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THE HAWAII EXPERIENCE 1970-1980

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DECENTRALIZED ENERGY DEVELOPMENT: THE HAWAII EXPERIENCE 1970-1980

By

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ABSTRACT

DECENTRALIZED ENERGY DEVELOPMENT:
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A multifaced debate over centralized versus decentralized renewable systems will certainly be the major element in any national renewable energy policy-making. With diverse renewable energy resources occurring in different forms and quantities in different parts of the country, the vulnerability of centralized energy policy control seems apparent. Typically, Federal organizations and agencies have developed policy research and analysis that do not emphasize particular climatic, socio-economic, and natural resource characteristics of specific regions. A decentralized energy policy implies a heightened planning and programming capacity for local communities, states and regions. However, if communities, states and regions are to become increasingly responsible for energy policy, they will need not only to develop the necessary technical expertise but also efficient structures to initiate and implement these policies. There are few legal precedents and almost no no organizational precedents in preparing such systems. A

number of obstructions stand in the way of development. These are listed under the headings of education, financial, marketing, legal, utility, regulatory, technical, policy and social. The intent of the study is to develop a model system to deal with these barriers. The method will be to analyze Hawaii's alternative energy program and compare it to several other developing programs to isolate workable methods and organizational structures. The results will be useful to planners and programmers of future local, state or regional units attempting to develop and implement their own energy policy. In this study, it was found that a successful program of decentralization most likely would contain the following components:

a) The education of the public concerning potential alternatives and the possible means to develop them.

b) The organization of committees to involve the community in problem solving and development of the resource.

c) The procuring of funds to finance research and development of the alternatives.

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INTRODUCTION

Problem Setting

Perhaps the most important energy question today concerns the transition from concentrated, non-renewable energy sources to more diffuse, sustainable sources and what the implications of such a transition will be for our future way of life. Unquestionably in such a change, a vastly greater decentralization of energy programs is needed from the federal to regional, state, and local levels of government. The traditional fossil energies have required a centralized control. Distribution, international supply acquisition and extraction controls all necessitate federal jurisdiction. Some energy sources are necessarily centralized because of the engineering efficiencies possible with increased scale; others are inherently dangerous energy sources which can be permitted widespread growth only under strict federal control. Additionally, a great deal of capital is usually required to find the energy source, to recover it, and to transport it. Local regional groups or individuals generally do not have the financial ability to maintain their own supplies. Recently, however, the non-renewability of supplies, high costs due to shortages, and potential environmental concerns have directed energy

managed by a decentralized control.

With the United States currently relying on fossil fuels for more than 90 percent of its energy requirements, change will require major shifts in organization and procedures. The renewable energy resources are inherently diverse. They occur in different forms and quantities in different parts of the country. At all levels from federal to local, renewable energy planners and programmers will need to design new organizations and modify existing ones in ways that will meet the new system's developing needs. Presently there are few legal precedents, and almost no organizational precedents for regional energy development. There remain numerous unanswered questions about how decentralization of this energy decision-making will proceed. Evaluation of the few embryo programs must occur in order to isolate the components and structures that facilitate decentralized energy development. This information may be used in designing other regional programs and accelerate the overall ability of the United States to supply its future energy needs.

Objective

This paper will perform policy research and analysis of existing programs to identify barriers to regional, state, and local energy development. The aim is to provide local authorities the organizational structure to:

1. Establish policies and devise strategies for replacing dwindling fossil fuels with renewable resources.

2. Promote the incentives that will encourage alternative energy development.

3. Determine the barriers to and necessities for the development of alternative energies.

4. Formulate strategies that would reduce those barriers.

The problem involves the elimination of laws, procedures, perceptions, and practices which prevent decentralized systems from competing on an equal basis with conventional forms of energy. Many of the barriers to be identified do not require (and probably would not be responsive to) financial incentives. Most are questions of land-use planning, zoning, and administrative procedure, rather than of barriers within the energy marketplace. Those factors dealing with the marketplace, however, must be considered. Due to the essential nature of energy requirement, reliance solely upon free market commercialization may be a luxury the poor cannot afford. Development must proceed at a rate which may in fact be faster than the free market would have allowed, but necessitated by the needs of society. The Domestic Policy Review of Solar Energy concludes that,

> Actions at all levels of government and by large numbers of individuals and groups will certainly be required to achieve significant solar penetration.[1]

In establishing procedures to encourage alternative energy development, the ability to overcome barriers will receive

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[1]U.S. Department of Energy, Renewable Energy Development: Local Issues and Capabilities. (Washington, D.C.: U.S. Government Printing Office, January 1980), p. 1.

the major consideration. If these barriers cannot be efficiently dealt with, regional, state, and local energy authorities will be so in name only.

The major barrier to be overcome will be the resistance of traditional energy supplies and the government officers in our existing centralized energy network to change. This is due partially to the considerable investment in traditional sources. As a result, little information has been offered by industry or government to prepare the American public for alternative energy development. If anything, the effort has been made to downplay the potential of alternative energies and to maximize estimates of the time required for meaningful implementation. Consequently, the first barrier to be overcome will be an educational one. Cooperation, not only from the general public, but professional people and/or politicians, community leaders, and the construction industry (and unions) will be necessary to make the development a reality.

Other barriers that must be prepared for are:

1. Financial barriers due to economic impediments;
2. Marketing barriers, including problems with standards, scales, licensing and consumer protection;
3. Legal barriers due to the lack of needed legislation;
4. Utility barriers due to conflicts with energy companies;
5. Regulatory barriers due to existing regulations or problems with agencies;

6. Technological barriers and areas which need more research;

7. Policy barriers: including governmental and utility policies;

8. Social and cultural barriers.

Dealing with these barriers will be a major test for regional planners. One state, Hawaii, has already established an alternative energy program. Its experience in developing organizational structures and identifying barriers and the responding to these barriers provides examples that, although locally oriented, are extremely valuable to anyone making regional energy decisions. Hawaii has developed a network approach which involved an infrastructure of people, programs, and governmental agencies working together to solve problems of alternative energy conversion. The model that will be developed will be based upon this approach of meshing the public and private sectors.

The urgency of this project is evident. Current fluctuations in the energy situation indicate the need for the establishment of stable decentralized energy control structures. Efforts in this direction will be forthcoming throughout the country as the reality of the situation hits the general populace. High prices and lack of supply will encourage public demand for more alternatives and local control of their energy supply. The organizational procedures must be established beforehand if a smooth transition is to result.

Limitations of The Study

Research that directly aids the study is unfortunately limited. The concept of decentralizing energy management on a large scale is a recent proposal and only a few projects are underway throughout the nation. With most efforts being at an initial stage of development, detailed reports are generally incomplete. Technical applications are new and unproven over the long term. Legal precedents, marketing strategies, and organizational networks are only beginning to be established. Social acceptance and participation are a major question mark. Studies concerning whether the general public is willing to take a more active role in providing for their own energy needs are either non-existent or incomplete. The uncertainty of these issues creates obvious difficulties in establishing a decentralized energy model. However, the existing programs do provide adequate information to begin establishing the mechanism for overcoming these problems. In fact, many of the limitations inhibiting this study are those which the model is designed to resolve.

The determination of research needs in the decentralization of energy policy are controlled, to an extent by local requirements and available resources, however, enough similarities are present in the many potential regions across the United States to make a model system in designing individual programs useful to energy planners.

Plan of Presentation

Background information on the changing energy situation and a review of previous related studies is presented in Chapter II. The Hawaii approach to alternative energy development is described in Chapter III. Obstacles to alternative energy development and potential solutions are presented in Chapter IV. Chapter V provides a summary and recommendations for decentralized energy development and suggested further research.

CHAPTER II

THE CHANGING ENERGY SITUATION AND REVIEW OF APPROPRIATE LITERATURE

U.S. energy consumption is measured in quads, with one quad being the equivalent of 1,000,000,000,000,000 Btu's, (one barrel of oil being equal to 5.5 million Btu's). As indicated in figure one, the majority of energy use in the United States is derived from fossil energies.

1980 U. S. Energy Consumption

Coal	15.8 quads
Natural Gas	20.5 quads
Domestic Oil	20.5 quads
Imported Oil	15.2 quads
Nuclear	2.9 quads
Other	3.1 quads
	78.0 Total Quads

Figure 1.--Department of Energy

The 3.1 quads representing "other" forms of energy productions include hydroelectric, geothermal, and various solar methods. Expanded development within this spectrum is necessary as more and more strain is placed upon our

traditional sources of energy.

Historically, the United States has increasingly relied upon oil as its single most important energy source. Oil provides nearly 45 percent of the nation's present energy needs. In 1980, the U. S. demand for oil was approximately 6.2 billion barrels, of which 41 percent had to be imported. This demand marked a substantial decline from the 1979 demand of 6.8 billion barrels, of which 44 percent was imported. Decreasing use has not, however, been matched by an overall lowering of petroleum costs for the nation. In actuality, oil costs have increased drastically in the past ten years. The total U. S. cost has jumped from $4.77 billion in 1972 to $41.46 billion in 1978,[2] following a general increase in oil use throughout this same period. In 1979, the cost topped 60 billion, and in 1980 the figures show a rise to 80 billion,[3] which is almost a 100 percent increased over the 1978 figure. With the world's potential oil supply decreasing, an increase in cost is likely to continue.

