the analysis. The basic analytical structure is depicted in Fig. 3-1.

The measures of implementation success of primary interest in this project are indicators of scale or level of effort, administrative costs, and implementation outcomes, rather than indicators of policy goal attainment. There are three reasons for deferring attention to ultimate policy or program consequences to later research:

- The recent enactment of most state solar energy initiatives precludes the collection and use, in the short term, of ultimate program outcome measures such as Btu saved, jobs created, new knowledge produced, or new technologies developed and disseminated.
- The desire to produce information useful to public policy makers as quickly as possible requires data collection and analysis activities less complex and time-consuming than for a full-scale assessment of program outcomes.
- Explanations of why initiatives in some states are functioning sooner and more effectively than others are of immediate interest to decision makers interested in improving program effectiveness.

The three types of measures of program outcomes were developed from several sources. First, the standard program evaluation literature offers distinctions among program consequences such as Suchman's (1967) types of process evaluation (effort, performance, and process). Second, the literature on organizational behavior (particularly organizational effectivenss) recognizes similar distinctions among intermediate outcomes, effectiveness, efficiency, and impacts (Price 1978). A SERI pilot study of state incentives suggested, on the basis of interviews with state officials, that information about these types of program outcomes would be of great interest (Ashworth et al. 1979). Third, efforts to think about evaluating public programs whose outputs are difficult to specify and measure have resulted in useful concepts such as those of Rubenstein (1976), who distinguishes among immediate outputs, intermediate outputs, pre-ultimate outputs, and ultimate outputs of R&D programs. The three types of outcome variables we decided upon meet three criteria: they include the major types of "intermediate" outcomes identified in the literature, they are of interest to policy makers, and data can be collected from

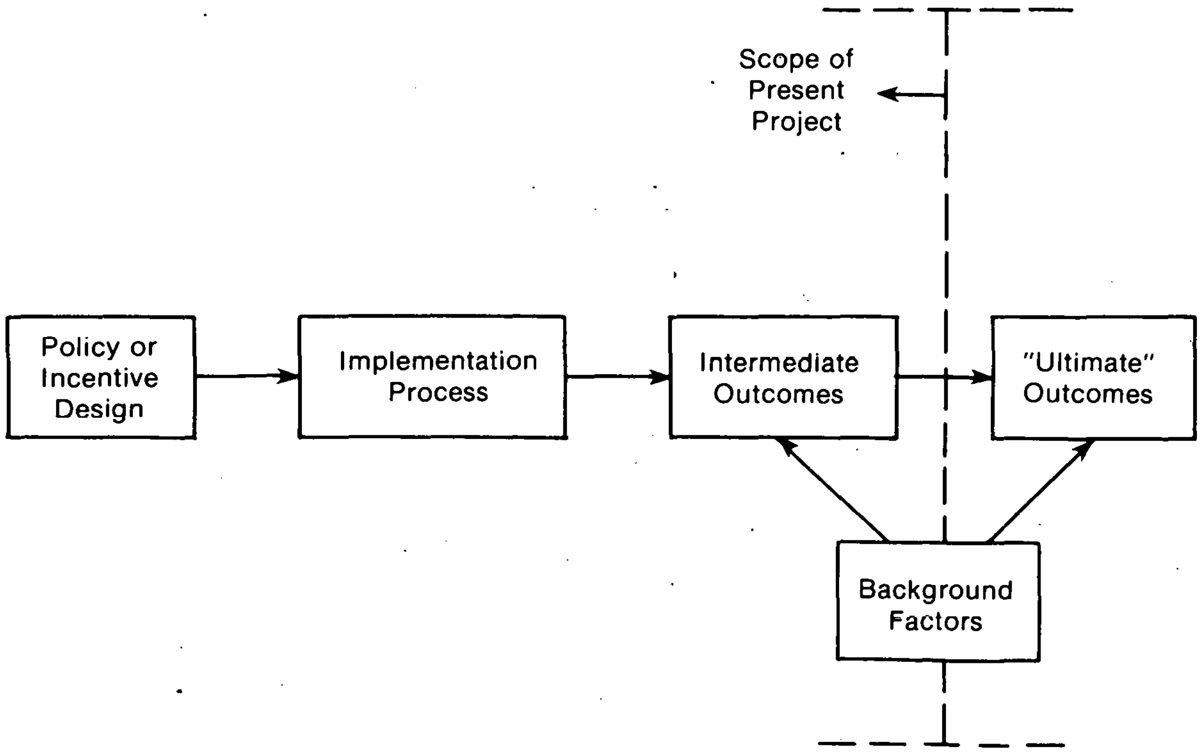

Figure 3-1. Basic Analytic Structure

state program officials and records. Specific measures for these variables will be described in Section 4.0 for financial incentives and Section 8.0 for RD&D programs.

3.4 FACTORS AFFECTING IMPLEMENTATION

As defined earlier, implementation factors are those that describe the process of interpreting, refining, and executing authoritative policy mandates. Previous implementation research has suggested some general categories of these factors. Programmed versus adaptive implementation processes, for example, result from different assumptions about the source of implementation problems: insufficient specification of goals and inadequate management control versus excessive rigidity which cannot accommodate necessary bargaining and compromise, adjustment to local conditions, or adjustment of original goals to reflect actual program outcomes (Berman 1978). Elmore's (1978) characterization of implementation processes in terms of different organizational models suggested a related but more detailed set of variables which are likely to account for differences in implementation outcomes: effectiveness of management control, technical capacity to implement, goal consensus between policy makers and implementors, and goal consensus among implementing agency officials. The SERI pilot study of state incentives suggested that the fiscal and political autonomy of the implementing agency, the agency's linkages to outside groups such as solar energy lobbies and industry groups, the primary function of the implementing agency, and the characteristics of agency staff are likely to affect implementation outcomes. Factors likely to influence implementation success also were identified from direct information about the problems and issues that face state agencies charged with implementing solar incentive legislation.

The implementation literature yielded rich conceptual insights and indicated general areas of organizational structure, process, and setting that should be addressed in studies of policy implementation. It did not, however, suggest explicit measures for key variables or discuss problems associated with the collection, validity, and analysis of data on implementation processes. No doubt this reflects the fact that most available empirical studies of implementation are descriptive, single-case analyses (e.g., Pressman and Wildavsky 1973; Bardach 1977). The present study thus represents an early effort to develop measures for some of the factors expected to influence policy implementation. Our procedure was iterative, involving consideration of concepts drawn from the literature, information derived from observations of state solar incentive programs, and the realities of data availability in the field. Table 3-1 lists the factors identified in this manner and for which data were acquired from archival data, interviews, and observation. Where appropriate, the source(s) for each factor is identified. There were no major differences in the implementation process factors identified a priori for financial incentives and RD&D programs; the analyses of implementation success in Section 7.0 (financial incentives) and Section 11.0 (RD&D programs) introduce a small number of additional factors unique to each type of program.

Background conditions in the states could, in specific cases, largely account for the program outcomes (e.g., a governor's hostility to solar energy or preoccupation with other issues can thwart legislative intent). In the more usual case, the state's size, growth rate, energy use patterns, energy prices, tax policies, and history of executive-legislative relationships may have much to do with the efficacy of a solar sales tax rebate, the visibility of energy issues (and the degree of consensus on solar energy as a viable solution), or the feasibility of general solar tax credit eligibility requirements that must be interpreted for each specific claim. Both the identity of those background factors likely to be significant and their importance emerged from our pilot study of state incentives; the complete list appears in Appendix A.

Table 3-1. FACTORS EXPECTED TO INFLUENCE IMPLEMENTATION SUCCESS OF BOTH FINANCIAL AND RD&D PROGRAMS

Factor	Source
Amount of organizational change required to implement incentive.	Van Meter and Van Horn (1975)
Amount of conflict between executive and legislative branches in the state in all policy areas.	
Amount of conflict between executive and legislative branches in the state on solar energy related issues.	
Extent of involvement of implementing agency officials in formulating the legislative basis for the solar incentive.	Elmore (1978); Van Meter and Van Horn (1975)
Existence of formal advisory arrangements between implementing agency and external groups such as solar interest groups, industry and trade associations, and universities.	Ashworth et al. (1979); Van Meter and Van Horn (1975)
Professional backgrounds of implementing agency staff.	Ashworth et al. (1979)
Degree of enthusiasm for solar energy among implementing agency staff.	Ashworth et al. (1979)
Number of registered solar lobbyists in the state.	
Amount of informal interaction between implementing agency and external groups.	Ashworth et al. (1979); Van Meter and Van Horn (1975)
Amount of influence on implementing agency activities by external groups.	Ashworth et al. (1979); Van Meter and Van Horn (1975)
Public hearings have been held on implementing agency plans, especially rules and regulations.	

3.5 RESEARCH APPROACH AND STUDY DESIGN

This was a study of organizational behavior. The unit of analysis was the state government agency charged with responsibility for implementing financial incentives for solar energy or for implementing a state-supported solar energy RD&D program. Since for every incentive program there is a corresponding implementing agency, our route to selection of agencies for study was through the universe of state financial and RD&D programs. As of mid-1978, that universe consisted of 17 state solar RD&D programs and 61 financial incentive programs; from it we selected 12 RD&D programs and 11 financial incentive programs for intensive study. This set of programs was chosen to exhibit the following characteristics (National Conference of State Legislatures 1978; The Franklin Institute 1978):

- All had operated long enough (more than one year) to have generated evidence of implementation success.
- All major types and sizes of financial incentives—tax credits, loans, sales tax exemptions, and accelerated amortization—were represented.
- RD&D programs with each of the major types of funding sources—mineral severance tax, energy use tax, general revenues—were represented.
- Most, if not all, programs likely to serve as models for other states were included.
- A range of variation on the implementation outcome measures employed in the study was expected.*

The states in which each of the 23 programs studied are located and some descriptive information about them are listed in Tables 3-2 and 3-3.

This number of programs was large enough to represent the major types of incentive programs and implementation strategies, to exhibit variation in the variables of interest, and to permit comparative analysis within program types; it was small enough to permit the intensive case study approach to data collection which is appropriate for the complexity of the implementation process, the lack of theory about implementation, and the multiple-theory status of organizational behavior (Yin 1979; Elmore 1978). Given our interest in studying the actual behavior of state organizations and the number of organizations involved, we employed what are generally referred to as "field methods" to collect data. We used a variety of field methods—interviews, observation, and the analysis of archival materials—to balance the strengths and limitations of one method against the others (Scott 1965). This strategy combined the strengths of the case study, or intensive approach (which captured the complexity of the implementation process), with the strengths of the extensive or survey approach (which permited limited generalizations to be derived from the data), and was consistent with the resources available to conduct the study.**

*These judgments were made on the basis of knowledge gained during the pilot study and from conversations between SERI staff and state solar energy officials.

**For a discussion of the use of intensive and extensive approaches in social research, see Brown (1974). R. Scott (1965) provides an excellent discussion of the strengths and weaknesses of exploratory and descriptive approaches to the study of organizations versus the hypothesis-testing approach. Yin (1979) presents a detailed analysis of methodological issues involved in the study of complex decision-making processes such as implementation.

Table 3-2. STATE FINANCIAL INCENTIVE PROGRAMS STUDIED

State	Year	Incentive Type	Implementing Agency
Arizona	1977	Income Tax Credit	State Department of Revenue
	1974	Property Tax Exemption	
	1977	Use Tax Exemption	
	1975	Accelerated Amortization	
California	1976	Income Tax Credit	Franchise Tax Board; California Energy
	1978	Loan Terms	Commission Department of Housing and
			Community Development
Hawaii	1976	Income Tax Credit	State Tax Department
	1976	Property Tax Exemption	
Kansas	1976	Income Tax Credit	State Department of Revenue
	1977	Taxable Income Deduction (Business)	
	1977	Property Tax Reimbursement	
	1977	Accelerated Amortization (Business)	
Massachusetts	1975	Property Tax Exemption	Local Assessor
	1977	Sales Tax Exemption	State Department of Corporation
	1976	Deduction-Business	and Taxation
	1977	Loan Terms	Local Bank/Credit Union
Michigan	1976	Property Tax Exemptions	Local Government Services
	1976	Use Tax Exemption	State Department of Treasury
	1976	Business Activities Exemption	State Tax Commission
Montana	1977	Income Tax Credit	State Department of Revenue
	1977	Tax Deduction—Capital Investment	Income Tax Section
	1975	Loan Terms	Public Service Commission
New Mexico	1975	Income Tax Credit	State Department of Taxation
	1977	Tax Credit-Irrigation	and Revenue
North Carolina	1975	Income Tax Credit	State Department of Revenue
	1975	Property Tax Exemption	Local Assessor
North Dakota	1977	Income Tax Credit	State Tax Commission
	1975	Property Tax Exemption	Local Assessors
Oregon	1977	Income Tax Credit	State Department of Revenue
	1975	Property Tax Exemption	Local Assessor
	1977	Loan Terms	State Department of Veterans Affairs

Table 3-3. RD&D PROGRAMS STUDIED

State	Year of Enactment	Source of Funds	Implementing Agency
Arizona	1977	GR	Arizona Solar Energy Research Commission
Colorado	1974	GR	Colorado Energy Research Institute
California	1974	EUT	California Energy Resources, Conservation & Development Commission
Florida	1974	GR	Florida Solar Energy Center
Hawaii	1974	GR/B	Department of Planning and Economic Development
Maine	1975	GR	Maine Office of Energy Resources
Montana	1975	ST	Department of Natural Resources and Conservation
New Mexico	1975	ST	Energy and Minerals Department
New York	1975	EUT	New York State Energy Research & Development Authority
North Carolina	1975	GR	North Carolina Energy Division, Department of Commerce
Ohio	1975	GR	Ohio Energy and Resource Development Agency
Texas	1977	GR	Texas Energy Advisory Council

SOURCE: Franklin Institute (1978); National Conference of State Legislatures (1978); and internal SERI sources.

GR = General Revenue
EUT = Energy Use Tax
B = Bonds
ST = Severance Tax

3.6 DATA COLLECTION AND DATA SOURCES

The key to our data collection strategy was a small, highly trained group of SERI professional staff charged with collecting data on implementation processes. Our pilot study showed that state incentive programs vary widely in size, complexity, formality, accessibility, and the amount of written documentation describing internal management practices, levels of activity, and types of program output. Our staff had to determine for each program, on the basis of preliminary information obtained by telephone in advance of site visits and the situation encountered at each site, the appropriate blend of field methods (interviews, observation, and archival search) that maximized the amount, accuracy, and relevance of information obtained. In addition, the staff was sensitized in advance to the basic issues involved in implementation so that threads of conversation, data on program administration, or viewpoints of particular nongovernment observers which promised insight into implementation could be investigated more fully.

Five to seven persons were interviewed for each state program. For a typical program, two or three of these were from the legislative branch whose responsibilities included oversight of and/or appropriations for the administrative agency(ies) carrying out the solar incentive, two to four persons directly responsible for implementing the incentive (implementing-agency officials, budget agency officials, governor's staff, state energy office staff), and one or two independent observers such as university researchers, interest group leaders, or media representatives.

Site visits were conducted in 18 states by teams of two SERI staff members who were responsible for collecting all necessary data. Wherever possible, both members were present during personal interviews to ensure that all issues were addressed and that interesting leads were pursued. Each team submitted a case report on each program that described the field methods selected, the reasons for the selection, the identity and position of persons interviewed, observations made, archival data reviewed, and archival material physically obtained both in advance and on site. In addition, each team filled out a structured questionnaire to record its responses to items intended to measure key implementation process and implementation outcome variables.

This procedure served several purposes: it provided a structured format for team members to report case study data (an amalgam of archival data, interview data, observation, and impressions); it enabled intrateam responses to be compared and differences resolved; it permitted comparison between team responses and archival data; and it enabled program information to be coded for easy retrieval and analysis.* Following data collection and recording, another member of the project staff not involved in data collection carefully reviewed each program file and compared data from interviews, records, and case reports. This validation process revealed any inconsistencies in the data and led to their resolution.

*This type of approach has been used successfully in several recent studies, most notably in a Rand Corporation study of the implementation of innovations in local government service organizations (Yin 1978).

3.7 ANALYSIS PLAN

The basic analytic approach in this study combined comparative case analysis with simple correlation and cross-tabulation. The 23 programs studied were divided into two groups, financial and RD&D. Analysis proceeded within each of these groupings: we sought relationships between each of the appropriate implementation variables and measures of implementation success for that type of program. Findings for each type of incentive program typically were developed from a series of pairwise correlations and cross-tabulations, with one axis representing the measure of implementation program success and the other representing the implementation variable in question. The distribution of state programs within each table indicated the direction and strength of the relationship of interest. These findings were complemented by case-by-case analyses of other factors that, upon close examination of each program, proved significant for implementation.

This scheme was appropriate to the level of knowledge in the field of implementation research, to the level of knowledge concerning the factors that influence the success of solar (or other technological change) incentive programs, and to the small number of cases involved. The basic analytic approach was used successfully in the recent, well-received analysis of 24 federally funded demonstration projects (Baer et al. 1977).

The patterns observed were examined in the light of qualitative evidence from each case; that is, the findings were modified as required by the knowledge that, in particular cases, the relationship between a program's intermediate effects and each pertinent measure of implementation success was strengthened or weakened by unique, localized influences. Data on these influences for each program were drawn from the background data and from site visits.

It is likely that no single measure of implementation success would suffice for any one program, much less for all types of programs. Given the large set of possible measures, individual outcome measures were clustered to reduce the number of dependent variables as much as possible. Details of this clustering procedure are presented in Appendix B. The basic analytic product, then, is a series of statements describing the existence and direction of relationships between implementation factors and derived measures of implementation success for each major type of incentive.

Three limitations were intrinsic to the study, given its objectives and the available data and theory. First, we could not identify in advance (and may not have identified during site visits) intervening variables that affect relationships between implementation and outcome. As Berman notes, "The implemented program depends on the complex interplay between the policy choice and the policy's institutional setting, which consists of one and often of many formal and informal organizations" (Berman 1978). We were in no position to speculate what the entire array of possible intervening influences would be; we could only incorporate qualitatively such factors as political setting. Only those relationships that emerged clearly from the analysis and withstood scrutiny from the local perspective and from comparison with analogous programs results were afforded much confidence. Second, we could not guarantee that there would be sufficient variation across state programs to permit meaningful analysis in every case. One contribution of the pilot study was to identify those factors that appear to influence implementation and that vary across states, but we had to eliminate some analyses because of lack of change in the variables of interest. Finally, lack of theory in the field of implementation, lack of knowledge about the factors that influence successful public programs to stimulate the application of solar energy, and innate complexities of the processes involved in designing and implementing public programs suggest that expectations for this study should be modest.

SERI

SECTION 4.0

OVERVIEW AND EXPECTATIONS: STATE SOLAR FINANCIAL INCENTIVES*

4.1 INTRODUCTION

This section examines why governments, particularly at the state level, employ financial incentives to stimulate solar activity, what types of incentives might be used, and what results are expected from the application of incentives. Specifically, these issues are discussed:

- why governments use financial incentives,
- why financial incentives may increase the propensity of consumers and producers to enter the solar marketplace,
- what types of financial incentives can be employed by state governments and what advantages and limitations they possess, and
- what can be expected to result from the implementation of financial incentives at the state level and how the results can be assessed.

This section also discusses planned and actual data employed to measure the extent to which state solar financial incentive programs were successfully implemented. Problems encountered in developing and using measures of implementation are described.

4.2 THE RATIONALE FOR GOVERNMENTS TO EMPLOY INCENTIVES

Governments, particularly at the federal and state levels, have an interest in expanding solar energy use. Legislators and executive officers are interested in limiting their region's dependence on conventional fuel sources as these fuels become increasingly scarce and expensive. Public officials and their constituents want to ensure the availability of energy in the future to sustain economic growth and the standard of living. In addition, there is considerable interest in developing renewable energy technologies instead of promoting the use of expensive imported fuels and the production of energy from environmentally hazardous sources.

Because organized public interest in alternative energy supplies is growing and because solar technologies are not yet well established in the marketplace, government policy makers consider alternative strategies for expanding the use of solar energy. One mechanism available is enacting financial incentives to encourage consumers and producers to invest in solar equipment by effectively reducing its high initial costs. Since most solar energy applications currently are in a decentralized form, financial incentives for solar equipment to private producers (to increase supplies of solar technologies) and to consumers (to increase demand) are one way to expand the solar market.

In a perfect market, "prices should reflect the valuation, at the margin, which households place on commodities they consume" and the value of the production inputs; prices should be reliable indicators of social costs and benefits (Aaron 1971, p. 40). This pricing

*This section was drafted by Jean Neuendorffer.

principle is the theoretical basis for private market pricing. As Aaron (1971) points out, the economic justifications for governments to use tax and other financial incentives are (1) that the "free market" system does not always function adequately, and (2) no economy, including that of the United States, is entirely a market economy. Government may intervene in the private market with incentive mechanisms to overcome pricing imperfections and may also use incentives to alter market forces in favor of certain commodities, such as solar energy systems. Several distortions exist which cause the price of solar and other energy supplies as determined by consumer demand to be an inaccurate measure of their value. For solar energy equipment, one potential distortion may be in the way consumers interpret the price. Consumers may compare the initial price of solar equipment with that of furnaces or boilers and, because of lack of knowledge, fail to calculate and compare the life-cycle costs (which include fuel and maintenance costs as well as capital investment) of solar and conventional energy. Consequently, because of imperfect information, consumers may not include the long-term saving in their valuation of solar equipment and may judge the equipment's initial price as too high compared to the price of conventional alternatives. Also because of imperfect information, consumers may perceive a high degree of risk with a new type of energy system and, therefore, may undervalue solar units more than is warranted by the units' actual performance.

Even if consumers do consider life-cycle costs for different energy forms, a fair comparison of values cannot be made because of distortions in the prices of conventional fuels. Subsidies and price regulations for electricity, oil, and gas prevent their prices from being an accurate valuation of these energy sources (Bezdek et al. 1977, pp. 12-15). Uncertainty about future fuel costs may also cause incorrect life-cycle cost calculations by consumers.

The prices of conventional fuels also may not include environmental and social costs since consumers are not fully charged for the externalities associated with these fuels' production. In addition, they cannot correctly gauge the long-term supply of these fuels and, therefore, the full social costs are not known. These factors influence supply as well as demand. Thus, investments in conventional fuel production will seem more attractive in the short-run. Producers have imperfect knowledge about new solar technologies; therefore, they may not want to invest in solar technology, and they may add a risk premium to their actual costs.

Since several distortions of the free market do exist which make solar units seem more expensive than conventional systems, tax and other incentives can be employed to reduce the price of solar equipment to consumers and to reduce the risk perceived by investors and producers. The incentives make the price of solar units reflect true long-term value more accurately. Financial incentives are not the only method for trying to compensate for distorted energy market prices. For example, consumer information and education programs would help the consumer evaluate the price of energy equipment in life-cycle terms, and government decontrol of conventional fuel prices would allow market prices to reflect more accurately the relative availability and value of energy sources. State governments as well as federal and local governments can implement financial incentives directed at overcoming many of the barriers which consumers, producers, and financers perceive about solar energy equipment.

4.3 THE EFFECT OF FINANCIAL INCENTIVES ON THE COSTS OF SOLAR UNITS

The government may use financial incentives and other mechanisms to overcome the perceived barriers outlined in the previous section. Financial incentives are intended to reduce the initial high cost of purchasing or manufacturing solar units. Financial incentives may also have a psychological impact on the potential solar consumer and producer (Booz Allen and Hamilton 1976). To the extent that consumers regard government financial incentives for solar use as a demonstration of public commitment, they may feel that less risk and uncertainty are involved in a solar purchase.

In assessing the extent to which a financial incentive will make solar purchases more attractive to consumers, the effect of the incentive on the cost of the solar unit needs to be calculated. Listed below are the standard ways of calculating solar unit costs and of comparing them with conventional energy system costs (Bezdek, Hirshberg and Babcock 1979, pp. 12-17; Booz Allen and Hamilton 1976, I-3 and III-5; and A. D. Little 1976, pp. 21-33).

Payback period: the years it takes a consumer to recoup the initial investment through annual fuel savings.

Life-cycle costs: the total cost of the solar unit over the life of the unit.

Calculations of the incentive's effect will vary a great deal depending on:

- climatic conditions,
- variations and availability of information about future electricity and fuel prices, and
- variation in lifetime and maintenance costs of different energy systems (Bezdek, Hirshberg and Babcock 1979, p. 1215).

Since the impacts of financial incentives can vary so much, analysis must be done for each type of incentive for particular locations and types of solar units. Studies have been performed which calculate the effects of certain incentives on costs in various regions (Bezdek, Hirshberg, Babcock 1979; R. Ruegg 1976; MITRE Corp. 1978; and Booz Allen and Hamilton 1976), but generalized conclusions about the incentives' cost impacts are difficult to make.

Although the specific effects of financial incentives on cost competitiveness are not easily summarized, Appendix C lists each type of financial incentive and cites the general benefits and limitations of each incentive for overcoming cost barriers to solar expansion. The list also indicates which level of government can most appropriately implement the incentives, thereby delineating the range of financial incentives that states might employ.

Each level of government needs to design its incentive programs with the incentives of other levels of government in mind, so that the total package of incentives available locally will promote solar activity while minimizing duplication or unnecessary public expenditures.

4.4 EXPECTATIONS OF THE IMPACTS OF FINANCIAL INCENTIVES ON SOLAR PURCHASES

Several studies calculated the expected cost-effectiveness of solar equipment with and without the presence of financial incentives. Cost-effectiveness varies with the type of solar equipment, climate, costs, and availability of conventional fuels for the present and future, and the type and level of financial incentives. The studies focus on expectations for specific locations and make certain assumptions about future energy costs.

In some studies, methods for predicting the impact of incentives have been devised by modeling the expected response of consumers and the economy to the introduction of incentives. These models account for various other phenomena that affect the growth of solar purchases, such as conventional fuel price increases and the region's climate. A MITRE study (MITRE Corp. 1978) used a quantitative, market penetration model to conclude that overall state incentives would have a small impact on fuel savings but that in certain regions state incentives would have an appreciable impact on solar use. Ruegg (1976), who used a similar model to predict the effect of incentives, found that the impact of incentives varies by region as well as by type of building considered and fuel prices.

Ruegg concluded that a combination of state incentives may be needed to make solar units attractive to consumers. Ruegg also noted that the financial incentives in use would significantly change the behavior of commercial consumers, because their opportunity cost for capital was higher than for residential consumers and because commercial enterprises can deduct conventional fuel payments from their taxes (Ruegg 1976, p. iv-vi, and 45).

Bezdek et al. (1977, pp. 102-112) summarize and compare Ruegg's study with a second cost-effectiveness study by Peterson (1976). The two studies use different assumptions, measures of savings impact, and amount of incentives, but Bezdek et al. adjusted the incentive amounts in order to compare the results of the two studies. Based on Ruegg and Peterson's calculations, as adjusted, Bezdek et al. ranked incentives by their level of effectiveness and predicted that tax credits would be more effective and sales tax exemptions and loans less effective than other types of incentives.

Bezdek's own study verifies and refines these conclusions, although the measures of impact are different from those used by Ruegg and Peterson. Measuring the effect of various incentives on the annual production rate of solar heating and air conditioning systems, the study found that tax credits from 15%-40% were more effective than 5% loans in accelerating market penetration of these systems (Bezdek et al. 1977, pp. 113-121).

Because of differences in the assumptions and conditions used in these types of studies, one cannot generalize about the efficacy of particular incentives. However, the methodologies and models used in these reports can be used by states to estimate the impact of an incentive, given the state's particular energy demand and climate. Because of the variety of needs and existing financial institutions in each state, individual states need to analyze which incentive package will be most appropriate. As Minan and Lawrence point out (1978, p. 857):

> Widespread uncertainties in the economic feasibility of solar energy systems require that effective incentive legislation be both broad enough to cover all reasonable costs of an effective solar energy system and precise enough to create confidence in the incentive's operation. Furthermore,

substantial differences in geographically dependent variables such as climate, construction costs, and conventional fuel prices require that each state formulate its own scheme of incentives.

When analyzing the efficacy of various types of state incentives, it is important to realize that all types of state tax incentives are limited in their impact on consumers because the dollar value of the credits is, in general, not substantial. Even income tax credits, which the studies discussed above cited as most effective, are not large because state income taxes are not very high percentages of income; over half the states' income tax rates are less than 10% of income. The tax savings from most state income tax credits appear particularly small when compared to the federal solar tax credit enacted by the 1978 National Energy Act. Because the federal income tax rate is much higher than the state tax rate, the federal tax credit offers a larger tax savings than the state in the year of the solar purchase, when the consumer is faced with the large first cost of the system. However, the initial year's recovery of eligible credit is limited to the taxpayer's tax liability, thereby limiting the incentive's influence largely to relatively affluent homeowners. Consequently, most state tax credits probably will not have much impact unless they can be claimed along with the federal tax credit or are very large (e.g., 50%).

4.5 EFFECTS OF THE NATIONAL ENERGY ACT PROVISIONS ON STATE SOLAR PROGRAMS

The federal legislation that most directly affects state financial incentives for solar development is the Energy Tax Act of 1978, as amended by the Windfall Profits Tax Act of 1980. The latter Act established a federal tax credit for primary residences installing solar systems; it allows for an income tax credit of 40% for expenditures up to $10,000.

4.5.1 Financial Impact of Federal Versus State Credits

Federal and state tax credits offer very different levels of potential tax savings because the federal tax rate is much larger than that of the states. The annual amount of state income tax per capita is approximately $661 (Statistical Abstracts 1978, p. 274). For a $2000 solar system, the federal tax credit would be $800, which is close to the average amount of federal income tax paid per capita in 1976, $661. For a $2000 system with a state tax credit of 25% (the median level for all states with solar tax credits), a credit of $500 could be claimed. However, the state tax liability per year for the average resident is far below this figure. Most states have carry-over provisions so that the consumer may obtain some or all of the solar credit over a few years. However, most state tax credits do not offer large savings to the average taxpayer in the year of the solar purchase, when many customers need a substantial savings in order to help them overcome the high initial costs of a solar system.

Since the federal tax liability is higher than the liability for a state taxpayer, more of the federal credit can be claimed in the first year of the purchase. Because the federal tax credit allows for a one-year carry-over, the full credit may be realized in the first two years after purchase. In most cases, the federal credit is, theoretically, more attractive to consumers than the state credits because it allows for a larger savings in the year of purchase and, consequently, reduces the consumer's reluctance or inability to pay the high first cost of a solar system.

This comparison of the financial effect of federal versus state tax credits is based on the average annual tax paid per capita. These figures do not convey the effect of incentives on members of higher income groups who may be interested in tax savings. For these people, the federal tax credit is also likely to be more attractive than the state credit because of the progressive structure of federal tax rates. State income tax rates range from zero to 19% of income with over half of the states charging tax at 1% to 10% of income, whereas the federal income tax paid ranges from 13% to 60% of income (Statistical Abstracts 1978, p. 271). The federal government tax rate (percentage of income) gets progressively higher for income brackets up to $1 million and over, whereas the highest income brackets which a state classifies for its top tax rate is $200,000 and above. For example, while millionaires face a federal tax rate of 60% of their income, they are charged for only 14.5% to 24% of their income in Alaska, the state with the highest tax rate for upper income brackets.

4.5.2 Implementation of the Tax Credit

Although the federal tax credit may be more attractive financially to consumers than most state tax credits, some state tax credits may be more widely used than the federal credit because a state may have had more experience and success in administering the credit than the federal government. The state credits may be more accessible and attractive to consumers than the federal incentive for the following reasons: (1) they may cover a more extensive range of solar devices (e.g., passive design); (2) they may be more widely advertised to the public; and (3) the standards and warranties for solar equipment may be more developed in certain states. In some states, the state tax credit may be more widely used than the federal credit because the state credit is larger and has a longer carry-over period than the federal credit, as in California, with 55% solar tax credit and an unlimited carry-over period. How the administration and implementation of a government solar tax credit program can affect the extent to which the solar credit is claimed will be discussed at length later in this report. Since the federal tax credit has been enacted recently, some of the same implementation problems which states encountered may also affect the success of the federal program.

