MASTER

Making Solar Laws Work

A Study of State Solar Energy Incentives

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Executive Summary

SERI

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Making Solar Laws Work

A Study of State Solar Energy Incentives

Volume 1: Executive Summary

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FOREWORD

This is an executive summary of a report that describes the results of an 18-month study of solar financial incentive and RD&D programs in 18 states. The study was part of a series of studies undertaken by the Solar Energy Research Institute (SERI) and sponsored by the U.S. Department of Energy (DOE), 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., 1979. The Implementation of State Solar Incentives: A Preliminary Assessment, SERI/TR-51-159, Golden, CO, Solar Energy Research Institute) surveyed the major state solar programs and reached preliminary conclusions about the issues central 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 this 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 study is scheduled for completion in late 1980.

We wish to thank many persons for their contributions to this study. 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 benefited greatly from these persons' criticisms and suggestions, but the authors bear responsibility for the quality of the final product.

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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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A NOTE TO THE READER

This executive summary is divided into two sections. For a quick overview of the major findings of the study and a discussion of their implications for state and federal solar incentive programs, read the first section of this summary. The second section includes the findings in greater detail and summary tables of the data and analytical findings. For greater detail, including all data tabulations and a full presentation of the study's background, research design, data collection strategy, and findings, read the full technical report, Volume II, which bears the same title and SERI number as this executive summary.

SECTION 1.0

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

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 lacking 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. It was not the type of agency per se that mattered, but 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 tradeoffs 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.

FINANCIAL INCENTIVES: FINDINGS AND CONCLUSIONS

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.

*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.

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 in encouraging or even requiring 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 the results outlined earlier are also desirable (i.e., technical specificity and rapid implementation), 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 comprising 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 than

*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.

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.

FINDINGS AND CONCLUSIONS: RD&D PROGRAMS

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 only on 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 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 and award procedures more rapidly than programs funded through surcharges or severance taxes, perhaps due to the increased time pressures that periodic accountability to the legislature can bring. 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 then 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.

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. The mechanism for providing public funds to support a solar RD&D program has important implications for program 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 as well. 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 staff. Implementing-agency staff with a mix of backgrounds—engineering and science,

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

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.

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 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 similarly 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 2.0

DETAILED SUMMARY OF DATA AND FINDINGS

INTRODUCTION

This section summarizes the data and findings of a study of the implementation* of state programs intended to stimulate demand for solar energy systems. Research was restricted to selected research, development, and demonstration (RD&D) programs and financial incentive programs initiated and supported by the states. Of the approximately 17 states that have solar energy RD&D programs, 12 were selected for intensive study; of the more than 60 programs of financial incentives directed toward solar applications, 11 (primarily income tax credits) were selected. The objective of the study was to identify factors associated with successful and less successful implementation of these incentive programs.

The project's objectives reflected the assumption that the steps taken to execute a policy—its implementation—are as significant for achievement of policy objectives as the design of the policy itself. Our analysis focused on measures of "implementation success" and on the relationships between these effects and a variety of factors that describe the way particular state solar energy initiatives have been executed through administrative action.

Our analysis sought to identify what difference a variety of factors identified in the implementation literature** and in related SERI work made for successful implementation of solar incentive legislation. Examples of such factors are the type of implementing agency (energy office, tax authority, other state agency), source of funding, staff characteristics, extent of interaction with outside groups, specificity of original legislation and of rules and regulations, amount of documentation required for tax credit claims, and type of RD&D award procedure. In addition, we were interested in whether implementation success was more a matter of favorable climate, rising relative fuel costs, and energy availability than of the way solar incentive programs were administered.

Data were collected during the spring and summer of 1979 from a variety of sources in each of 18 states (Tables 2-1 and 2-2). Teams of two researchers visited each state in which an incentive program to be studied was located. Data were collected from archival sources (usually agency reports, budget documents, and internal analyses), from interviews, and from observation. Typically, interviews were held with three to four staff members of the agency responsible for implementing the incentive, two to three legislators and/or key legislative staff, and two to three knowledgeable persons outside the government such as university researchers, heads of solar interest groups, and the

*Implementation is 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 requirements; the development of administrative procedures and practices; and the establishment of organizational responsibilities and institutional arrangements.