The nation's proven reserves of oil are about 40-45 billion barrels, including reserves on the North Slope of Alaska. Barring unpredicted future discoveries of large fields, and with the possible loss of foreign sources, the supply's predicted lifespan is questionable, but likely

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[2]U. S. Department of Energy, The Energy Consumer (Washington, D.C.: U. S. Government Printing Office, February/March 1980), p. 2.

[3]Ibid.

limited. Enhanced recovery, oil shale development, and gasification of coal all have the potential to temporarily extend the useful limits of oil. Most experts paint an ominous picture if unconventional sources should not prove out. As Earl Hayes, former chief scientist at the U.S. Bureau of Mines, points out,

> There is no longer much argument with the conclusion that U.S. resources of conventional oil will be seriously depleted by the year 2000.[4]

Increased costs alone, however, are sufficient to trigger a turn toward other additional sources of energy.

The only readily available large-scale domestic energy sources that could even, in principle, reverse the decline in domestic energy production over the remainder of this century is coal, which itself faces a variety of technical, political, and environmental obstacles, making it difficult to expand very rapidly.

> In 1977, electric utilities used 479 million tons of coal, or about 70% of the total U.S. production of 685 million tons, to produce 47% of the total electric generation in this country. By 1990, utilities will most likely be consuming 1,005 million tons of coal per year to generate 40% of America's total electric energy.[5]

With the U.S. having the largest estimated recoverable coal reserves in the world, the inclination of many energy experts is to significantly increase its role in the

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[4]"Energy: Facing Up To The Problem, Getting Down to Solutions," National Geographic, February 1981, p. 17.

[5]M. Simmons and P. Craig, Distributed Energy Systems in California's Future Interim Report Vol. I and II (Washington, D. C.: U.S. Government Printing Office, May 1978), p. 185.

nation's energy future. Initially, this would appear to be a plausible solution to any future energy problems. However,

> To use coal within the framework of the present energy production, consumption, and distribution system, it must be converted to a refined fluid or gas. Conversion of coal to refined fluid fuels, under the best of conditions, can probably only take place with efficiencies of 55 to 65%. The capital costs of the conversion technologies are very high, and environmental constraints are a serious limitation.[6]

The potential volume of coal required in such a scenario is also a major problem. The state of California alone would require between one-third and almost one-half of the coal currently used in the entire United States.[7] Projecting this demand over the entire U.S. raises many serious questions with regard to the problems of expanding extraction and resultant environmental impacts. With the potential shortages in petroleum and the obvious problems in increased coal use, many communities have begun investigating the possibility that a combined program of energy conservation and locally available renewable energy resources (such as solar, wind, water, and biomass) might provide a more stable base for the local economy than the currently utilized fuels. The benefits of such a local energy self-reliance are numerous. The development of local resources provides jobs and keeps money in circulation within the community, and reliance on locally generated

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[6]Herman E. Koenig, Running Out of Energy (Extension Bulletin E1173, Michigan State University Extension Service, November 1977).

[7]Simmons and Craig, p. 187.

energy insulates the community from fuel shortages and rising prices.

As might have been expected, in the past, major emphasis was placed upon the centralized technologies, while near-term technologies for the direct production of heat and fuel and community-scale applications have not received adequate support. Through 1978, the Federal government has provided $124 billion in subsidies and incentives for the fossil fuel industry while the solar industry has received less than $1 billion.[8] With the overwhelming scientific and empirical evidence indicating that the industrialized economies are now in an era of rising real energy costs and real limits on supply,[9] it is likely that a change in emphasis is forthcoming. The remaining stocks of nonrenewable energy resources must be used to facilitate the transition to a renewable energy base. The cost of such a change will be great and require a major efforts, not only by the Federal Government, but by regional, state, and local agencies and organizations across the country. Currently, the energy industry in most states is one of extreme concentration of power and supply in the hands of a few large companies. In California, for example, 95 percent of

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[8]Solar Action Incorporated, Citizen's Solar Program: State Reports On Barriers and Strategies To Renewable Energy Development, (Washington, D.C.: U.S. Government Printing Office, October 1978), p. XI.

[9]Herman E. Koenig, Industrial Societies In Transition: The Role of The Family Unit, (Prepared for American Home Economics Association, 71st Annual Meeting, Dallas, Texas, June 1980).

all electrical energy is delivered by three public utilities.[10] Pacific Gas and Electric is the largest of these, employing 24,580 persons and having revenues of 2.65 billion dollars in 1976.[11] Decentralization, in the energy context, is usually associated with small-scale facilities, owned and operated by individuals or communities.

> The term 'distributed energy systems (DES)' is applied to those energy systems which use (largely, but not exclusively) local energy sources to meet local energy needs. They may vary in size from small solar systems designed to supplement the hot water needs of a single-family residence, to a co-generation plant which uses, for example, wood wastes to provide electricity and process steam to a paper mill and the local community.[12]

Although there are serious problems and deficiencies in the existing centralized energy industries, the alternative energy sources and technologies have been insufficiently exploited in the past. Therefore, it is unlikely that the future energy systems in the United States will be all centralized or all decentralized; it is much more likely that both classes of technology will be required, and ways must be found to ensure that the two complement one another. The creation of decentralized arrangements whereby an effective infra-structure can be developed to aid in the

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[10]Council on Energy Resources, Energy Policy in California, A Directory, (Berkeley: University of California, 1975).

[11]Simmons and Craig, p. 62.

[12]Arthur D. Little, Distributed Energy Systems: A Review of Related Technology (Washington, D.C.: U.S. Government Printing Offices, November 1979), p. 1-2.

introduction of renewable technologies into the present energy system is paramount.

The United States now consumes about 78 quads of energy a year, with the majority coming from centralized sources. The widespread use of solar energy can add diversity and flexibility to this energy supply, providing insurance against the effects of shortages in other major energy systems. In addition, solar systems can sometimes be matched to end-uses more efficiently than centralized systems; thus, their use can help reduce energy waste. Solar energy may hold the potential for supplying a significant portion of the nation's energy needs in the future.

> A recent report by the Council on Environmental Quality predicts that one quarter of all U.S. energy could be supplied by solar technology. The Domestic Policy Review of Solar Energy estimates that by the year 2000, solar energy technologies could displace between 9.4 and 18.1 quads of energy supplied by other fuels. The report assumes that publicly funded efforts will encourage solar energy commercializations, and that problems relating to the diffusion of solar energy technologies can be overcome or minimized.[13]

In 1978, the residential sector of U.S. society accounted for about 25 percent of total primary domestic energy consumption. The energy used directly for heating and cooling residential buildings was produced from the following sources: natural gas, 55%; petroleum, 22%; electricity, 16%; liquified petroleum gas, 4%; wood, 2%; and

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[13]Barbara Burns, Bert Mason, and Keith Armington, The Role of Education and Training Programs In The Commercialization and Diffusion of Solar Energy Technologies (Menlo Park, California: SERI, January 1979), p. 3.

coal, 1.0%.[14] The Department of Energy estimates that by the year 2000, solar energy could provide 2.9 quads, or 17 percent of the total residential energy supply.[15]

However, for solar energy to provide even 2.0 quads, energy displacement in housing in the year 2000 would require approximately 47 million active solar thermal installations, using about 17 billion square feet of collectors. It is estimated that to achieve this installed production capacity from the 16 million square feet produced in 1979 would require a sustained average growth of 35 percent per year for twenty years.[16] The Office of Technology Assessment has found that on-site solar hot water systems are economically competitive with electric hot water systems in most parts of the United States. Solar energy: 1) draws on an inexhaustible source of energy; 2) is widely available; 3) does not produce significant environmental problems and; 4) will reduce fossil fuel consumption.[17]

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[14]U.S. Department of Energy, The 1978 National Interim Energy Conservation Survey, (Washington, D.C.: U.S. Government Printing Office, February 1980), p. 41.

[15]U.S. Department of Energy, "Domestic Policy Review of Solar Energy: Response Memorandum To the President," Renewable Energy Development: Local Issues and Capabilities, (Washington, D.C.: U.S. Government Printing Office, January 1980), p. 34.

[16]U.S. Department of Energy, Solar Energy Objectives: Calendar Year 1980, (Washington, D.C.: U.S. Government Printing Office, April 1980), p. 35.

[17]Randall Feuerstein, Utility Rates and Service Policies as Potential Barriers To the Market Penetration of Decentralized Solar Technologies, Menlo Park, California: SERI, August 1979, p.1.

With the amount of solar energy falling in the United States rated at approximately 9,000 trillion kwt per year, the exploitation of this energy is only limited by need and desire to do so. A significant potential exists for expanding the nation's use of solar energy in areas other than residential use. Renewable energy sources, principally biomass and hydropower presently contribute about 5.0 quads, or 6.4 percent, to the American energy supply.[18] The goal of the U.S. biomass program is to provide 2.5 quads a year by 1985 through increased direct combustion and conversion into gaseous and alcohol fuels, 4.2 quads by 1990, and 7.5 quads by 2000[19] through developments in terrestrial and aquatic energy forms and improved biochemical and thermochemical conversion techniques.