4.5.3 Complementary Federal and State Tax Credits

If states do not allow taxpayers to claim both state and federal credits, taxpayers probably will opt for the federal credit unless the state credit is over 40% and can be carried over sufficiently so that it offers a larger tax savings than the federal credit. If states do allow consumers to claim both the federal and the state credits, then the state credit would be an effective way to increase the total tax savings for the solar consumer. If states use the federal credit to their advantage, the state's solar tax credit program should be enhanced by increased publicity about solar incentives and increased solar activity.

Forty-five of the fifty states have income tax incentives which allow consumers to claim both the 40% federal tax credit and the state tax credit for their solar purchases. Consequently, the effective level of solar tax incentives for most of these states now varies from 50%-75% of the solar system rather than from 10%-35%. California allows both federal and state tax credits to be claimed for one solar installation but gives the builder the option of claiming part of the credits or passing it on to the consumer. California is, therefore, using the existence of both credits to offer a new incentive to the builder, which may increase the amount of new construction using solar systems.

4.6 EVALUATING THE EFFECT OF FINANCIAL INCENTIVES

Once state incentives have been enacted, the effectiveness of the incentives in stimulating solar purchases should be assessed. Through such assessments states can learn which types of incentives seem to be successful and why. There are two crucial phases to the assessment of incentives. One examines the implementation of incentives to identify problems that have hindered their administration. The other evaluates the effect of incentives, once implemented, on the increased use of solar energy. Measures of implementation success are described in later sections of this report.

Once the implementation process is understood and documented, an examination of whether incentives actually induced increased sales of solar systems needs to be undertaken. Some measurements of financial incentives' effectiveness have been devised although they have not been applied to evaluate the actual outcomes of current incentive programs.

One way to assess incentives is in terms of their costs and benefits. Benefits can be defined as the conventional fuel savings that result from the increase in solar unit installations stimulated by financial incentives. The direct costs of the incentive are the costs to government, specifically lost revenue due to tax breaks, loans, or grants and the administrative costs of implementing the incentive program (Booz Allen and Hamilton 1976, p. IV-4-5). Performing such a cost-benefit comparison is difficult because the fuel savings resulting from increased solar use cannot be easily related to the financial incentives. Similarly, measures of incentives' impact, such as the increased number of solar units since the introduction of incentives, are limited because of the difficulty in establishing a causal relationship between the introduction of the incentive and the appearance of new solar units.

Research on evaluation of incentives is very limited. As discussed in Section 4.5, some studies estimate how incentives will alter the cost-effectiveness of solar systems. The extent to which incentive programs do, in fact, encourage solar purchases has not been thoroughly investigated. The effects of incentives are likely to vary a great deal depending on the attitudes of consumers, the local climate, other financial incentives and tax policies, expectation about fuel prices, the amount of information available to consumers about incentives, and variations in perceptions of the barriers to solar use. This study represents one of the first efforts to document the consequences of solar financial incentives. SERI will make more detailed assessments of solar incentives during FY 1981.

4.7 MEASUREMENT OF IMPLEMENTATION PROCESSES AND OUTCOMES

Different measures of implementation success were developed for each of the two types of incentive programs studied. In each case, measures of the level of effort and of administrative costs were straightforward in concept although, as discussed below, frequently difficult to use due to the absence or poor quality of data. Measures of implementation outcome, on the other hand, were straightforward in neither concept nor practice. The program evaluation and implementation literatures offered little guidance for specific measures of implementation outcome, though the broader dimensions of implementation success were clear enough. Accordingly, we devised measures of implementation outcome based primarily on the unique elements of state financial incentive programs, as follows:

- The number of valid claims processed as a proportion of total number of state tax returns. This indicates the extent to which the financial incentive has successfully reached a proportion of the state's taxpayers. It is a function of publicity, ease of compliance, size of the incentive, and the cost-competitiveness of solar systems in the state.
- Percentage increase in the number of claims processed betweed 1977 and 1978. This is another measure of the success with which the financial incentive is attracting purchasers of solar systems.
- Percentage increase in the number of valid claims processed between 1977 and 1978. This measure assumes that the proportion of valid claims is a function of the clarity of eligibility requirements.
- Ratio of median adjusted gross income to average state per capita income. This is a measure of the equity of the incentive, a concern expressed by numerous state officials.
- Ratio of number of claims processed to the number of solar systems installed in 1977. This is yet another measure of the success with which the incentive is stimulating solar system purchases. Measures of implementation outcome were employed for the seven states studied that had a tax-based financial incentive and for which data were available on the number of claims received and granted. The only year for which such data were available was the tax year 1977.
- The time between enactment of the legislation creating a state financial incentive program and the time rules and regulations governing eligibility for the incentive were formally promulgated. Successfully implemented programs, we reasoned, move relatively quickly from enactment to promulgation of rules and regulations.

Only a portion of these potential measures actually could be used in the analysis.

Factors likely to influence implementation outcome were identified from the literature on policy implementation and from direct information about the problems and issues that face state agencies charged with implementing solar incentive legislation. The implementation literature yielded rich conceptual insights and indicated general areas of organizational structure, process, and setting that should be addressed in studies of policy implementation. It did not, however, suggest explicit measures for key variables or discuss problems associated with the collection, validity, and analysis of data on implementation processes. No doubt this reflects the fact that most available empirical studies of implementation are descriptive, single-case analyses (e.g., Pressman and Wildavsky 1973; Bardach 1977). The present study thus represents an early effort to develop measures for some of the factors expected to influence policy implementation. Our procedure was iterative, involving consideration of concepts drawn from the literature, information derived from observations of state solar incentive programs, and the realities of data availability in the field.

4.8 MEASUREMENT PROBLEMS AND DATA LIMITATIONS

Four general kinds of problems arose during this research: translating concepts into measures, data availability, data comparability, and concept measurement. The first problem was discussed in Sec. 4.7. A second kind of measurement problem concerned the availability of data for our measures. In some instances, the available data were not as specific as the measures or questions. For instance, only 3 of the 15 agencies had data on annual (1977, 1978) administrative costs associated with implementing solar incentive programs. Most agencies had expenditure data, but it had not been disaggregated into categories of costs such as administrative and program operations costs. In some instances and for a variety of reasons, data were not even available. For instance, most agencies knew the number of valid claims processed in 1977, but they had not recorded the number of claim applications they received in 1977.

A third kind of problem was comparability of data both across time periods and implementing agencies. Problems of comparability across time periods are exemplified by the data for the number of valid claims processed in 1977 and 1978. In the analysis, comparisons were made of the number of claims processed by time period. The data on claims processed for one agency were aggregated across all three years during which claims were processed, but not broken down by year. These data were not comparable with time series data from other agencies. Problems of comparability of data across agencies are illustrated by the data on total costs of solar financial incentive programs. Differences in the size of agency programs required that the data be normalized to permit comparisons. In a few cases, normalizing data were precluded because state expenditures for energy were unavailable.

The fourth problem was shrinkage in the number of measures for a given concept. Multiple measures of level of effort were made, but some were not useful because of lack of usable data. For instance, level of effort was measured by the following indicators: number of full-time (FTE) staff; number of claims processed; and number of valid claims processed. Because 7 of the 15 agencies reported zero full-time (FTE) staff and two agencies had no data, that measure was also lost. As a consequence, measurement of level of effort was not as complete as planned.

4.9 MEASURES OF IMPLEMENTATION SUCCESS: FINANCIAL PROGRAMS

The problems just described required that some of the developed measures of implementation success be omitted from the analysis. The primary reason for excluding these measures was lack of sufficient data. In the case of financial incentives, most of the measures omitted were based upon counts of the number of tax credit claims processed in 1977 and/or 1978. Data on claims were available (by year) from only six states, and only for the 1977 tax year at the time we collected data in the spring of 1979. Thus a number of interesting questions such as the relationship between size and type of tax credit and median adjusted gross income of claimant and the increase in the proportion of valid claims between 1977 and 1978 could not be addressed through statistical analysis.

Measures of level of effort used in the analysis were:

- total program costs, 1977;
- number of staff or full time equivalents, 1977 and 1978;
- total program costs as a proportion of state population, 1977; and
- number of valid claims processed, 1977.

Measures of administrative costs were available for 1977 and 1978, but costs per dollar cost of program or per claim processed were not. Measures of implementation success employed in the analysis were:

- the length of time between enactment of the incentive and formal promulgation of rules and regulations governing eligibility,
- the number of claims processed as a proportion of solar systems installed during 1977, and
- the number of valid claims processed as a proportion of the number of state tax returns for tax year 1977.

SECTION 5.0

DESCRIPTION OF SOLAR FINANCIAL INCENTIVE PROGRAMS*

5.1 INTRODUCTION

This section sets the stage for subsequent sections' analyses of the factors that influence successful implementation of state financial incentives. It describes how the programs studied varied with respect to some of those factors. First, the settings for implementation of financial incentives in the several states are described: the types of agencies responsible for implementation, their interactions with external groups and advisory committees, and the extent of conflict between legislative and executive branches. Second, the level and types of activities in financial incentive programs are described, including the size and background of implementing agency staff, the number and dollar value of solar income tax claims made for the 1977 tax year, and the administrative costs incurred in income tax credit programs. Third, three very different processes by which financial incentive legislation could be formulated are described and some preliminary evidence of the consequences of these different routes is presented. Fourth, variations in the specificity of solar income tax credit legislation are detailed. Finally, processes are described by which the rules and regulations governing eligibility for financial incentives are developed and the implications of different administrative choices about those rules and regulations discussed.

5.2 IMPLEMENTING AGENCY SETTING

Five kinds of solar financial incentive programs were being implemented in the 11 study states at the time this study was initiated: income tax credits, property tax exemptions, sales and use taxes, loans, and business tax credits. The 11 states, the types of financial incentives enacted in each as of late 1978, and the primary implementing agencies are listed in Table 3-2, Sec. 3.0.

The most common types of solar financial incentive were income tax credit programs directed toward individual homeowners. Nine of the eleven states studied had such incentives, while other types of financial incentives were scattered among these and the remaining states. Because income tax credits dominated the solar-related financial activities of the states studied, most of the data included in the quantitative analysis (findings presented in Sec. 7.0) were gathered from agencies implementing this type of program. In two states the principal solar financial incentive to be implemented was a loan program, so in these states the agencies responsible for the loan program provided data on implementation.

In the 11 study states a total of 15 state agencies were responsible for implementing solar or alternative energy financial incentive programs. Of the 15 implementing agencies studied, 9 were tax authorities, 4 were energy agencies, 1 was a building office, and 1 was a veteran's affairs office. Of the nine study states with some form of income tax credit, two had programs for which implementation responsibility was shared jointly by two agencies. In California and Arizona, the energy agency and tax authority formally shared responsibility for implementing the income tax credit incentive. In New Mexico

*Substantial parts of this section were drafted by Craig Piernot.

and Oregon, implementation responsibility was informally shared by the energy agency and tax authority. In Oregon, two solar financial incentive programs were studied, each of which had its own implementing agency. The Oregon income tax credit program was implemented by the Department of Energy, and the veterans loan program for solar applications was implemented by the Department of Veterans Affairs. The Massachusetts energy office was technically involved in implementing each of that state's financial incentive programs, but the business tax credit was largely the responsibility of the Bureau of Building Construction.

In 13 of the 15 agencies only a minor change of responsibility was required to implement the solar financial incentive problem. A major change was required in one of the two remaining agencies, and the second was an entirely new agency. Three of the fifteen implementing agencies had formal advisory arrangements with groups outside of state government such as industry groups, solar lobby groups, and universities. Three more agencies (two energy agencies and a solar office) had informal interactions with similar external groups. Officials of these three energy agencies were highly involved in the process of formulating financial incentive legislation, while officials from the other kinds of implementing agencies had low involvement. The three energy agencies and one tax authority have held public hearings to discuss their agency implementation plans.

Conflict between the executive and legislative branches on solar energy matters was low in 8 of the 11 study states and high in 1. Some conflict was acknowledged in the remaining 2 states. Consequently, political controversy usually did not affect the implementation of financial incentives. Patterns in the amounts of conflict between the executive and legislative branches on solar energy matters and in general suggest that solar energy was not an issue that created unusual political controversy.

5.3 PROGRAM RESOURCES AND ACTIVITY

The majority of implementing agencies had neither funds appropriated nor staff specifically designated or hired to carry out their implementation responsibility. Only 6 of the 15 implementing agencies had funds appropriated for implementing financial incentives; 5 of the 6 had designated or hired staff to implement incentive programs. Of the five agencies with designated or hired staff in 1977 and 1978, only two had at least one full-time equivalent (FTE) person, two others had less than one FTE, and one had none. In the remaining ten agencies the incentive program was being implemented with less than one FTE in two agencies and with none formally designated in six others. (Two agencies did not provide information about staffing.)

More than half (eight) the implementing agencies studied were staffed predominantly by persons with business and economics backgrounds, largely reflecting the type of persons staffing state departments of revenue or taxation. Four agencies were staffed with a mix of backgrounds, two had primarily scientists and engineers, and one employed mostly persons with managerial or administrative backgrounds.

The dollar value of claims made in 1977 under solar income tax programs, excluding administrative cost, ranged from zero to $11.4 million for the eight agencies reporting data (see Table 5-1). The median cost was $46,200. Seven of the eight reported 1977 administrative costs ranging from zero to $46,200 with a median of $7500. For 1978, only four agencies reported both claims data and administrative costs. Only very sketchy data on program costs were available for financial incentives other than income tax credits. Generally, the level of activity in these other programs was low, and very little

Table 5-1. DATA ON STATES IMPLEMENTING SOLAR INCOME TAX CREDIT LEGISLATION IN 1977 TAX YEAR

State	Size of Tax Credit[a] (%)	Dollar Amount of Claims, 1977[a]*	Number of Claims, 1977[a]*	Estimated Solar Systems Installed During 1977[b]	Number of Solar Systems In Place, 1978[c]	State Per Capita Income, 1977 ($)	Number of Tax Returns 1977[d]	Number of Claims per 10,000 Tax Returns 1977
Arizona	35	135,000	388	500	2,500	6,199	832,462	46
California	55	11,400,000	16,000	9,000	35,000	7,151	9,000,000	170
Hawaii	10	230,000	1,101	1,600	6,500	7,080	370,732	290
Montana	10	5,000	75	100	400	5,689	341,000	20
North Dakota	10	6,300	76	13	70	5,846	300,000	20
New Mexico	25	85,249	173	500	2,100	5,322	499,863	30

[a]Size of tax credit, number of claims, and dollar value of claims are not strictly comparable across states because of differences in definitions of eligible systems, maximum permissible amount of claims, and carry-over provisions.

[b]Extrapolation of data from Solar Energy Institute of North America (1979).

[c]Solar Energy Institute of North America (1979). Differences in definition of a "solar system" between states and the Solar Energy Institute of North America account for much of the discrepancy between number of claims and estimates of the number of installations during 1977 and the number of systems in place in 1978.

[d]NA means not available.

*Sources of claims data:

Arizona: data for dollar amount of claims from interviews with officials of Arizona Solar Energy Commission (data are total solar program costs for 1977); data for number of claims from interviews with officials of State Department of Revenue.

California: data from interviews with officials of California Franchise Tax Board and from Rains (1979.)

Hawaii: data from report by State Tax Department, "Tax Credit Claimed by Hawaii Residents—1977" (January 1979).

Montana: data from interviews with officials of State Department of Revenue and from report, Research Division, "Energy and Taxation in Montana: A Study of the Alternative Energy Tax Credit and Energy Conservation Deduction" (1979).

North Dakota: data from interviews with officials of State Tax Commission.

New Mexico: data from report by Tax Research Office, Taxation and Revenue Department," New Mexico Personal Income Tax Credit for Solar Heating/Cooling Equipment Purchase, CY1977" (April 1979).

interest was exhibited by state officials in obtaining data on the costs or number of claims made. It was evident that these costs probably are quite low, reflecting the low level of program activity we observed.

Eleven of fifteen agencies reported data on the number of valid claims processed in 1977. Only 6 of the 11 agencies reported both an aggregate number of claim applications and the number of valid claims. Table 5-1 presents data on claims processed for tax year 1977, dollar value of claims, and other data for the six states for which data were available.

The numbers of valid claims ranged from zero to 16,000 with a median of 173. It should be noted that the very large amount of California's dollar claims and the number of claims made for the tax year 1977 are due largely to claims for pool covers, which were included in that state's definition of eligible solar systems. According to data developed by the California Energy Commission (Rains 1979), more than 70% of the claims made for 1977 were for pool covers.

Only two agencies reported both the number of aggregate claim applications and validated claims in 1978. Two of the fifteen agencies had claims data that could not be disaggregated into annual data. When 1978 data for both the number of aggregate claims applications and the number of valid claims processed become available, a more valid basis will exist for assessing the consequences of different sizes of tax credits and definitions of eligible systems.

5.4 FORMULATING FINANCIAL INCENTIVE LEGISLATION

The role of implementing agencies in formulating financial incentive legislation is important to the agency's understanding of legislative intent and, accordingly, to implementation of the incentive. Three patterns of implementing agency participation emerged from study observations. In the first pattern, "energy agency push," the energy agency writes the incentive bill, identifies a legislative sponsor, and provides testimony to legislative committees on its technical aspects. This pattern is called energy agency push because the other major type of implementing agency, the tax authority, sees its responsibility as administering rather than creating legislation; the legislature acts in a responsive mode.

A second pattern of participation is called "legislative push." A legislator or small group of legislators prepares and sponsors financial incentive legislation. The energy agency becomes involved in formulating the legislation only in a technical support capacity. The legislator or group contacts supporters for the legislation both to review drafts of the bill and to provide testimony favorable to its passage.

In the third pattern, "weak legislative push," a legislator or group of legislators sponsors a bill responsive to broad public concern, such as a possible shortage of fossil fuel. The energy agency and potential interest groups play a minimal, if any, role in creating the bill. Each of these patterns of participation in the formulation of financial incentive legislation and their implications for subsequent implementation is discussed in greater detail.

5.4.1 Energy Agency Push

Two of nine study states with income tax incentives exhibited the energy agency push pattern. A number of advantages appear to accrue to the implementing agency when the energy agency initiates financial incentive legislation. In pushing financial incentive legislation for solar energy adoption, not only does the energy agency participate in specifying legislative intent but it acquires responsibility for implementing that intent when the legislation is enacted. This is not to suggest that other implementing agencies like the tax authority contribute less to the formation of legislation. But the energy agency's knowledge of solar energy technologies enables it to contribute essential detail about the definition of solar energy and solar technologies, applications of solar technologies, warranties, performance, and certification criteria. While legislation is being written these details help increase legislative specificity and thereby enhance the probability of successful implementation.

In most states, as in the study states, the tax authority is at least minimally involved in the formulation process when it provides testimony on the fiscal impacts of major financial incentive legislation. However, the tax authority can play a meaningful role in the formulation of all financial legislation by advising on the size of each incentive, fiscal benefit for claimants, fiscal impacts on the state treasury, application procedures, auditing claims, and claims data record-keeping and compilation. While most of these issues may appear mundane, they have been substantial barriers to implementing enacted legislation. Eliciting the assistance and contributions of the implementing agencies results both in legislation that is more likely to be implemented successfully and in cooperation and collaboration among agencies critical to successful implementation.

In the two study states exhibiting the energy agency push pattern, the energy agency and tax authority formally shared responsibility for implementing the incentive. In each state, both agencies had participated in formulating the incentive legislation. The energy agencies initiated the legislation and provided support and testimony for it. The tax authorities contributed testimony on the potential fiscal impacts. The energy agency in each state obviously understood both legislative intent and technical elements of the law and was able to promulgate appropriate and specific rules and regulations. The tax authority in each state processed claim applications and looked to the energy agency for technical and legal assistance and opinions on issues of eligibility raised in auditing the applications. The energy agencies looked to the tax authority for both details about claims and the applicability of the rules and regulations for implementing legislative intent.

5.4.2 Legislative Push

The legislative push pattern was exhibited in three of the nine study states with income tax incentives. In this pattern a legislator or small group of legislators interested in energy matters writes and sponsors the bill. A member of one of the state's energy committees usually is involved. This pattern of participation differs from energy agency origination in two ways. First, because the authors are politicians and not energy specialists, the legislation tends to lack technical specificity. Second, rather than representing the promotion by state government of a technological application deemed in the public interest, the legislation reflects a petition from interested groups for public support of technological development. Energy Agency Push is similar in that authors of the legislation know their intentions in creating the legislation and will actively support its implementation.

In legislative push, the authors of the proposed legislation seek information from interest groups and potentially impacted state agencies. For instance, in three study states the solar energy industry association, particular solar firms, the state energy agency, and the state tax authority contributed to the formulation of the financial incentive and to the development of rules and regulations. In addition to seeking information, the legislators were available to address questions and discuss issues about their proposal. Public hearings were held to elicit concerns of interested parties.

As a consequence of the number of participants in legislative push, the enabling legislation provides some essential details to guide implementation. Also, the interests of the legislator or legislators in implementing the incentive assured their availability to discuss details of legislative intent.

However, numerous questions of a technical nature that were not addressed in the legislation had to be resolved by the implementing agencies as they developed and implemented the rules and regulations. Some of those questions concerned eligibility of passive solar design features, relationship between state and federal credits, costs covered by the credit, and the amount of credit carried forward against future tax liability.

5.4.3 Weak Legislative Push

The third pattern, weak legislative push, was exhibited in four of the nine study states with income tax incentives. In this case, legislators participated in the formulation process for a variety of politically expedient reasons. Here, the legislative committees responsible for energy legislation usually did not have staff expertise in solar energy. Together, the sponsoring legislators and energy committees had only cursory knowledge of solar energy technologies, their performance capabilities in differing applications, and their potential fiscal impacts both on claimants and the state treasury. Also, the agency or agencies with implementation responsibility had only minimal input into the formulation process. That input usually was testimony on the projected fiscal impact of the incentive on the state treasury.

Under weak legislative push conditions, the resulting legislation lacked clear legislative intent, technical specificity, and implementation guidance. There was no evidence of a legislative oversight function or schedule for implementation. In these four study states the tax authority was the responsible implementing agency, which did little to increase the specificity of the legislation for fear of appearing to interpret legislative intent. In these states, implementation was accomplished by adding a line item for the tax credit on the income tax return form with a paragraph of elibility instruction that merely restated legislative language. Once claim applications began to arrive, the problems of implementing legislation that lacked specificity were accentuated. Processing claims required that criteria be established to determine eligibility of solar energy systems, applications, and claims. In three of the four cases, general eligibility criteria were established by the tax authority using the enabling legislation as a guide.

5.5 LEGISLATIVE SPECIFICITY

An important factor in implementing financial incentive legislation is the guidance the legislation itself provides to the implementing agency. Ashworth et al. (1979) concluded that clarity of legislation was important for the implementation of policy. We identified legislative specificity as one measurable element of legislative clarity; it refers to the extent of guidance or direction provided in the law for administering its intent. Specificity of legislation was examined in the individual income tax credit legislation of 9 of the 11 study states; the legislation involved was the original enactment which provided for a credit against income tax liability for the purchase of a solar application.

Table 5-2 lists nine items of legislative specificity and indicates the status of each state's income tax incentive legislation with respect to each item. Each of the nine pieces of legislation examined specified the amount of the income tax credit, whether eligibility was restricted to principal residences, and whether part of the credit due in a given year could be carried over and applied to future tax liability.

Specificity of legislation with respect to the remaining seven items varied considerably across states. In many states it is clear that significant issues defining the solar incentive were delegated to the responsible implementing agency for resolution. The legislation in eight states did not specify whether insulation costs were eligible for the incentive; four did not specify whether installation costs could be claimed; seven did not spell out what types of procedures were required to apply for the credit.

Legislative specificity is significant because it offers guidance to the implementing agency (though some might claim that it also limits administrative flexibility and discretion). Our observations coincide with those of Ashworth et al. (1979): generally, very large amounts of discretion concerning interpretation of legislative intent were delegated to implementing agencies. As will be noted in Section 5.6, technical and economic resources often were not available to (or could not be afforded by) the implementing agency, which resulted in substantial amounts of uncertainty in the resulting administrative rules and regulations governing eligibility for the incentive.

Legislative specificity governed the number of issues that were delegated to implementing agencies for resolution and thus were expected to affect measures of implementation such as staff size, administrative costs, and the time required to promulgate rules and regulations. Specificity of rules and regulations, on the other hand, influenced the level of uncertainty faced by the prospective tax credit claimant. We found that it was much easier to determine whether a state's rules and regulations governing eligibility for the solar tax credit were specific. Basically, in some states a number of critical elements were addressed (e.g., treatment of passive solar design, inclusion of labor costs, warranty and other consumer protection requirements, pass-through provisions), while in the remaining states none of these elements were addressed in the rules and regulations. Specificity of rules and regulations was also expected to be associated with measures of implementation success, and these relationships are explored in Section 7.0.

5.6 DEVELOPMENT OF RULES AND REGULATIONS GOVERNING ELIGIBILITY FOR SOLAR INCOME TAX CREDITS

When state energy agencies participated in the formulation of rules and regulations to interpret legislation, more specific guidelines were created. In 8 of the 11 study states, responsibility for implementation of financial incentive legislation was delegated to the tax authority. The state energy agencies were available to provide technical assistance. In two states, responsibility for implementation was shared formally and jointly by the state energy agency and tax authority. We found that the most specific rules and regulations were formulated in the four states (Arizona, California, New Mexico, Oregon) where implementation responsibility was shared. Formal, joint responsibility for implementation vested in the energy agency and tax authority appears to result in the development of more specific rules and regulations governing implementation.

Table 5-2. **ELEMENTS OF SPECIFICITY IN THE INDIVIDUAL INCOME TAX CREDIT LEGISLATION OF NINE STATES**

	Study State and Date of Enactment of Original Legislation								
Elements of Legislative Specificity	AZ 77	CA 77	HA 76	KS 76	MT 77	NM 75	NC 77	ND 77	OR 75
Specific amount of tax credit (%)	35	55	10	25	10	25	25	5	25
Eligibility of principal residential applications only	No	No	No	Yes	Yes	Yes	No	No	No
Provision to carry tax against future tax liability	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Specifies whether insulation costs are eligible for credit	No	Yes	No	No	No	No	No	No	No
Specifies whether installation costs are eligible for credit	No	Yes	No	No	Yes	No	Yes	Yes	Yes
Contains statement of policy objectives	No	No	No	No	Yes	No	Yes	No	No
Identifies implementing agency	Yes*	Yes	Yes	Yes	Yes	No	Yes*	Yes*	Yes
Specifies relations between state and federal credits	No	Yes	No	No	No	No	No	No	No
Specifies application procedures and documents needed to apply	No	No	No	No	Yes	No	No	No	Yes

*Agency inferred from statute number assigned to the enacted legislation.

A number of programmatic decision options accrue to the implementing agency(ies) by virtue of their responsibility for formulating rules and regulations. Among them is the option to promulgate rules and regulations that are specific or general, explicit or implicit, and inclusive or exclusive. Other programmatic decisions concern system eligibility criteria, system certification, warranty requirements, filing procedure for claims, and the relationship between state and federal credits. Agency decisions on these and other options can dramatically affect both implementation success and the effectiveness of the enacted legislation. A few examples will illustrate this point.

In promulgating rules and regulations, agencies can be either explicit or implicit in identifying eligible systems for the tax credit. An explicit rule states that only domestic active water systems qualify, while an implicit rule states that any solar system or mechanism to provide hot water qualifies. An advantage of explicit rules is that eligible applications are clearly distinguishable from ineligible ones. For example, if a rule states that only domestic, active water systems qualify for the credit, then all passive solar applications (e.g., greenhouses, south-facing glass, etc.) are ineligible. A disadvantage is that passive solar applications may be eliminated because they are not technically eligible. An advantage of implicit rules is that a variety of applications qualify for the incentive, regardless of their technical features. A number of disadvantages arise, however, including the opportunity for fraud, confusion about eligible and ineligible systems, and the need for close scrutiny of all claim applications. In the four states where implementation responsibility was shared, updating rules and regulations resulted in both the elimination of some of these problems and the formulation of more specific rules.

A second programmatic decision in formulating rules and regulations highlights the effects of rules that are either inclusive or exclusive. For example, California and Arizona included solar swimming pool heaters as eligible systems. In one of these states, claims data indicated that nearly 70% of the solar claims made in one year were for active pool heating and/or covers. In addition, the median income of claimants was well above the median income of all the state's taxpayers that year. The inclusion of this solar application in the rules and regulations reflects the power of the implementing agency to interpret legislative intent, to direct the course of an incentive, and to expand the incentive to include its preferred applications. Similarly, the exclusion of low-cost, passive solar retrofit applications (e.g., south facing overhangs with double-glazed windows) from most states' eligible solar systems reflects the power of implementing agencies to interpret legislative intent.

A third programmatic decision that can accrue to the implementing agency and has substantial importance to implementation success is the assignment of responsibility for system certification. In two states that have attempted to resolve the certification issue, such decisions resulted in differing certification procedures. In both states, however, the certification procedure was developed to expedite implementation of the state's solar tax credit. In California, the energy commission, with endorsement from the revenue department and in collaboration with the state's solar industry association, developed the CALSEAL Program. The program provides taxpayers with guidance for determining whether or not an installed solar system qualifies for the California solar energy tax credit. Acquiring a CALSEAL label means that a system meets, in the opinion of the energy agency and the solar industry association, the technical and legal requirements for the tax credit. This program expedites processing of income tax returns by the tax authority and standardizes the certification procedure. However, the CALSEAL is not required for a system to be eligible for the credit. In Oregon the energy agency has thoroughly standardized the process of certifying systems as eligible for the tax credit. Unlike the California program, in which the solar industry association administers the certification program, in Oregon the energy agency administers the program. The prime objective of the Oregon program is to ensure that installed systems provide a minimum of 10% of a residence's energy needs. The Oregon certification process has expedited the processing of applications for the tax credit and maintains the energy agency's control over both systems certification and program implementation.

One important observation about rules and regulations was that they are subject to modification. In the four states where the tax authority and energy agency share responsibility for implementation, the rules and regulations have been updated. In the other states they had not been updated. Updates usually resulted in an expansion of the rules in one or more ways. One way was to add specificity to earlier general rules. For example, Arizona's original definition of eligible solar energy devices did not specify whether swimming pool covers were included. After public hearings on the rules, when the swimming pool industry challenged the original definition, the eligibility rules were changed to include pool covers and pool blankets if they were an integral part of an active pool heating system.

Rules and regulations also were updated by adding previously excluded solar applications. The original rules for the California income tax credit did not explicitly address eligibility of passive solar energy applications. Subsequently, passive solar design features and applications such as greenhouses, skylights, Trombe walls, and drumwalls became eligible. A third way in which rules were changed over time involved expanding the interpretation of the enabling legislation. For instance, Oregon extended its interpretation of eligible alternative energy systems from geothermal and solar to include wind energy systems. In sum, agency willingness to alter rules and regulations has resulted in both the resolution of technical and legal problems and an increase in the number of applications.

SECTION 6.0

EFFECTS OF STATE BACKGROUND CONDITIONS ON IMPLEMENTATION OF FINANCIAL INCENTIVE PROGRAMS

6.1 INTRODUCTION

This section discusses the effects of specific state background conditions upon implementation of solar financial incentives. The background factors likely to affect implementation are discussed, as well as the analytical procedure used. Findings relating state background conditions to the successful implementation of financial incentives in the 11 states studied are presented. In addition, differences in background conditions between the 11 states studied and the remaining 39 states are identified.

6.2 BACKGROUND FACTORS LIKELY TO AFFECT IMPLEMENTATION OF FINANCIAL INCENTIVES

Successful implementation of state solar incentives undoubtedly is a function of both the organizational, procedural, and structural features that are the subject of this study, and the socioeconomic, political, and climatic features of the individual states studied. We expected that a state's energy supply characteristics—the diversity of its energy production sources; its indigenous fossil fuel reserves; the cost of electricity, natural gas, and heating oil; and the amount of solar radiation available—would affect the likelihood that significant solar and renewable energy incentive programs would be proposed and successfully implemented. In addition, a state's energy demand as indicated by average annual heating degree days, energy consumption per capita and per capita consumption growth rate, and population growth should influence the extent to which alternative energy programs would be initiated and successfully implemented. Finally, a state's political and demographic setting are likely to influence its interest in solar and alternative energy programs. For example, states with a history of innovative activity (Walker 1971), low levels of interparty competition (Munger 1966), relatively high levels of fiscal resources, and relatively high levels of economic growth should be more likely than other states to initiate and implement financial incentives. States in which a relatively large proportion of revenues is derived from income and sales taxes would be more likely to develop tax-based financial incentives for solar systems.