**See, for example, Hargrove (1975), Van Meter and Van Horn (1975), and Elmore (1978).

Table 2-1. 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 Commission Department of Housing and Community Development
	1978	Loan Terms	
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 and Taxation
	1976	Deduction-Business	
	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 and Revenue
	1977	Tax Credit—Irrigation	
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 2-2. RD&D PROGRAMS STUDIED

State	Year of Enactment	Source of Funds	Implementing Agency
Arizona	1977	GR[a]	Arizona Solar Energy Research Commission
Colorado	1974	GR	Colorado Energy Research Institute
California	1974	EUT[b]	California Energy Resources, Conservation & Development Commission
Florida	1974	GR	Florida Solar Energy Center
Hawaii	1974	GR/B[c]	Department of Planning and Economic Development
Maine	1975	GR	Maine Office of Energy Resources
Montana	1975	ST[d]	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[e]

Source: Franklin Institute 1978; National Conference of State Legislatures 1978.

[a]GR is general revenue.

[b]EUT means energy use tax.

[c]B is bonds.

[d]ST stands for severance tax.

[e]Now the Texas Energy and Natural Resources Advisory Council.

press. The findings reported here therefore refer to conditions in the states visited as of the summer of 1979.

Measures of implementation success used in the research indicated scale or level of effort (e.g., cost of the program to the treasury and number of staff), administrative costs, and implementation outcomes. For state solar financial incentive programs, implementation outcomes were measured by:

- time required for the implementing agency to develop and formally introduce rules and regulations governing eligibility for the incentive;
- ratio of number of solar income tax credit claims processed to number of solar systems installed during 1977; and
- ratio of number of valid claims processed to total number of tax returns filed in 1977.

For state solar RD&D programs, implementation outcomes were measured by:

- the extent of user involvement in the RD&D project selection process;
- whether market analyses were performed as part of the selection process for projects intended for commercialization;
- time required for the implementing agency to develop and formally introduce rules and regulations governing eligibility for RD&D funds, application procedures, and project selection processes and criteria;
- proportion of cost sharing with RD&D performer;
- proportion of cost sharing with the federal government; and
- percentage increase in dollar value of grants and contracts from 1977 to 1978.

Administrative and organizational factors expected to influence implementation success were identified from the literature on implementation, from the earlier pilot study of state solar incentive programs (Ashworth 1979), and from discussions with state solar energy officials. Table 2-3 lists factors that are common to both RD&D and financial incentive programs.

DESCRIPTION OF STATE SOLAR FINANCIAL INCENTIVE PROGRAMS

In late 1978 when this project was initiated, 5 kinds of solar financial incentive programs were being implemented in the 11 study states: 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 2-1.

The most frequent type of solar financial incentive was the income tax credit for individuals. Nine of the eleven states had such incentives; 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 analysis were derived from agencies implementing this type of program. In 2 of the 11 states studied the principal solar financial incentive to be implemented was a loan program; therefore, in these states the agencies responsible for the loan program provided data on implementation.

Table 2-3. 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	

In the 11 study states, a total of 15 state agencies were responsible for implementing solar or alternative energy financial incentive programs. Of the nine study states with some form of income tax credit, two states 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 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 program. A major change was required in one of the two remaining agencies, and the second agency was entirely new. Thus, responsibility for implementing solar financial incentives usually was not perceived to be a major burden for the agency. Conflict between the executive and legislative branches on solar energy was minimal in 8 of the 11 study states and high in 1 state. Some conflict was acknowledged in the remaining two states. Consequently, political controversy did not significantly affect the implementation of financial incentives. The patterns in the amounts of conflict suggest that solar energy was not an issue that created unusual political controversy.

Only 6 of the 15 implementing agencies had 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 10 agencies, the incentive program was being implemented with less than 1 FTE in 2 agencies and with none formally designated in 6 others. (Two agencies did not provide information about staffing).