A number of other types of solar power currently provide smaller amounts of energy production. Wind energy and solar thermal energy are examples. Presently, solar thermal provides 0.001 quads of energy production per year. It is expected to provide 0.4 quads by 1985, and 0.9 by 1990.[20] The Domestic Policy Review projects that industrial, agricultural and utility uses could displace 3 quads of conventional fuels by the year 2000. Overall, solar thermal energy is expected to contribute 5 quads by the turn of the century. Wind energy systems, in addition,

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[18]Doe Solar Energy Objectives, p. 7.

[19]Ibid., p. 16.

[20]Doe Solar Energy Objectives, p. 18.

are expected to provide .02 quads by 1990 and 1.4 quads by the year 2000.[21]

A maximum effort by federal, state, and local government could increase the contribution of all solar energy sources, including hydropower, to 20 quads per year, or 22 percent of the estimated energy need by the year 2000.[22] The total national energy consumption for the year 2000 is projected as 95 quads.[23] Dr. H. Koenig, of Michigan State University estimates that, "if solar systems...are to be expanded to 20 quads by the turn of the century (as some have proposed) then the required growth rate of the (total) solar industry is 17.5 percent per year."[24]

One important consideration in evaluating the effect of the projected 20 quad production by solar devices is that this energy is direct (at the point of use). The 78 quad of centralized sources required by the United States in 1980 actually result in 50 quads of energy delivered to the end users. The remaining 28 quads were consumed or lost in production and transmission of the energy supplied.[25] Thus, the twenty quads of solar energy potentially represents an

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[21]Ibid., p. 12.

[22]Ibid., p. 12.

[23]Doe Review of Solar Energy Response Memorandum, p. II-2.

[24]Herman E. Koenig and Thomas C. Edens, Energy Economics: Foundations of Energy Policy, (Prepared for the Second Energy Seminar for Michigan Legislators and Staff, May 7, 1979), p. 5.

[25]Doe Solar Energy Objectives, p. 8.

even greater portion of the nation's energy demand in the next twenty years. Arthur Little estimates that "if a solar panel replaces electrical heating, every 100 units of energy produced by the panels saves 333 units at the power plant.[26] About 70 percent of the energy used to produce electricity is wasted along the way.

Conservation methods and additional renewable energy sources, such as ocean thermal and geothermal energy sources, have the potential to make an even greater impact on the energy demand of the United States by the end of the century. These sources, along with the conventional solar devices, are best developed and controlled by decentralized methods. One of the advantages of decentralized and smaller scale technologies is that they may be better adapted to local applications, especially with respect to the efficient use of energy.

> Decentralized sources of energy can be designed and evaluated with site-specific characteristics in mind, among them being:
>
> 1. balance between and extent of electrical and thermal requirements;
> 2. daily and seasonal variations in energy requirements;
> 3. local availability of renewable resources, e.g. sunlight, wind, water power;
> 4. projected fuel prices and vulnerability to sudden changes;
> 5. capital availability;
> 6. environmental restrictions;
> 7. personnel capabilities;

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[26]Solar Action Incorporated, Citizen's Solar Program: State Reports on Barriers and Strategies to Renewable Energy Development, Washington, D.C.: U. S. Government Printing Office, October 1978), p. V.

8. local utilities-rates, gas pressure;
9. reliability of requirements.[27]

Action at all levels of government and by large numbers of individuals and groups will certainly be required to achieve significant development of these decentralized sources.

Literature Review

In researching the topic there is little indication of extensive work having been accomplished on this problem. Most references point toward the need for such an effort, but do not list any completed or on-going projects.

The Domestic Policy Review of Solar Energy[28] concluded that

> Actions at all levels of government and by large numbers of individuals and groups will certainly be required to achieve significant solar penetration.

This recognition that development beyond federal control will be necessary for solar power to be significant is a first step in the decentralization of energy policy making.

The Department of Energy[29] agrees that

> New inter-governmental organizational models may be necessary from a local to a regional level, for

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[27]Little, p. 1-13.

[28]U.S. Department of Energy, "Domestic Policy Review of Solar Energy: Response Memorandum to the President," Renewable Energy Development: Local Issues and Capabilities, (Washington, D.C.: U.S. Government Printing Office, January 1980), p. 1.

[29]U.S. Department of Energy, Renewable Energy Development: Local Issues and Capabilities, (Washington, D.C.: U.S. Government Printing Office, January 1980), p. 33.

> financing, education and professional training, decision-making, etc. These models must be finetuned in order to identify various barriers and incentives, established legal precedents, and prepare for the administration of an effective regulatory structure before they can be used to facilitate broad implementation of renewable systems.

The importance of local input was noted by Dick Holt[30] in another Department of Energy publication in which he stated that,

> The information...indicates that there exists at the local level throughout the nation a large and growing capability to contribute significantly to the transition to renewable energy systems.

As the Citizen's Solar Program[31] report states,

> Solar is an inherently decentralized technology that should be nurtured and promoted by all our country's institutions but not swallowed by existing companies and bureaucracies. Solar is a relatively simple and accessible technology that should be kept that way and not controlled by a few or manipulated for a profit.

Many of the principal arguments in favor of decentralized energy systems are found in the works of Schumacher[32], Lovins[33,34], and Commoner. Lovins' criticisms of the centralized approach to energy control are based mainly upon environmental effects and acceleration of

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[30]Doe Response Memorandum, p. 3.

[31]Citizen's Solar Program, p. II.

[32]E. F. Schumacher, Small Is Beautiful, (New York: Harper and Row, 1973).

[33]A. B. Lovins, Soft Energy Paths: Toward A Durable Peace, (Cambridge, Massachusetts: Bollinger Publishing Company, 1977).

[34]A. B. Lovins, "Energy Strategies: The Road Not Taken?" Foreign Affairs, October 1976, p. 65.

capital costs. He ignored the political and social implications of any widespread introduction of alternative energy technologies, but has developed a comparison of centralized vs. decentralized gross primary energy use based on his evaluation of technological potential. This evaluation led to his belief that decentralization energy development was superior.

Supporting the decentralized theme, Simmons'[35] report Distributed Energy Systems in California's Future states,

> There are problems and deficiencies in the existing centralized energy industries, and there are alternative energy sources and technologies that may have been insufficiently exploited in the past.

He goes on to point out, however, that,

> It is not at all clear that the largescale use of biomass to produce liquid fuels, or solar energy to generate electricity, will not encounter problems and organizational structures similar to those of today's centralized power utilities.

Finally, Simmons calls for the evaluation of decentralized development when he points out,

> The social, institutional, and legal implications of the widespread use of distributed energies systems are not understood and have been greatly understated.

Dr. Herman Koenig, in Industrial Societies in Transition: The Role of the Family Unit,[36] states,

> Rising real costs of energy and increased dependence on biologically derived resources will eventually have a significant impact on human settlements. Rural and

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[35]Simmons, p. 183.

[36]Herman E. Koenig, Industrial Societies In Transition: The Role of The Family Unit, (Prepared for American Home Economics Association, 71st Annual Meeting, Dallas, Texas, June 1980), p. 3.

> urban communities will become increasingly dependent upon the integrated use of forests and other ecological and physical resourceswind, hydro, solarthermal, etc., as supplements or partial replacements nonrenewable materials and energy resources. Since the technical characteristics of most renewable resources are very different from conventional fuels, integrated use of these resources will require new adaptations in the physical, social, political, and economic structure of the community.

Perry and Streiter[37] agree that,

> The evaluation must include not only an examination of the technical and economic status, but just as importantly, the nature of the environmental, political, institutional, legal, regulatory, and financial barriers that must be overcome before the technology can be deployed widely enough to make an important contribution to energy supply.

The major area of distributed energy systems that has been investigated is the state of technical development, where the problems are, and the probable direction of future improvements. A series of such reports have been presented by the Department of Energy, an example of which is Distributed Energy Systems: A Review of Related Technologies, by Arthur Little.[38]

A three year study by Steven Nadis[39] described in "An Optimal Solar Strategy" dealt with

> Available and affordable technical measures that improve energy productivity,

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[37]H. Perry, Multiple Paths For Energy Policy, A Critique of Lovins' Energy Strategy, (New York: National Economic Research Association, 1977), p. 12.

[38]Arthur D. Little, Distributed Energy Systems: A Review of Related Technologies, (Washington, D.C.: U.S. Government Printing Office, November 1979).

[39]Steve Nadis, "An Optimal Solar Strategy," Environment 21, November 1979, p. 9.

and,

> ...determined that a solar power strategy appears to be technically and economically feasible.

In actual regional planning for decentralized energy systems, one project approaches the purpose of this study. In Management of Energy/Environmental Systems: Methods and Case Studies, Wesley Foell[40] focused on more effective energy management and alternative energy/management futures at the regional and subnational levels comparing three regions: the German Democratic Republic, Rhone-Alps in France, and Wisconsin.

However, in general, specific planning has been developed primarily for the county and local level only. Alan Okagaki and Jim Benson,[41] in their County Energy Plan Guidebook: Creating A Renewable Energy Plan, advocate energy planning being done at the local, rather than national, level. Their goal is to gather as many local plans as possible to aggregate these plans into state energy plans and, in turn, into a national energy plan.

In Energy-Efficient Community Planning: A Guide To Saving Energy and Producing Power At the Local Level, James

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[40]Wesley Foell, Management of Energy/Environment Systems: Methods and Case Studies, (New York: Wiley-Interscience, June 1979).