6.3 ANALYTICAL PROCEDURE

The analytical procedure followed was first to correlate each of the variables that describes a state's background with each measure of implementation success. To maintain a conservative approach, we employed a nonparametric statistic, Spearman's Rho, to test for significance; the criterion for significance was 0.05 or less. We were also interested in how the background characteristics of the 11 states studied differed from those of the remaining states. Since study states represented, as of late 1978, every state that had passed a significant solar financial incentive sufficiently long ago for some implementation outcomes to be observed, a comparison of study and nonstudy states should suggest how states with relatively long-lived, significant solar programs differ from other states.

Of the hundreds of possibly significant relationships between state background characteristics and measures of program implementation, only a relatively small number (about 50), were statistically significant and included a sufficient number of cases to be meaningful. These significant relationships can be grouped according to the type of measure of implementation success: level of effort, administrative costs, and implementation outcome.

When analysis of relationships between state background conditions and the implementation of solar incentives is conceived in this manner (i.e., the elements of implementation success are broken into the several measures employed for level of effort, administrative costs, and implementation outcome), the theoretical or logical basis for each relationship becomes difficult to ascertain. In the absence of accepted, operational definitions of implementation, we adopted a variety of measures suggested in the conceptual literature; the result is numerous measures that make sense individually but do not interrelate empirically. The search for patterns among relationships becomes, therefore, a judgmental exercise. For this reason, all the significant relationships that emerged from the quantitative analysis are listed in Appendix D.

6.4 BACKGROUND CHARACTERISTICS AND THE IMPLEMENTATION OF FINANCIAL INCENTIVES

The total number of financial incentive programs studied was 11, but in 4 states 2, rather than 1, agencies were assigned responsibility for implementing the incentive. In these states, typically the solar office or solar energy program within the energy agency developed the rules and regulations governing eligibility and the Department of Revenue administered the tax credit program. Thus the total number of implementing agencies for the 11 programs studied was 15. Many measures of implementation success were based upon the number of claims for tax credits processed; this obviously limited the utility of quantitative analysis since data were available for only the seven states studied that had implemented a tax credit program. We restricted our quantitative analysis of the relationships between state background characteristics and measures of implementation success to those cases for which data on 10 or more implementing agencies were available. Appendix D lists the statistically significant relationships observed for measures of level of effort and implementation success.

Larger financial incentive programs, as measured by the number of staff and the number of valid claims processed during 1977, occur in states with relatively large per capita budget surpluses and oil reserves per capita, large and growing populations, and high levels of insolation. This level of activity is not driven by high energy costs or energy consumption within active states, however. Only a few of the dozens of possible relationships between state characteristics and implementation outcome proved significant. No clear or easily explainable pattern appeared among those that were. The time it took for a state to develop formal rules and regulations determining eligibility for the financial incentive is an indicator of implementing agency staff skills and the degree of consensus and political support for the incentive. States with high levels of insolation appear to be states in which these conditions exist, but these are not states with high heating requirements.

6.5 DIFFERENCES IN CHARACTERISTICS OF STUDY AND NONSTUDY STATES

Study states generally exhibited in late 1978 a higher level of solar activity than non-study states. For this reason, we expected that the background conditions that differentiated states on implementation success would also differentiate study and nonstudy states. This was the case for the 11 states with significant solar financial incentives versus the other 39 states, in that few of the expected relationships were observed and no clear patterns in these relationships emerged. One interesting finding was that study states were more likely than nonstudy states to be ranked as regional leaders and as more innovative than their neighbors in past studies of innovativeness among states. Note that state solar financial incentive activity does not, in general, appear to be a consequence of energy cost, consumption rates, or availability.

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SECTION 7.0

EFFECT OF ORGANIZATIONAL AND ADMINISTRATIVE FACTORS ON IMPLEMENTATION OF STATE SOLAR FINANCIAL PROGRAMS*

7.1 INTRODUCTION

This section analyzes relationships between how states organize and administer financial incentive programs for solar applications and the extent to which these programs have been successfully implemented. Because of the predominance of solar income tax credits among the 11 states studied, this form of financial incentive is emphasized in the analysis. Overviews of the problems and issues that have arisen in implementing solar income tax credits and four other types of financial incentives—sales and use tax exemptions, loans, property tax exemptions, and business tax credits—follow this introductory section. Then, details are discussed of the setting in which implementation occurs and a preliminary assessment is given of the implications of different settings for successful implementation. Elements of the implementation setting that appeared to influence implementation success included the state's political priorities (especially as reflected in the governor's energy policy), the type and extent of legislative oversight of solar financial incentive programs, and the problems associated with internal audits of financial incentive programs. Finally, the findings of a quantitative analysis of relationships between specific measures of implementation success (level of effort, administrative costs, and implementation outcomes) and measures of organizational and administrative factors likely to affect implementation success (listed in Table 3-2, Sec. 3.0) will be presented and discussed.

Several administrative and organizational factors unique to financial incentive programs were identified as likely to influence successful implementation:

- type of implementing agency: energy agency, tax authority, the joint responsibility of these two agencies, or another type of agency entirely;
- the degree of specificity of rules and regulations that govern eligibility for the incentive; and
- the amount of documentation required to verify a claim for a financial incentive.

Tables of the results of the quantitative analyses and cross-tabular presentations of relationships found to be significant are presented in Appendix E. Section 7.7 summarizes the results of the analysis, incorporates these findings with those of the qualitative discussions of earlier subsections, and presents the results in a single summary table.

7.2 IMPLEMENTING DIFFERENT FINANCIAL INCENTIVES: AN OVERVIEW

A variety of financial incentives have the potential for reducing both the price of solar equipment to consumers and the risk perceived by investors and producers. Most of these incentives are intended to reduce the initial high cost of purchasing or manufacturing solar applications. Implementation issues that arise for each of five kinds of financial

*Substantial parts of this section were drafted by Craig Piernot.

Table 7-1. DATA ON STATES IMPLEMENTING SOLAR INCOME TAX CREDIT LEGISLATION IN 1977 TAX YEAR

State	Size of Tax Credit[a] (%)	Dollar Amount of Claims, 1977[a]*	Number of Claims, 1977[a]*	Estimated Solar Systems Installed During 1977[b]	Number of Solar Systems In Place, 1978[c]	Increase in Number of Solar Systems Installed, 1977-1978 (%)	Adjusted Median Gross Income of Claimant ($)
Arizona	35	135,000	388	500	2,500	25	N/A[d]
California	55	11,400,000	16,000	9,000	35,000	35	29,876
Hawaii	10	230,000	1,101	1,600	6,500	33	28,250
Montana	10	5,000	75	100	400	33	23,906
North Dakota	10	6,300	76	13	70	23	N/A
New Mexico	25	85,249	173	500	2,100	31	19,608

[a]Size of tax credit, number of claims, and dollar value of claims are not strictly comparable across states because of differences in definitions of eligible systems, maximum permissible amount of claims, and carry-over provisions.

[b]Extrapolation of data from Solar Energy Institute of North America, (1979).

[c]Solar Energy Institute of North America, (1979).

[d]NA means not available.

*Sources of claims data:

Arizona: data for dollar amount of claims from interviews with officials of Arizona Solar Energy Commission (data are total solar program costs for 1977); data for number of claims from interview with officials of State Department of Revenue.

California: data from interviews with officials of California Franchise Tax Board and from Rains (1979).

Hawaii: data from report by State Tax Department, "Tax Credit Claimed by Hawaii Residents—1977," (January, 1979).

Montana: data from interviews with officials of State Department of Revenue and from report, Research Division, "Energy and Taxation in Montana: A Study of the Alternative Energy Tax Credit and Energy Conservation Deduction" (1979).

North Dakota: data from interviews with officials of State Tax Commission.

New Mexico: data from report by Tax Research Office, Taxation and Revenue Department, "New Mexico Personal Income Tax Credit for Solar Heating/Cooling Equipment Purchase, CY1977" (April, 1979).

Table 7-2 SUMMARY OF FINDINGS FOR FINANCIAL PROGRAMS: ORGANIZATIONAL AND ADMINISTRATIVE FACTORS BY MEASURES OF IMPLEMENTATION SUCCESS

Implementation Outcome

Organizational and Administrative Factors	Level of Effort	Normalized Level of Effort	Administrative Cost	Time from Enactment to Rules and Regulations	Ratio of Number of Claims Processed to Number of Solar Systems Installed During 1977	Ratio of Number of Valid Claims Processed to Total Number of Tax Returns Filed in 1977
Professional Background of Staff	NS[a]	NS	NS	NS	NS	NA[e]
Type of Implementing Agency	NS	NS	NS	X[d]	NS	NS
Amount of Organizational Change Required to Implement	NS	ID[c]	NS	NS	NS	ID
Level of Legislative/Executive Conflict in General	NS	NS	NS	NS	NS	NS
Level of Legislative Executive Conflict Over Solar Issues	-[b]	NS	-	+	NS	NS
Involvement of Agency Officials in Legislative Formulation	+[b]	NS	+	NS	NS	ID
Staff Enthusiasm for Solar Energy	+	NS	+	-	NS	NS
Number of Registered Solar Lobbyists	NS	ID	+	-	ID	+
Extent of Informal Interaction of External Groups with Program Activities	+	NS	+	NS	ID	NS
Amount of Influence External Groups Have on Agency Activities	+	NS	+	NS	ID	NS
Public Hearings Held	+	NS	+	-	NS	NS
Specificity of Rules and Regulations	+	ID	+	-	NS	ID
Amount of Documentation Required to Verify a Claim	+	ID	+	NS	NS	ID

[a]NS means not significant.

[b]+ and - indicates direction of significant relationship.

[c]I enotes insufficient data.

[d]X stands for significant relationship.

[e]NA means not available.

incentives will be discussed: individual income tax incentives, sales and use tax exemptions, loans, property tax exemptions, and business tax credits.

7.2.1 Income Tax Incentives

State income tax incentives often have been viewed as effective fiscal tools by which to influence investor and consumer behavior. However, most of the studies analyzing financial incentives for the promotion of solar energy systems examine only the expected fiscal impacts and rarely the issues associated with implementation (Bezdek et al. 1977; R. Ruegg 1976; Minan and Lawrence 1978; Bezdek, Hirshberg and Babcock 1979; Booz Allen and Hamilton 1976; and Arthur D. Little 1976.) These studies ignore implementation issues and employ fiscal models to forecast impact. They do not examine the process of implementation or incorporate the costs associated with it in their analyses.

The most crucial aspect of implementing an income tax incentive is the formulation of rules and regulations governing eligibility. The incentive requires rules and regulations because of the real and potential impact upon the state treasury. However, there was little uniformity among the rules and regulations in the nine study states with income tax incentives. The rules that guided implementation addressed many of the same issues (e.g., size of credit, types of eligible system, carry-over) without being identical. For instance, the size of the tax credit varied from 55% to 10%, and the type of eligible system ranged from active solar water heating only to all solar, wind, and geothermal systems. In addition, the complexity of rules and regulations varied considerably; in some states the tax authority simply added a line item deduction on their income tax form for solar energy. Only four of the eleven study states (Arizona, California, New Mexico, Oregon) formulated extensive rules that included definitions of eligible systems and applications, relationship to the federal income tax credit, etc.

Three factors related to the formulation of rules and regulations help explain some of the differences among state implementation of income tax incentives: a state's established and accepted pattern of doing things, the technical expertise and primary mission of the implementing agency, and the resources available to write rules and regulations. First, a state's established and accepted pattern of doing things influences both the kind of incentive and the form and content of its rules and regulations. For instance, New Mexico uses tax rebates as incentives while Arizona uses credits against tax liability. Historical patterns of the use of fiscal instruments in policy in each state suggest that New Mexico would be unlikely to use a credit and that Arizona would be unlikely to use a tax rebate. Similarly, California prepared extensive and specific rules to guard against unanticipated and fraudulent burdens on the treasury. In contrast, North Dakota prepares rules that are simple and uncomplicated to lighten the administrative burden and to ensure understandability by the citizenry.

A second factor concerns both the technical expertise available in the implementing agency to help formulate rules and regulations and the agency's primary mission. Agencies with expertise in solar energy systems and equipment can formulate rules and regulations that delineate system eligibility criteria, certification procedures, warranty requirements, filing procedures, etc. Agencies without expertise in solar energy technology tend to write general rules and regulations or none at all. In each of the four study states with energy agencies responsible for implementation (Arizona, California, New Mexico, Oregon), these agencies participated in the legislative process through the Governor's Call, legislative hearings, and technical advising to bill drafters. Each agency possessed staff expertise in both solar energy and drafting legislation and could participate actively in the legislative process. They had an active interest in implementing the enacted legislation, could estimate the amount of agency change required to implement the law, and could assign priority to implementing the law within the agency's larger set of priorities. Consequently, these energy agencies sought and accepted the responsibility for implementing enacted legislation and have been relatively successful in doing it.

In contrast, the tax authority in each of the study states rarely possessed either the statutory mandate or the staff expertise to actively influence energy legislation. Their role was restricted to providing testimony on the administrative burden anticipated by passage of the energy bills and the fiscal impacts upon the state treasury. Officials of tax authorities in several states disclosed that the incentive program was of relatively low priority within the agency's set of priorities and that only a minimal change in agency responsibility was required to implement the law. While tax authorities were legally responsible for implementing an enacted financial incentive, they tended to resent use of the state treasury for social engineering programs. These agencies developed their own rules and regulations, doing little more than rewording the language within the enacted legislation. Description of eligible systems was minimal because the staff lacked the technical expertise to do more. Publicity also was minimized because the authority saw itself as a "tax collector" rather than as a disseminator of public information. Finally, tax authorities often viewed implementation of financial incentives as a waste of their time and the state's money because of the size of the credit and the likelihood that only a relatively few tax taxpayers would regard it as a sufficient incentive to purchase an eligible solar system.

The third factor is related to the second in that if resources were available to write rules and regulations, the technical expertise to formulate detailed guidelines might be attainable. Also, the availability of resources is important to how the tax incentive is implemented routinely. Without resources explicitly available for formulating rules and regulations, implementing agencies must "piggyback" both the writing of rules and regulations and the implementation of the incentive on personnel with other primary responsibilities. In five of the nine study states where the tax authority was the responsible implementing agency, lack of resources and expertise severely constrained implementation of the income tax incentive. Also, minimal or no rules and regulations have been promulgated, no staff have been officially assigned to implementing the incentive, and very few if any claims have been processed completely.* These problems were less significant in states where responsibility for implementation of the income tax credit was the joint responsibility of the tax authority and energy agency.

7.2.2 Property Tax Incentives

The property tax incentive is a popular financial incentive for solar energy; 10 of the 11 study states had enacted some form of this incentive. This incentive is attractive to state legislatures because it has no fiscal impact on the state treasury but is revenue foregone from the treasuries of county or municipal governments. It does not generally involve the expenditure of revenues. However, in one study state, the incentive provided for a rebate of property taxes paid from the state to claimants. Property tax incentives tend to be one of three types: total exemption of a solar system from property taxes, system assessment as if it were a conventional heating system, and an exemption equal to the assessed value of the system. The length of time allowed for the property tax incentive ranged from five years from date of installation to the life of the solar system.

*These observations held as of spring 1979.

Crucial to the implementation of a property tax incentive is a cadre of local property assessors skilled in appraising solar energy applications. In Kansas and Michigan, where property tax incentives were the dominant solar financial incentive, most local assessors were not skilled in appraising solar systems. In addition, most local assessors did not know the financial incentive existed. Those that did, found the enabling legislation to be broad, vague, and difficult to translate into appraisal guidance. In addition, because of the variety in solar applications and limitations on retail sales data, local assessors were reluctant to make any decisions about the contributions to property value of solar applications. Local assessors viewed active solar systems as having no value because of a lack of comparable retail sales data of property with and without these applications. They had no evidence that an active system increased the sales price of a house above that of one without a system. Even more problematic for local assessors was passive solar design features and applications. In most cases the addition of a sunspace (e.g., greenhouse, solarium) was viewed as additional taxable living space and not as a passive solar collector's solar storage. As a consequence, many study state energy agencies reported a variety of consumer complaints about local assessors' not allowing a property tax break or exemption because the assessor was unaware of the incentive, could not make an appraisal, or failed to give the full measure of the incentive.

In most states guidance for appraising solar energy applications had not been formulated by the energy agencies or disseminated to local assessors through the appraisal division of state government. Even questions raised by local assessors and addressed to the state's appraisal division were not routinely passed along to the energy agency. Guidance for property appraisal provided by the state appraisal office to local assessors has not specifically addressed solar energy applications. At present, the burden of proof for claiming the property tax incentive rests more on the property owner than on the local assessor. The owner has to be aware of the incentive, inform the assessor of the incentive, and work with the assessor to acquire an equitable appraisal of both the solar energy system and the property. It is almost certain that inequities will exist just as current appraisal inequities exist both across states and among counties within the same state. A recent study (Brandon, Rowe, Stanton) of property assessments in Trenton, N.J., reported that property owners could have overpaid or underpaid property taxes by as much as $1,000 a year on a $30,000 home. Also, it has been reported that more than half the states in the country had over 20% error in assessment uniformity the year of the Trenton study.

7.2.3 Sales and Use Tax

In 3 of the 11 study states, the first legislative support for solar energy development came in the form of a sales or use tax exemption. The intention of the sales or use tax exemption is straightforward: to lower the first cost of solar energy sytems by exempting them from sales taxes. Admittedly, the incentive is small in terms of the monetary savings to purchasers of solar systems. But it does reflect state legislative support for solar energy, and it gives the state government some experience with implementing a solar tax incentive.

Two basic approaches to administering the sales and use tax exemption are to rebate taxes paid or to give credit for taxes paid at the point of purchase. Common to both methods are problems of formulating implementation rules and regulations similar to those with the income tax incentive. Whether taxes paid are rebated or credited at the point of purchase, some rules and regulations need to be formulated to guide implementation. Because the exemption of sales and use taxes on the purchase of systems or components is treasury revenue foregone and of relatively minimal fiscal impact, the three study states exerted little effort toward implementing this incentive. Neither resources to prepare and promulgate rules and regulations nor funds for technical expertise to prepare them were available. As a consequence, remarks about sales and use tax credits as ineffective in stimulating purchase of solar energy applications have little basis in experience. Insufficient claims data exist to determine the utility and effectiveness of the sales tax incentive to promote solar energy development.

One approach to administering the sales and use tax exemption is to rebate taxes paid. Upon purchase of a solar system or components for a solar system, the claimant submits his purchase receipts for rebate of paid sales taxes. The major constraints of this approach are that it does not lower the first costs of purchasing solar energy applications, but it adds administrative costs for state processing. Both consumer and state government perceptions of administrative red tape and a net loss in trade-offs (e.g., time to gather receipts and obtain rebate versus dollar value of the exemption) in exempting say, a 3%-4% sales tax for solar systems can limit the effectiveness of this approach.

The second approach to the tax exemption gives credit for taxes paid at the point of purchase. This does lower the first cost of solar systems and system components, but it requires that all commercial businesses become familiar with the exemption and determine on a purchase-by-purchase basis whether or not an exemption is legitimate. Implementing the incentive using this approach is complicated by the necessity to inform businesses of the exemption, provide guidance on what to exempt and how to maintain records of exemptions, etc. The complexity of this approach can be illustrated by the experience of the director of the energy agency in one study state. To obtain the sales tax exemption for the purchase of components for a passive solar system (e.g., 2 x 4's and glazing materials) from a hardware store proprietor, the director had to show his business card. In this state, the energy agency's proposed resolution of this type of problem was a simple sales contract. The contract, signed by both parties and distributed to both would specify the materials purchased, their costs, sales tax credited, and the intended use for the materials.

7.2.4 Loans.

Loans and special interest rate loans have not been used frequently by states as financial incentives for the adoption of solar energy systems. Only 3 of the 11 study states had enacted legislation sponsoring loan programs. In two cases, the loan programs were implemented by state agencies. In the third case, the legislation authorized private financial institutions to offer the incentive for purchasing solar systems. Each loan program was unique so together they provide limited insight into the implementation of solar loans.

In Oregon, the state Department of Veterans Affairs has had a solar loan provision in its home loan program since 1977. This agency has considerable organizational autonomy. It is an independent agency and has a bonding authority through which it raises funds for its home loan program. The solar loan provision of the home loan program raises the mortgage limit by $3,000 if the house includes a solar energy system or if a solar energy system is to be installed. The loan interest rate is set to cover only costs of program administration and overhead, currently approximately 6%. A prerequisite of the additional loan is basic weatherization to ensure energy conservation. (The solar system also must contribute a minimum of 10% of the building's energy requirements.) The administration's branch offices routinely implement the loan program and refer only special cases to the main office.

In California, loans are made to disaster victims to restore residential buildings with solar water and space heating equipment. Eligibility is limited to owners of dwellings damaged or destroyed by disasters in areas declared states of emergency. The loan, limited to $3,000, is interest free except for a 2% origination fee and can extend to 30 years. Participating borrowers are required to report their monthly energy use of conventional fuels. Agency records indicate that (as of mid-1979) 56 loans had been made since the program began in 1977, hardly enough to permit an assessment of the program.

A third example of a solar loan incentive is a voluntary loan program enacted in Massachusetts to encourage private financial institutions to lower their interest rates on loans for the purchase and installation of solar wind-powered systems. Loans of up to $7,000 could be obtained for up to 10 years by individuals or incorporated entities if at least $2,000 of the real estate loan financed a solar or wind system. Thirty-nine private financial institutions participated in the program. Of the 354 loans made at the time our data were collected, two banks that actively marketed and publicized the program had more than a third of all activity, 123 loans. The marketing effort of these two banks suggested that information about the program was a key factor in attracting loan applications. The results of the program suggest that lowering interest rates by between 0.5% and 1% can serve as an effective incentive for the purchase and installation of solar energy systems if aggressive marketing is undertaken.

7.2.5 Business Tax Credits

Only 2 of the 11 study states offered business tax incentives to adopt solar energy applications. The incentive was offered to business purchasing solar systems rather than to manufacturers, dealers, or installers of systems. This kind of incentive is usually offered in conjunction with individual tax incentives but often is considered of secondary importance. Because of this, it is unlikely to be implemented. Resources for implementing the enabling legislation will be directed toward the primary incentive first and only then will the secondary incentive be considered.

In Kansas the incentive was a 25% income tax credit and rapid amortization of solar or wind energy system equipment over 60 months. In Massachusetts, the incentive was a 100% income tax deduction for corporations. In both states active implementation was effectively stalled in mid-1979 because rules and regulations had not been formulated and the incentive was not publicized. In each state some businesses applied for the credit but these applications had not been acted upon.

Offering financial incentives to the business community to adopt solar energy applications could result in a significant drain on a state's treasury. Even a small percentage incentive can mean large dollar tax claims for the adoption of expensive industrial and commercial solar energy applications. The absence of financial incentives for businesses in most states suggests that state legislatures prefer to avoid major fiscal impacts on the treasury.* Delays in promulgating rules and regulations in the two study states with business tax incentives may well be the result of fiscal conservatism on the part of the administering executive agency.

*It may also be that few business interests lobbied for such incentives.

7.2.6 Summary

Exploration of the five kinds of financial incentives and issues relevent to their implementation yielded three general observations. First, within each state, financial incentive legislation and programs are not elements of a systematic, integrated plan. In the nine study states with both income and property tax incentives, the incentives were not implemented with similar technical expertise or regulatory detail. As noted earlier, the energy agencies rarely provided technical expertise for property tax incentives, but did for the income tax incentives. Also, technical details of the rules and regulations (e.g., system certification and system eligibility criteria) for the income tax incentive were rarely communicated to or adapted by the agency implementing the property tax incentive. As a consequence, the incentives were not complementary in fostering solar energy development. Such integration and complementarity seem necessary if states are to offer meaningful financial incentive programs.

A second observation is that state agencies charged with implementing solar financial legislation often do not receive any appropriations for carrying out the mandate. For instance, tax authorities responsible for income tax incentives were provided with neither additional money nor manpower to keep records, audit claims, or prepare rules and regulations for the solar incentive. As a consequence, the solar incentive usually was given low priority. A minimal effort was made to prepare rules and regulations and only routine sampling audits were conducted. In addition, short-term programs, programs with small potential fiscal impact, special interest programs, and programs requiring extensive study were given low priority. This suggests that financial incentive legislation should explicitly authorize appropriations for implementing the incentive, or that responsibility for implementation be shared jointly by the tax authority and the energy agency which receives appropriations for energy programs.

A third observation is that in some nonenergy agencies technical expertise was limited. Anecdotal reports on solar energy systems sometimes unfavorably influenced key persons in implementing agencies. For example, upon hearing that an active hot water system had leaked water into a house, an agency official exclaimed his distrust of water systems and stated that he would not want one in his house. This suggests the need to educate agency staff about technical aspects of solar systems and to exercise care in choosing implementing agencies.

7.3 THE IMPLEMENTATION SETTING

7.3.1 State Political Issues and Priorities

A key factor in the successful implementation of a financial incentive program is the "design" placed upon the program by state politicians, especially the governor. In several states, state legislators or legislative committees on energy or resources were acquiring political visibility and mileage from discussions about solar energy. Similarly, governors have tactfully employed solar financial incentive legislation to acquire visibility as forward-looking, energy-conscious, and concerned chief executives. However, once financial incentive legislation is enacted, the governor's continued endorsement or lack of it substantially affects the implementation of an incentive.

The stances taken by the governors of the 11 study states on incentives for solar energy can be categorized as endorsement, skepticism, or generalized low-profile encouragement. In five of the states, new governors were elected in 1978 and their sentiments on solar energy were quickly learned by key state legislators and top officials within the energy agencies and tax authorities. Two new governors actively and publicly endorsed the development and use of solar energy. In each case, the endorsement was followed by gubernatorial action that intensified energy agency efforts to implement an enacted financial (income tax credit) incentive. In one of these cases, the new governor elevated the energy office from an arm of this office to an administrative unit of state government. It was evident from that action that the intent was to build a strong agency with both technical expertise in energy and related matters and to create a policy formulating capacity. In the second case, the governor convened a new energy policy advisory council with the director of the energy agency as its chairman. The council then requested the tax authority to report on the claims taken against both personal and corporate income taxes for solar installations and energy conservation. The message was clear that the governor was interested not only in the incentive but in the results of the program as well.

In two of the remaining three states with new governors in 1978, the governors challenged the importance of and need for independent state energy agencies. In one case, the challenge resulted in six months of intense agency work to justify its importance in state government. The agency saved itself and concluded that a "low profile" was essential to its existence and level of operations. As a consequence, the state's incentive program for adoption of solar energy technologies suffered a setback because the agency's information dissemination activities, active interagency encouragement of solar energy, and legislative thrusts were suppressed. In the second case, the governor's challenge resulted in an equally lengthy agency justification process at the expense of continued efforts in program implementation. Not only did the agency successfully justify its importance as a state agency, but the governor switched his stance from skepticism to endorsement and increased the energy agency's budget substantially.

In the final case of a newly elected governor, a highly visible and autonomous solar program was disbanded and incorporated within a newly formed energy agency. The governor's action represented a functional and programmatic decision to change the direction and emphasis of the state's energy policy and program. The important implications of this action were: a significant loss in public visibility for solar energy; a significant loss of autonomy from state government bureaucracy; and a substantial gain in influence for the governor in state energy matters. In this case, successful implementation of a financial incentive program became contingent upon the programmatic decisions of the governor.

The political stance of the governors in five of the remaining six states can be described as generalized low-profile encouragement. In each of these states, the political environment and mix of energy resources formed the context within which the governor acts on energy related matters. For the most part, the solar energy and alternative energy initiatives taken by legislators and other politicians can be endorsed by the governors because of the popularity and relatively minor impacts of the initiatives upon the state's treasury, economy, and policy. But these governors refrain from publicly advocating policies and programs for solar energy because of the potential political upheavals that would result within their constituencies. Specifically, constituents involved in the development, distribution, and use of conventional energy could interpret the governor's action as contrary, in the long-term, to their interests and needs. In sum, these governors make known to their administrators and political allies their general sentiments on energy, but downplay their support of solar energy development and use as a potentially viable, future alternative energy source. They neither discourage implementation of existing financial incentive programs nor encourage the formulation of additional legislation.

7.3.2 Legislative Oversight

A fourth influential factor in implementation success is legislative oversight. Oversight addresses the questions of whether legislative goals and intentions have been met and the public's money responsibly and efficiently spent. Legislative oversight is a broad form of program evaluation that is the responsibility of the legislature.

In the 11 study states and across the variety of financial incentive programs there were few examples of enabling legislation that clearly incorporated legislative oversight requirements. Most solar financial incentive legislation ignored legislative oversight; however, there were some exceptions. In California there was an example of a long-term, general oversight requirement in the 1977 legislation creating the 55% solar income tax credit. The legislation specified that the Franchise Tax Board was required to report to the legislature before 15 January 1980 about the bill's effect*, and the energy commission was required to establish guidelines and criteria for solar energy systems eligible for the credit on or before 1 January 1978. Michigan's sales tax credit legislation for the purchase of solar energy systems specified that the Department of Revenue is to report to the legislature annually on the operations and effects of the bill. While each state's legislature had the capacity to perform legislative oversight, most legislators and legislative committees were so overworked that little oversight was performed. Unless concern for the implementation of a particular enactment arose because of special interest, public concern, committee concern, or legislator interest, oversight was not done because it did not promise political rewards and was a burden for an already overworked legislature. Some legislators viewed the sizes of the solar financial incentives as not warranting oversight. In one state, an informal form of legislative oversight was being performed by members of the legislature's two energy committees. These legislators maintained informal communication with the implementing agencies about the operations and performance of the financial incentive programs.

7.3.3 Program Audits

Agency audits of programs tend to address questions of program management, operation, and performance. Internal agency auditing is a narrow form of program evaluation and is conducted for the administration. Agency audits of programs can be legislatively mandated or required by program administrators, but they are intended to insure that programs are both managed and operated in a fiscally responsible manner.

Program evaluation by agency audit was more common than legislative oversight among the study states. In 4 of the 11 study states, agency audits required the cooperation of the state's energy agency and tax authority. In four others, the tax authority as implementing agency requested the technical assistance of the energy agency in order to implement and audit its program. In the remaining three states, audits were internal to the tax authority—as the sole implementing agency. Whether they entail cooperation between state agencies, program audits are contingent upon the promulgation of rules and regulations, the availability of technical expertise in solar energy technologies, the establishment of an audit criterion, and the retrieval of claims data. In the eight states

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*Specifically the FTB report must include the number and amount of credits, an estimate of the distribution of the credit by income class, distribution of the credit between single-family dwellings and other premises, and the state revenue loss attributable to such credits.

with both energy agency and tax authority involvement, the tax authority recorded the impact on state revenues of financial incentive programs, established audit criteria, processed and audited credit claims, and stored and retrieved claims data. The energy agency promulgated rules and regulations and provided technical expertise in solar energy needed by the tax authority to both establish audit criteria and to resolve technical issues in claim processing.

Program audits in states requiring interagency cooperation were encumbered by a variety of problems. Some of them stemmed from the form of interagency cooperation, and some arose from intraagency procedures. Two examples illustrate the kinds of problems stemming from the form of interagency cooperation. In several states, energy agencies had not promulgated rules and regulations for implementing an incentive. In other states delays in formulating rules and regulations constrained the tax authority in processing claims. Without technical guidelines, the tax authorities set applications aside to be processed when rules were promulgated. A second problem concerned interpretation of what costs associated with the installation of eligible systems qualified for inclusion in claims. This kind of problem necessitated both technical and legal interaction of the agencies and resulted in repetitious processing of claims and delays in completely processing claims.