The dollar value of claims made in 1977 under solar income tax programs, excluding administrative costs, ranged from $0 to $11 million for the eight agencies reporting data (See Table 2-4). The median cost was $46,200. Seven of the eight reported 1977 administrative costs ranging from $0 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. The level of activity in these other programs was low, and state officials showed little interest 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 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 2-4 presents information on claims processed for tax year 1977, dollar value of claims, and other available data for the six states. The numbers of valid claims ranged from 9 to 16,000 with a median of 173. The very large amount of California's dollar claims and the number of claims made for the tax year 1977 are largely due to claims for active pool heating and/or 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 active pool heating and/or covers. When 1978 data for both the number of aggregate claims applications and the number of valid claims processed become available, there

Table 2-4. 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). Differences in definition of a "solar system" between states and the Solar Energy Institute of North America account for much of the discrepancy between numbers of claims and estimates of the number of installations during 1977 and the number of systems in place in 1978.

[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 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" (Jan. 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).

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will be a more valid basis for comparative assessments of the consequences of different amounts of tax credits and definitions of eligible systems.

EFFECTS OF STATE BACKGROUND CONDITIONS ON IMPLEMENTATION OF FINANCIAL INCENTIVE PROGRAMS

Successful implementation of state solar incentives undoubtedly depends on the socioeconomic, political, and climatic conditions 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, low levels of interparty competition, 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.

We first correlated 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 18 states studied differed from those of the remaining states. 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 about 50 were statistically significant and included a sufficient number of cases to be meaningful.

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 outcomes proved significant, but no clear 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 indicates the staff skills of the implementing agency and the degree of consensus and political support for the incentive. States with high levels of insolation appear to be states which have a well-staffed implementing agency and political backing for the incentive, but these are not states with high heating requirements.

Because study states in late 1978 generally exhibited more solar activity than nonstudy states, we expected (and subsequently found) that background conditions differentiating states with relatively successfully implemented solar programs would differentiate also between study and nonstudy states. Compared with 39 other states, the 11 states with

significant solar financial incentives exhibited few of the expected relationships, 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 a regional leaders and as more innovative than their neighbors in past studies of innovation among states. It is important to note that state solar financial incentive activity does not, in general, appear to be a consequence of energy cost, availability, or rates of consumption.

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

This section summarizes an analysis of relationships between the ways 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 was emphasized in the analysis. In addition to the administrative and organizational factors expected to influence both financial and RD&D programs, several 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.

The analysis combined statistical tests of significance between measures of organizational and administrative factors and measures of implementation success with qualitative analysis based on interviews and observations in the states studied.

State solar financial incentive legislation and successfully implemented solar financial incentive programs result from different forces acting on state policy makers and administrators. The passage of incentive legislation may be politically symbolic and significant for increased solar applications. 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 incentives, there were few property assessors skilled in appraising solar applications to execute the law locally. In fact, in these states most local building officials did not know there were state solar property tax laws. Sales and use taxes have minimal fiscal impact and, therefore, the taxes often are enacted for symbolic reasons. This incentive resulted in minimal efforts to implement it. 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 successful implementation are possible now. Business solar tax credits* are rare, and 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 minimal effort has been devoted to their implementation.

*Business credits were offered to businesses purchasing solar systems rather than to manufacturers, dealers, or installers of systems.

Solar income tax credits directed toward individuals proved to be the most significant incentive in terms of implementation activity and fiscal impact. Choice of a reimbursement mechanism and the complexity of the rules and regulations governing eligibility depended on a state's size and its historical pattern of use of fiscal instruments to achieve policy goals.

The type of agency selected to implement solar 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 party 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. 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 tax credits as part of their mission, lacked the 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.

Table 2-5 summarizes the findings of analyses 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. These large staffs were heavily involved in the formulation of the incentive legislation, were favorably disposed toward solar energy, and enjoyed a political setting exhibiting little conflict between the executive and legislative branches over solar energy issues. In most cases, the characteristics of large staffs 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 (written when energy agencies were involved in implementation) 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 (See Table 2-6). The median adjusted gross income of solar claimants is high, reflecting both the high initial capital cost of solar systems and the attraction of higher-income taxpayers to tax credits. Large differences in the size of tax credits in these six states had little influence on the percentage of increase in installed solar systems between 1977 and 1978, 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 we can draw.