[41]Alan Okagaki and Jim Benson, County Energy Plan Guidebook: Creating a Renewable Energy Plan, (Fairfax, Virginia: Institute for Ecological Policies, July 1979).

Ridgeway[42] calls for a national energy plan based on the creation of several hundred public energy districts in the United States.

The Southwest Border Regional Commission (SWBRC) is an attempt by four states, (New Mexico, Texas, Nevada, and California) to pool energy information in the establishment of an energy program. The major aim of this program is to develop and deomonstrate solar technologies that are applicable to residences of low-income people in the border areas. Other aims of the program are to train local people in the design, installation, and maintenance of appropriate solar applications and technologies, to stimulate economic development, and business activity in solar fields, and to evaluate the individual solar plans for each of the four states with respect to the border region. This is the first program of its kind to be conducted on a regional basis.[43]

The Department of Energy in 1978 established a Comprehensive Community Energy Planning Methodology.[44] It is set up as a logical progression of planning activities consisting of four major parts: The process begins with an

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[42]James Ridgeway, Energy-Efficient Community Planning: A Guide To Saving Energy and Producing Power At The Local Level, (Emmaus, Pennsylvania: The J. G. Press, November 1979).

[43]Edward Lumsdaine, Roger Farrer and David Miller, "Solar Upgrading of Low-Income Housing," Proceeding of the Western Sun 1980 Solar Update, 1980).

[44]U.S. Department of Energy, Comprehensive Community Energy Planning Vol. 1, (Washington, D.C.: U.S. Government Printing Office, November 1979).

assessment, or audit, of a community's energy use patterns. This is followed by an analysis to determine potential energy problems and to select objectives. The third major part is the selection of energy management and conservation alternatives that will best achieve the previously derived objectives. Lastly, some considerations concerning planning for implementation are provided.

Curtis Priest[45] has prepared a report for the FEA that reviewed federal, state, and local land use law as it related to energy conservation and summarized land use energy research. He concluded that short energy-saving land use patterns entail: 1) More multifamily residences; 2) More densely populated activity centers to promote transit use; 3) Rearranging industrial, commercial, and residential activities to promote the utilization of waste heat.

The legal aspect of alternative energy development is one of the barriers to decentralization. Hawaii has been solving this problem through an aggressive program of legislation. Other attempts at delineating the legal approaches are set down by Miller[46] in his article, "Legal Obstacles to Decentralized Solar Energy Technologies, Part I

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[45]Curtis Priest and Kenneth M. Happy, An Overview and Critical Evaluation of the Relationship Between Land Use and Energy Conservation, (Cambridge, Massachusetts: Technology and Economics, Inc., 1976).

[46]Alan S. Miller, "Legal Obstacles To Decentralized Solar Energy Technologies," Solar Law Reporter, Vol. 1, No. 3, September/October 1979, p. 598.

and Part II." Miller states that,

> While energy problems are usually thought of as being in the sphere of decision-making by national authorities, many policies affecting energy supply and demand lie primarily in the domain of state and local authorities.

Amory Lovins[47] further stated the position when he wrote

> The ends sought are so fine-grained, locally tailored, dispersed, and small-scale, and the means--the policy tools--can be chosen, according to practical and ideological convenience, form such an enormous array of options, that the choice can fully respect pluralism and voluntarism. Indeed, so diverse are our societies, and hence the local conditions to which soft path innovations must adapt, that a centralized management approach to a soft path simply would not work.

[47]Lovins, Soft Energy Path, p. 22.

As Simmons states,

> The mood is not necessarily one of hostility or resentment toward the existing order, but rather is characterized by the conscious exercise of choice in the use of time, effort, and money in pursuit of an improved quality of life and personal self-sufficiency.[48]

Research that directly aids the proposed study is unfortunately limited. Besides the Hawaii State Energy Plan,[49] the County of Hawaii Energy Plan,[50] and numerous technology and barrier studies, the majority of information must come from task force reports, direct contact with local officials and community leaders, and on-site evaluation of project development.

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[48]Simmons, p. 304.

[49]State Department of Planning and Economical Development, State Energy Plan: A State Functional Plan, (Honolulu, Hawaii, February 1980).

[50]Y. K. Hahn, Energy Self-Sufficiency Plan For County of Hawaii: Energy Demand Pattern and Projections, (Hawaii Natural Energy Institute, June 1979).

CHAPTER III

THE HAWAIIAN APPROACH

Geography and Environment

Hawaii refers collectively to all of the 132 islands, islets, reefs, sandbars, and rock dots that rise above the surface of the north Pacific Ocean over a 1,600 mile route, running from the northwest to the southeast. Discounting the tinier specks, there are eight major islands in the Hawaiian chain: Niihau, Kauai, Oahu, Molokai, Lanai, Maui, Kahoolawe, and Hawaii. All, except Kahoolawe, are inhabited, with Oahu supporting four-fifths of the state's entire population.

The following chart lists the size and population of the eight largest islands:

ISLAND	SIZE (sq. miles)	POPULATION 1980	LARGEST CITY
Kahoolawe	45	Uninhabited	
Niihau	73	200	
Lanai	140	2,500	Lanai
Molokai	261	5,000	Kaunakakai
Kauai	553	30,000	Lihue
Oahu	608	700,000	Honolulu
Maui	729	60,000	Kahului
Hawaii	4,038	80,000	Hilo

Figure 2--State of Hawaii Data Book, 1980
Size and Population Figures for the Eight Largest Islands of The Hawaiian Chain

There are only four counties in the state, and largest is the City and County of Honolulu, an official appellation combining what might have been two bodies into a single governmental unit. It includes the entire island of Oahu, with all its smaller communities and, for administrative purposes, almost all of the long chain of tiny, mostly uninhabited, islets northwest of Kauai, called the Leeward Isles.

The other three counties are Kauai (including the islands of Kauai and Niihau), Maui (Maui, Molokai, Lanai, and Kahoolawe Islands), and Hawaii (the Big Island). All four counties are administered under a mayor/council system.

Hawaii is the only American state with just two levels of local government. There are no separate boards for the various towns and villages scattered over the islands.

Hawaii Energy Program

Until recently, Hawaii has obtained about 92 percent of its energy supply from imported petroleum. The remainder consists of energy supplied from indigenous energy resources which are utilized to generate electricity; 7 percent from biomass, and one percent from steam harnessed from hydropower.[51] Obviously, any shortage in the U.S. petroleum supply would drastically effect Hawaii. In addition, the petroleum imports represent more than $1 billion in payments

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[51]State Department of Planning and Economic Development, State Energy Plan: A State Functional Plan, (Honolulu, Hawaii, February 1980), p. 8.

flowing out of the Hawaiian economy every year.[52] The spiraling cost of imported oil, coupled with the growing political instability of the major oil producing nations, have intensified concern over energy issues. Recognizing the state's extremely vulnerable position, Hawaii in 1978, initiates a State Functional Plan for energy development.

> The Hawaii State Plan defines two major energy objectives:
>
> - Dependable, efficient, and economical State-wide energy systems capable of supporting the needs of the people, and;
> - Increased energy self-sufficiency for Hawaii.[53]

To accomplish the mandate set forth by the State Legislature in the Energy Plan, a network approach was developed involving an infrastructure of people, programs, and governmental agencies working together to solve problems of alternative energy conversion with a common goal of securing the greatest possible rate of utilization. It was determined in the State plan that the proposed actions necessary for implementation would be generalized into the following categories:

1. Provision of economic incentives for conservation and the development of indigenous energy resources.
2. Research, development, and demonstration of alternate energy technologies.
3. Regulation.
4. Education.

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[52]Ibid., p. 8.

[53]State Energy Plan, p. 8.

5. Removal of institutional/legal barriers.

6. Policy guidance for facility systems planning.[54]

The Hawaii system established a large number of task forces within each local region and each technical alternative to identify the barriers and develop means of removing them. These task forces consisted of representatives from state, private industry, and, in many cases, federal and academic experts. Hawaii's energy situation is presently at the mercy of outside influences. Its people have no choice but to quickly cut through the problem.

In making their determinations, the task forces considered two factors as delineated in the State Energy Plan:

1. The contribution to the increase in energy security and stability from alternative actions will be weighed against the costs to government, the consumer, and the overall effect on the economy in order to make wise economic choices for the long-term, and avoid unjustifiable costs in the near-term, and;

2. Selection of alternative actions will be based on the desire to maintain the integrity of Hawaii's natural resources and environmental quality.[55]

Within the framework of these goals, the committees have made significant progress towards satisfying the mandate set forth by the state legislature in the Energy Plan.

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[54]State Energy Plan, p. 10.

[55]State Energy Plan, p. 10.

The four counties under the State Functional Plan, have developed independent approaches to energy self-sufficiency. For example, the County of Hawaii has developed alternative energy programs in: 1) Solar, which includes active and passive systems, wind power generation and ocean thermal energy conversion; 2) Biomass and methanol production; 3) geothermal and; 4) hydroelectric. All of these alternatives have required extensive restructuring of the energy system on the island.

The purpose of this chapter will be to examine the structure of the government organizations and citizen committees alluded to in the above sections. As part of this evaluation it is necessary to discuss the energy picture in Hawaii to best understand reasons for the composition of the committees and the directions these groups have pursued.