The second source of problems in agency audits arose from intraagency procedures. For instance, most of the tax authorities conduct audits of tax returns some 18 months after the year for which the returns are filed. As a consequence, current data on the level of program operation as well as data on the number of valid claims and problems encountered in filing claims were unavailable. Another kind of problem in agency audits was caused by the failure of the taxpayer to submit documentation substantiating either purchase of an eligible solar system or placement of a system in an eligible building. In most states, the tax authority would set the claim application aside and initiate correspondence with the applicant to acquire the necessary documentation. These "pending claims" tended to add confusion both to the audit process and to the level of performance of the incentive program.

When the implementing agency was solely the state tax authority, program audits tended to be no more than accounting reports. In one of the three states of this type, no audit had been done of the financial incentives. In the other two states, the audit reports specified total number of claims, number of claims by county, total dollar value of all claims, dollar value of claims by county, and the number and dollar value of claims by gross income categories. The evidence suggests that program audits have not yet become beneficial to financial incentive programs.

7.4 FACTORS INFLUENCING LEVEL OF EFFORT IN FINANCIAL INCENTIVE PROGRAMS

The level of effort states devote to implementing financial incentive programs consists of the cost of the program to the state treasury, the size of the staff charged with implementing the program, and the administrative costs associated with the program. The total program costs of financial incentive programs (largely made up of the dollar value of claims for tax credits in 1977) were unaffected by implementation factors, and this finding was unchanged by adjusting costs for differences in state population. This was not the case for the size of the staffs employed in implementing financial incentives. These are not large staffs by any measure; even the largest programs in 1978 had fewer than two persons devoted full-time to implementing the financial incentive. In the more usual case, no one was formally assigned responsibility for this task on a full time basis. In accord with our expectations, programs in states with low levels of conflict between legislative and executive branches over solar energy matters had larger staffs than programs in states with high levels of conflict. Similarly, and probably reflecting this consensus, these states with low levels of conflict were ones in which members of the implementing agency (or persons who would become members of the implementing agency staff following enactment of the incentive) were involved in the formulation of the financial incentive legislation. (It should be noted that, in general, few cases of significant involvement by implementing agencies in writing legislation were observed.) Departments of Revenue staff rarely were consulted extensively during formulation of tax credit legislation. These (relatively) well-staffed programs interacted informally with outside groups such as industry and trade associations, public interest groups, and universities; one other form of interaction was through public hearings on agency plans. These interactions translated into relatively high levels of influence on program activities. The usual situation, however, was one of relatively little interaction between implementing agencies and outside groups. Twelve of the fifteen agencies studied exhibited low levels of interaction with, and influence by, external groups such as industry and trade associations. Larger programs probably developed and grew in a setting characterized by high levels of consensus among key political actors and outside groups and effective political action by supporters of solar and renewable energy throughout the state. Once programs were implemented, external support was maintained through extensive involvement of outside groups in the agency's activities.

This picture of relatively well-staffed programs having been implemented in an atmosphere of consensus, involvement with external groups, and early interaction with the legislature is rounded out by the finding that staff for these programs have relatively favorable attitudes toward solar energy. One might expect the preponderance of tax authorities or departments of revenue among the 15 implementing agencies studied (10 of the 15 were tax authorities) would produce, on average, neutral staff attitudes toward solar energy. In fact, about half the implementing agencies were neutral or skeptical, while the remainder were either moderately or very enthusiastic. Not surprisingly, all three of the state agency staffs were enthusiastic about solar energy.

Implementation factors that failed to influence the level of effort of state financial incentive programs are of equal interest to factors that did. Only 2 of the 15 agencies studied experienced more than minor organizational change. This is probably because tax credits often were the responsibility of revenue departments, which regarded solar credits as a minor addition to an already complex tax form, and because energy agencies usually were in place prior to enactment of solar tax credits. Though executive-legislative conflict over solar matters clearly influenced the level of solar activity in a state, this was not the case for conflict in general; the presence or absence of chronic conflict between the two branches of state government neither enhanced nor inhibited the growth of solar financial programs. The existence of registered solar lobbyists had little effect on total program costs or staff sizes.

7.5 FACTORS INFLUENCING ADMINISTRATIVE COSTS

The magnitude of administrative costs was influenced by the same factors that influenced staff size. This is not surprising, since administrative costs consist largely of staff salaries. The bulk of administrative costs are incurred in energy agencies, where rules and regulations are conceived and formulated, rather than in tax authorities, where most implementation activity involves simply processing tax forms (as yet, auditing has not been initiated). It also turned out that programs with larger staffs and with higher administrative costs were programs whose staff wrote relatively specific rules and regulations governing eligibility for the financial incentive and which required documentation of solar purchases from taxpayers claiming credits. This is as expected since larger programs' staff resources were available to develop detailed rules and to evaluate documentation submitted by claimants. Additional analysis will test the expectation that staffs consisting largely of scientists and engineers write highly specific regulations and that staffs consisting of business school graduates and career administrators tend to require a large amount of documentation from claimants.

7.6 FACTORS INFLUENCING IMPLEMENTATION OUTCOMES

One measure of outcome was the time required for an implementing agency to develop and formally promulgate rules and regulations specifying eligibility for the incentive.

Among the 12 programs studied, some required as little as 3 months to develop rules and regulations, while others had not yet introduced them officially 4 years after enactment of the original legislation. (The average time required was just under 2 years—21 months). If substantial conflict exists between legislative and executive branches on solar energy matters, it takes longer to develop rules and regulations than if consensus exists. As might be expected, too, the presence of registered solar lobbyists in the state, suggesting a well-developed political basis for government action to promote solar technology, shortens the time required to develop rules and regulations. High degrees of specificity in rules and regulations does not mean that it takes longer to develop them; evidently delays in developing rules and regulations are not the result of difficulties that arise due to the desire to be highly specific. As expected, skeptical attitudes toward solar energy are associated with longer times between enactment and introduction of rules and regulations; enthusiasm among implementing agency staff apparently speeds the development of regulations. There is some evidence that agencies staffed primarily by persons with business and economic backgrounds (all of which were tax authorities or other state agencies rather than energy agencies) took longer to develop rules and regulations than did other agencies.

The level of conflict between legislation and executive branches on all issues did not influence the time required for an agency to develop rules and regulations, nor did the extent to which implementing agency officials were involved in the formulation of the financial incentive legislation (recall that, in general, the amount of such involvement was slight). The extent to which implementing agencies interacted with outside groups did not appear to influence the time required to develop rules and regulations, though this finding should be considered tentative since only a small number of agencies experienced significant outside involvement. Seven of the fifteen implementing agencies held public hearings on their proposed rules and regulations, but this did not slow down the process of rule development relative to agencies that did not hold (or have not yet held) public hearings.

A second measure of administrative outcome is the percentage increase in the number of solar system installations since the incentive was enacted. If data from the present study on the number of solar tax credit claims for 1977 are adjusted to reflect the definitions of solar systems used by the Solar Energy Institute of North America (e.g., cooling systems and swimming and commercial installations are not included),* and extrapolations are made from 1974 (when only a very small number of installations existed in most states relative to 1978) to 1978, it is possible to generate a ratio of the number of solar tax credits processed by a state for the 1977 tax year to an estimate of the number of solar systems installed during the year.

The result is a crude indicator of the extent to which a state's solar tax credit successfully reached persons in the state who installed systems during the year. It is, of course, not a measure of the extent to which purchasers' behavior was changed by the existence of the credit, and it is not strictly comparable across states because differences in eligibility criteria and the time of introduction of the incentive (e.g., California's tax credit was not introduced to the public until November 1977). As it turned out, none of the implementation factors were related to this indicator.

Because of the enormous differences in size, resources, definitions of solar systems, and carry-over provisions across states with solar tax credits, it is not instructive (and may be misleading) to conduct simple, comparative analyses of the apparent consequences and costs of state solar tax credits. Some idea of the widely differing size of incentives, numbers of claims, number of claims as a proportion of total tax returns, and proportional increase in number of systems installed can be gained from the data listed in Table 7-1. One meaningful comparison can be made, however. It is clear that the median adjusted gross income of claimants for solar tax credits is fairly high ($28,250), reflecting the expectation that tax credits are more attractive to relatively high income individuals or families. When adjustments are made to the median income figures in the table to reflect the different per capita income levels in states, New Mexico stands out as attracting, on average, a lower income population. No doubt this is a result of that state's use of a rebate system, in which the amount of the tax credit above a claimant's tax liability in a given year is paid in the form of a check directly from the state (Ashworth et al. 1979). The effect of the size of a solar income tax incentive on the number of systems installed can be estimated only after data on 1978 installations (and perhaps additional years) are available.

7.7 SUMMARY

State solar financial incentive legislation and successfully implemented solar financial incentive programs are the result of different forces acting on state policy makers and administrators. The passage of incentive legislation may be politically symbolic, politically significant for increased solar applications, or both. Property tax exemptions or reductions were popular among the states studied because no state funds are required for their implementation; but in the two states where these were the primary financial incentive, few property assessors skilled in appraising solar applications were available to implement the law at the local level. In fact, in the relevant states, most local building officials did not know of the existence of state solar property tax laws. Similarly, sales and use taxes have minimal potential fiscal impact and therefore often are enacted for

*The Solar Energy Institute of North America (1979) surveyed the states by telephone to develop data on the number of solar systems installed during 1978 and 1979 and on the total number of installations in each state at the end of these years. The validity of these data has not been determined, but they do represent the only currently available, comparable information on the amount of and recent growth in the number of solar installations on a state-by-state basis.

symbolic reasons. The small size of this incentive resulted in minimal efforts to implement it. Each of the three solar loan programs studied was unique, oriented toward specialized audiences and implemented under widely varying conditions. As a result, no generalizations about the conditions leading to successful implementation are possible at this time. Business solar tax credits are rare; when present, they usually accompany and are overshadowed by individual solar income tax credit programs. Business credits are considered secondary in importance to individual tax credits, and only weak efforts have been devoted to their implementation.

Solar income tax credits directed toward individuals proved to be the most significant incentive in terms of implementation activity and fiscal impact. The type of agency selected to implement solar tax credit legislation had a profound influence on the type and amount of expertise that was brought to bear on implementation, the specificity of the rules and regulations written, the level of staff resources allocated to implementation and, through these factors, on implementation success. If state energy agencies are involved in the implementation of solar tax credit legislation (either as the only responsible party or jointly with the state tax authority), technically specific rules and regulations tend to be prepared that cover major contingencies such as system eligibility, certification, and warranty coverage. If other types of agencies, particularly tax authorities, have sole implementation responsibility, the result is very general rules and regulations—or none at all. Generally, tax authorities do not regard implementing solar tax credits as part of their mission, lack the technical expertise in solar energy, allocate minimal staff to implementation, and provide little information to taxpayers about the existence and interpretation of the solar incentive.

Table 7-2 summarizes the findings of quantitative analysis of how organizational and administrative factors are related to measures of implementation success. Most states allocated very small staff resources to implementing solar financial incentives, but those agencies with relatively large staffs interacted extensively with, and were significantly influenced by, external groups such as industry and trade associations and solar interest groups. Larger staffs were heavily involved in the formulation of the incentive legislation, were favorably disposed toward solar energy, and enjoyed a political setting exhibiting low levels of conflict between the executive and legislative branches over solar energy issues. In most cases, these characteristics were present in states that chose an energy agency to implement the solar financial incentive. The most useful measure of implementation success—the time required for the implementing agency to prepare rules and regulations governing eligibility—revealed that highly specific rules and regulations, the kind written when energy agencies were involved in the implementation process, were associated with shorter implementation periods. Registered solar lobbyists, possibly reflecting a favorable overall political climate in the state for solar energy development, appeared to speed the process of writing rules and regulations.

Preliminary observations can be made on the results of solar income tax credit claims made in six states for the 1977 tax year. The median adjusted gross income of solar claimants is high, reflecting both the high initial capital cost of solar systems and the appeal tax credits have for higher income taxpayers.* Large differences in the size of tax credits in these six states had little influence on the percentage increase in installed solar systems during 1977, or on the number of solar tax credit claims per 10,000 tax

*This result may also reflect the fact that low-income persons may not be able to afford the cost of a solar system, have limited access to financing, and rent their dwellings more frequently than persons with higher incomes.

returns, but differences in system definitions, the conditions under which the incentive was introduced in these states, and the uncertain quality of the data limit the conclusions one can draw.

Overall, solar financial incentives are rarely part of an integrated state plan with consistent rules, definitions of eligible solar systems, and coordinated efforts among different implementing agencies. Multiple financial incentives in the same state therefore do not complement one another. Gubernatorial endorsement of incentives influenced their implementation, often revealing whether an incentive was largely symbolic or substantive. States exhibited large variations in the governor's stance toward solar energy incentives, and the election of a new governor often led to large changes in the fate of incentive legislation and to only partially implemented programs. On the other hand, legislatures rarely paid much attention to a financial incentive once the legislation was passed. Oversight generally is a function with low priority among legislators and was rarely performed in the case of solar financial incentive programs. In most states, the potential impact of solar financial incentives on the treasury was small enough that oversight was not deemed warranted.

SERI

SECTION 8.0

OVERVIEW AND EXPECTATIONS: STATE SOLAR RESEARCH, DEVELOPMENT, AND DEMONSTRATION PROGRAMS

8.1 RATIONALE FOR GOVERNMENT SUPPORT OF RD&D

The National Science Foundation defines research as "systematic, intensive study directed toward fuller scientific knowledge or understanding of the subject studied" (NSF; 1977, p. 54). Whether research is defined as basic or applied, according to NSF, depends upon the goals of the performer; in basic research the investigator intends to gain a fuller understanding of the subject under study, while in applied research the investigator is concerned with the practical use of knowledge or increased understanding for the purpose of meeting some need. Development is systematic use of research-based knowledge to produce useful materials, devices, systems, or methods, including prototypes. One authoritative source defines a demonstration as "a project, involving an innovation operated at or near full scale in a realistic environment, for the purpose of (1) formulating national policy or (2) promoting the use of the innovation" (Glennan et al. 1978, p. 3). The federal government and the states support each of these kinds of activities, but the rationales for government support vary with the type of research.

Government support of basic research has been justified largely because of the attributes of information, the major product of this type of research. Information cannot be divided but is (technically) available to all consumers; it is difficult for the producer of information to establish unique rights to it; and it is difficult to predict in advance what the value of the product of research will be (Rettig, Sorg, and Milward 1974, pp. 16-35). Economists agree that, because of the attributes of information, the private market will support less basic research than is "socially optimal." The subtleties of the argument need not be repeated here. The point is that these attributes of information lead to "market failure" evidenced by the private market's insufficient investment in basic research. Because these theoretically based arguments are well accepted in the political realm, some level of public support for basic research is not challenged seriously. Economic theory provides no operational guidance, however, on the question of how much basic research the government should support.

Rationales for government support of applied research and development differ in some respects from those for the support of basic research. Underlying any proposed public investment, of course, are the general requirements that the benefits of society exceed the costs imposed on society by the investment, and that inadequate incentives exist for nongovernment entities to make the proposed investment. Different authors have proposed various criteria for government support of applied research. Nelson, Peck, and Kalachek (1967) argue that (1) the proposed research should hold promise of producing knowledge that, if applied, would result in significant increases in the performance or efficiency of a class of products or processes; (2) a reasonable chance of success should exist at a level of funding commensurate with a high rate of return; and (3) there are good reasons why business firms are not undertaking projects of the proposed type. Alternatively, Bean and Roessner (1979) list technological uncertainty, market uncertainty, and the existence of public benefits that would accrue from the research that cannot be captured by private firms. In cases where government support of applied R&D takes the form of direct intervention in the private market to influence the rate and direction of technological innovation (e.g., commercialization), more explicit criteria have been suggested. Nelson, Peck, and Kalachek (1967) list the conditions that should exist if government support of industrial research is warranted: the industry should exhibit both a low level of R&D activity and a low rate of technical progress, the industry should have institutional barriers that deter private investment in R&D, and the industry should show promise of substantial improvement if the rate of technical progress were to increase. Finally, Pavitt and Walker (1976) list intervention criteria in terms of specific types of market imperfections. They include management "imperfections" (esentially lack of management skills), knowledge imperfections among potential buyers of innovations in the market, the existence of externalities (including amenity and job satisfaction), inadequate or inappropriate economic incentives for socially desirable innovations due to market structure or government policies (e.g., patent or tax system), and inadequate investment in long-term, relatively radical innovations due to risk-aversion, short-term time horizons, or cost.

Rationales for government support of technology demonstrations are discussed in a recent article summarizing the results of a major study of federally funded demonstrations (Baer, Johnson, and Merrow 1977). The government supports demonstrations to provide information to policy makers about whether to pursue a particular policy (e.g., the income maintenance experiments) or to promote the use of an innovation (e.g., the HUD solar hot water demonstration projects). The arguments for government support largely parallel those for intervention in private markets—the existence of externalities that could be compensated for by accelerated introduction of new technology and the existence of market imperfections such as excessive concentration or government-caused distortions. The authors of the article warn that market imperfections are ill-defined and easily can be misapplied to justify ill-conceived government projects (Baer, Johnson, and Merrow 1977, p. 951).

8.2 THE STATE ROLE IN R&D

Large-scale government support of R&D has been an accepted policy since the end of World War II. The conditions that led to this policy have been national in scope: the need to support graduate education, the desire for technological supremacy in defense preparedness, concern with understanding the cause of disease. Both the conditions and the responses have focused on the national government, with states playing virtually a nonexistent role until relatively recently. States can rarely justify investment in research because they cannot capture fully the benefits of the research. Moreover, the budgets of individual states are dwarfed by the federal budget, so that resources available for research rest almost exclusively with the federal government. Between 1964 and 1973, state expenditures for R&D rose from $72 million to $264 million, but these expenditures represented only 0.6% and 1.6%, respectively, of total federal spending for R&D (NSF 1975b). State governments used their own funds to support about half of this amount of R&D during this period, with federal money accounting for nearly all the remainder. State R&D spending as a proportion of federal R&D has remained roughly constant at 1.6% between 1973 and 1977, the last year for which data are available.

The states tend to emphasize applied research over basic research or development. The proportion of state R&D expenditures devoted to applied research rose from 46% in 1964 to 62% in 1973 (NSF 1975b, p. 8), and the share devoted to basic research has fallen from 35% to 22% during the same period. Data are not available on what proportion of state expenditures for basic and applied research are drawn from state revenues, but it is likely that the bulk of the basic research is federally funded. One indication of this is that of the approximately $1.2 billion expended by state public institutions (including state universities) for basic research in 1973, only $50 million (or about 4%) was expended by state government agencies (NSF 1975a).

State agencies spend most of their R&D money on health and natural resources. These areas include biomedical research, research on the delivery of health services, and the management of agricultural and natural resources such as fish, game, parklands, and coastal areas. State R&D expenditure for energy development and conservation was, until the Arab oil embargo, a miniscule part of total state spending for R&D: it was $41,000 in 1964 and $562,000 in 1973, the latter figure representing only 0.2% of total state R&D in 1973. By 1977, however, state energy R&D expenditures had risen to about $31.5 million, or almost 9% of the total. Total state appropriations for renewable energy R&D were approximately $15 million in fiscal year 1976 (House Committee on Science and Technology 1975, p. 48).

In 1973, 15 states accounted for almost three quarters of total state expenditures for R&D, with the top 2 states (New York and California) alone spending almost $100 million, more than a third of the total (NSF 75-303, p. 11). This situation still existed in 1977, when the two states accounted for 38% of total state R&D expenditures.

The foregoing information leads to a number of expectations with respect to state solar energy RD&D programs. First, states will tend to emphasize applied research and demonstration with their own money. They will look for short-term payoffs and visible results from their expenditures. Second, renewable energy RD&D will constitute a substantial proportion of state energy RD&D, but a relatively small number of states will account for most of these expenditures. Finally, the recent entry of states into RD&D program design and management, and the even more recent rise of state energy RD&D programs, suggest a lack of experience with planning and managing RD&D. We would expect, therefore, to find that state solar energy RD&D programs have encountered a great many "growing pains" and will have had to learn by making mistakes, since so little experience existed from which present program staff could draw.

8.3 REVIEW OF STATE SOLAR RD&D INITIATIVES, 1974-1979.

Since 1974, many states have enacted legislation creating energy RD&D programs, including solar energy RD&D. Table 8-1 lists all state energy RD&D programs which include solar energy. As Table 8-1 illustrates, over the last four years states have shown an increasing interest in establishing their own energy RD&D programs. In 1974, 4 state programs were initiated; in 1975, 6; in 1976, 1; in 1977, 7; and 1978, 1 (total of 19 programs).

There are a large number of institutional arrangements and fiscal mechanisms available to a state for the creation and implementation of an internally funded solar energy RD&D program. The choice of mechanisms and instruments is partly governed by the program emphasis preferred by the particular state. The term "Solar Energy RD&D" has been used to describe a large spectrum of activities at the state level, ranging from research on materials and experimental technologies to near-term commercialization assistance. Included in state solar energy RD&D activities have been the following:

- research on materials and experimental technologies;
- modification of existing technologies for local conditions and for local energy use patterns;
- inventories of existing renewable energy resources and of the potential applications of solar energy systems;

Table 8-1. STATE SOLAR ENERGY RD&D PROGRAMS

	Legislation/ Statute	Date	Funding[a]	Administering Agency
Alaska	HB 12	1978	Gen. Rev.	Alaska Office of Science and Technology
Arizona	Chap. 58 HB 2062	1977	Gen. Rev.	Arizona Solar Energy Commission
California	AB 1575 Chap. 276	1974	EUS	California Energy Resources, Conservation, and Development Commission
Colorado	SB 50 Chap. 95	1974	Gen. Rev.	Colorado Energy Research Institute
Florida	SB 721 Chap. 185	1974	Gen. Rev.	Florida Solar Energy Center
Hawaii	SB 1585 Chap. 235 & 236	1974	Gen. Rev. & Bonds	Hawaii Department of Planning and Economic Development
Illinois	PA 80-432	1977	Bonds	Illinois Institute of Natural Resources
Iowa	SB 289 Chap. 56	1975	Fed. & Gen. Rev.	Iowa Energy Policy Council
Kentucky	Chap. 299	1976	Gen. Rev.	Kentucky Department of Energy
Maine	PL 1558 Chap. 340	1975	Gen. Rev.	Maine Office of Energy Resources
Minnesota	Chap. 455	1977	Gen. Rev.	Minnesota Energy Agency
Montana	SB 86 Chap. 501	1975	MST	Montana Department of Natural Resources and Conservation
Nevada	Chap. 636	1975	Gen. Rev.	University of Nevada, Desert Research Institute
New Mexico	Chap. 255	1977	MST	New Mexico Energy and Minerals Department
New York	A 8620 Chap. 864	1975	EUS & Bonds	New York State Energy Research and Development Authority
North Carolina	Exec. Order # 17	1977	Gen. Rev.	North Carolina Department of Commerce
Ohio	HB 584	1975	Gen. Rev.	Ohio Department of Energy
Oklahoma	HJR 1013	1977	Gen. Rev.	Oklahoma Department of Energy
Texas	HB 1799 Chap. 838	1977	Gen. Rev.	Texas Energy Advisory Council[b]

[a]Funding Types:
Bonds
General Revenues (Gen. Rev.)
Energy Use Surcharge (EUS)
Mineral Severance Tax (MST)
Federal Support Funds (Fed.)

[b]Now the Texas Energy and Natural Resources Advisory Council

- cooperation with private industry for the testing of solar energy systems;
- demonstrations and monitoring of solar energy systems; and
- dissemination of results of research, product development, and demonstration monitoring.

To support one or more of these activities, each state has a number of fiscal options. The choice of funding mechanisms may have important implications for program design and continuity, stability of funding, program autonomy, and administrative flexibility. Some of the common funding mechanisms for state solar energy RD&D programs include:

- annual legislative appropriations from general revenues;
- "ear-marking" of funds from existing special revenues (primarily state mineral severance taxes);
- levying of a surcharge on energy sold by regulated utilities;
- sale of state bonds;
- solicitation of outside funds (generally from federal government sources or from private foundations); and
- cost-sharing with private industry.

In general, there are several distinct approaches that the states have taken to promote solar energy RD&D. They include:

- institutional support for the creation of new research institutes at state universities;
- the awarding of grants or contracts to existing private organizations or individuals by an administering agency;
- funding of specific projects through existing state agencies;
- annual competition for available funds or solicited, noncompetitive proposals; and
- cost-sharing with private industry, i.e., resource assessment and governmental participation in ongoing private demonstration facilities.

The relative priority given to potential state solar energy RD&D activities and availability of local institutional resources will largely determine what institutional arrangements and mechanisms a state will select for the performance of solar energy RD&D.

There are also a number of project-specific choices which must be made, either by the legislature or by the implementing agencies. These include:

- type of projects as determined by definition of solar, renewable, or alternate energy;
- type of project emphasis (basic research, demonstration, etc.);
- maximum funding size for projects;
- duration of projects; and
- applicant eligibility criteria.

8.4 MEASURING THE IMPLEMENTATION OF RD&D PROGRAMS

This study's emphasis on the implementation of RD&D programs is particularly useful for policy purposes because of the extreme difficulty in measuring the effectiveness of such programs. Toward the basic research end of the R&D spectrum, measures of effectiveness are avoided and resource inputs (usually dollar and scientific manpower data) typically are employed by analysts as the only indicators of activity. Due to the difficulty of tracing the contribution that individual projects make to knowledge in a field and of attributing causality to relationships between aggregate expenditure figures for basic research and measures of payoff such as economic growth and productivity, inputs are taken as measures of output. The National Science Board's Science Indicators 1976 (NSB 1977) uses the number of research articles published in different fields as measures of basic research output, but the shortcomings of such measures as indicators of effectiveness are obvious.

Inventions are one major product of successful applied research, and patents have been used extensively as measures of inventive activity (NSB 1977). In general, "the social and economic effects of innovation... and R&D... are not yet understood well enough to make possible the presentation of quantitative indicators of these effects" (NSB 1977, p. 125). Existing studies have focused on aggregate effects on the economy or on returns to the industrial firm due to investment in RD&D; these efforts provide little that could be used to assess the effectiveness of particular R&D programs such as those supported by state government.

With respect to demonstration projects, the Rand Corporation's study (Baer, Johnson, and Merrow 1977) offers three measures of outputs: information success, application success, and diffusion success. Information success occurs if potential adopters obtain enough information from the demonstration to make an informed decision about whether to adopt or reject it; application success occurs if the technology works well in its intended setting; and diffusion success occurs if the technology passes into general use as a result of the demonstration. It should be clear that data on these measures of success are rarely obtained inexpensively, usually require observation over a period of several years, and cannot easily be analyzed to yield firm conclusions about the effects of the demonstration.

In the absence of valid, agreed-upon, or easily obtained indicators of the effectiveness of R&D programs, analysts frequently resort to measures of management or "process" factors as surrogate indicators of quality or effectiveness. Use of surrogates rests upon the findings of research and evaluation studies that sought associations between the outcome of R&D programs and a variety of managerial practices, organizational arrangements, and staffing patterns. To the extent that consistent patterns are found between "successful" R&D programs and particular management strategies, for example, one can regard the existence of those strategies in an unevaluated R&D program as (indirect) evidence of the program's effectiveness. For example, assessment of technology transfer programs have used measures of the extent of interaction between program staff and intended users, staff professionalism, and staff experience in user communities as substitute measures of program effectiveness (NSF 76-400). In industrial R&D settings, close coupling of R&D and marketing personnel appear to be associated with successful efforts to introduce innovations into the marketplace (Twiss 1974, p. 212). A major study of the management of federal civilian R&D programs found that managers of successfully commercialized projects tended to include market assessments at the project planning or project selection stage (McEachron et al. 1978). In the case of federally supported demonstrations, projects that included potential manufacturers, purchasers, regulators, and other target audiences in the planning phases were more successful than projects that did not (Baer et al. 1976). These findings served as the basis for several implementation measures for state solar energy RD&D programs that we employed in this study.

8.5 MEASUREMENT OF IMPLEMENTATION PROCESSES AND OUTCOMES

As noted in Sec. 3.3, our measures of implementation fall into three categories: level of effort, administrative costs, and implementation outcome. For the case of RD&D programs, level of effort was measured with data on total annual program costs, the number of full time equivalent (FTE) staff devoted to implementing the RD&D program, the number of research proposals received and awards made during FY79 and FY78, and the total dollar value of contracts and grants awarded during these two years. For purposes of analysis, these measures were normalized by total state expenditures and state population to increase the comparability across states that have widely varying resources available to them. Administrative costs were measured with data on administrative costs per proposal processed and per dollar cost of the program, and the staff FTEs per proposal processed and per dollar cost of the program. Implementation outcome was measured by:

- The ratio of funds cost-shared with the grantee or contractor to total grant and contract funds. While this is not a measure of "outcome," many states mentioned leverage of state money as a program goal; in addition, cost sharing with contractor or performer has been found to be associated with successful demonstration projects and R&D projects intended for commercialization (Baer et al. 1976; McEachron et al. 1977).
- The ratio of funds cost-shared with the federal government to total grant and contract funds. This measure is one dimension of total leverage of state funds; attracting federal dollars was mentioned particularly as one desirable feature of state solar RD&D programs.
- Whether market analysis was performed as part of the project selection process for projects intended for commercialization. This, again, is a "process" variable based upon the findings of the SRI International (McEachron 1977) study of the commercialization of federal R&D projects.
- The extent of end user involvement in project selection. This process variable applies to all types of research: if researchers are more involved in selecting research projects, if industrial or commercial interests are involved in selecting development projects, and if representatives of potential producers and buyers are involved in technology demonstration projects, then it is more likely that successful projects will be selected. The bases for these assumptions are cited in the previous section.
- The percentage increase in the total dollar value of grants and contracts awarded between 1977 and 1978. The assumption here is that an increase in available funds results from evidence of good performance and/or astute and sensitive interaction with state legislature. By itself, this is an unsatisfactory indicator of program effectiveness, but solar staff in several states indicated that it should be included among our several measures of programmatic success.
- The time between enactment of the legislation creating a state solar energy RD&D program and the time rules and regulations for eligibility for grants and contracts, proposal review procedures, and award criteria were formally promulgated. Successfully implemented programs, we reasoned, move relatively quickly from enactment to promulgation of rules and regulations.

8.6 MEASURES OF IMPLEMENTATION SUCCESS: RD&D PROGRAMS

Due primarily to lack of data, a number of proposed relationships between implementation variables and implementation success could not be tested. For the most part, the problem arose from absence of data on administrative costs of programs studied; many states (about half those studied) simply do not keep records in a form that would allow accurate estimates of administrative costs to be made. Though we can list the range and average value of administrative costs for the programs that kept such data, we cannot provide findings on the influence implementation factors have on the administrative costs of state solar RD&D programs. When measures for which insufficient data were available were excluded, measures of level of effort employed in the analysis were:

- total program costs, 1978;
- number of staff or full time equivalents responsible for implementing the RD&D program, 1978;
- number of grants and contracts awarded, 1977 and 1978;
- total dollar value of grants and contracts awarded, 1977 and 1978;
- total dollar value of grants and contracts awarded as a proportion of total state expenditures, 1977;
- total program costs as a proportion of state population, 1977 and 1978; and
- total dollar value of grants and contracts awarded as a proportion of state population, 1977 and 1978.

Measures of implementation outcome used in the analysis included:

- whether projects intended to enhance commercialization were subjected to market analyses as part of the project selection process;
- the extent of end user involvement in project selection;
- the length of time between enactment of the RD&D program and formal announcement of the regulations governing awards and the criteria for project selection;
- the ratio of funds cost-shared with the performer to total grant and contract funds;
- the ratio of funds cost-shared with the federal government to total grant and contract funds;
- percentage increase in dollar value of grants and contracts, 1977-1978.

Unlike the case with proposed measures of implementation outcome for financial incentive programs, data were available from enough states to enable all of these six measures of implementation outcome for RD&D to be used.