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 varied greatly in their governor's stance toward solar energy incentives, and the election of a new governor often led to large changes in incentive legislation and partially implemented programs. On the other hand, legislatures rarely paid much attention

Table 2-5. SUMMARY OF FINDINGS FOR FINANCIAL PROGRAMS: RELATIONSHIP BETWEEN ORGANIZATIONAL AND ADMINISTRATIVE FACTORS AND MEASURES OF IMPLEMENTATION SUCCESS

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	NS

[a] NS means not significant.
[b] Symbols + and - indicate direction of significant relationship.
[c] ID denotes insufficient data.
[d] X stands for significant relationship.
[e] NA means not available.

Table 2-6. 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	NA[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	NA
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" (Jan. 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" (Apr. 1979).

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to a financial incentive once the legislation was passed, especially to a solar financial incentive whose impact on the treasury of most states was small.

DESCRIPTION OF RD&D PROGRAMS IN SELECTED STATES

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 value of about $700,000. In 1978, the range was from $16,000 to $6.4 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 (See Table 2-7).

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.

State-generated program funds can be used to lever federal, private, or other government RD&D funds on a matching or cost-sharing basis. Based on data from eight programs, RD&D performers contributed, on the average, a dollar of their own funds for every dollar of state funds for solar RD&D projects. State solar programs attracted on the 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.

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 these programs overall allocated approximately equal resources to each type of activity, the variation among states was very large (see Table 2-8). This finding is inconsistent with our expectation that state RD&D programs would emphasize applied research and demonstrations. Though National Science Foundation definitions for research and development were used in our field work, respondents may have introduced a systematic bias toward research-oriented answers 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.

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 relatively urbanized, growing, wealthy states that have had a history of high levels of spending for RD&D programs. States with large programs face relatively high

Table 2-7. STATE SOLAR RD&D PROGRAMS: PER CAPITA EXPENDITURES, 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	0.22	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; California: 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, January 1979.

Table 2-8. 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
Maine	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
Texas19	48	33	
TOTAL	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, New York State Energy Research and Development Authority, Jan. 1, 1979; North Carolina: Correspondence from North Carolina Energy Institute, July 1980; Texas: Texas Energy Advisory Council interviews.

costs for electricity and tend to produce more of their electical 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. These states enjoy high levels of insolation.

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, administrative costs tended to be high in states that could afford it: they had relatively larger government surpluses, higher per capita incomes, and lower electricity and natural gas prices.

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 limitations in the number of cases for many variables render 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.

The 12 states studied with solar RD&D programs enjoy significantly more insolation than other states and, as expected, they spend more on energy RD&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 from 1960 to 1976) showed no significant relationship to solar activity. These results suggest that state solar RD&D activity is not, in general, a consequence of economic, political, demographic, or climatic conditions.

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

This section describes the results of an analysis of relationships between the organization and administration of solar RD&D programs by states and the extent to which those programs have been successfully implemented. Specific measures of organizational and administrative factors likely to affect implementation success include those listed in Table 2-3 as well as these factors unique to the implementation of solar RD&D programs:

- 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?

Table 2-9 summarizes the significant relationships described in the preceding subsections. It is apparent that three things influence 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 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 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. Programs within larger states with more highly differentiated bureaucratic structures 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 funds' 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. However, 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 2-9. SUMMARY OF FINDINGS FOR RD&D PROGRAMS: RELATIONSHIP BETWEEN ORGANIZATIONAL AND ADMINISTRATIVE FACTORS AND MEASURES OF IMPLEMENTATION SUCCESS

Organizational and Administrative Factors	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 Background 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 Informal Interaction of External Groups with 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	+[d]	NS	-	NS	ID	ID	NS	ID
Percentage of Funds for Demonstration	-[d]	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] Symbols + and - indicate direction of significant relationship.

SECTION 3.0

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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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a. Descriptors Demonstration Programs ; Energy Policy:T2 ; Financial Incentives:Q1,Q3 ; Implementation ; Legal Incentives:Q1 ; Legislation ; Research Programs ; Solar Energy:T1 Solar Heating ; State Government:Q1,T3 ; Tax Laws ; Energy ; Energy Sources ; Government

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