State Energy Use and Production

Hawaii's economic vulnerability is best understood through data on the origin of petroleum imports. Sixty-three percent of the state's crude oil and petroleum products supply is shipped directly from foreign sources. Twenty percent of the remaining supply is shipped from the mainland, but originates from foreign sources.[56] With 92 percent of the state's energy production resulting from petroleum (149,000 barrels of crude oil and petroleum

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[56]State Energy Plan, p. III-15.

SOURCES OF ENERGY,
HAWAII VERSUS THE U.S., 1976

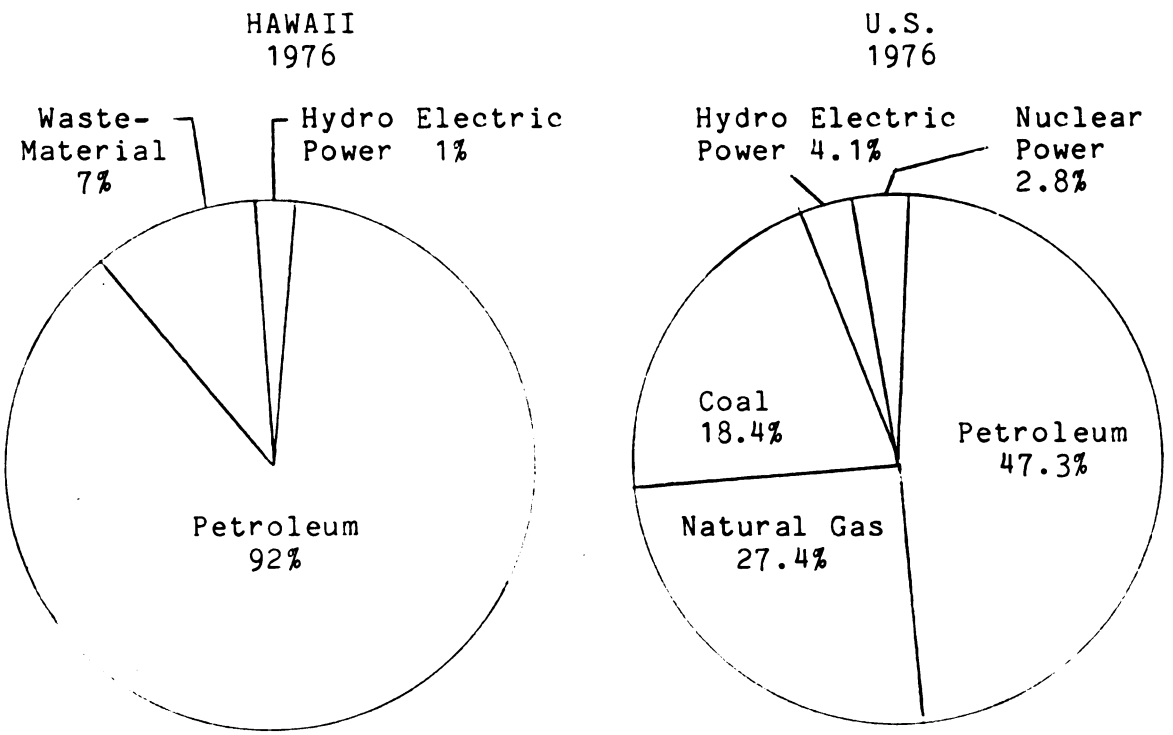

Figure 3--Department of Planning and Economic Development, State Energy Office. Energy Use in Hawaii, November 1977

products daily),[57] any oil market dislocations resulting from political instability on an oil producing nation could create severe economic impact for Hawaii.

The sources of energy for Hawaii versus the rest of the United States in 1976 (Figure 3) showed a disproportionate use of petroleum use in Hawaii. Clearly, any shortages in petroleum would have a much greater impact on the Hawaiian

[57]Ibid., p. III-18.

economy than on the U.S. mainland economy. A nationwide twenty-percent cut in petroleum would decrease the mainland's total energy supply by only 9.5 percent. A similar twenty percent cut in petroleum supply for Hawaii, however, would result in an almost full 20 percent energy shortage, with no readily available substitute sources.

Biomass is the state's second largest source of energy. Biomass, wood chips, and macadamia nut shells are combusted for electricity. Increased use of biomass is presently making the greatest inroads at replacing petroleum in the Islands.

In 1978, bagasse and oil-burning in sugar mills accounted for only two percent of the electricity generated on Oahu, although it played a more significant role on the islands of Hawaii (45 percent), Maui (27.6 percent), and Kauai (23.2 percent).[58] (See Figure 4)

Hydropower resources are utilized at 15 sites throughout the state. The contribution to total energy supply from hydropower generation is low due to the seasonality of the resource and the lack of dams.

All the bagasse-burning and the majority of hydro-electric power plants are privately owned by sugar plantations. Two hydro-electric plants in Hilo on the island of Hawaii are owned by public utility. All other facilities are owned by the private utility companies.

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[58]State Energy Plan, p. III-34.

SUMMARY OF ELECTRICAL GENERATION AND ELECTRICITY USED BY SUGAR PLANTATIONS IN HAWAII, 1978

ISLAND/ PLANTATION	GENERATED (KWH x 10^6)		PURCHASED		USED (KWHx10^6)	SOLD (KWH x 10^6)				TOTAL INCOME($)
	Steam	Hydro/Diesel	Quantity	Total Cost		Firm	Standby	Inter-ruptible	Total	
HAWAII										
Hilo Coast Proc.			2.58	158,600						
Pepeekeo	130	0			29	101.87	0	0	101.87	2,607,400
Papaikou	NA	NA			NA	0	0	0.10	0.10	400
Honokaa	20.98	0.71	0.47	33,400	14.46	0	0	7.70	7.70	74,100
Laupahoehoe	18.7	0	1.83	127,300	18.63	0	0	1.90	1.90	7,600
Ka'u	13.49	0.16D	0.36	33,00	14.06	0	0	0	0	0
Puna	67.74	0	0.55	22,200	29.99	38.30	0	0	38.30	1,023,800
Island Total	250.91	0.86	5.79	374,500	106.14	140.17	0	9.70	149.87	
KAUAI										
Kekaha	16.24	5.17	1.93	87,800	14.11	0	0.20	3.86	4.06	21,000
Lihue	22.27	6.86	0.13	6,400	22.41	0	0	6.85	6.85	35,100
McBryde	23.37	29.78	2.81	146,100	46.21	0	0	9.75	9.75	63,400
Olokele	7.31	4.01H 0.31D	0.42	70,000	11.22	0	0	0.83	0.83	3,300
Island Total	69.19	46.13	5.29	310,300	93.95	0	0.20	21.29	21.49	122,800
MAUI										
HC & S	125	24	2.82	*	142.46	0	1.98	7.38	9.36	128,800
Paia										
Puunene										
Pioneer	43.14	0	3.40	**	41.13	0	0.53	4.88	2.00	171,700
Wailuku***	NA	0	NA	NA	NA	0	0	0	0	0
Island Total	168.14	24	6.22		183.59	0	2.51	12.26	11.36	300,500
OAHU										
Oahu	74.33	0	35.87	1,505,700	110.09	0	0	0.14	0.14	1,700
Waialua	35.56	0	21.85	889,500	56.76	0	0	0.65	0.65	7,700
Island Total	109.89	0	57.72	2,395,200	166.85	0	0	0.79	0.79	9.400
STATEWIDE TOTAL	598.13	70.99	75.02	308,000	550.53	140.17	2.71	44.04	183.51	1,456,500

NA - Not Available

*KWH-for-KWH trade with utility; annual power pool settlement. Takes into account electricity traded. Total revenue received by HC & S dependent upon contractual arrangement with the utility. Old contract to expire in 1979; new contract presently (1979) being negotiated.

**KWH-for-KWH trade with utility; after exchange, Pioneer sold 1.47 x 10^6 net KWHs to the utility. Total income includes demand fee paid to Pioneer.

***Wailuku Sugar closed factory in 1978; values indicated represent 1975 generating and buying capability.

Figure 4--Summary of Electrical Generation and Electricity Used by Sugar Plantations in Hawaii, 1978.

The Hawaiian Electric Company (HECO) is the public utility on Oahu. Two subsidiaries of HECO, the Hawaii Electric Light Company (HELCO) and the Maui Electric Company (MECO), operate facilities on the islands of Hawaii and Maui, respectively. Molokai Electric Company is that island's only power generator and distributor. (See Figure 5).

The State's electricity generating capacity equalled 1.661.5 megawatts in 1978.[59] Eighty-nine percent (1447.4 MW) of this was public utility capacity, with the remainder from private generating capacity. Petroleum-based facilities comprise 89 percent of the State's generating capacity. Bagasse and oil burning facilities provide 10 percent of the State's electricity generating capacity. The remaining one percent is contributed by the fifteen hydroelectric plants.[60]

Governing Structure

There are three State Organizations in Hawaii with major energy roles: The Department of Planning and Economic Development (DPED), the University of Hawaii, primarily through its Hawaii Natural Energy Institute (HNEI) at its Manoa Campus, and the Natural Energy Laboratory of Hawaii (NELH). The major responsibilities (Figure 6) for energy involvement in the state are divided among the three agencies.