SECTION 9.0

DESCRIPTION OF RD&D PROGRAMS IN SELECTED STATES*

9.1 INTRODUCTION

This section describes the 12 state solar or renewable energy RD&D programs studied in terms of variations in program size, staffing, structure, procedures, and other features. Analyses of some of these program features are also presented. The data were gathered during on-site interviews and from archival sources. These data should be useful to program administrators and staff, legislative staff, and special interest groups seeking to gain a better understanding of the present status, capabilities, and resources of state solar energy RD&D programs. Also, the data should provide a basis for additional analysis by other interested parties. Most of the data are presented in tabular form in this section; supplemental data are listed in Appendix F.

9.2 PROGRAM RESOURCES AND FUNDING

The total dollar value of grants and contracts awarded in 1977 for the 12 programs studied ranged from $30,000 to $3.9 million, with a mean of about $900,000. Large, wealthy states are not necessarily those states that allocate the most resources to solar and renewable energy RD&D on a per capita basis. Hawaii, Montana, New Mexico, and Arizona stand with New York as the states most generous in their funding of such programs (Table 9-1).

State solar energy RD&D programs are funded through the appropriation of state general revenues, the sale of state revenue bonds, levying of a surcharge on energy sales, or "earmarked" funds received from a mineral severance tax. In several states a combination of these funding methods is being used. Among the states studied, seven RD&D programs were funded by annual appropriations, two through a mineral severance tax, and one each by an energy sales surcharge, a combination of annual appropriations and bond sales, and a combination of an energy sales surcharge and bond sales. Funding sources for study states and for seven additional states are listed in Table 8-1. Different funding arrangements may have different effects on program implementation, admininstration, stability, and outcomes. The following discussion delineates several actual and potential impacts of the variety of state RD&D program funding methods.

Unlike many other state expenditures, RD&D programs are better suited to a multiyear time horizon and commitment than to annual appropriations.** For this reason, energy use surcharges and mineral severance taxes would appear to be preferable methods of RD&D program funding since they are relatively predictable, dependable, and stable. Annual appropriation of state general revenues and, to a lesser extent, proceeds from state bond sales are subject to political fluctuations in the legislature. With the growing taxpayer revolt, funding mechanisms which rely upon state income taxes or general revenues may not be dependable.

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*Bruce Green contributed extensively to this section.

**The basis for this assertion is the (relatively) long time frame in which payoff from a research project is expected.

Table 9-1. PER CAPITA EXPENDITURES OF TWELVE STATE SOLAR RD&D PROGRAMS: 1977 and 1978

	Total Dollar Value of Grants and Contracts Awarded in 1977* (x1000)	State Population in 1977 (x1000)	Equivalent per Capita Expenditure for 1977	Total Dollar Value of Grants and Contracts Awarded in 1978* (x1000)	State Population in 1978 (x1000)	Equivalent per Capita Expenditure for 1978
Arizona	490	2,305	0.21	490	2,354	0.21
California	728	21,887	0.03	744	22,294	0.03
Colorado	30	2,625	0.01	0	2,670	0
Florida	1,236	8,466	0.14	555	8,594	0.06
Hawaii[a]	NA[c]	891	-	1,666	897	1.85
Maine	0	1,084	0	16	1,091	0.01
Montana[b]	937	766	1.22	287	785	0.36
New Mexico	388	1,196	0.32	235	1,212	0.19
North Carolina	150	5,515	0.03	300	5,577	0.05
New York	3,900	17,932	.22	6,400	17,748	0.36
Ohio	61	10,696	0.005	50	10,749	0.004
Texas	-	12,806	-	406	13,014	0.03

[a]Includes OTEC grant and contract funds.

[b]Montana's renewable energy grants program did not engage in a full funding cycle in 1978 owing to legislative review of the program and judicial review of the programs' funding source, a coal severance tax.

[c]NA indicates not available.

*Sources: Arizona: Arizona Solar Energy Commission interviews; Calfornia: Contract Report, 1977-78, Contract Report 1977-78, Contract Report 1978-79, Resource Development Division; Colorado: Colorado Energy Research Institute Project Summaries, 1975-78; Florida: Florida Solar Energy Center Activities Report, 1977 and 1978; Hawaii: Energy Resources Coordinator Annual Report, 1978, Department of Planning & Economic Development; Maine: Office of Energy Resources interviews and correspondence; Montana: Alternative Renewable Energy Grants Program Report to the Montana Legislature, January, 1979; New Mexico: Department of Energy and Minerals, A Status Report on the New Mexico Energy Research and Development Program, March, 1979; North Carolina: Correspondence from the North Carolina Energy Institute, July, 1980; New York: New York State Energy Research and Development Authority (NYSERDA) Annual Report, 1978 and 1979, and NYSERDA Report to the Director of the Budget, Jan. 1, 1979; Ohio: Energy and Resource Development Agency Annual Report, 1977, Ohio Department of Energy 1978 Energy Status Report and staff interviews; Texas: Texas Energy Development Fund, Volume 2 and Project Status Reports, Texas Energy Advisory Council, Jan., 1979.

General revenue funding may mean that the administering agency could be subjected at least annually to program review by a legislative oversight committee. This review may center around issues such as why a certain project was not funded in certain legislators' districts or may become embroiled in a partisan dispute. Generally, this situation did not prove to be a significant problem in the states studied because of the legislature's limited interest in exercising oversight.

State bond sales may also prove erratic as a program funding method. State bond sales will probably precede the initiation of an RD&D project where this funding method is used. RD&D program funding levels may become dependent on the relative success of bond sales. Economic factors at a variety of levels (e.g., national, regional, and state) may affect the sales of state bonds at various times. Incurring additional state debt may not be politically acceptable at certain times, and RD&D program funds may therefore be jeopardized if they rely on bond sales as a funding method. As with state revenues, bond sales may be an unpredictable and irregular method of program funding.

Federal funds are normally used to supplement state solar energy RD&D funding or to support specific projects. Federal funds may be irregular and subject to federal budget priority changes. Additionally, the federal government has not generally funded RD&D efforts at the state level, but rather has managed RD&D efforts on its own or designated this responsibility to federally contracted laboratories.

Several exceptions to these generalizations were observed in the states studied. The Montana program, which is funded through "earmarked" revenues received from their coal severance tax, had been a very stable program until 1979 when the legislature temporarily prohibited the expenditure of program funds. Litigation regarding the constitutionality of the Montana coal severance tax was initiated, and the RD&D program was subject to doubts about its future. Program funds have since been released but litigation is continuing.

In contrast, the Florida Solar Energy Center, which depends upon annual appropriations from general revenues for the funding of its RD&D program, has consistently received budget increases and rapid legislative approval for its program.* It appears that in Florida the location of the solar energy RD&D program within a respected and politically powerful university system has led to dependable and regular funding. This factor will be discussed later in this section.

State-generated program funds also can be used to lever federal, private, or other governmental RD&D funds on a matching or cost-sharing basis. Based on data from eight programs, RD&D performers contributed, on average, a dollar of their own funds for every dollar of state funds for solar RD&D projects. State solar programs attracted, on average, two federal dollars for every state solar RD&D dollar. Among the programs studied, the ability to attract federal RD&D funds ranged from zero to eight-and-one-half times one state's program funds (Hawaii). Only two programs (Texas and North Carolina) required some cost-sharing with the RD&D performer. The Texas RD&D program attempts to limit its share of project funding to 33% for demonstrations, 50% for development projects, and up to 100% for research. The New York alternate energy program, with the largest budget of the state programs studied, averaged 4% matching funds from RD&D project performers.

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*In 1977, the RD&D budget contained the testing program's budget. In 1978, the testing program was moved organizationally from the RD&D program. The budget figures in Table 9-1 reflect this change.

Program emphasis, as indicated by the proportion of funds devoted to research, development, and demonstration, showed no general pattern over the 10 programs for which data were available. Though overall these programs allocated approximately equal resources to each type of activity, the variation among states was very large (Table 9-2). This finding is not consistent with our expectation that state RD&D programs would emphasize applied research and demonstrations. Though NSF definitions were used in our field work, respondents may have introduced a systematic bias toward research and development into the data. No attempt was made to validate the data by classifying state RD&D projects using project titles as a guide to their position along the spectrum from research to demonstration.

9.3 INSTITUTIONAL SETTING

A state's energy policies may be such that renewable energy RD&D is given low priority. Several state energy RD&D programs are overwhelmingly oriented toward coal. This situation may limit the viability of a renewable energy RD&D program. Similarly, in several cases state agencies given responsibility for renewable energy RD&D programs had little or no experience in administering RD&D programs. These considerations seem likely to inhibit successful implementation of a renewable energy RD&D program.

Clear delegation of lead responsiblility for renewable energy RD&D within a state may also be important. In Florida, the multilayered institutional arrangement of the Florida Solar Energy Center (FSEC) gives the FSEC a relatively high degree of institutional and political autonomy. FSEC is organizationally located within the large and influential state university system. Administratively, the FSEC reports to the University of Central Florida (UCF) which, in turn, reports to the Florida Board of Regents (BOR). The BOR reports to the Florida legislature. FSEC staff feel that this institutional setting provides them with substantial flexibility in administering the RD&D program as well as in maintaining program continuity, job security, and staff stability. The state university system also provides much needed equipment and technical expertise. The FSEC's state university system affiliation and the BOR's strong influence in the state legislature have helped counteract possible negative effects (e.g., irregularity, politically motivated program review and evaluation) of using general revenues for RD&D program funding. FSEC funds generally have been readily approved and increased by the legislature.

The Montana Renewable Alternate Energy Grants Program is located within the Montana Department of Natural Resources and Conservation (DNRC). The DNRC has sole responsibility for all energy-related state programs and projects. This clear delegation of administrative responsibility for energy programs has limited duplication of effort, centralized RD&D experience and talent, and minimized interagency turf-fighting. Since one agency is responsible for all energy programs, time which would have been spent coordinating interagency activities within the executive branch is available for program management and related tasks.

The New Mexico RD&D program relies heavily upon four university-situated energy institutes including the New Mexico Solar Energy Institute (NMSEI) which is part of New Mexico State University at Las Cruces. This approach has required the lead executive RD&D agency, the Energy and Minerals Department (EMD), to spend considerable time coordinating and monitoring the efforts of these various energy institutes. The EMD is beginning to require program planning by these institutes as a means of coordination and administration of the state's overall energy RD&D program.

Table 9-2. RD&D PROGRAM EMPHASIS

State	Proportion of Program Funds Devoted to Research (%)	Proportion of Program Funds Devoted to Development (%)	Proportion of Program Funds Devoted to Demonstration (%)
Arizona	20	40	40
California	66	17	17
Colorado	100	0	0
Florida	50	50	0
Hawaii	0	50	50
Main	0	0	100
Montana	36	21	43
New Mexico	50	30	20
North Carolina	44	6	50
New York	20	40	40
Ohio	NA[a]	NA	NA
Texas	19	48	33
Average	36.1	29.6	34.3

[a]NA means not available.

Sources: Arizona: Arizona Solar Energy Commission interviews, Arizona Solar Energy Plan (draft), March 1979; California: California Energy Commission interviews; Colorado: Colorado Energy Research Institute interviews; Florida: Florida Solar Energy Center interviews; Hawaii: Department of Planning and Economic Development and Hawaii Natural Energy Institute interviews; Maine: Office of Energy Resources interviews; Montana: data developed by Manager, Alternative Renewable Energy Grants Program; New Mexico: Department of Energy and Minerals interviews and A Status Report on the New Mexico Energy Research and Development Program, Department of Energy and Minerals, March 8, 1979; New York: Report to the Director of the Budget, Grants, New York State Energy Research and Development Authority, Jan. 1, 1979; North Carolina: Correspondence from the North Carolina Energy Institute, July 1980; Texas: Texas Energy Advisory Council interviews.

9.4 ENERGY SETTING AND POLICIES

State energy policies are likely to have a large effect on an energy RD&D program. As discussed previously, state energy policies dominated by coal may assign low priority to renewable energy RD&D. Policies designed to move a state away from dependence on imported oil or nuclear power can influence renewable energy RD&D. Several states that sought to decrease their use of nuclear power or imported oil also engaged in aggressive conservation and renewable energy RD&D programs.

Several states have been fortunate in having political situations highly favorable to solar energy. An aggressively supportive governor and legislature usually results in an ambitious program. This situation of renewable energy advocacy by the governor and/or legislature often is a complement to other policies intended to decrease reliance on nuclear power or imported oil. California exemplifies the interaction of these factors. California has implemented policies to decrease dependence on nuclear power and substantially increase use of solar energy and conservation practices. These measures are intended to offset proposed nuclear capacity. Largely due to this situation, the California program has been ambitious in its goals and has had considerable political support. The California situation therefore requires that solar applications prove themselves reliable and that the "solar potential" be realized and implemented rapidly. Florida, due to its heavy reliance on imported oil, is in a position similar to that of California—it is state policy to decrease this dependence. Florida views solar energy as having great potential for accomplishing this goal. Hawaii also illustrates the coupling of dependence on imported oil and the existence of an ambitious state renewable energy RD&D program. This program has received considerable support from the governor and legislature, and our interviews with Florida officials suggest the legislature wants to see even more rapid progress by the state RD&D program.

9.5 ADMINISTRATIVE ACTIVITIES

Administrative costs in 1978 ranged from $1,250 to $63,000 for the seven programs for which data were available. The mean administrative cost for these programs was about $34,000, or about 12% of the total dollar value of grants and contracts for 1978 (Table 9-3). The number of full-time staff (or full-time equivalents) working on the RD&D programs studied averaged about 4.7 persons in 1977 and 5.3 persons on 11 programs in 1978. Data available for staff size for both 1977 and 1978 showed an annual increase of 16.3%. The average program awarded 17 grants and contracts in 1977 and 24 in 1978, though the ranges were very large. For example, in 1978 programs studied made as few as 1 and as many as 49 awards.

The proportion of program funds allocated to administrative costs ranged considerably. There are several reasons for this. The nature of the RD&D program grant and/or contract procedure will influence administrative costs. Several programs use an unsolicited proposal approach, some use a request-for-proposal (RFP) approach, others use a sole-source contracting procedure, and some use a combination of these approaches. Similarly, certain administrative procedures such as the use of formal advisory panels for proposal review and selection probably add to administrative costs.

For programs with administrative costs under 10% of the total value of grants and contracts for 1978, the extent of involvement of external groups in proposal review and project selection, monitoring, and evaluation was consistently low.

Table 9-3. RD&D PROGRAM ADMINISTRATIVE COSTS, 1978

State	Program Administrative Cost for 1978[a] ($000)	Total Value of Grants or Contracts[b] for 1978 ($000)	Administrative Costs as a Proportion of Total Value of Grants and Contracts for 1978 (%)
Arizona	44.00	490.00	8.9
Florida	27.70	554.80	4.9
Maine	1.25	16.00	7.8
Montana	63.00	286.80	21.9
New Mexico	25.00	235.00	10.6
North Carolina	25.60	300.50	8.5
Texas	50.00	406.50	12.3
Average	33.80	302.40	12.3

[a]Administrative costs are not strictly comparable across states because definitions of such costs differed, especially with respect to inclusion of clerical support, reproduction, telephone costs, etc.

[b]Total program costs are the sum of the first two colums.

Resources: Arizona: Arizona Solar Energy Commission interviews; California: Contract Report, 1977-78, Contract Report 1977-78, Contract Report 1978-79, Resource Development Division; Colorado: Colorado Energy Research Institute Project Summaries, 1975-78; Florida: Florida Solar Energy Center Activities Report, 1977 and 1978; Hawaii: Energy Resources Coordinator Annual Report, 1978, Department of Planning & Economic Development; Maine: Office of Energy Resources interviews and correspondence; Montana: Alternative Renewable Energy Grants Program Report to the Montana Legislature, January, 1979; New Mexico: Department of Energy and Minerals, A status Report on the New Mexico Energy Research and Development Program, March, 1979; North Carolina: Correspondence from the North Carolina Energy Institute, July, 1980; New York: New York State Energy Research and Development Authority (NYSERDA) Annual Report, 1978 and 1979, and NYSERDA Report to the Director of the Budget, Jan. 1, 1979; Ohio: Energy and Resource Development Agency Annual Report, 1977, Ohio Department of Energy 1978 Energy Status Report and staff interviews; Texas: Texas Energy Development Fund, Volume 2 and Project Status Reports, Texas Energy Advisory Council, Jan., 1979.

While program planning may occur, the contribution of external groups to program planning appears to be minimal. The SERI pilot study of RD&D programs (Green 1979, pp. 19-23) discusses in detail the need for program planning and its lack of emphasis as a problem that confronted the programs studied. That study also discussed the positive value that external groups, in an advisory capacity, can have on program design, implementation, acceptance, relevance, direction, and emphasis. These advisory groups, removed from administrative responsibility and not accountable to program administrators, can offer valuable, timely, and objective input. Program administrators from three programs that exhibited at least moderate involvement of external groups in program planning, proposal review, and project selection were very positive about the value of these groups.

A majority of our case-study states had devoted little attention to identifying program goals and objectives or program planning, a fact widely recognized by program administrators and staff. Several states, however, have engaged in these activities extensively and may serve as models. For example, the Florida Solar Energy Center (FSEC) established operating objectives in 1978. Using these objectives, administration and professional staff set priorities for FSEC projects. These objectives and priorities became the basis around which FSEC reorganized and also became the foundation for program planning. Administrators and staff felt that much had been gained through this process. Greater consensus on goals and clarity of direction were recognized as immediate benefits. The other examples are the New York State Energy Research and Development Authority (NYSERDA) and the North Carolina Energy Institute (NCEI). Both have engaged in program planning in order to reduce duplication of effort and inefficient use of program resources. NYSERDA has initiated one- and five-year RD&D plans. NCEI involves other state agencies in the review of its program plan in order to clarify roles and activities and help eliminate duplication of effort. Administrators of both state programs are positive about the value of program planning.

A closely related administrative problem is information dissemination. The extent to which dissemination of project-related information is neglected will directly affect the program's ability to contribute to the development of state-of-the-art technologies and applications and thus to energy savings. Elements of information dissemination such as project monitoring, evaluation, and other administrative reporting procedures for projects have been neglected to some degree in every case-study state. However, this problem was widely recognized by program administrators and most case-study state programs are already seeking to improve this situation. The Montana legislature has appropriated $40,000 in order to improve the information and evaluation elements of that state's program.

It will be briefly argued here that program advisory groups, composed primarily, if not entirely, of people not directly involved in RD&D program administration, can be of considerable value to the RD&D program. These groups can review program goals and plans for their relevance and feasibility. If major actors in state solar energy activities are represented, such advisory groups lend greater credibility to the process of identification of program goals and program planning. These groups may be appropriate for the tasks of setting priorities among RD&D needs, program direction and evaluation, and proposal review and recommendation. Advisory group members also can help build a supportive program constituency. Removed from program administrative responsibility and not accountable to program administrators, advisory groups can offer valuable, timely, and critical input to the program and add legitimacy to its procedures and activities.

Nearly every program studied has an advisory group or panel. However, none of the advisory bodies deals with all the items described above. Hawaii has implemented technology-specific advisory panels which offer advice on RD&D needs as well as state government policy needs. Montana relies on an outside Advisory Council to review and recommend project proposals—the director of the Department of Natural Resources and Conservation has final approval authority. In North Carolina an Energy Policy Council establishes RD&D policies for the Energy Institute. However, a Board of Scientific Advisors acts as a source of guidance and review in the operations of the Energy Institute. This board also gives advice on priorities for energy research, the content of competitive solicitations, the criteria for selection, and the awarding of contracts.

9.6 LEGISLATIVE SPECIFICITY

Clarity of legislative intent in enabling a renewable energy RD&D program is likely to facilitate program implementation. In many cases, lack of legislative guidance has meant that program administrators themselves determine as well as implement policy. Clear, explicit direction, if given on the following seven items, can enhance RD&D program implementation and administration.

- designation of responsibility for policy implementation;
- definition of alternative, renewable, or solar energy resources;
- criteria for grant or contract recipient eligibility;
- identification of RD&D program goals and objectives;
- program emphasis: balance among research, development, and demonstration;
- proposal review and selection process; and
- program planning requirements and guidance.

In principle, it is possible to measure how well each state's enabling legislation meets these criteria. Our attempt to accomplish this was unsuccessful in that we observed no consistent relationship between high levels of "specificity"—as determined by judging each state's enabling statute against each of the seven criteria—and successful program implementation. This may have been due to the large number of factors other than legislative specificity that influence implementation or to the failure of our measures of specificity to capture that concept adequately. Nonetheless, several observations about legislative specificity seem both appropriate and defensible, based on our observations in 12 states.

Clear delegation of authority and administrative responsibility is important to a program administrator who seeks to enter into a joint research, development, or demonstration contract with another entity. As an example, if clear delegation of authority is given, an administrator knows whether he or she has legal authority to obligate the agency or state to a joint project.

An RD&D program's scope of effort should reflect legislative intent. The legislature can show its initial intent for the scope of RD&D efforts by defining what is included in or meant by alternative, renewable, or solar energy resources or applications. The California Energy Commission (CEC) was compelled to clarify the scope of its RD&D program, enabled in 1974, by drafting Assembly Bill 1512 in 1977 (became law as Chapter 1081).

Eligibility criteria for RD&D grant or contract recipients will clarify the obvious—who the legislature desires as performers of RD&D and whether there are any qualifying constraints. As part of their administrative procedures, several state programs require minimum matching funds on certain projects (Arizona, Florida, Hawaii, New Mexico, and Texas). Some state programs will fund only not-for-profit entities while other programs will consider anyone in the state.

Identification of program goals and objectives can help shape program direction and RD&D priorities. Again, these decisions, which involve legislative intent, are important enough that they deserve legislative consideration in order to be made explicit. These explicit goals and objectives can be an important element in program evaluation and redirection. For example, a state legislature may desire that an RD&D program emphasize demonstrations. It may be the legislature's intent that these demonstrations be experimental in nature or, conversely, that the demonstrations be commercially ready. This intent should be clarified because it influences program direction and planning.

The proposal review and selection process is a potentially controversial procedure. A legislature can confer legitimacy by outlining at least minimum requirements for the process. As an example, a review panel made up of some designated mix of private industry, special interest group representatives, legislators, and members representing the executive branch might be called for in the enabling legislation.

Program planning was covered earlier in this discussion and in a previous SERI report (Green 1979). Since this has been recognized as an area of administrative deficiency, it may be desirable for the enabling legislation to require formal program planning, though a legislative mandate clearly does not ensure that planning will occur.

In sum, the implications of the variety of RD&D program funding mechanisms should be carefully considered when designing, implementing, administering, and evaluating RD&D programs. The relationship between program stability, planning time horizons, legislative oversight, and funding dependability have been explored in this section. The institutional setting within which an RD&D program is implemented may also be an important consideration. Existing state energy policies, commitment to the realization of these policy goals, and organizational and institutional arrangements may influence the implementation success of an energy RD&D program. Similarly, a state's energy resource characteristics and use may bear upon program implementation and success. The extent to which program goals are identified, program planning occurs, project information is disseminated, and other administrative procedures are followed may also influence program capabilities.

SECTION 10.0

EFFECTS OF STATE BACKGROUND CONDITIONS ON IMPLEMENTATION OF STATE SOLAR RD&D PROGRAMS

10.1 INTRODUCTION

This section discusses the effects of specific state background conditions upon the implementation of solar RD&D programs. The background factors likely to affect implementation are discussed as is the analytical procedure used. Findings relating state background conditions to the successful implementation of RD&D programs in the 12 states studied are presented. In addition, differences in background conditions between the 12 states studied and the remaining 38 states are identified.

10.2 BACKGROUND FACTORS LIKELY TO AFFECT IMPLEMENTATION

Successful implementation of state solar incentives undoubtedly is a function of both the organizational, procedural, and structural features of its administrative execution that are the subject of this study and of the socioeconomic, political, and climatic features of the individual states studied. We expected that a state's energy supply characteristics—the diversity of its energy production sources; its indigenous fossil fuel reserves; the cost of electricity, natural gas, and heating oil; and the amount of solar radiation available—would affect the likelihood that significant solar and renewable energy incentive programs would be proposed and successfully implemented. In addition, a state's energy demand as indicated by average annual heating degree days, energy consumption per capita and per capita consumption growth rate, and population growth should influence the extent to which alternative energy programs would be initiated and successfully implemented. Finally, a state's political and demographic setting are likely to influence its interest in solar and alternative energy programs. For example, states with a history of innovative activity (Walker 1971), low levels of interparty competition (Munger 1966), relatively high levels of fiscal resources, and relatively high levels of economic growth should be more likely than other states to initiate and implement financial incentives. RD&D programs were expected in states with a history of investment in R&D programs generally and in energy R&D particularly.

10.3 ANALYTICAL PROCEDURE

The analytical procedure followed was first to correlate each of the variables that describes a state's background with each measure of implementation success. (A complete list of these variables appears in Appendix A.) Separate analyses were conducted for states with financial incentives and for states with RD&D programs. To maintain a conservative approach, we employed a nonparametric statistic, Spearman's Rho, to test for significance; the criterion for significance was 0.05 or less. We were also interested in how the background characteristics of the 18 states studied differed from those of the remaining states. Since study states represented, as of late 1978, every state that had passed a significant solar RD&D program sufficiently long ago for some implementation outcomes to be observed, a comparison of study and nonstudy states should suggest how states with relatively long-lived, significant solar programs differ from other states. Of the hundreds of possibly significant relationships between state background characteristics and measures of program implementation, only a relatively small number (about 50), were statistically significant and included a sufficient number of cases to be meaningful. These significant relationships can be grouped according to the type of measure of implementation success: level of effort, administrative costs, and implementation outcome.

When analysis of relationships between state background conditions and the implementation of solar incentives is conceived in this manner (i.e., the elements of implementation success are broken into the several measures employed for level of effort, administrative costs, and implementation outcome), the theoretical or logical basis for each relationship becomes difficult to ascertain. In the absence of accepted, operational definitions of implementation, we adopted a variety of measures suggested in the conceptual literature; the result is (as the earlier section on clustering of measures of implementation success revealed) a number of measures that make sense individually but do not interrelate empirically. The search for patterns among relationships becomes, therefore, a judgmental exercise. For this reason, we list for the reader in Appendix F all the significant relationships that emerged from the quantitative analysis.

10.4 BACKGROUND CHARACTERISTICS AND THE IMPLEMENTATION OF RD&D PROGRAMS

Relatively high levels of solar RD&D program activity (both absolute and per capita) are found in urbanized, growing, wealthy states with a history of high levels of spending for R&D programs. States with large programs face relatively high costs for electricity and tend to produce more of their electrical energy from oil than do other states in the study. Yet climatic conditions and levels of energy consumption cannot explain their interest in solar RD&D: these states also are relatively low per capita consumers of energy and have lower heating requirements than other study states. This appears to be the case because of the high levels of insolation that these states enjoy.

The data available on administrative costs of RD&D programs are sufficiently sparse that quantitative analysis is probably inappropriate. (Data on administrative costs were available from only about half the programs studied.) For those programs where data were available, there was a tendency for administrative costs to be higher in states that could afford it: they had relatively larger government surpluses, higher per capita incomes, and lower electricity and natural gas prices. This should be regarded as an observation rather than as a finding due to the limited number of programs for which data were obtained.

Few clear patterns emerged among relationships between measures of implementation success and state background characteristics. In general there were few significant relationships at all, though limitation in the number of cases for many variables renders this a tentative conclusion. The remaining significant relationships lack ready explanation. In the absence of theory to guide expectations, neither prediction nor explanation of the observed relationships is simple.

10.5 DIFFERENCES IN CHARACTERISTICS OF STUDY AND NONSTUDY STATES

As noted earlier, study states generally exhibited a higher level of solar activity than nonstudy states. For this reason, we expected that the background factors that differentiated states by relative success in solar program implementation would also differentiate study and nonstudy states. This was the case in that few of the expected relationships were observed and no clear patterns in these relationships emerged.

The 12 states studied with solar RD&D programs enjoy significantly more insolation than other states and, as expected, they spend more on energy R&D (total and per capita). They had significantly more solar installations at the end of 1978 than nonstudy states, but the existence and direction of a cause/effect relationship cannot be inferred from these data alone. RD&D study states also exhibited significantly more residential housing starts in 1977 and 1978 than other states, but other measures of growth rates (e.g., population growth during these years and growth in energy consumption 1960-1976) showed no significant relationship to solar activity. These results suggest that state solar RD&D activity is not, in general, a consequence of energy supply, cost, or rate of consumption.

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SECTION 11.0

THE EFFECT OF ORGANIZATIONAL AND ADMINISTRATIVE FACTORS ON IMPLEMENTATION OF STATE SOLAR RD&D PROGRAMS

11.1 INTRODUCTION

This section describes the results of an analysis of relationships between how states organize and administer their solar RD&D programs and the extent to which those programs have been successfully implemented. For RD&D programs, specific measures of implementation success (level of effort, administrative costs, and implementation outcome) are listed in Sec. 8.0. Specific measures of organizational and administrative factors likely to affect implementation success include those listed in Table 3-1 (Sec. 3.0) as well as a number of factors unique to the implementation of solar RD&D programs. These additional factors are:

- Type of implementing agency: does the implementing agency administer most state energy and natural resources RD&D, most state energy RD&D, or most state alternative energy RD&D; or is it a non-RD&D agency?
- Source of implementing agency funds: is the state's solar RD&D program funded through annual appropriations, a severance tax, an energy surcharge, or some combination of these?
- Location of information dissemination activities concerning results of RD&D projects: is dissemination accomplished by staff of the RD&D agency, by RD&D performers, or jointly by the two?

Results of quantitative analyses and cross-tabular presentations of relationships found to be significant are presented in Appendix F. This section summarizes the results of the analysis and presents the findings in a summary table.

11.2 FACTORS INFLUENCING LEVEL OF EFFORT IN RD&D PROGRAMS

To a much greater degree than was the case with solar financial incentive programs, organizational and administrative factors expected to influence implementation had little effect on the size of RD&D programs. Total program costs, the number of staff, and the dollar value of grants and contracts awarded were not significantly influenced by most of the factors identified. One exception involved the relative emphasis state programs placed on research, development, and demonstration activities. As noted in Sec. 9.0, though individual states varied widely, programs were about evenly divided in their emphasis: the 12 programs together allocated about 37% of their funds for research, 30% for development, and 33% for demonstrations. This is surprising in view of our expectation that states would place heavy emphasis on projects closer to the commercialization end of the RD&D spectrum, i.e., to demonstrations.

The unexpectedly large allocation of funds to research may reflect the influence of state university systems which, in some states such as Florida, Hawaii, and New Mexico, were assigned formal responsibilities for implementing the solar RD&D program. Indeed, the largest RD&D programs (measured in terms of dollar value of grants and contracts and staff size) tend to spend relatively few of their dollar resources on development and demonstration projects. There was also a tendency for larger programs—both in the absolute sense and on a per capita basis—to be staffed by scientists and engineers rather than by persons with other backgrounds and expertise. Three of the five largest programs, measured in terms of number of staff or full-time equivalents, were staffed with scientists and engineers, while none of the smallest programs were so staffed.

Perhaps unexpectedly, programs staffed with scientists and engineers do not tend to emphasize research over development and demonstration. There was no pattern suggesting that staff expertise shaped the allocation of program resources to research versus more applied activity. If the 12 programs are ranked according to the ratio of the total dollar value of grants and contracts in 1978 to state population, a similar pattern emerges. None of the programs among the six lowest ranking were staffed with scientists and engineers, while half the top ranking programs had staffs with this background. (The relationships for 1977 are virtually identical.) There was also a tendency for the largest RD&D programs to be situated in separate, alternative energy organizational units that were assigned implementation responsibilities. The smallest programs (measured in terms of dollar value of grants and contracts awarded in 1977 and 1978) operated within energy and natural resources R&D programs.

The source of a state solar or alternative energy RD&D program's funding has considerable influence on its size and on the success with which it has implemented its policy mandate. We expected that programs dependent upon annual appropriations rather than on energy surcharges or mineral severance taxes would be subject to more intensive and critical oversight by the legislature and, as a result, would be smaller, slower growing, more heavily focused on short-term results (e.g., demonstrations), and less successfully implemented. On the other hand, we expected that close scrutiny by legislatures might result in greater degrees of involvement of external groups in the program, greater cost sharing with performers, and greater leverage for federal funds. Eight of the RD&D programs studied were totally or partially dependent upon annual appropriations (one program supplemented appropriations with revenues from the sale of bonds), two derived their funds from state severance taxes, and two programs depended upon energy surcharges or surcharges supplemented by bond sales. It is clear that the political independence and financial security of severence taxes and energy surcharges lead to larger solar RD&D programs. None of the four smallest programs (those whose 1978 grants and contracts amounted to $200,000 or less) drew support from surcharges or severance taxes, while half the eight programs with larger 1978 grant and contract outlays drew support from these sources. This basic pattern remains unchanged when variations in state population and expenditures are accounted for.

A surprising number of implementation factors were not associated with the size of solar and alternative energy RD&D programs. The amount of organizational change involved in setting up the solar RD&D program, the extent of conflict between executive and legislative branches, the degree of involvement of implementing agency officials in formulating the enabling legislation, staff attitudes toward solar energy, the type of implementing agency, the amount of formal program planning activity, and the extent of involvement of external groups in program activities had no significant effect on the size of staff or budgets of solar RD&D programs studied. These findings should be contrasted with the case of financial programs, but it should be noted also that program size probably is not a very good indicator of implementation success. Program budgets and staffing might equally well be considered program inputs rather than the consequences of implementation processes. Clearly more work needs to be done before the concept of implementation can be made operational as a set of empirical measures.

11.3 FACTORS INFLUENCING IMPLEMENTATION OUTCOMES OF RD&D PROGRAMS

It was earlier hypothesized that, on the basis of past studies of the commercialization of government-supported research projects, successful implementation is more likely if a program conducts market analyses* in conjunction with selecting projects intended to enhance the commercialization of solar technologies. Both development and demonstration projects might be expected to benefit from such analyses. Our findings reveal that those programs that could benefit most from market analyses are those least likely to conduct them. None of the five programs allocating the highest proportion of their resources to demonstration projects conducts market analysis as a part of the process of selecting projects for funding. In fact, the three programs that do conduct market analyses tend to be heavily oriented toward research rather than demonstration. None of these three programs is among the three programs studied that are staffed primarily by scientists and engineers.

Market analyses are most likely to be performed in RD&D programs situated in state energy R&D agencies rather than in agencies whose responsibilities include the broader scope of natural resources or are restricted to alternative energy R&D alone. This may reflect the recent incorporation in energy policy of commercialization as a function of government, and the small size of most state RD&D programs that focus only on alternative energy. Agencies focusing entirely on all forms of energy may be most sensitive to the commercialization problem, while the small size of alternative energy RD&D programs precludes their conducting or funding market analyses to support their project selection activities. These explanations must be tempered by the fact that, though the three agencies conducting market analyses are situated in state energy agencies, the other four programs similarly situated do not conduct them. There was no clear tendency for source of program funding to be associated with whether a program conducts market analyses as part of its project selection process.

Past research on the management of R&D programs found that the more the intended end user of a research or development product was involved in the project selection process, the more likely the R&D product would be used. The generalization holds whether the intended users are other researchers, industrial producers, or ultimate consumers of a commercial product. We found that none of the 12 RD&D programs studied could be described as having a high degree of involvement of intended users in the project selection process. Only a third had moderate involvement, and the remaining programs exhibited little or no involvement of intended users. Only two implementation factors were associated with the extent of end-user involvement in the programs studied: the professional backgrounds of program staff and, as might be expected, the amount of involvement in project selection by a variety of external groups such as solar energy interest groups, industry and trade associations, and universities. RD&D programs staffed by scientists and engineers do not involve intended users in project selection, while other programs show at least some tendency to do so. This may reflect the bias toward technical development to the exclusion of market considerations that characterizes federal R&D programs (House and Jones 1977). End users were not more heavily involved in project selection in programs dependent upon annual appropriations.

Only the type of implementing agency affected the time required for rules and regulations governing grant and contract awards to be developed and officially instituted. The

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*Market analyses are studies designed to identify the characteristics of potential markets for new products. Usually, factors that may affect the acceptance of the product are also identified.

average time required for study states to develop rules and regulations was eight months, and half the programs studied required less than six months. If an implementing agency administered most of the state's energy RD&D, it was more likely to move quickly to develop rules and regulations than agencies having broader (natural resources) or narrower (alternative energy only) R&D responsibilities. Since so few implementation factors were associated with length of time between enactment and promulgation of rules, an explanation for this finding is not apparent. There was a slight tendency for programs subject to the annual appropriations process to move more quickly from enactment to promulgation of rules and regulations.

Several state energy officials told us that cost-sharing with performers and with the federal government were desirable results of alternative energy RD&D programs and indicated one element of successful implementation. The programs we studied varied widely on both these indicators. There was some degree of cost-sharing with the research performer in all eight programs for which data were available. Performers contributed as little as 4% in one program and 200%—double the amount of state funds—in two others. On average, the RD&D programs operated with one-to-one matching with performers. The picture was similar for cost-sharing with the federal government. Data were available from all but one program; two programs did not cost-share at all, two programs managed to lever one dollar of state funds into seven or more dollars of federal money, and the average program obtained two dollars of federal money for each state dollar.

Our data and analysis provide few suggestions for how to enhance performer cost-sharing, except that programs extensively involved with outside groups enjoyed substantially greater amounts of cost sharing with performers. This is to some extent redundant, since the negotiations involved in cost-sharing can be regarded as a form of program interaction with outside groups. In any case, it is not clear whether a commitment to cost-sharing with performers brings extensive involvement with outside groups, or vice versa.

Most programs supported by annual appropriations exhibited considerable cost-sharing by RD&D performers; although data were available from only 8 of the 12 programs studied, 4 of the 5 programs in which performers matched or more than matched state funds were supported with annual appropriations. There was, however, no similar pattern in the case of federal cost-sharing.

On a proportional basis, implementing agencies that administered most state energy RD&D programs were less likely to obtain substantial cost-sharing with the federal government. Agencies whose scope was confined to alternative energy RD&D seemed to be more successful at attracting federal funds, though the small number of cases involved renders this finding highly tentative.

A public program's growth can result from several things: the political astuteness of its officials, a strong legislative push, and/or evidence of goal attainment that encourages outside groups to engage in actions intended to secure larger appropriations. To some extent, then, a solar RD&D program's ability to secure increased funds is a measure of implementation success. Unfortunately, we were able to obtain data on the percentage increase in the dollar value of grants and contracts from only seven states. Sketchy data suggest that program growth is more likely if funds are derived from energy surcharges than from other sources. Among the seven programs for which data were available, the only two that experienced growth between 1977 and 1978 were supported from energy surcharges. In one of these states (New York), the solar RD&D program enjoyed a substantial increase in appropriations, which was supplemented by the surcharge on energy use. California's budget increase was a very modest one for these two years.

11.4 SUMMARY

Table 11-1 summarizes the significant relationships described in the preceding subsections. At a glance, it is apparent that three things make a difference in successful implementation of state solar RD&D programs: the professional backgrounds of implementing agency staff, the type of implementing agency, and the source of funds for the RD&D program. Programs heavily staffed with persons from science and engineering backgrounds tend to have larger budgets and staffs (both in absolute and per capita terms), but engineers and scientists appear to be less interested in, or capable of, performing market analyses as part of the project selection process, involving end users in project selection decisions, and attracting federal money on a cost-sharing basis.

The largest RD&D programs were organizationally separate from larger departments of energy and/or natural resources, probably reflecting the legislature's decision that in those states solar and alternative energy RD&D warranted both a substantial budget and distinct organizational status. This situation occurred, as expected, in larger states with more highly differentiated bureaucratic structures. Agencies of this type also were more likely to obtain federal RD&D funds, but were less likely than programs housed in state energy RD&D agencies to move quickly to promulgate rules and regulations governing funding procedures and eligibility, and less likely to conduct market analyses for projects intended for commercialization. Finally, implementing agencies funded partially or wholly from severance taxes and energy surcharges were larger and enjoyed a relatively higher rate of budget growth between 1977 and 1978 than agencies funded through annual appropriations. On the other hand, the annual appropriations process appeared to foster more rapid development of rules and regulations and a higher degree of cost sharing with RD&D performers.

Table 11-1. SUMMARY OF FINDINGS FOR RD&D PROGRAMS: RELATIONSHIP BETWEEN ORGANIZATIONAL AND ADMINISTRATIVE FACTORS AND MEASURES OF IMPLEMENTATION SUCCESS

Organizational and Administration Factors	Implementation Success: Level of Effort	Normalized Level of Effort	Market Analysis Performed	End-User Involvement	Time from Enactment to Rules and Regulations	% Cost Sharing with Performer	% Cost Sharing with Federal Government	% Increase in Dollar Value of Grants and Contracts, 1977-78
Professional Backgrounds of Staff	X	X	X[c]	X	NS	NS	X	NS
Type of Implementing Agency	X	NS	X	NS	X	NS	X	NS
Source of Implementing Agency Funds	X	X	NS	NS	X	X	NS	X
Location of Information Dissemination Activities	NS[a]	NS	NS	NS	NS	NS	NS	X
Amount of Organizational Change Required to Implement	NS	NS	+	NS	NS	NS	NS	NS
Level of Legislative/Executive Conflict in General	NS	NS	NS	NS	NS	NS	NS	NS
Level of Legislative/Executive Conflict over Solar Issues	NS	NS	NS	NS	NS	NS	NS	NS
Involvement of Agency Officials in Legislative Formulation	NS	NS	NS	NS	NS	NS	NS	NS
Staff Enthusiasm for Solar Energy	NS	NS	NS	NS	NS	NS	NS	NS
Number of Registered Solar Lobbyists	ID	ID	ID	ID	ID	ID	ID	ID
Extent of Involvement & External Groups in Program Activities (planning, proposal review, project selection)	NS	NS	NS	+	NS	+	NS	NS
Amount of Formal Program Planning	NS	NS	NS	NS	NS	NS	NS	NS
Percentage of Funds for Research	+[d]	NS	+	NS	ID	ID	NS	ID
Percentage of Funds for Development	+	NS	–	NS	ID	ID	NS	ID
Percentage of Funds for Demonstration	NS	–	NS	ID	ID	NS	ID	
Specificity of Enabling Statute	–	NS	NS	NS	NS	NS	NS	NS

[a]NS means not significant.

[b]ID indicates insufficient data.

[c]X denotes significant relationships.

[d]+ and – indicates direction of significant relationship.

SECTION 12.0

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

12.1 OVERVIEW OF MAJOR FINDINGS

Financial incentives for solar systems in 11 states and solar energy RD&D programs in 12 states were studied to identify organizational arrangements and administrative procedures that led to successfully implemented programs—programs that were relatively well-budgeted and staffed and whose outcomes indicated that public benefits were likely to result.* State officials had substantial control over these arrangements and procedures, but we expected that a state's energy supply, demand, and demographic characteristics, over which they have far less control, also would influence its aggressiveness in initiating and implementing solar incentive programs. The diversity of state energy production sources, energy costs, the amount of solar radiation available, per capita energy consumption and growth, and heating requirements as well as demographic features, therefore, were included in the analysis. While many conditions favoring successfully implemented state solar financial programs differed from those favoring successfully implemented RD&D programs, several findings held for both.

- Contrary to expectations, states with "need," defined as having high energy costs, per capita consumption, and heating requirements and lack of indigenous fossil fuel reserves, generally were not those to first initiate and rapidly develop solar financial or RD&D programs. Instead, the opportunity to employ solar energy as a heating source, by virtue of a state's high average level of insolation, best accounted for the level of solar program activity observed.
- Successful implementation of solar financial and RD&D programs was significantly influenced by the type of agency selected to implement the law. The important characteristics of an agency were the attitudes and backgrounds of its staff, its primary mission, and its location within the larger organizational structure of state government.
- Involvement of outside groups (solar industry and trade associations, grassroots organizations, builders, other state organizations, university researchers) in agency planning, establishment of administrative procedures and rules, and project selection facilitated solar incentive program implementation either by speeding up the implementation process (RD&D programs) or by encouraging greater levels of program activity (financial incentive programs).**
- Specificity of language in formal documents that defined the incentive (the enabling legislation) or that defined eligibility for it (rules and regulations)

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*A successfully implemented program is essential if the original policy's intent is to be achieved. Examples of legislative intent include increased solar installations in the state, a strengthened solar industry, and reduced dependence upon fossil fuel. Indicators of successful implementation took different forms, depending on the type of program.

**In the case of financial incentives, there was a positive relationship between program size and the use of outside groups. Though the causal relationship is unclear, we suggest tentatively that the political support gained through involvement of outside groups enhanced program growth.

generally facilitated implementation by speeding up the process and by reducing ambiguity and conflict among implementing agency officials.

Though it is accurate to conclude that these factors significantly influenced solar incentive program implementation, their impact on implementation was not uniformly positive or negative; the nature of the relationship depended upon the type of incentive program. Also, even for a given type of incentive, these and other organizational and administrative factors often had opposite effects on different measures of implementation success. In other words, a state considering which type of agency should implement an incentive or the type of staff to hire would have to make trade-offs among the likely results of each alternative. The complexity of these relationships requires that this study's findings and discussions of their implications be presented according to the type of incentive and, within each, by specific measures of implementation success. The following sections detail the separate findings for solar financial incentives and solar energy RD&D programs and suggest some implications for state and federal action.

12.2 FINANCIAL INCENTIVES: FINDINGS AND CONCLUSIONS

12.2.1 Summary of Findings

The individual income tax credit was the major vehicle used by states to stimulate solar system purchases. As of 1979, 9 of the 11 states studied had enacted such incentives. Most state expenditures for solar financial incentives have been for income tax credits to individuals. Data on claims for the 1977 tax year, available from only six states, showed that the cost to the treasuries of most of the states was very modest, averaging just over $90,000 if California is excluded. However, the dollar value of claims in California amounted to more than $11 million, nearly three-quarters of which was for active pool heating and/or covers. Administrative costs for these programs also were very low. Only a small minority of states had formally designated staff and/or appropriated funds to pay for implementing financial incentive legislation. In most states, responsibility for implementing the income tax incentive was given to the state tax authority or department of revenue, whose staff usually regarded the new assignment as requiring only minor changes in administrative procedures.

Other types of financial incentives attracted little attention from legislators or administrative officials. Property tax exemptions or reductions were popular among the states studied because no state funds were required to implement them, but in the two states where these were the primary financial incentive, few property assessors were skilled in appraising local solar applications. In fact, in these states most local building officials did not know state solar property tax laws existed. Sales and use taxes were expected to have minimal fiscal impact and, therefore, often were enacted for symbolic reasons. The expected slight impact on solar purchases (and thus on the state treasury) led to minimal efforts to implement such taxes. Each of the three solar loan programs studied was unique, directed toward specialized audiences, and implemented under widely varying conditions. As a result, no generalizations about the conditions leading to their successful implementation are possible. Business tax credits were rare, usually accompanied and overshadowed by individual solar income tax credit programs. Apparently, legislators considered business credits secondary in importance to individual income tax credits, and only minimal effort was devoted to their implementation.

Multiple financial incentives in the same state usually did not complement one another. Solar financial incentives were rarely part of an integrated state plan with consistent rules, definitions of eligible solar systems, and coordinated efforts among different implementing agencies. This was partly the result of selecting different agencies to implement different incentives, enacting different financial incentives at different times, and varying gubernatorial endorsement of different incentives. In addition, legislatures rarely paid much attention to a financial incentive once the legislation was passed, especially to an incentive whose impact on the treasury was expected to be small.

The type of agency selected to implement solar income tax credit legislation profoundly influenced the expertise that was brought to bear on implementation, the specificity of the rules and regulations written, and the level of staff resources allocated to implementation. If state energy agencies helped to implement solar tax credit legislation (either as the only responsible agency or jointly with the state tax authority), they tended to prepare technically specific rules that covered major contingencies such as system eligibility, certification, and warranty coverage, and they tended to write rules and regulations more quickly than if other types of agencies were responsible. If other types of agencies, particularly tax authorities, had sole implementation responsibility, they drew up very general rules and regulations—or none at all. Generally, tax authorities did not regard implementing solar income tax credits as part of their mission, lacked technical expertise in solar energy, allocated minimal staff to implementation, and provided little information to taxpayers about the existence and interpretation of the solar incentive.

Preliminary observations of the results of solar income tax credit claims in six states for the 1977 tax year indicated that the median adjusted gross income of solar claimants is high. This probably reflected a number of factors, including the attraction of tax credits for higher-income taxpayers, the greater access to information about incentives among the wealthy, the greater proportion of high-income people who own their homes, and the greater willingness of high-income, highly educated persons to try something new. Despite large differences in the size of state income tax credits (10% to 55% among the states studied), similarly large differences did not appear in the percentage increase in installed solar systems between 1977 and 1978, the first year in which the tax credits were in effect or in the number of claims for solar tax credits as a proportion of all tax returns in the state.*

High levels of state solar activity in the financial incentives area appeared to be driven by opportunity rather than by need. Aside from the economic strength of a state (particularly whether it enjoyed a budget surplus in recent years), only the amount of insolation a state experiences consistently accounted for its high level of resources and relatively early activity devoted to solar financial incentives. No clear patterns appeared between conventional energy supply, cost, or consumption and the existence of aggressive solar financial incentive programs.

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*Differences in solar system definitions, the timing and conditions under which tax incentives were introduced in each state, and the uncertain quality of the data on state solar installations limit the confidence one can place on these findings and, accordingly, in the implications that can be drawn from them.

12.2.2 Implications for States

Though it is clear that state officials can significantly influence the likelihood that solar financial incentives will be successfully implemented, they should consider carefully which aspects of "success" they wish to emphasize before making specific choices on organizational matters. If they want a more specific law, with more specific rules and regulations governing eligibility and less time for those rules to be promulgated, then they should involve officials from the state energy agency and tax authority in formulating legislation and designate the energy agency alone (in cooperation with the tax authority) or jointly with the tax authority as the responsible implementing agency(ies). This recommendation is based on the typical state energy agency's staff characteristics (enthusiasm for solar energy, technical expertise, and professional background) and its primary mission. Tax authorities generally do not regard their agencies as appropriate instruments for achieving particular social or technological goals.

There are advantages for legislators and implementing agencies to encourage or even require the involvement of outside groups in planning, establishing administrative procedures, and defining systems eligible for solar financial incentives. If industry and trade associations, builders, installers, local building code officials, realtors, and grassroots solar organizations are a part of implementation, administrators benefit from outside views, gain political support, and enlist groups likely to help publicize the existence of financial incentives for solar installations.

If states wish to employ a diverse set of financial incentives to stimulate solar development, then considering these incentives together as a legislative package and designating a lead agency responsible for their implementation increases the likelihood of achieving the policy goal. If technical specificity and rapid implementation are also desirable, then that agency should be the state energy agency, interacting with the tax authority. Clear signals in the enabling legislation about the priorities to be placed on the different incentives constituting the package would assist the implementing agency in allocating resources.

The larger analytic question confronting state legislators is, of course, whether financial incentives represent cost-effective and socially equitable policy instruments for stimulating the use of solar energy. This study provides only tentative, indirect information that could be used to help state policy makers resolve this issue. First, income tax credits attract a relatively affluent portion of the population, while a rebate system such as New Mexico's broadens the income base of persons who take advantage of a financial incentive. Second, there is at most an indirect relationship between the size of an income tax incentive and an increase in the number of solar systems installed in a state in the year following enactment of the incentive. Third, with the exception of California, the initial impact of a solar financial incentive on a state's treasury tends to be modest. Only data from the 1978 and 1979 tax years will provide evidence of the longer term costs of state solar financial incentives. Finally, the efficacy of a solar incentive depends on far more than just its size and successful implementation. While high first cost may represent a significant barrier to solar purchases, current research* (other

*The extent to which high initial cost deters prospective solar purchasers probably will differ from state to state, depending in part upon the existing level of market penetration of solar systems in the state. At very early stages in the introduction of solar technologies (or any innovation) into a market, noncost factors often dominate purchaser decisions. See Rogers and Leonard-Barton (1980), Unseld and Crews (1979), and Roessner et al. (1979) for evidence related to the solar energy area.

than that reported here) indicates that noncost factors are important and may even dominate decisions of those who are among the first to purchase solar systems. States need to identify the potential long-term payoffs of solar RD&D programs, information outreach programs, consumer protection programs, and other nonfinancial support programs and weigh them against the potential benefits and costs of short-term financial incentives.

12.3 FINDINGS AND CONCLUSIONS: RD&D PROGRAMS

12.3.1 Summary of Findings

The 12 state RD&D programs studied encompassed an enormously varied range of activities: fundamental and applied research, demonstrations, technology development, standards development, solar system testing and evaluation, and certification. Our focus was on only those program elements directed toward the support of outside grantees or contractors for the conduct of solar energy research, development, or demonstration projects. Data for 1977 and 1978 showed that the states studied spent as little as $16,000 and as much as $6.4 million annually on solar and renewable energy RD&D grants and contracts. Gauged by per capita expenditures, smaller states equalled and in some cases exceeded large states in their support for solar RD&D. Though we expected states to emphasize projects close to the commercialization end of the RD&D spectrum (i.e., demonstrations), this did not turn out to be the case. Overall, states allocated roughly equal portions of their budgets to solar research, development, and demonstration projects. Variations in emphasis among the states could not be attributed simply to any of the agency or background conditions studied.

Three organizational and administrative factors clearly influenced successful implementation of state solar RD&D programs: the professional backgrounds of the implementing agency staff, the type of implementing agency, and the source of funds for the RD&D program. Programs staffed heavily with persons from science and engineering backgrounds tended to have larger budgets and staffs (both in absolute and per capita terms), but these programs appeared to be less interested in, or less capable of, performing market analyses as part of the project selection process, involving end users in project selection decisions, and attracting federal money on a cost-sharing basis. The reasons for these relationships are unclear and require further study. Large well-funded programs may be better able to afford the higher salaries of engineers, and programs with large staffs and budgets may have decided that federal funds were not needed.

State solar RD&D programs were housed in departments of energy and natural resources, in energy RD&D agencies, or existed as separate organizational units. The largest solar RD&D programs were organizationally separate, probably reflecting the legislature's decision that in those states solar and alternative energy RD&D warranted both a substantial budget and distinct organizational status. Programs within larger states which were institutionally autonomous were more likely to obtain federal RD&D funds, but they were less likely than programs housed in state energy RD&D agencies to move quickly to promulgate rules and regulations governing funding procedures and eligibility, and less likely to conduct market analyses for projects intended for commercialization.

Implementing agencies funded partially or wholly from severance taxes and energy surcharges were larger and enjoyed a relatively higher rate of budget growth between 1977 and 1978 than agencies funded through appropriations. Though part of this relationship was due to the increased cost of energy, at least some of the budget growth was due to the stability of severance taxes and surcharges as a funding pool. However, state solar RD&D programs dependent upon annual or biennial appropriations tended to develop their rules and regulations governing eligibility for grants and contracts as well as their award procedures more rapidly than programs funded through surcharges or severance taxes, perhaps due to the increased time pressures brought about by periodic accountability to the legislature. Programs funded through appropriations also required a higher degree of cost sharing with their RD&D performers, possibly a result of the actuality or anticipation of budget constraints on the program.

State background conditions affected solar RD&D programs in much the same way as they did solar financial incentive programs. While no pattern emerged that clearly linked a state's energy supply, cost, and consumption to successful implementation, we found that relatively high levels of RD&D activity occurred in wealthy, urbanized states that had previously shown high levels of support for nonsolar research and development programs. States that were among the first to initiate and that subsequently developed solar RD&D programs were states that enjoyed high levels of insolation, but their innovativeness was not associated with high heating requirements or high energy costs.

12.3.2 Implications for States

States can do little about how much sun they receive, but they can improve their existing incentive programs and design better, ones by learning from the experiences of other states. In the case of solar RD&D programs, the mechanism for providing public funds to support the program has important implications for its size and speed of implementation. If legislators wish to promote the rapid growth of solar RD&D programs, then providing program funds from a state energy surcharge or severance tax will increase the likelihood of this result.* The reason for this, though not a direct finding of our study, probably is that such an arrangement insulates a politically vulnerable, long-term payoff program from the short-term horizons of legislatures and ties funding to a virtually guaranteed, growing pool of revenues. But funding through the appropriations process has some positive results. The time and political pressures of the annual or biennial appropriations process appears to help accelerate the writing of rules and regulations governing project selection and performer eligibility.

Establishing the solar or alternative energy RD&D program as a separate organizational entity rather than as part of an energy RD&D agency or department of energy and natural resources was associated with larger program size, but the causal basis for this is unclear. It may be that the high degree of political consensus that leads to the creation of a separate, visible solar program also explains its larger size. We found, though, that if the solar RD&D program were placed within a larger energy RD&D agency, development of rules and regulations was expedited and the date of the first award hastened. It is likely that in these cases the experience gained and procedures developed in implementing the state's larger energy RD&D policy were applied directly to facilitate development of the program's new solar element.

Effective management of state solar RD&D programs, an element of their successful implementation, is highly dependent upon the professional backgrounds of the program

*The constitutionality of state mineral severance taxes has recently been questioned.

staff. Implementing agency staff with a mix of backgrounds—engineering and science, business and economics, management and administration—engaged in more effective management practices than agencies staffed primarily with scientists and engineers. While technically strong, agencies with the latter type of staff may be less well-equipped than a more balanced staff to deal with critical program activities such as legitimizing proposal review and award processes, ensuring that research and demonstration projects are responsive to the needs of their intended audiences, and speeding the development of rules and regulations.

12.4 IMPLICATIONS FOR FEDERAL POLICY

The National Energy Act created federal income tax credits for conservation and solar expenditures. What does state experience with tax credits reveal about the problems with, and likely efficacy of, this federal solar incentive? First, equity issues will arise, since use of the tax system will discriminate against those who pay low or no taxes. Direct subsidies in the form of grants (rebates)* are more equitable from the perspective of the income of potential claimants. Second, the problems that states had in dealing with passive solar design and labor costs for backyard systems also will occur at the federal level. A tax authority's emphasis on a straightforward audit and ease of administration created a bias in the definition of eligible systems toward manufactured systems. Though states have not developed single or simple solutions to these issues, state experience suggests that more successful implementation will result if the Internal Revenue Service draws extensively on solar expertise as it develops and amends rules and regulations governing eligibility for NEA solar tax credits. Third, there is only a weak relationship between the size of a financial incentive and the probability of purchase, at least during the early stages of solar penetration in residential building markets. This suggests the need to emphasize, at the federal level, programs directed toward other factors that influence purchase decisions such as information, system reliability, system performance, consumer protection, and installer training. The search for the optimum size of a solar financial incentive is to some extent misguided, since the relationship between an incentive's size and its eventual impact on solar system purchase decisions is both highly complex and poorly understood.

Federal grant and assistance programs spend large amounts of money through state agencies to achieve national objectives and to provide support for state and local activities. Choices of which institutions and projects to support and which agencies to select as managers of federal funds are central from the perspective of efficient use of those funds. This study showed that the type of agency administering a solar financial incentive or a solar RD&D program significantly affected the likelihood that the ultimate goals of the incentive program would be achieved. Because of the complexity of the relationships involved, no guidelines are given here, but federal program managers should consider carefully the staffing, organizational location, and source of support of state agencies proposing to implement a federally funded program or project.

There is, additionally, information of benefit to federal energy RD&D program managers. State solar RD&D programs have objectives and face problems similar to those of their federal counterparts. One message from state experience is that staffing federal RD&D programs with persons from a variety of professional backgrounds rather than with predominantly technical persons has a favorable influence on program implementation. Another is that involving outside groups such as industry associations and university

*Low interest loans would also serve this purpose.

researchers in program planning and project selection has similar positive consequences for implementation.

Finally, if successful implementation of a federal program hinges ultimately on the actions of nonfederal officials such as tax assessors and building code officials [as it does in the case of the Building Energy Performance Standards (BEPS) program], considerable attention should be paid to information and training programs for local officials. Whenever laws passed at one level of government must be implemented at another, the implementation process acquires additional complexity. Informing state and local officials about the intent and intricacies of federal legislation such as BEPS and training them to implement it would appear to be essential to its ultimate success.

SECTION 13.0

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APPENDIX A

STATE BACKGROUND VARIABLES AND THEIR SOURCES OF DATA

This appendix lists state background variables and the information sources for state background data.

Table A-1. STATE BACKGROUND VARIABLES

003	Type and level of party competition
004	Regional leadership and innovativeness among states
005	Total SECP funds per capita, 1977
006	Total SECP funds per capita, 1978
007	Percentage of electrical energy production from coal
008	Percentage of electrical energy production from oil
009	Percentage of electrical energy production from natural gas
010	Percentage of electrical energy production from nuclear
011	Percentage of electrical energy production from hydro
012	Annual average daily terrestrial solar energy received on a horizontal surface, average of all reporting sites in state
013	Percentage of total state revenues accounted for by income and sales taxes
014	R&D expenditures per capita
015	State expenditures for energy R&D per capita
016	Heating degree days, heating season 1975-76
017	Average cost of electricity, 1978
018	Average residential gas price, 1976
019	State population, 1977
020	Population growth rate, 1977-78
021	Total state expenditures per capita, 1977
022	Total state expenditures, 1978
023	Average per capita income, 1976
024	Average per capita income, 1977
025	Intergovernmental revenues from the federal government, 1977
026	Energy consumption, residential, 1975
027	Energy consumption, commercial, 1975
028	Energy consumption, industrial, 1975
029	Energy consumption, transportation, 1975
030	Line/conversion loss, 1975
031	Total energy consumption, 1975
032	Total energy consumption, 1976
033	Per capita energy consumption, 1976
034	Average annual growth in per capita energy consumption, 1960-76
035	Existing solar collectors per capita, 1978
036	Average residential heating oil price, November 1978
037	Residential housing starts, 1977
038	Residential housing starts, 1978
039	Buying power index, 1977
040	Government surplus/deficit per capita, 1977
041	Coal reserves per capita
042	Natural gas reserves per capita
043	Oil reserves per capita
044	Total energy produced per capita, 1975
045	Percentage of urban population, 1970

Table A-2. INFORMATION SOURCES FOR STATE BACKGROUND DATA

Variable Number	
POLITICS	
033	Politics in the American States, Second Edition H. Jacob and K. Vines; Little, Brown & Company, Boston, 1971. Table 1, p. 87-88, "The State Party Systems"; Table 8, p. 113, "Legislative Party Cohesion and Inter-Party Competition."
004	Ibid. Table 1, p. 358, "Composite Innovation Scores for the American States." Note: Other innovation tables can be found in the following publications: Journal of Politics: Vol. 40, pp. 212-224, 1978 (Fall). Savage, Robert L. "Policy Innovativeness as a Trait of American States." Journal of Politics: Vol. 40, pp. 179-187, 1978 (Fall). Foster, John L. "Regionalism and Innovation in the American States."
SECP FUNDS	
005	Report to the President and to the Congress on the State Energy Conservation Program. Dec. 1977. U.S. Dept. of Energy, Assistant Secretary for Conservation and Solar Applications.
006	Office of State and Local Programs. Feb. 1978, DOE/CS-0019/1, pp. 10,11 and Appendix D pp. 71-77.
ELECTRIC POWER	
007-011	Statistical Yearbook of the Electric Utility Industry. Edison Electric Institute; Oct. 1977, No. 44; New York, NY E.E.I. Table 135, p. 21, "Generation by Fuel - Total Electric Utility Industry by States and Type of Prime Mover Driving the Generator." Calculation Required: Table 145, p. 23, "Generation by Fuel - Total Electric Utility Industry by States and Type of Fuel." Note: Data from Federal Power Commission
013	State Government Tax Collections in 1978. U.S. Department of Commerce, Bureau of Census, GF '78, No. 1, Dec. 1978. Table 6, "Percent Distribution of State Government Tax Revenue for Cal. Req: Select Taxes: 1978."
RD&D FUNDS	
014 and 015	Preliminary Findings: Survey of State Government Research & Development. National Sceince Foundation: Division of Science Resource Studies. 1980.