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[59]State Energy Plan, p. III-32.

[60]Ibid., p. III-32.

SUMMARY OF ELECTRICAL GENERATION BY PUBLIC UTILITIES IN HAWAII, 1978

POWER PLANT OWNERSHIP/LOCATION	INSTALLED CAPACITY Megawatts (MW)	% Total	County (MW)	NET MWH GENERATED	TYPE OF GENERATOR	TYPE OF FUEL	FUEL OIL CONSUMPTION BARRELS	MBTU
OAHU - HAWAIIAN ELEC. CO.								
Honolulu	180.0		15	262,216	Steam	Residual	559,579	3,487,660
Waiau	532.4		44	1,874,421	Steam/Gas Turbine	Residual/ Deisel	3,281,977	20,420,177
Kahe	497.0		41	3,193,992	Steam	Residual	4,960,975	31,587,978
SYSTEM TOTAL:	1,209.4		100	5,330,629	---	---	8,802,531	55,495,815
HAWAII - HAWAII ELEC.LIGHT								
Waiakea	23.9		23	28,859	Steam	Residual	73,325	462,281
Kanoelehua	58.6		57	233,170	Steam/Gas Turbin/Dsl.	Residual/Dsl.	473,973	2,982,317
Puueo	5.3		3	14,956	Diesel/Hydro	Diesel	10	58
Waimea	11.3		11	4,164	Diesel	Diesel	7,690	44,372
Ke-ahole	5.5		6	3,669	Diesel	Diesel	6,590	38,025
Waiau	1.1		0	5,393	Hydro	---	---	---
SYSTEM TOTAL	102.3*		100	290.211	---	---	561,588	3,527,053
MAUI - MAUI ELECTRIC CO.								
Kahului	39.5		47	221,619	Steam	Residual	498,660	3,144,046
Maalaea	45.2		53	180,321	Diesel	Diesel	305,173	1,760,856
SYSTEM TOTAL:	84.7		100	401,940	---	---	803,833	4,904,902

*The system total represents firm installed capacity; hydroelectric capacity at the Waiau and Puueo plants is intermittent, and is not included in the system total. The hydropower generator at Puueo represents 2.3 MW of the total 5.3 MW installed capacity at that facility.

Figure 5--Hawaiian Electric Company, September, 1979. Summary of Electrical Generation by Public.

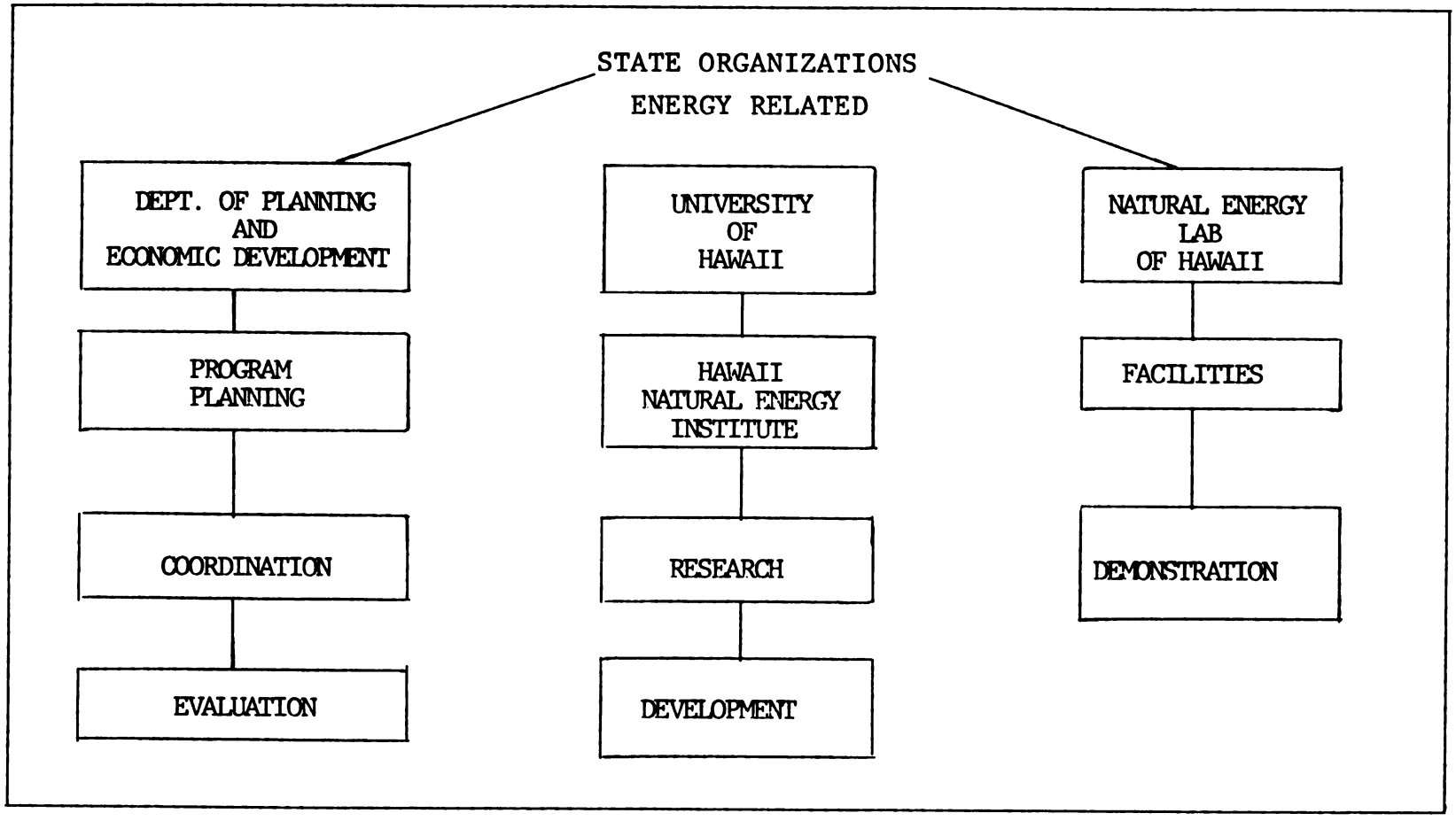

Figure 6.-- State of Hawaii - State Organizations Energy Related.

Figure 7 shows the organization of the State's present energy arrangement. The Director of the Department of Planning and Economic Development has been assigned the additional role of State Energy Resources Coordinator (ERC).[61] His responsibilities as the ERC include the comprehensive planning of energy programs and coordinating the efforts of Federal, State, County, and private agencies involved in various aspects of energy-related activities, including development of alternate energy sources as well as energy conservation and management.

Two organizations in DPED are involved in carrying out energy program activities. They are the Center for Science Policy and Technology Assessment (CSPTA) and the State Energy Office (SEO). The SEO provides advice and assistance to the Energy Resources Coordinator in energy planning and management. The SEO also is involved in contingency planning, including plans to locate a portion of the Strategic Petroleum Reserve in Hawaii, and administering of any fuel allocation program.

The SEO is responsible for a number of Federally-funded energy conservation programs. (See Figure 8)

The Center for Science Policy and Technology Assessment (CSPTA) participates in planning and carries out special projects in the areas of science and technology. Its purpose is to maintain contact with researchers and

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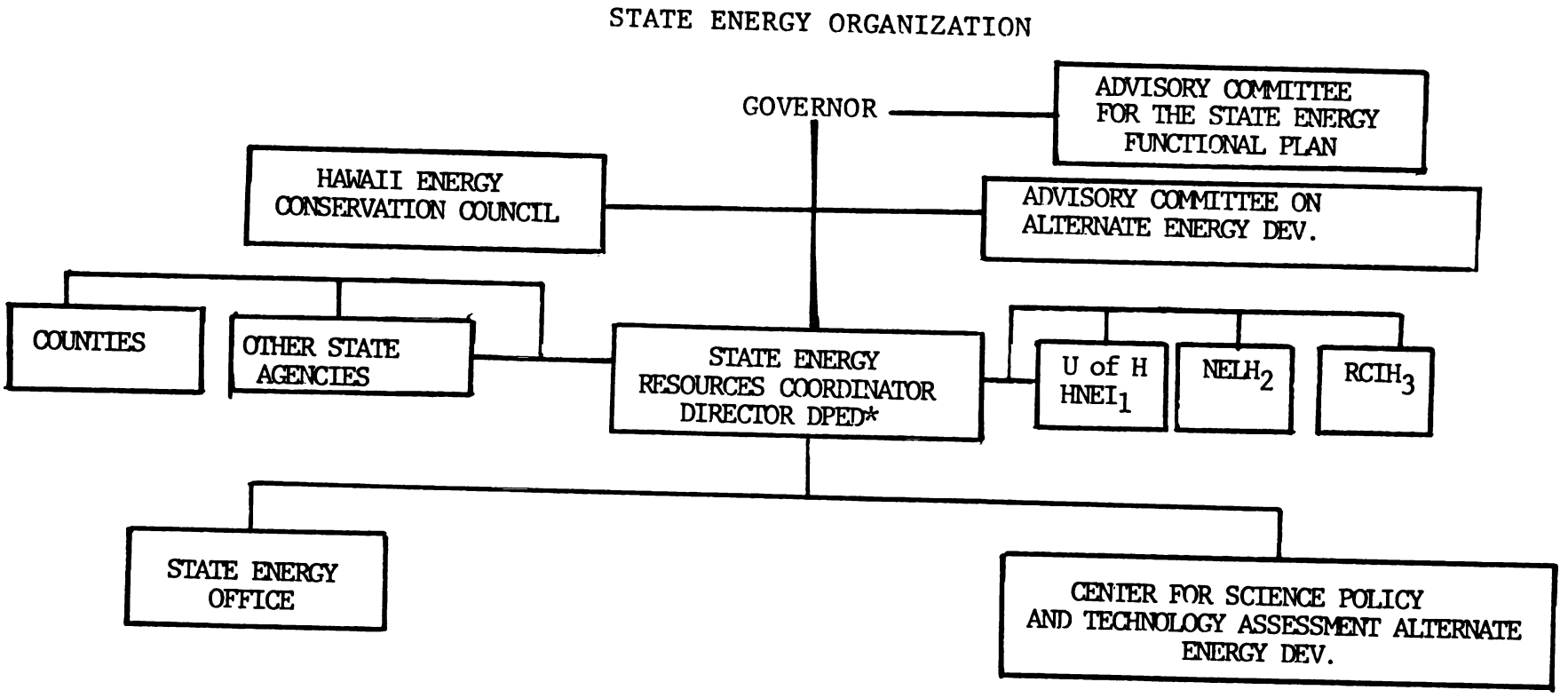
[61]Hawaiian Law, Sections 196-1 to 196-4, Conservation And Resources, p. 450.