DEGREE DAYS

016 Gas Facts: 1976. A Statistical Record of the Gas Utility Industry. American Gas Association, 1977
Table 75, p. 94, "Heating Degree Days by Calendar Year and Heating Seasons, 1975-1976 and Thirty Year Normals."

Note: Data from National Oceanic and Atmospheric Administration.

ELECTRICITY PRICES

017 Statistical Yearbook of the Electric Utility Industry. Edison Electric Institute; Oct. 1977, No. 44; New York, NY E.E.I.
Table 365, p. 45, "Revenues - Total Electric Utility Industry by States and Class of Service".
Calculation Required. Table 225, p. 33, "Energy Sales - Total Electric Utility Industry by States and Class of Service".

GAS PRICES

018 Gas Facts: 1976. A Statistical Record of the Gas Utility Industry. American Gas Association, 1977.
Table 93, "Average Residential Gas Prices by State, 1955-1976."

POPULATION

019 State Government Tax Collections in 1978
U.S. Department of Commerce, Bureau of Census, GF 78, No. 1, Dec. 1978.
Supplementary Data; Table 7, "Fiscal Year, Population and Personal Income by State: 1977 and 1978."
Current Population Reports
U.S. Department of Commerce, Bureau of Census, No. 790, Dec. 1978.

POPULATION GROWTH

020 Current Population Reports.
U.S. Department of Commerce, Bureau of Census, No. 790, Dec. 1978.

STATE EXPENDITURES

021 State Government Finances in 1977.
U.S. Department of Commerce; Bureau of Census, GF 1977, No. 3, Sept. 1978.
Table 9, p. 29, "State Government Expenditure, By Type and Function, '77."

PER CAPITA INCOME

023 State Government Tax Collections in 1977.
U.S. Department of Commerce, Bureau of Census, GF 1977, No. 1, Dec. 1977.
Table 7, p. 11, "Fiscal Year, Population, and Personal Income by State: 1976 and 1977."

Note: Data from U.S. Department of Commerce; Survey of Current Business.

024 State Government Tax Collections in 1978.
U.S. Department of Commerce, Bureau of Census, GF.1978, No. 1, Dec. 1978.
Table 7, p. 11, "Fiscal Year, Population, and Personal Income by State: 1977 and 1978"

Note: Data from U.S. Department of Commerce; Survey of Current Business, 1978.

INTERGOVERNMENTAL REVENUE

025 State Government Tax Collections in 1978
U.S. Department of Commerce, Bureau of Census, GF 1978, No. 1, Dec. 1978.
Table 7, p.11, "State Government Revenue by Sources: 1977:

Note: More specific information included in: U.S. Department of the Treasury: Federal Aid to States Fiscal Year 1978.

ENERGY CONSUMPTION

026-031 Energy Flow Patterns for 1975
R. B. Kidman, et al.; Los Alamos Scientific Laboratory, Los Alamos, N.Mex., June 1977, LA 6770, pp. 12-61.

032-034 Energy Supply, Demand, and Prices for the Southern States Detailed by Source and End-Use
Southern States Energy Board, Sept. 1978, Atlanta, Ga.
Table 1, p. 1-3, "States Energy Consumption Statistics for 1976."
Table 2, p. 1-4, "Energy Growth Versus Income Growth 1960 - 1976."

SOLAR COLLECTORS

035 SEINAM'S Solar State of the Union Report 1979
Solar Energy Institute of North America, 1979, Washington, D.C. pp. 4 and 5.

OIL PRICES

036 Heating Oil Prices and Margins
U.S. Department of Energy, EIA-0031
Table 5, "Average Residential Heating Oil Prices for Selected States." 1979.

CONSTRUCTION

037 Construction Review
U.S. Department of Commerce

038 Industry and Trade Administration, Vol. 25, No. 4, Apr. 1979.
Table C-4, p. 26-27, "Total Housekeeping Residential Construction (Private and Public) Authorized in 14,000 Permit-issuing Places in the United States: Number of Housing Units by State."

BUYING POWER

039 1979 Survey of Buying Power Forecaster's Handbook
Sales and Marketing Management Magazine, 1979
pp. 1-1, 1-6, "Population, Effective Buying Income, Retail Sales, and Buying Power Index" [BPI].

GOVERNMENT INDEBTEDNESS

040 State Government Finances in 1977
U.S. Department of Commerce, Bureau of Census, GF 77, No. 3, Sept. 1978.
Calculation Required. Table 13, p. 45, "State Government Indebtedness and Debt Transactions: 1977."
Table 14, p. 49, "State Government Cash and Security Holdings at End of Fiscal Year, by Purpose and Type of Asset: 1977."

FOSSIL FUEL RESOURCES

041 Coal Resources of the United States
Averitt, Paul; January 1, 1967; Geological Survey Bulletin 1275, p. 10-11.

042 Gas Facts: 1976 A Statistical Record of the Gas Utility Industry.
American Gas Association, 1977.
Table 3, "Changes in Estimated Proved Recoverable Reserves of Natural Gas by State, During 1976."

043 Ibid.
Table 7, "Changes in Estimated Proved Recoverable Reserves of Crude Oil by State, During 1976."

044 Energy Flow Patterns for 1975
R. B. Kidman et al.; Los Alamos Scientific Laboratory, Los Alamos, N.Mex., June 1977, LA 6770, pp. 12-61.

URBAN POPULATION

045 1970 Census Characteristics of the Population
U.S. Department of Commerce, Bureau of Census.

APPENDIX B

PROCEDURE FOR CLUSTERING MEASURES OF DEPENDENT VARIABLES

This appendix consists of a discussion of the relationships among measures of implementation success and a set of tables that identify measures of implementation success and specify the results of clustering measures of some dependent variables.

RELATIONSHIPS AMONG MEASURES OF IMPLEMENTATION SUCCESS

Measures of the extent of implementation of solar programs were grouped into three categories: level of effort, administrative costs, and implementation outcomes. We expected that, within each category, some individual measures would be related. If this were the case, some form of clustering could be used to reduce the number of variables in the analysis. To identify the extent and nature of the relationships among these variables, correlation matrices were developed for each measurement category for both types of incentives programs studied: financial and RD&D.

Table B-1 lists measures of implementation success for RD&D programs employed in this study. Measures for which insufficient data existed (N* less than 6) were deleted from the table. On the basis of a complete set of correlations among these measures (using the criterion of Spearman's rho and p less than 0.05), clustering of the data was identified. In the case of measures of normalized level of effort, all measures for which data existed were highly interrelated, as Table B-2 illustrates. Accordingly, in subsequent analyses these five variables were replaced by a single variable, "normalized level of effort," created by equating variables 302, 304, 305, and 306 to variable 307. Though on a pairwise basis other measures of level of effort were highly correlated, no similar clustering of more than two measures emerged. On a pairwise basis, no measures of administrative costs of RD&D programs were correlated and, for measures of implementation, only one pair of measures was significantly related. In the latter case, the extent of end-user involvement in RD&D project selection was significantly related to the ratio of RD&D funds cost-shared with the grantee or contractor to total grant and contract funds. In the absence of clustering, each measure of administrative costs and implementation outcome was treated separately in subsequent analyses.

Table B-3 lists measures of implementation success for financial incentive programs. As in the case of RD&D programs, measures for which insufficient data existed (N less than 6) or for which no variation was observed were deleted. Among measures of level of effort, clustering was observed for measures of staff size costs in 1977 and 1978 and for staff size per claim processed; among measures of administrative costs, clustering was observed for measures of these costs for 1977 and 1978 and for administrative costs per dollar cost of the program. These interrelationships are depicted in Table B-4; in subsequent analyses, a single variable (number of full time staff or equivalents, 1978, and administrative costs associated with implementing the program, 1977, respectively) took the place of the other two that highly correlated with it. As in the case with measures of implementation of RD&D, only scattered pairwise relationships of significance were observed and, in particular, no clear clusters of measures of implementation outcomes emerged.

*N means number of cases.

Table B-1. MEASURES OF IMPLEMENTATION SUCCESS: RD&D PROGRAMS

Level of Effort

Total program costs, 1977 and 1978

Number of full-time staff or full-time equivalents devoted to implementing the incentive, 1977 and 1978

Number of proposals received, 1978

Number of proposals processed, 1978

Total dollar value of contracts and grants awarded, 1977 and 1978

Total dollar value of contracts and grants as a proportion of state population, 1977 and 1978

Administrative Costs

Administrative costs of implementing program, 1978

Administrative costs per dollar cost of progam, 1978

Number of staff or full-time equivalents per dollar cost of program, 1978

Implementation

Ratio of funds cost shared with grantee or contractor to total grant and contract funds, 1977 and 1978

Ratio of funds cost shared with federal government to total grant and contract funds, 1977 and 1978

Market analyses performed as part of project selection process for projects intended for commercialization

Extent of end-user involvement in project selection

Percentage increase in total dollar value of grants and contracts awarded between 1977 and 1978

Time from enactment of incentive to establishment of rules and regulations for incentive administration

Table B-2. CLUSTERING OF MEASURES OF NORMALIZED LEVEL OF EFFORT: RD&D PROGRAMS

		Variable Number				
		302	304	305	306	307
Variable Number	302	1.000	1.000	0.9411	0.9627	0.7547
	304	1.000	1.000	0.9276	1.000	0.9276
	305	0.9411	0.9276	1.000	0.9266	0.9286
	306	0.9627	1.000	0.9266	1.000	0.8165
	307	0.7547	0.9276	0.9286	0.8165	1.000

302 = Dollar value of grants and contracts as a proportion of state expenditures, 1977.

304 = Total program costs as a proportion of state population, 1977.

305 = Total program costs as a proportion of state population, 1978.

306 = Dollar value of grants and contracts as a proportion of state population, 1977.

307 = Dollar value of grants and contracts as a proportion of state population, 1978.

Table B-3. MEASURES OF IMPLEMENTATION SUCCESS: FINANCIAL PROGRAMS

Level of Effort

Total program costs, 1977

Number of full-time staff or full-time equivalents devoted to implementing the incentive, 1977 and 1978

Number of claims processed, 1977

Number of valid claims processed, 1977

Normalized Level of Effort

Total program costs as a proportion of total state expenditures, 1977

Total program costs as a proportion of state population, 1977

Number of claims processed as a proportion of total state expenditures, 1977

Administrative Costs

Administrative costs of implementing program, 1977 and 1978

Administrative costs per dollar cost of program, 1977

Administrative costs per claim processed, 1977

Implementation

Number of valid claims processed as a proportion of total number of state tax returns, 1977

Number of valid claims as a proportion of total claims processed, 1977

Percent increase in number of valid claims processed between 1977 and 1978

Time from enactment of incentive to establishment of rules and regulations for eligibility for financial incentive

Ratio of number of claims processed as a proportion of solar installations in the state during 1977

Table B-4. CLUSTERING OF MEASURES OF LEVEL OF EFFORT: FINANCIAL PROGRAMS

		Variable Number		
		213	214	325
Variable Number	213	1.000	0.8111	0.8854
	214	0.8111	1.000	0.8111
	325	0.8854	0.8111	1.000

213 = Administrative costs associated with administering solar incentive program, 1977.

214 = Administrative costs associated with administering solar incentive program, 1978.

325 = Administrative costs per dollar cost of program, 1977.

		Variable Number		
		211	212	327
Variable Number	211	1.000	0.9090	0.7638
	212	0.9090	1.000	0.6831
	327	0.7638	0.6831	1.000

211 = Number of staff or full-time equivalents devoted to implementing solar incentive, 1977.

212 = Number of staff or full-time equivalents devoted to implementing solar incentive, 1978.

327 = Number of staff or full-time equivalents per claim processed, 1977.

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APPENDIX C

FINANCIAL INCENTIVES TO OVERCOME BARRIERS TO PURCHASE OF SOLAR ENERGY EQUIPMENT

This appendix lists barriers that inhibit the purchase of solar equipment, suggests incentives that could be employed to overcome them, and outlines the benefits and limitations of strategies specifically directed toward cost-related barriers.

Table C-1. BARRIERS AND INCENTIVES THAT CAN BE EMPLOYED TO OVERCOME THEM

Barriers	Incentives to Overcome the Barriers
Barriers to consumer purchases:	
High initial cost of equipment	- Low-cost loans - Grants - Tax incentives for consumers
Long payback period	- Tax incentives - Grants
Difficult to amortize costs to monthly payments competitive with conventional fuel payments	- Low-cost loans - Accelerated depreciation
Consumers are unaccustomed to basing purchases on life cycle costs and are unlikely to do so because of: - lack of information - uncertainty about future fuel prices - inertia	- Information and education program to illustrate to consumers the long-term advantages of solar systems
Consumers are unwilling to install systems which will increase their property taxes	- Property tax exemption
Consumers are unsure of the salability and market value of buildings with solar systems	- Government financial incentives, informational and demonstration programs may increase the acceptability of solar systems and buildings
Lack of information about the feasibility and durability of solar systems	- Information and demonstration programs

Table C-1. BARRIERS AND INCENTIVES THAT CAN BE EMPLOYED TO OVERCOME THEM (Continued)

Barriers	Incentives to Overcome the Barriers
Barriers to consumer purchases: (Continued)	
Consumers are averse to risk	- All types of financial incentives which reduce the consumer's financial risk - All types of informational and demonstration programs
For consumers with commercial buildings, solar units have a low rate of return	- Tax incentives - Low-cost loans - Grants
Barriers to manufacturers and builders	
High capital and startup costs	- Investment tax credit - Income tax incentives - Low-cost production and construction loans - R&D funding to develop better production techniques
Uncertainty of the market	- Investment tax credit - Consumer tax and other financial incentive to stimulate the solar market - Information and demonstration programs on solar technology, applications, installation, and production - Government guaranteed production and construction loan - Government procurement
Barriers to financing of solar purchases and manufacturing because financial institutions:	
Fear a high default rate on solar systems because of the uncertainty about their feasibility and durability	- Government loan guarantees for solar purchases - information and demonstration programs which reach the financial community

Table C-1. **BARRIERS AND INCENTIVES THAT CAN BE EMPLOYED TO OVERCOME THEM** (Concluded)

Barriers	Incentives to Overcome the Barriers
Barriers to manufacturers and builders (continued)	
Are uncertain about the marketability of buildings with solar units	- Government mortgage guaranteees and government purchases of mortgages on solar buildings on the secondary mortgage market - Information and demonstration programs aimed at consumers to illustrate to them that buying a building with a solar system is a good investment
Do not include life-cycle savings when calculating loan payment terms	- Government loan guarantees which require that life savings be recognized - Information program geared to educating the financial communities about life-cycle savings and advantages of solar systems

Sources: Bezdek et al. 1977; Ruegg 1976; Miran and Lawrence 1978; Bezdek, Hirshberg, and Babcock 1979; Booz Allen and Hamilton 1976; A. D. Little 1976.

Table C-2. TYPES OF INCENTIVES TO OVERCOME COST BARRIERS: BENEFITS, LIMITATIONS, AND APPROPRIATE LEVEL OF GOVERNMENT

Type of Incentives	Benefits	Limitations	Appropriate Level of Government
FOR CONSUMER PURCHASING SOLAR SYSTEMS			
TAX INCENTIVES (in general)	Reduces the payback period by the amount of the tax savings Reduces the initial costs of the unit by the amount of the tax saving in the year of the purchase The government's support for solar development demonstrated by tax incentives may have a positive psychological effect on the consumer		
Specific types of tax incentives to consumers:			
Personal Income Tax Deductions	A state income tax is usually not high enough for a deduction to reduce the tax bill by a substantial amount The tax deduction offers a greater tax saving to high income consumers, so the deduction is not equitable to all solar consumers		Federal, state but impact minimal

Table C-2. TYPES OF INCENTIVES TO OVERCOME COST BARRIERS: BENEFITS, LIMITATIONS AND APPROPRIATE LEVEL OF GOVERNMENT (Continued)

Type of Incentives	Benefits	Limitations	Appropriate Level of Government
Corporate Income Tax Deductions	The deduction could provide a substantial incentive for a corporation if the corporate tax is very high		Federal
Personal Income Tax Credit	Tax credits directly reduce the consumers' tax liability	Discriminates against persons who pay little or no state income taxes	State; federal (State/federal policies should complement each other)
	A tax credit is more equitable than a deduction across income groups because all consumers are allowed to claim the same credit		
Sales Tax Exemption	Reduces initial cost at the time of the purchase	The consumer receives only a small savings, usually less than 5% of the purchase price	States, which have the legal authority to approve sales tax
Property Tax Exemption	Alleviates the consumer's concern that the installation of a solar unit would increase the property tax liability	The exemption offers only a small financial incentive per solar unit	Local government, where property tax is administered
	Is easy to administer	It does not reduce capital costs at time of sale	State can impose mandatory property tax exemptions

Table C-2. **TYPES OF INCENTIVES TO OVERCOME COST BARRIERS: BENEFITS, LIMITATIONS, AND APPROPRIATE LEVEL OF GOVERNMENT** (Continued)

Type of Incentives	Benefits	Limitations	Appropriate Level of Government
LOW COST LOANS			
	Reduces the initial high cost of the solar unit by lowering the finaneing cost	Loan programs are expensive to administer	State, federal
	Allows the consumer to amortize the solar unit costs to monthly payments which may be more competitive with monthly charges for conventional energy systems		
	Provides low cost financing when conventional financing may be expensive or nonexistent for solar units		
	The government can raise money more cheaply than consumer can		
	Are generally equitable to all income groups		
GRANTS	Lowers initial high costs	Costly program relative to the potential benefits of stimulated sales	Federal, because of the total loan expense and the high administrative costs
		The grants may cause consumers to purchase higher cost, less efficient solar equipment because they are using someone else's funds	State, if loan expertise and adequate funds available

Table C-2. **TYPES OF INCENTIVES TO OVERCOME COST BARRIERS: BENEFITS, LIMITATIONS, AND APPROPRIATE LEVEL OF GOVERNMENT** (Continued)

Type of Incentives	Benefits	Limitations	Appropriate Level of Government
		The use of the grants must be limited and should be monitored to avoid misuse of the solar grant	
FOR MANUFACTURERS OF SOLAR EQUIPMENT			
<u>TAX INCENTIVES</u> (in general)	The government can tailor the incentives to a specific type of investment, R&D, and production in solar units The tax saving for the manufacturer reduces the initial high costs of setting up production and should make more funds available for improvements in manufacturing process	Through providing financial incentives to the solar producers, the government may not be improving the market for solar units; the tax savings for the producer may not result in lower market prices for the consumer If financial incentives are geared to a particular type of solar manufacturer, then the government supports a certain aspect of solar development which might not be the most attractive to the consumer Tax incentives for producers may need to be monitored to ensure they are properly applied; however, this will be expensive for the government	

Table C-2. **TYPES OF INCENTIVES TO OVERCOME COST BARRIERS: BENEFITS, LIMITATIONS, AND APPROPRIATE LEVEL OF GOVERNMENT** (Continued)

Type of Incentives	Benefits	Limitations	Appropriate Level of Government
Specific type of tax incentives for manufacturers:			
Corporate Income Tax Deductions		The deductions probably will not provide a large enough tax saving to stimulate new production	State; federal
Investment Tax Credit	This credit encourages investment, is likely to offer greater tax saving than a deduction	The credit for solar manufacturing investment must be greater than the the current 10% corporate investment tax credit in order to stimulate new investment in solar production	Federal
Accelerated Depreciation	This mechanism increases the producer's return on investment in the early years of production, which would be an advantage to manufacturers who are unsure of the activity of the solar market in the short run		

Table C-2. **TYPES OF INCENTIVES TO OVERCOME COST BARRIERS: BENEFITS, LIMITATIONS, AND APPROPRIATE LEVEL OF GOVERNMENT** (Continued)

Type of Incentives	Benefits	Limitations	Appropriate Level of Government
LOW COST LOANS	Reduces financing costs and, consequently, reduces production costs Make more financing available for solar commercial ventures The government can direct the loans to specific types of solar investment which needs to be stimulated Administering loans may be easier than managing consumer financial incentives because the potential producers are easier to identify and contact than the potential consumers	The loans are not tied directly to the number of increased solar units sold as consumer incentives and loans would be; therefore, it is difficult to evaluate the benefit of the producer loans in terms of increased solar units installed. The administrative cost of a loan would be high.	Federal, because of existing business loan programs; state, if loan experience and adequate funds are available

Table C-2. **TYPES OF INCENTIVES TO OVERCOME COST BARRIERS: BENEFITS, LIMITATIONS, AND APPROPRIATE LEVEL OF GOVERNMENT** (Continued)

Type of Incentives	Benefits	Limitations	Appropriate Level of Government
SUBSIDIES	Reduces the initial high cost and reduces the risk to the producer	The government might subsidize inefficient or unpopular types of solar unit production Expensive to administer	Federal, because of the high costs of direct grants and subsidies and of their administration because of existing federal business subsidy programs (e.g. the Small Business Administration)
INCENTIVES FOR FINANCIAL INSTITUTIONS (in general)	Increases the availability of capital from financers who: - Fear a high default rate for solar loans because the durability and feasibility of solar systems have not been proven, - Are uncertain of the marketability of buildings with solar units installed, and - Do not include the life cycle savings of solar systems into the payment terms		

Table C-2. **TYPES OF INCENTIVES TO OVERCOME COST BARRIERS: BENEFITS, LIMITATIONS, AND APPROPRIATE LEVEL OF GOVERNMENT** (Concluded)

Type of Incentives	Benefits	Limitations	Appropriate Level of Government
Specific type of incentives: Government Guarantees for Solar System and Solar Production Loans.			State, especially where strong mortgage guarantee programs exist (such as V.A. Dept.'s). Federal
Current Government Mortgage Guarantee Programs Expanded	Expand current programs to include the costs of solar systems and to reflect the life cycle.		Federal, state if mortgage guarantee programs exist.

Sources: Bezdek et al. 1977; Miran and Lawrence 1978; Bezdek, Hirshberg, and Babcock 1979; Booz, Allen and Hamilton 1976; Ashworth et al. 1979; A. D. Little 1976.

APPENDIX D

BACKGROUND FACTORS AND IMPLEMENTATION SUCCESS

This appendix consists of a set of tables that describe proposed relationships between background factors and implementation success for state financial incentive programs, RD&D programs, and study versus nonstudy states. Also included is a table illustrating the rank of financial incentive study states on innovativeness.

Table D-1. PROPOSED RELATIONSHIPS BETWEEN BACKGROUND FACTORS AND IMPLEMENTATION SUCCESS

State Supply Characteristics

The greater the extent of a state's dependence on fossil fuels for electric energy production, the greater the likelihood of implementation success. Also, the greater the diversity of sources for electrical energy production, the less the likelihood of implementation success.

The higher the average cost of electricity, the higher the level of implementation success.

The higher the average residential gas price, the higher the level of implementation success.

The greater a state's coal, natural gas, and oil reserves (both net and per capita), the lower the degree of implementation success.

The higher the mean daily solar radiation, the greater the degree of implementation success.

State Energy Demand Characteristics

The higher the number of heating degree days for the state, the higher the level of implementation success.

The greater a state's residential energy consumption, the greater the level of implementation success. The elements of this general hypothesis include commercial energy consumption, industrial energy consumption, transportation energy consumption, total energy consumption, and per capita energy consumption.

The greater the average annual growth in a state's energy consumption (total and per capita), over the period 1960–1976, the greater the degree of implementation success.

State Political and Demographic Setting

The type and level of party competition will influence the extent of implementation success. High-conflict conditions (two-party states with moderate to strong party cohesion) will be associated with lower levels of implementation success.

The greater the innovativeness of the state, the greater the degree of implementation success.

State solar financial incentives will exhibit greater implementation success in states where a relatively large proportion of revenues is derived from income and sales taxes.

Larger states, wealthier states, states with larger expenditures, and more rapidly growing states will exhibit higher levels of implementation success.

Table D-1. PROPOSED REELATIONSHIPS BETWEEN BACKGROUND FACTORS AND IMPLEMENTATION SUCCESS (Concluded)

State Political and Demographic Setting (continued)

The larger the amount of intergovernmental revenues (total and per capita) enjoyed by the state, the greater the level of implementation success.

The larger the number of residential housing starts, the greater the degree of implementation success.

The larger a state's buying power index (an indicator of wealth), the greater the extent of implementation success.

The greater the state government surplus (total and per capita), the greater the extent of implementation success.

The greater the degree of urbanization in a state, the lower the degree of implementation success.

Table D-2. STATISTICALLY SIGNIFICANT RELATIONSHIPS BETWEEN BACKGROUND CHARACTERISTICS AND THE IMPLEMENTATION OF STATE FINANCIAL INCENTIVE PROGRAMS

Dependent Variable	By	Independent Variable	N	Rho	Sig.
Level of Effort					
Number of staff or full-time equivalents, 1977		Government surplus/deficit per capita, 1977	12	0.5960	0.021
		Oil reserves per capita	12	0.4996	0.05
Number of staff or full-time equivalents, 1978		Government surplus/deficit per capita, 1977	14	0.4793	0.042
Number of valid claims processed, 1977		Percentage of total state revenues accounted for by income and sales taxes	10	0.7423	0.007
		Heating degree days	10	-0.7791	0.004
		Average annual terrestrial solar energy	10	0.5951	0.035
		Per capita energy consumption 1976	11	-0.5688	0.034
		Number of solar systems per capita, end of 1978	11	0.7281	0.006
		Residential housing starts, 1978	11	0.7281	0.006
		Percentage of urban population	11	0.5688	0.034
Implementation Outcome					
Time from enactment of legislation to official announcement of rules and regulations		Percentage of electrical energy production from hydro	15	0.5763	
		Heating degree days	14	0.6630	0.005
		Population growth rate, 1977-1978	15	-0.8668	0.001
		Average annual terrestrial solar energy	13	-0.5038	0.040
		Government surplus/deficit per capita, 1977	15	-0.5645	0.015

Table D-3. STATISTICALLY SIGNIFICANT RELATIONSHIPS BETWEEN BACKGROUND CHARACTERISTICS AND THE IMPLEMENTATION OF STATE RD&D PROGRAMS

Dependent Variable	By	Independent Variable	N	Rho	Sig.
Level of Effort					
Total program costs, 1978		Average annual terrestrial solar radiation	8	0.7381	0.019
		Number of solar installations per capita, end of 1978	8	0.8810	0.002
		Percentage of urban population	8	0.8810	0.002
		Percentage of electrical energy production from oil	8	0.6905	0.029
		Percentage of electrical energy production from hydro	8	-0.6946	0.028
		Average cost of electricity, 1978	8	0.7143	0.024
Number of staff or full-time equivalents, 1978		Percentage of urban population	11	0.5923	0.028
Number of grants or contracts awarded, 1977		Rate of population growth, 1977-1978	9	0.6444	0.031
		Government surplus/deficit per capita, 1977	9	0.7364	0.012
Number of grants or contracts awarded, 1978		State expenditures per capita 1977	11	0.8747	0.001
		Percentage of electrical energy production from coal	12	-0.6773	0.008
		Energy R&D expenditures per capita	9	0.7167	0.015
Dollar value of grants and contracts, 1977		Per capita income, 1977	11	0.5780	0.032
		Number of solar installations per capita, end of 1978	11	0.5780	0.032
		Percentage of urban population	8	0.8810	0.002
		R&D expenditures per capita, 1977	11	0.5872	0.029
		Average cost of electricity, 1978	11	0.5321	0.046

Table D-3. STATISTICALLY SIGNIFICANT RELATIONSHIPS BETWEEN BACKGROUND CHARACTERISTICS AND THE IMPLEMENTATION OF STATE RD&D PROGRAMS (Continued)

Dependent Variable	By	Independent Variable	N	Rho	Sig.
Dollar value of grants and contracts, 1978		State expenditures per capita 1977	11	0.6364	0.018
		Per capita income, 1976	12	0.5245	0.041
		Per capita income, 1977	12	0.5594	0.030
		Per capita energy consumption 1976	12	-0.5804	0.024
		Number of solar installations per capita, end of 1978	12	0.6154	0.017
		Percentage of urban population	12	0.8042	0.001
		Percentage of electrical energy production from coal	12	-0.5493	0.033
		Percentage of electrical energy production from oil	12	0.6154	0.017
		R&D expenditures per capita, 1977	12	0.6154	0.017
		Heating degree days	11	-0.5364	0.045
		Average cost of electricity, 1978	12	0.6084	0.018
"Normalized level of effort"		State expenditures per capita 1977	11	0.7091	0.008
		Number of solar installations per capita, end of 1978	12	0.6993	0.006

Table D-3. **STATISTICALLY SIGNIFICANT RELATIONSHIPS BETWEEN BACKGROUND CHARACTERISTICS AND THE IMPLEMENTATION OF STATE RD&D PROGRAMS** (Continued)

Dependent Variable	By	Independent Variable	N	Rho	Sig.
"Normalized level of effort" (Continued)					
		SECP funds per capita, 1977	12	0.5455	0.034
		SECP funds per capita, 1978	12	0.5804	0.024
		R&D expenditures per capita, 1977	12	0.7692	0.002
<u>Implementation Success</u>					
Market analyses performed as part of project selection		SECP funds per capita, 1977	12	-0.5296	0.035
Extent of end user involvement in project selection		Percentage of electrical energy production from oil	12	-0.5121	0.045
		Average cost of electricity, 1978	12	-0.5121	0.045
		State expenditures per capita, 1977	11	-0.6455	0.016
		Per capita energy consumption, 1976	12	0.5121	0.045
Time from enactment of incentive to promulgation of rules and regulations		R&D expenditures per capita	9	0.6725	0.024
		State expenditures per capita, 1977	8	0.7365	0.019

Table D-3. STATISTICALLY SIGNIFICANT RELATIONSHIPS BETWEEN BACKGROUND CHARACTERISTICS AND THE IMPLEMENTATION OF STATE RD&D PROGRAMS (Continued)

Dependent Variable	By	Independent Variable	N	Rho	Sig.
Time from enactment of incentive to promulgation of rules and regulations (Continued)		Intergovernmental revenues per capita 1977	9	0.7065	0.017
		Total energy produced per capita	8	-0.7186	0.023
Ratio of funds cost-shared with grantee or contractor to total grant and contract funds, 1978		Percentage of electrical energy produced from oil	8	-0.7186	0.023
		Average cost of electricity, 1978	8	-0.7545	0.016
		State expenditures per capita, 1977	8	-0.7785	0.012
		Number of solar installations per capita, end of 1978	8	-0.6587	0.038
Ratio of funds cost-shared with federal government to total grant and contract funds, 1978		Percentage of electrical energy production from nuclear	11	-0.5987	0.026
		Heating degree days	10	-0.6322	0.025
		Rate of population growth, 1977-1978	11	0.5421	0.043
		Average annual terrestrial solar energy	11	0.8884	0.001

Table D-3. STATISTICALLY SIGNIFICANT RELATIONSHIPS BETWEEN BACKGROUND CHARACTERISTICS AND THE IMPLEMENTATION OF STATE RD&D PROGRAMS (Concluded)

Dependent Variable	By	Independent Variable	N	Rho	Sig.
Ratio of funds cost-shared with federal government to total grant and contract funds, 1978		Residential energy consumption, 1975	11	-0.6376	0.045
		Number of solar installations per capita, end of 1978	11	0.5513	0.040

Table D-4. STATISTICALLY SIGNIFICANT RELATIONSHIPS BETWEEN BACKGROUND CHARACTERISTICS AND STATUS AS A STUDY STATE

Dependent Variable	By	Independent Variable	N	Rho	Sig.
RD&D Programs					
Study/nonstudy status		SECP funds per capita, 1977	45	0.2902	0.027
		SECP funds per capita, 1978	45	0.2747	0.034
		Energy R&D expenditures per capita, 1977	25	-0.6472	0.001
		Average annual terrestrial solar radiation	39	-0.3086	0.028
		Number of solar installations per capita, end of 1978	45	-0.5262	0.001
		Residential housing starts, 1977	45	-0.2747	0.034
		Residential housing starts, 1978	45	-0.3173	0.017
		Percentage of urban population	45	-0.2979	0.024
Financial Incentive Programs					
Study/nonstudy status		Percentage of electrical energy produced from coal	47	0.2698	0.034
		Total state expenditures per capita, 1977	47	-0.2641	0.037
		Number of solar installations per capita, end of 1978	48	-0.3229	0.013
		Residential housing starts, 1977	48	-0.2482	0.045
		Government surplus/deficit per capita, 1977	48	-0.4731	0.001
		Total energy produced per capita, 1975	47	0.3988	0.003
		Percentage of urban population	48	-0.2953	0.021

Table D-5. STATE INNOVATIVENESS AND STATUS AS A FINANCIAL INCENTIVE STUDY STATE

State Ranking in Innovativeness and Regional Leadership (Walker, 1971)	Status		
	Study	Nonstudy	Total
Top Third	05	09	17
Middle Third	03	11	15
Bottom Third	02	12	14
TOTAL	10[a]	32	46

[a]No datum was available for Hawaii on this variable.

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APPENDIX E

FINANCIAL INCENTIVE PROGRAMS: QUANTITATIVE ANALYSIS

This appendix includes four tables that summarize results of a quantitative analysis of significant relationships for financial incentive programs.

Table E-1. STATISTICALLY SIGNIFICANT RELATIONSHIPS BETWEEN IMPLEMENTATION FACTORS AND SUCCESSFUL IMPLEMENTATION OF FINANCIAL INCENTIVE PROGRAMS

Dependent Variable	By Independent Variable	N	Rho	Sig.
Number of staff or full-time equivalents, 1977	Amount of conflict between executive and legislative branches on solar energy matters	12	-0.4333	0.029
	Extent of involvement of implementing agency officials in formulating incentive legislation	12	0.6937	0.007
	Agency staff attitudes toward solar energy	12	-0.5804	0.024
	Extent of influence on implementing agency activities by external groups	11	0.7770	0.003
	Public hearings held on implementing agency plans	12	0.8157	0.001
	Rules and regulations interpreting the solar incentive legislation are specific	9	0.6641	0.026
	Documentation required to verify purchase of qualified solar systems	9	0.9000	0.001
Number of staff or full-time equivalents, 1978	Amount of conflict between executive and legislative branches on solar energy matters	14	-0.5270	0.027
	Extent of involvement of implementing agency officials in formulating incentive legislation	14	0.7157	0.002
	Agency staff attitudes toward solar energy	14	-0.7313	0.002
	Amount of informal interaction with external groups	13	0.5180	0.035
	Extent of influence on implementing agency activities by external groups	13	0.6003	0.016
	Public hearings held on implementing agency plans	14	0.6700	0.005
	Rules and regulations interpreting the solar incentive legislation are specific	11	0.7266	0.006

Table E-1. **STATISTICALLY SIGNIFICANT RELATIONSHIPS BETWEEN IMPLEMENTATION FACTORS AND SUCCESSFUL IMPLEMENTATION OF FINANCIAL INCENTIVE PROGRAMS** (Continued)

Dependent Variable	By Independent Variable	N	Rho	Sig.
Number of staff or full-time equivalents, 1978 (continued)	Documentation required to verify purchase of solar system	11	0.8148	0.002
Number of valid claims, 1977	Number of solar lobbyists	10	0.7679	0.005
	Public hearings held on implementing agency plans	11	0.5220	0.050
	Rules and regulations interpreting the solar incentive legislation are specific	9	0.6113	0.041
Administrative Costs				
Administrative costs, 1977	Amount of conflict between executive and legislative branches on solar energy matters	11	-0.5809	0.031
	Extent of involvement of implementing agency officials in formulating incentive legislation	11	0.7315	0.006
	Agency staff attitudes toward solar energy	11	-0.6827	0.011
	Number of registered solar lobbyists	10	0.5993	0.034
	Amount of informal interaction with external groups	10	0.7192	0.010
	Extent of influence on implementing agency activities by external groups	10	0.6499	0.021
	Public hearings held on implementing agency plans	11	0.7240	0.006
	Rules and regulations interpreting the solar incentive legislation are specific	8	0.6394	0.044
	Documentation required to verify purchase of solar system	8	0.6712	0.035

Table E-1. STATISTICALLY SIGNIFICANT RELATIONSHIPS BETWEEN IMPLEMENTATION FACTORS AND SUCCESSFUL IMPLEMENTATION OF FINANCIAL INCENTIVE PROGRAMS (Concluded)

Dependent Variable	By Dependent Variable	N	Rho	Sig.
Administrative costs, 1978	Amount of conflict between executive and legislative branches on solar energy matters	9	-0.7145	0.016
	Extent of involvement of implementing agency officials in formulating incentive legislation	9	0.6508	0.029
	Extent of influence on implementing agency activities by external groups	8	0.8660	0.003
	Public hearings held on implementing agency plans	9	0.7717	0.008
Implementation Outcomes				
Time between enactment of legislation and announcement of rules governing eligibility for incentives	Amount of conflict between executive and legislative branches on solar energy matters	15	0.7329	0.001
	Agency staff attitudes toward solar energy	15	0.5394	0.019
	Number of solar lobbyists	14	-0.5932	0.013
	Public hearings held on implementating agency plans	15	-0.6988	0.002
	Rules and regulations interpreting the solar incentive legislation are specific	12	-0.6754	0.008
Number of valid claims as a proportion of all tax returns	Number of solar lobbyists	8	0.8729	0.003

Table E-2. TYPE OF IMPLEMENTING AGENCY BY ADMINISTRATIVE COSTS, 1977

	Administrative Costs, 1977		
Type of Agency	$5,000 or less	more than $5,000	Total
Energy agency	1	2	8
Tax authority or other state agency	7	1	3
TOTAL	8	3	11

*Six of these seven agencies reported no administrative costs associated with implementing the financial incentive.

Table E-3. TYPE OF IMPLEMENTING AGENCY BY STAFF ATTITUDES TOWARD SOLAR ENERGY

	Staff Attitudes				
Type of Agency	Skeptical	Neutral	Moderately Enthusiastic	Very Enthusiastic	Total
Energy agency	0	0	2	1	3
Tax authority or other state agency	3	5	2	2	12
TOTAL	3	5	4	3	15

Table E-4. TYPE OF AGENCY STAFF EXPERTISE BY LENGTH OF TIME TO DEVELOP RULES AND REGULATIONS

Primary Expertise	9 or Less	28	Total
Science and Engineering	2	0	2
Business and Economics	2	6	8
Management and Administration	1	0	1
Mix	2	2	4
TOTAL	7	8	15

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APPENDIX F

RD&D PROGRAMS: QUANTITATIVE ANALYSIS

This appendix consists of a set of tables that summarize results from quantitative analysis of significant relationships for RD&D programs.

Table F-1. STATISTICALLY SIGNIFICANT RELATIONSHIPS BETWEEN IMPLEMENTATION FACTORS AND SUCCESSFUL IMPLEMENTATION OF RD&D PROGRAMS

		N	Rho	Sig
Level of effort				
Number of staff or full time equivalents, 1978	Extent of involvement of external groups in program planning	10	-0.7113	0.011
	Percentage of program funds devoted to demonstration projects	9	-0.7531	0.010
	Percentage of program funds devoted to research projects	9	0.7311	0.013
	RD&D enabling statue is specific	11	-0.6871	0.020
Dollar value of grants and contracts, 1978	Percentage of program funds devoted to development projects	10	0.6483	0.022
Implementation outcome				
Market analyses performed as part of review process for projects intended to enhance commercialization	Amount of organizational change required to implement incentive	12	0.5443	0.034
	Percentage of program funds devoted to demonstration projects	10	-0.5692	0.043
	Percentage of program funds devoted to development projects	10	-0.5710	0.043
	Percentage of program funds devoted to research projects	10	0.7027	0.012
Extent of end user involvement in project selection, ratio of funds cost shared with performer to total amount of grant and contract funds	Extent of involvement of external groups in proposal review	12	0.5774	0.025
	Extent of involvement of external groups in program planning	7	0.9274	0.002
	Extent of involvement of external groups in proposal review	8	0.8724	0.003

Table F-2. PROFESSIONAL BACKGROUND OF IMPLEMENTING AGENCY STAFF BY SIZE OF STAFF, 1978

	Number of Staff or Full Time Equivalents, 1978		
Primary Expertise	1-3	5+	Total
Science and engineering	0	3	3
Business and economics	0	0	0
Management and administration	2	0	2
Mix	4	2	6
TOTAL	6	5	11

Table F-3. PROFESSIONAL BACKGROUND OF IMPLEMENTING AGENCY STAFF BY RATIO OF TOTAL DOLLAR VALUE OF GRANTS AND CONTRACTS, 1978, TO STATE POPULATION

	Ratio of Dollar Value of Grants and Contracts, 1978, To State Population		
Primary Expertise	0-0.033	0.065-0.36	Total
Science and engineering	0	3	3
Business and economics	0	0	0
Management and administration	1	1	2
Mix	5	2	7
TOTAL	6	6	12

Table F-4. SOURCES OF AGENCY FUNDING BY DOLLAR VALUE OF GRANTS AND CONTRACTS, 1978

	Dollar Value of Grants and Contracts, 1978			
Source of Agency Funding	0-$200,000	$200,000 - $500,000	more than $500,000	Total
Annual appropriations and appropriations plus bonds	4	2	2	8
Severance taxes	0	2	0	2
Energy surcharges and surcharges plus bonds	0	0	2	2
TOTAL	4	4	4	12

Table F-5. PROPORTION OF FUNDS ALLOCATED TO DEMONSTRATION PROJECTS BY WHETHER MARKET ANALYSES ARE PERFORMED AS PART OF PROJECT SELECTION PROCESS

	Market Analyses Are Performed		
Percent Allocated to Demonstrations	No	Yes	Total
0-20	3	2	5
40+	5	0	5
TOTAL	8	2	10

Table F-6. TYPE OF IMPLEMENTING AGENCY BY WHETHER MARKET ANALYSES ARE PERFORMED AS PART OF PROJECT SELECTION PROCESS

	Market Analyses Are Performed		
Type of Implementing Agency	No	Yes	Total
Administers most state energy and natural resources RD&D	2	0	2
Administers most state energy RD&D	4	3	7
Administers most state alternative alternative energy RD&D	3	0	3
TOTAL	9	3	12

Table F-7. PROFESSIONAL BACKGROUND OF IMPLEMENTING AGENCY STAFF BY EXTENT OF INVOLVEMENT OF END USERS IN PROJECT SELECTION

	Extent of Involvement of End Users In Project Selection		
Primary Expertise	Low	Moderate	Total
Science and engineering	3	0	3
Business and economics	0	0	0
Management and administration	1	1	2
Mix	5	2	7
TOTAL	9	3	12

Table F-8. TYPE OF IMPLEMENTING AGENCY BY LENGTH OF TIME BETWEEN ENACTMENT OF INCENTIVE AND PROMULGATION OF RULES AND REGULATIONS

Type of Agency	Number of Months Between Enactment and Promulgation of Rules and Regulations: 4 or less	6 or more	Total
Administers most state energy and natural resources RD&D	2	0	2
Administers most state energy RD&D	1	4	5
Administers most state alternative energy RD&D	1	1	2
TOTAL	4	5	9

Table F-9. SOURCE OF AGENCY FUNDING BY LENGTH OF TIME BETWEEN ENACTMENT OF INCENTIVE AND PROMULGATION OF RULES AND REGULATIONS

Source of Agency Funding	Number of Months Between Enactment and Promulgation of Rules and Regulations: 3 or less	4 to 6	8 or more	Total
Annual appropriations	3	3	0	6
Severence tax	0	1	1	2
Energy surcharges and bonds	0	0	1	1
TOTAL	3	4	2	9

Table F-10. SOURCE OF AGENCY FUNDING BY AMOUNT OF PERFORMER COST-SHARING

Source of Agency Funding	Ratio of Performer Funds to State Funds: 0 to 0.5	1 to 3	Total
Annual appropriations and appropriations plus bonds	2	4	6
All other sources	1	1	2
TOTAL	3	5	8

Table F-11. TYPE OF IMPLEMENTING AGENCY BY AMOUNT OF FEDERAL COST-SHARING

Type of Agency	Ratio of Federal Funds to State Funds: 1 or less	greater than	Total
Administers most state energy and natural resources RD&D	1	1	2
Administers most state energy RD&D	5	1	6
Administers most state alternative energy RD&D	2	2	3
TOTAL	7	4	11

APPENDIX G

CODEBOOK

Variable Number	Output Position	Question Number	Question and Response Codes
			PROGRAM ID NUMBER:
VAR001			Type of State Incentive Program 1 = RD&D Program 2 = Financial Program 3 = No incentive program
VAR002			State Name (Alpha coding as name) Alabama Alaska Arizona Arkansas Calif Colorado Conn Delaware Florida Georgia Hawaii Idaho Illinois Indiana Iowa Kansas Kentucky Louisiana Maine Maryland Mass Michigan Minnesota Miss Missouri Montana Nebraska Nevada New Hamp NJersey NMexico New York NCarolina NDakota Ohio Oklahoma

CODEBOOK (Continued)

Variable Number	Output Position	Question Number	Question and Response Codes
			State Name (continued) Oregon Penn RIsland SCarolina SDakota Tennessee Texas Utah Vermont Virginia Washington WVirginia Wisconsin Wyoming Financial 2nd Program in State: 1 = Tax Authority 2 = Energy Agency 3 = Other state agency
SECTION I: BACKGROUND INFO.			
VAR003	1	B1	Type and level of party competition (One response) 1 = One party 1 = Limited two-party 1 = One party dominant 2 = Two-party; strong party cohesion 1 = Two-party; weak party cohesion 2 = Two-party; moderate party cohesion
VAR004	2	B2	Regional leadership and innovativeness among states 3 = Top 1/3 in region 2 = Middle 1/3 in region 1 = Bottom 1/3 in region
VAR005	3	B9	Total SECP funds per capita 1977 (code as $)
VAR006	4	B10	Total SECP funds per capita 1978 (code as $)

CODEBOOK (Continued)

Variable Number	Output Position	Question Number	Question and Response Codes
VAR007	5	B11	Percentage of Coal for electric energy production (code as %) 1976
VAR008	6	B12	Percentage of Oil for electric energy production (code as %) 1976
VAR009	7	B13	Percentage of Natural Gas for electric energy production 1976 (code as %)
VAR010	8	B14	Percentage of Nuclear for electric energy production 1976 (code as %)
VAR011	9	B15	Percentage of Hydro for electric energy production 1976 (code as %)
VAR012	10	B16	Annual average daily terrestrial solar energy received on a horizontal surface average of all reporting sites in state (langleys/day)
VAR013	11	B17	Percentage of total state revenues accounted by income taxes and sales tax (code as %) 1978
VAR014	12	B19	R&D expenditures per capita (code as $) 1977
VAR015	13	B21	State expenditures for energy R&D per capita (code as $)
VAR016	14	B23	Heating degree days, heating season 1975-76 (code as number of days)
VAR017	15	B25	Average cost of electricity in ¢/kW (code as $0.00) 1978
VAR018	16	B27	Average residential gas price, 1976 (code as $)
VAR019	17	B29	State population - 1977 (code as number)
VAR020	18	B31	Population growth rate 77-78 (code as % gain + and loss -)
VAR021	19	B33	Total state expenditures per capita 1977 (code as thousands of $)
VAR022	20	B34	Total state expenditures per capita 1978 (code as thousands of $)

CODEBOOK (Continued)

Variable Number	Output Position	Question Number	Question and Response Codes
VAR023	21	B39	Average per capita income 1976 (code as $)
VAR024	22	B40	Average per capita income 1977 (code as $)
VAR025	23	B43	Intergovernmental revenues from the federal government per capita, 1977 (code as thousands of $)
VAR026	24	B44	Energy consumption - Residential 1975 (code as number)
VAR027	25	B45	Energy consumption - Commercial 1975 (code as number)
VAR028	26	B46	Energy consumption - Industrial 1975 (code as number)
VAR029	27	B47	Energy consumption - Transportation 1975 (code as number)
VAR030	28	B48	Line/Conversion loss 1975 (code as number)
VAR031	29	B49	Total energy consumption 1975 (code as number)
VAR032	30	B50	Total energy consumption 1976 (code as number)
VAR033	31	B51	Per capita energy consumption 1976 (code as thousands)
VAR034	32	B52	Average annual growth in per capita energy consumption 1960-1976 (code as % gain + and loss-)
VAR035	33	B53	Existing solar collectors per capita in 1978 (code as number)
VAR036	34	B54	Average residential heating oil price (code as $) November 1978
VAR037	35	B55	Residential housing starts - 1977 (code as number)
VAR038	36	B56	Residential housing starts - 1978 (code as number)
VAR039	37	B57	Buying power index 1977 (code as number)
VAR040	38	B58	Government surplus/deficit per capita, 1977 (code as thousands of $ and as - for deficit)

CODEBOOK (Continued)

Variable Number	Output Position	Question Number	Question and Response Codes
VAR041	39	B59	Coal reserves per capita (code as number of tons)
VAR042	40	B60	Natural gas reserves per capita (code as number of cubic feet)
VAR043	41	B61	Oil reserves per capita (code as number of barrels)
VAR044	42	B62	Total energy produced per capita 1975 (code as number of Btu)
VAR045	43	B63	Percentage of urban population in state, 1970 (code as %)

SECTION II: RD&D PROGRAM INFO.

VAR100	1R	R1 (F1)	Implementing agency funds have been appropriated Y = Yes N = No
VAR101	2R	R2 (F2)	Staff to implement program have been designated and/or hired and are in place Y = Yes N = No
VAR102	3R	R3 (F3)	Amount of organizational change required to implement incentive 1 = Minor change of responsibility of existing agency 2 = Major change of responsibility of existing agency 3 = New agency created
VAR103	4R	R6 (F5)	Amount of conflict between executive and legislative branches in general H = High M = Medium L = Low
VAR104	5R	R7 (F6)	Amount of conflict between executive and legislative branches on solar energy matters H = High M = Medium L = Low

CODEBOOK (Continued)

Variable Number	Output Position	Question Number	Question and Response Codes
VAR105	6R	R8 (F7)	Extent of involvement of implementing agency officials in formulation of legislative basis for solar RD&D program H = High M = Medium L = Low
VAR106	7R	R9 (F8)	Formal advisory arrangements exist with external groups (solar lobbyists, industry groups, universities) Y = Yes N = No
VAR107	8R	R11 (F13)	Type of agency staff expertise: primarily 1 = Science and engineering 2 = Business and economics 3 = Management and administration 4 = Mix
VAR108	9R	R12 (F14)	Agency staff attitudes toward solar energy 1 = Very enthusiastic 2 = Moderately enthusiastic 3 = Neutral 4 = Skeptical
VAR109	10R	R18	Total program costs - 1977 (code as $)
VAR110	11R	R18 (F15)	Total program costs - 1978 (code as $)
VAR111	12R	R19 (F16)	Number of full-time staff devoted to implementing solar incentive as of January 1, 1977 (code as number of FTEs)
VAR112	13R	R19 (F16)	Number of full-time staff devoted to implementing solar incentive as of January 1, 1978 (code as number of FTEs)
VAR113	14R	R20 (F17)	Administrative costs associated with implementing solar incentive programs in 1977 (code as $)
VAR114	15R	R20 (F17)	Administrative costs associated with implementing solar incentive programs in 1978 (code as $)
VAR115	16R	R25 (F23)	Number of registered solar lobbyists (code as number)

CODEBOOK (Continued)

Variable Number	Output Position	Question Number	Question and Response Codes
VAR120	17R	R4	Type of implementing agency 1 = Administers most state energy and natural resources RD&D 2 = Administers most state energy RD&D 3 = Administers most state alternative energy RD&D 4 = Non-RD&D agency
VAR121	18R	R5	Sources of agency funding 1 = Annual appropriation 2 = Special fund (e.g., trust fund) from which annual appropriations are drawn 3 = Severance tax 4 = Energy surcharge 5 = Bonds 6 = Annual appropriations and bonds 7 = Energy surcharge and bonds
VAR122	19R	R10	Extent of involvement of external groups (solar lobbies, industry and trade association, universities) in a) program planning H = High M = Medium L = Low
VAR123	19R	R10	b) proposal review H = High M = Medium L = Low
VAR124	19R	R10	c) program selection H = High M = Medium L = Low
VAR125	19R	R10	d) project monitoring H = High M = Medium L = Low
VAR126	19R	R10	e) project evaluation H = High M = Medium L = Low

CODEBOOK (Continued)

Variable Number	Output Position	Question Number	Question and Response Codes
VAR127	20R	R13	Nature of formal program planning activity 1 = Mandated by legislature 2 = Required by agency head 3 = Lack of formal planning 4 = Mandated by legislature and lack formal planning
VAR128	21R	R14	For projects intended to enhance commercialization, market analyses are performed as part of project selection or proposal review process Y = Yes N = No
VAR129	22R	R15	Extent of end user involvement in project selection or proposal review process (how does involvement occur?) H = High M = Medium L = Low
VAR130	23R	R16	Focus of information dissemination activities concerning results of RD&D projects: 1 = RD&D staff activity 2 = Non-RD&D staff in agency 3 = Performer of RD&D on project-by-project basis 4 = Other outside group (e.g., university) 5 = RD&D staff activity and non-RD&D staff activity 6 = Performer of RD&D activity and other outside group 7 = RD&D staff activity and performer activity
VAR131	24R	R17	Funds allocated for RD&D information dissemination (code as $)
VAR132	25R	R21	Number of grants or contracts awarded in 1977 (code as number)
VAR133	26R	R21	Number of grants or contracts awarded in 1978 (code as number)
VAR134	27R	R22	Number of proposals received in 1977 (code as number)
VAR135	28R	R22	Number of proposals received in 1978 (code as number)

CODEBOOK (Continued)

Variable Number	Output Position	Question Number	Question and Response Codes
VAR136	29R	R23	Number of proposals processed in 1977 (code as number)
VAR137	30R	R23	Number of proposals processed in 1978 (code as number)
VAR138	31R	R24	Proportion of program funds devoted to demonstration—demonstrating a working technology to the market (code as %)
VAR139	33R	R24	Proportion of program funds devoted to development—bringing a technology to the point of demonstration (code as %)
VAR140	33R	R24	Proportion of program funds devoted to research—developing promising ideas (code as %)
VAR141	34R	R26	Time from enactment of incentive to first award (code as number of months)
VAR142	35R	R27	Total dollar value of grants and contracts awarded - 1977 (code as $)
VAR143	36R	R27	Total dollar value of grants and contracts awarded - 1978 (code as $)
VAR144	37R	R28	Time from enactment of legislation to official announcement of rules and regulations governing award of RD&D grants and contracts (code as number of months)
VAR145	38R	R29	Ratio of funds cost-shared with performer to total grants and contract funds (code as the performer's portion of the ratio only)
VAR146	39R	R30	Ratio of funds cost-shared with federal government to total grant and contract funds (code as the federal government's portion of the ratio only)

CODEBOOK (Continued)

Variable Number	Output Position	Question Number	Question and Response Codes
VAR147	40R	R31	State solar energy RD&D enabling statute specificity (code as number of specific items included in enabling statute: definition of solar, renewable, or alternative energy; grant or contract recipient eligibility guidelines; program goal or objectives statements; proposal review and selection process; program planning guidance).

SECTION III: FINANCIAL PROGRAM INFO.

Variable Number	Output Position	Question Number	Question and Response Codes
VAR200	1F	F1 (R1)	Implementing agency funds have been appropriated Y = Yes N = No
VAR201	2F	F2 (R2)	Staff to implement program have been designated and/or hired Y = Yes N = No
VAR202	3F	F3 (R3)	Amount of organizational change required to implement incentive 1 = Minor change of responsibilities of existing agency 2 = Major change of responsibilities of existing agency 3 = New agency created
VAR203	4F	F5 (R6)	Amount of conflict between executive and legislative branches in general H = High M = Medium L = Low
VAR204	5F	F6 (R7)	Amount of conflict between executive and legislative branches on solar energy matters H = High M = Medium L = Low
VAR205	6F	F7 (R8)	Extent of involvement of implementing agency officials in formulating financial incentive legislation H = High M = Medium L = Low

CODEBOOK (Continued)

Variable Number	Output Position	Question Number	Question and Response Codes
VAR206	7F	F8 (R9)	Formal advisory arrangements with external groups exist (solar lobbies, industry groups, universities) Y = Yes N = No
VAR207	8F	F13 (R11)	Type of agency staff expertise: primarily 1 = Science and engineering 2 = Business and economics 3 = Management and administration 4 = Mix
VAR208	9F	F14 (R12)	Agency staff attitudes toward solar energy 1 = Very enthusiastic 2 = Moderately enthusiastic 3 = Neutral 4 = Skeptical
VAR209	10F	F15 (R18)	Total program costs (solar program only) 1977 (code as $)
VAR210	11F	F15 (R18)	Total program costs (solar program only) 1978 (code as $)
VAR211	12F	F16 (R19)	Number of full-time staff devoted to implementing solar incentive - as of January 1, 1977 (code as number of FTEs)
VAR212	13F	F16 (R19)	Number of full-time staff devoted to implementing solar incentive - as of January 1, 1978 (code as number of FTEs)
VAR213	14F	F17 (R20)	Administrative costs associated with implementing solar incentive program - 1977 (code as $)
VAR214	15F	F17 (R20)	Administrative costs associated with implementing solar incentive program - 1978 (code as $)
VAR215	16F	F23 (R25)	Number of registered solar lobbyists (code as number)
VAR220	17F	F4	Type of implementing agency 1 = State energy agency 2 = State tax authority 3 = Other state agency

CODEBOOK (Continued)

Variable Number	Output Position	Question Number	Question and Response Codes
VAR221	19F	F10	Amount of informal interaction with external groups (solar lobbies, industry and trade associations, universities) H = High M = Medium L = Low
VAR222	20F	F11	Extent of influence on implementing agency activities due to informal interaction with external groups H = High M = Medium L = Low
VAR223	21F	F12	Public hearings have been held on implementing agency plans Y = Yes N = No
VAR224	22F	F18	Number of applications or claims processed in 1977 (code as number)
VAR225	23F	F18	Number of applications or claims processed in 1978 (code as number)
VAR226	24F	F19	Average time required to process a claim (code as hours)
VAR227	25F	F20	Time between enactment of legislation and first claim processed (code as number of months)
VAR228	38F	F24	Time between enactment of legislation and official announcement of rules governing eligibility for financial incentive (code as number of months)
VAR229	39F	F25	Number of valid claims processed in 1977
VAR230	40F	F25	Number of valid claims processed in 1978
VAR231	41F	F26	Total number of individual state tax returns 1977
VAR232	42F	F26	Total number of individual state tax returns 1978

CODEBOOK (Continued)

Variable Number	Output Position	Question Number	Question and Response Codes
VAR233	43F	F27	Are rules and regulations interpreting the solar incentive enactment specific? Y = Yes N = No
VAR234	44F	F28	Documentation needed to verify acquisition of qualified solar application Y = Yes N = No
VAR235	26F	F21	Median income of person applying for claim in 1977 (code as $)
VAR236	27F	F21	Median income of person applying for claim in 1978 (code as $)
VAR237	30F	F22	Percentage of claims for passive technologies in 1977
VAR238	31F	F22	Percentage of claims for passive technologies in 1978
VAR239	32F	F22	Percentage of claims for active technologies in 1977
VAR240	33F	F22	Percentage of claims for active technologies in 1978
VAR241	36F	F22	Percentage of claims for manufactured systems in 1977
VAR242	37F	F22	Percentage of claims for manufactured systems in 1978
VAR243	45F	F29	Ratio of number of claims processed as a proportion of state solar installations - 1977

SECTION IV: DERIVED VARIABLES

Normalized Level of Effort ÷ RD&D

VAR300	1D	R18/B33	Total program costs as a proportion of total state expenditures - 1977
VAR301	2D	R18/B34	Total program costs as a proportion of total state expenditures - 1978

CODEBOOK (Continued)

Variable Number	Output Position	Question Number	Question and Response Codes
VAR302	3D	R27/B33	Total dollar value of contracts and grants awarded as a proportion of total state expenditures - 1977
VAR303	4D	R27/B34	Total dollar value of grants and contracts awarded as a proportion of total state expenditures - 1978
VAR304	5D	R18/B29	Total program costs as a proportion of state population - 1977
VAR305	6D	R18/B29	Total program costs as a proportion of state population - 1978
VAR306	7D	R27/B29	Total dollar value of contracts and grants awarded as a proportion of state population 1977
VAR307	8D	R27/B29	Total dollar value of contracts and grants awarded as a proportion of state population 1978
			<u>Normalized Level of Effort - Financial</u>
VAR308	1D	F15/B33	Total program costs as a proportion of total state expenditures - 1977
VAR309	2D	F15/B34	Total program costs as a proportion of total state expenditures - 1978
VAR310	5D	F15/B29	Total program costs as a proportion of state population - 1977
VAR311	9D	F18/B33	Number of claims processed as a proportion of total state expenditures - 1977
VAR312	10D	F18/B34	Number of claims processed as a proportion of total state expenditures - 1978
VAR313	11D	F18/B29	Number of claims processed as a proportion of state population - 1977
VAR314	12D	F25/F18	Number of valid claims as a proportion of total claims processed - 1977
VAR315	13D	F25/F18	Number of valid claims as a proportion of total claims processed - 1978
			<u>Administrative Costs - RD&D</u>
VAR316	14D	R20/R21	Administrative costs per grant or contract processed - 1977

CODEBOOK (Continued)

Variable Number	Position	Output Number	Question / Question and Response Codes
VAR317	15D	R20/R21	Administrative costs per grant or contract processed - 1978
VAR318	16D	R20/R27	Administrative costs per dollar cost of program 1977
VAR319	17D	R20/R27	Administrative costs per dollar cost of program 1978
VAR320	18D	R19/R23	Number of staff (FTEs) per grant or contract processed - 1977
VAR321	19D	R19/R23	Number of staff (FTEs) per grant or contract processed - 1978
VAR322	20D	R19/R27	Number of staff (FTEs) per dollar cost of program - 1977
			Administrative Cost - Financing
VAR323	14D	F17/F18	Administrative costs per claim processed - 1977
VAR324	15D	F17/F18	Administrative costs per claim processed - 1978
VAR325	16D	F17/F15	Administrative costs per dollar cost of program 1977
VAR326	17D	F17/F15	Administrative costs per dollar cost of program 1978
VAR327	18D	F16/F18	Number of staff (FTEs) per claim processed 1977
VAR328	19D	F16/F18	Number of staff (FTEs) per claim processed 1978
VAR329	20D	F16/F15	Number of staff (FTEs) per dollar cost of program - 1977
VAR330	21D	F16/F15	Number of staff (FTEs) per dollar cost of program - 1978
			Implementation
VAR331	22D	R27	Percent increase in total dollar value of grants and contracts awarded between 1977 and 1978
VAR332	23D	F25/F26	Number of valid claims processed as a proportion of total number of state tax returns - 1977
VAR333	24D	F25/F26	Number of valid claims processed as a proportion of total number of state tax returns - 1978
VAR334	25D	F18	Percentage increase in number of claims processed between 1977 and 1978

CODEBOOK (Concluded)

Variable Number	Output Position	Question Number	Question and Response Codes
VAR335	26D	F25	Percent increase in number of valid claims processed between 1977 and 1978
VAR336	27D	F21/B39	Ratio of average adjusted gross income of claimant to average state per capita income 1977
VAR337	28D	F21/B40	Ratio of average adjusted gross income of claimant to average state per capita income 1978
VAR338	29D	F18/B53	Ratio of number of claims processed to proportion of state solar installations - 1977

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15. Supplementary Notes

16. Abstract (Limit: 200 words)

This report summarizes the results of a research investigation of solar financial and research, demonstration, and development (RD&D) incentive programs in 18 states. The investigation focuses upon implementation -- the organization and administrative processes required to convert a law into a viable program. Eleven financial and 12 RD&D programs were investigated. Results indicate that four conditions are common to successful implementation of both types of incentive programs: the opportunity to use solar energy as a heating source; characteristics of the agency selected to complement the law; involvement of outside groups in program implementation; and the specificity of guidance given to those responsible for implementation. Other conditions specific to the implementation of each type of program are discussed as well as the implications of these findings for state and federal policy makers.

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