1. Natural Energy Institue
2. Natural Energy Lab of Hawaii
3. Research Corp. of Un. of Hawaii

*Department of Planning and Economic Development

Figure 7.--Hawaii State Energy Organization.

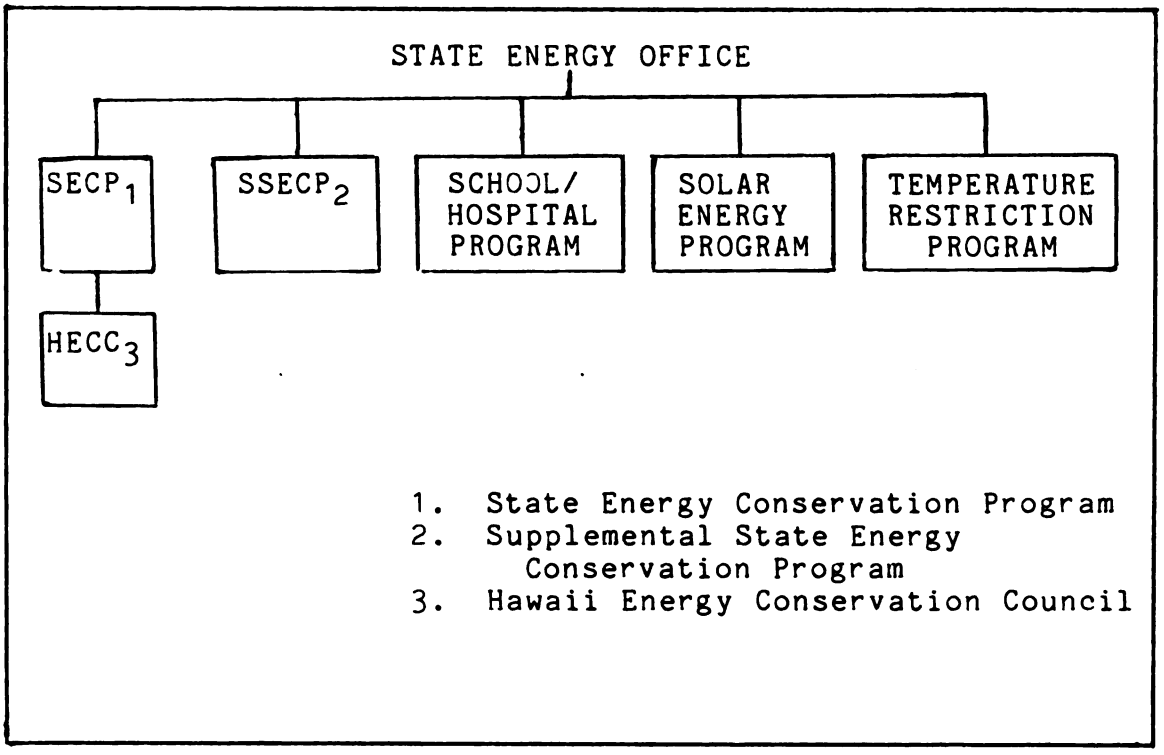


Figure 8.--Hawaii State Energy Office Structure.

investigators managing science and technology projects funded totally or in part by DPED. Areas of responsibility include telecommunications; solid waste; development, demonstration, and commercialization of alternate energy sources in Hawaii; appropriate energy technologies; ocean minerals, water desalting; marine pharmaceuticals; and other science resources.

CSPTA is presently involved with numerous energy projects and activities (Figure 9) that are expected to contribute heavily to Hawaii's goal of energy self-sufficiency.

The National Energy Laboratory of Hawaii has been organized as a research facility at Ke-ahole Point on the Big Island of Hawaii. The purpose of NELH is to manage and operate a research facility for research, development, and

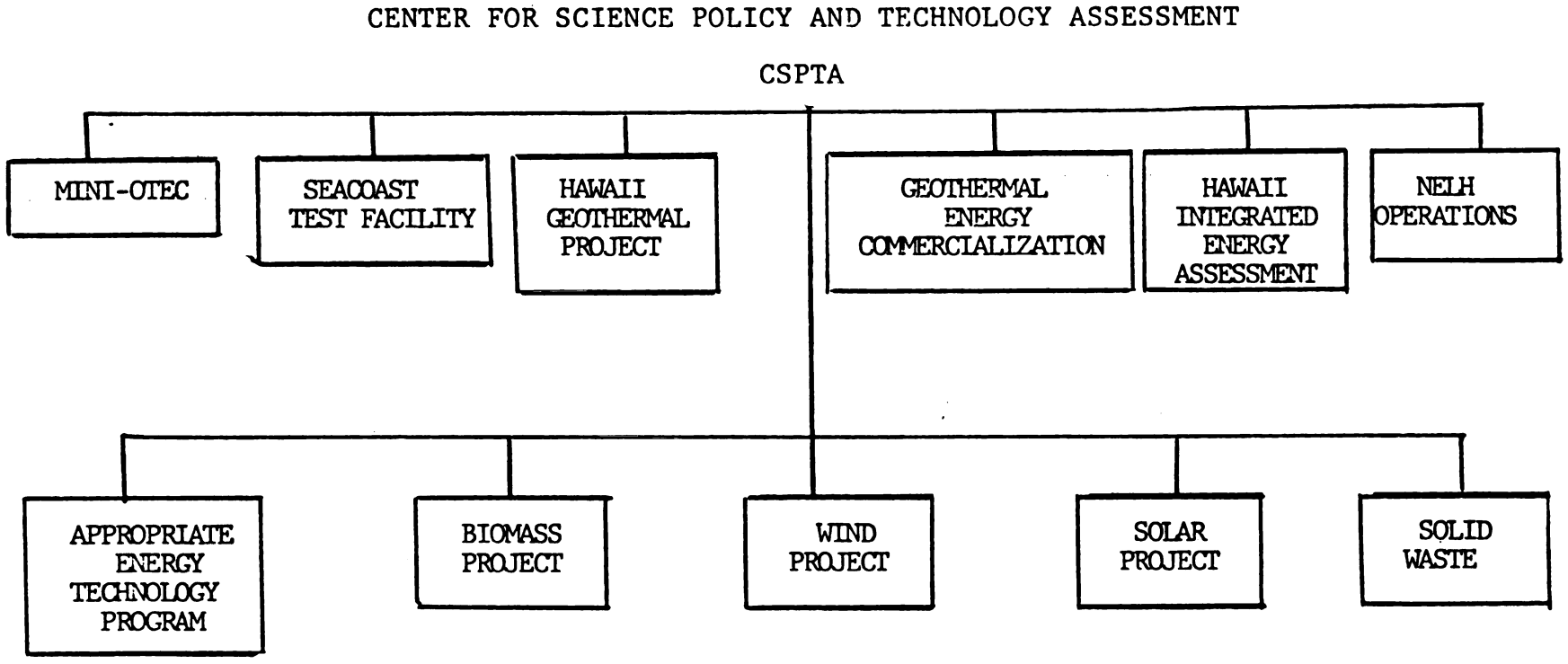


Figure 9.--Hawaii Center for Science Policy and Technology Assessment Structure.

scientific and technological investigations. It is administered by a board (Figure 10) of seven voting members representing the state, county, and academic interests.[62]

The Hawaii Natural Energy Institute was established in 1974 at the University of Hawaii at Manoa. It was established to coordinate and undertake the development of non-polluting natural energy sources for Hawaii. HNEI's primary role is that of a research organization which utilizes the resources of the University and the community in working with the DPED in a shared role of energy development. Accordingly, HNEI and DPED staffs work together through frequent meetings, joint sponsorship of workshops and conferences, energy development groups created for specific projects, technical energy committees and representation of both organizations on the managing board of NELH.

The Research Corporation of the University of Hawaii (RCUH) serves as contractor or consultant in carrying out a large number of energy-related studies and development projects.

Numerous other agencies within the state government also have energy-related responsibilities. Figure 11 lists some of the concerns of state agencies. For example, the Marine Affairs Coordinator's Office plays a major part in Ocean Thermal Energy Conversion, and the Office of

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[62]Hawaiian Law, Sec. 227-1 to 227-4, Planning and Economic Development, p. 132.

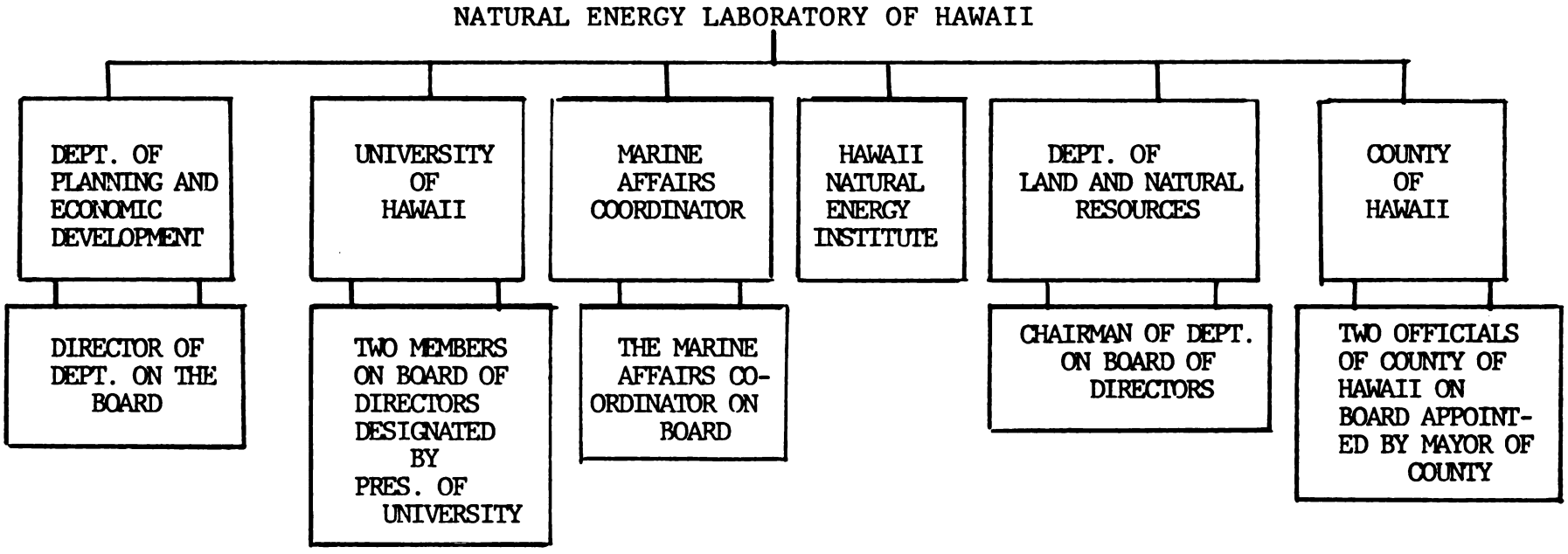

Figure 10.--Natural Energy Laboratory of Hawaii Structure.

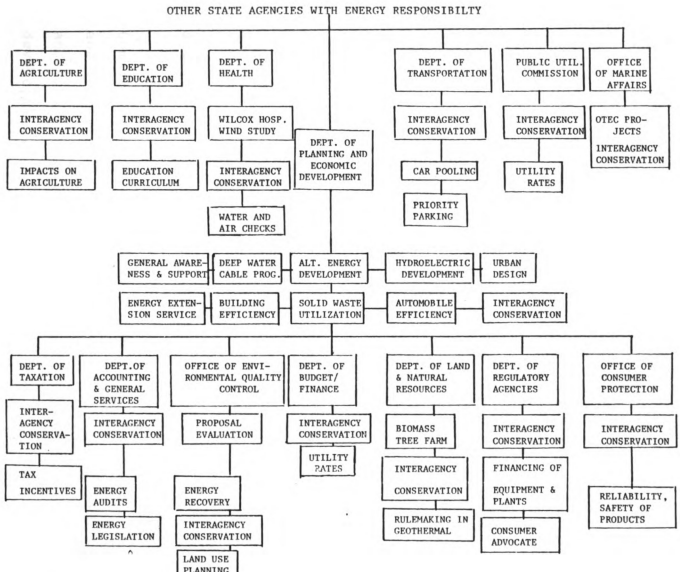

Figure 11.--Part of Dept. of Budget & Financing. Other State Agencies With Energy Responsibility in Hawaii.

Environmental Quality Control deals with aspects of energy recovery.

Acting in an advisory role to the Governor and the Energy Resource Coordinator, the Hawaii Energy Conservation Council is responsible for six major committees (Figure 12) and numerous technical subcommittees.

The initial group responsible for establishment of a state energy plan is the Advisory Committee for the State Energy Functional Plan.

Represented on the committee is a cross-section of state and county government, business, and academic interests (Figure 13). The goal of the committee is to provide input of the views and positions of all aspects of Hawaiian society. The State's position from the initial stages of an energy plan has been to actively include as many parts of the community as possible. An example is the Hawaii Senate Committee on Energy and Natural Resources, which is composed of ten task forces made up of one hundred scientists, citizens, and energy officials.

Each county in turn has an Energy Self-Sufficiency Committee which work closely with the various state agencies and task forces. Also, these committees act as coordinators and advisors to local community groups dealing with energy development.

Figure 14 is an example of one aspect of energy development. The Geothermal Development Group incorporates all the federal, state, county, industrial, and private groups involved in geothermal energy development in the

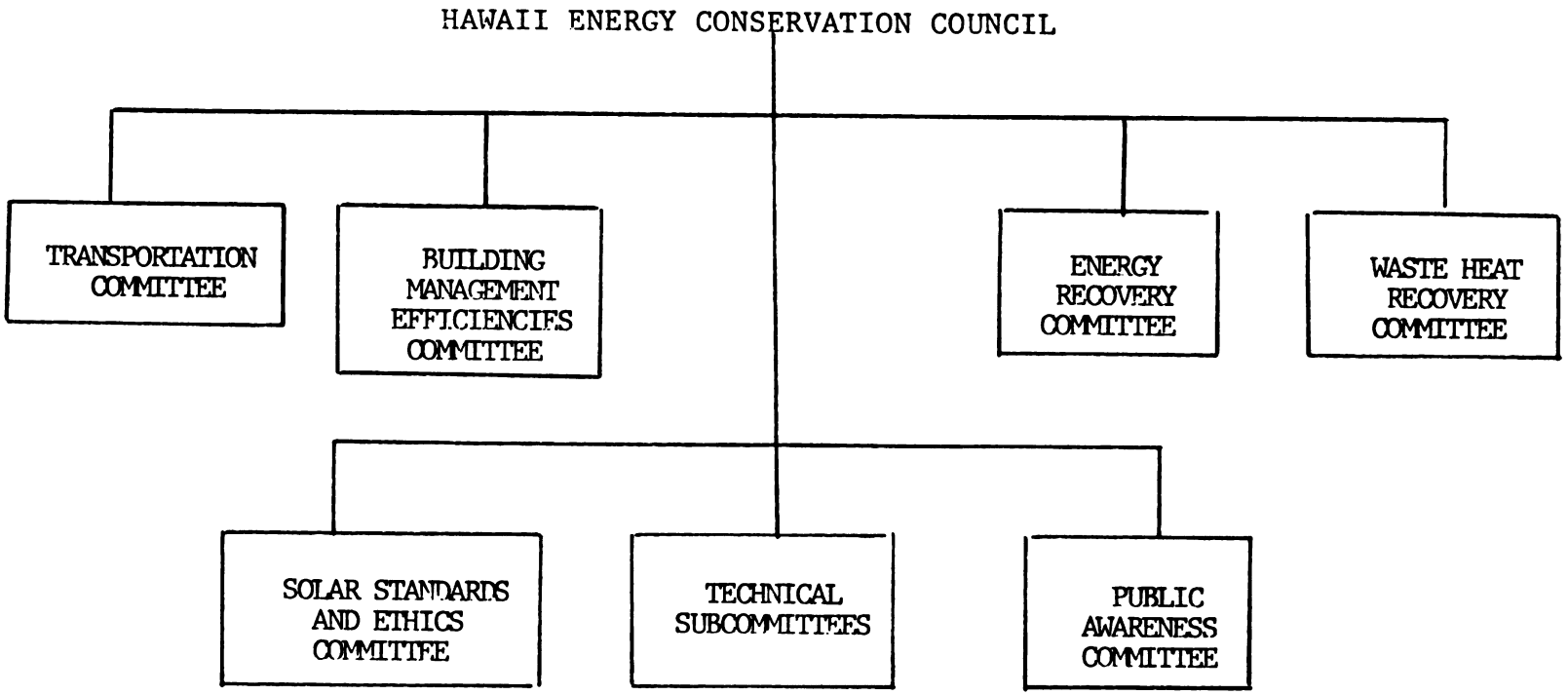

Figure 12.-- Hawaii Energy Conservation Council.

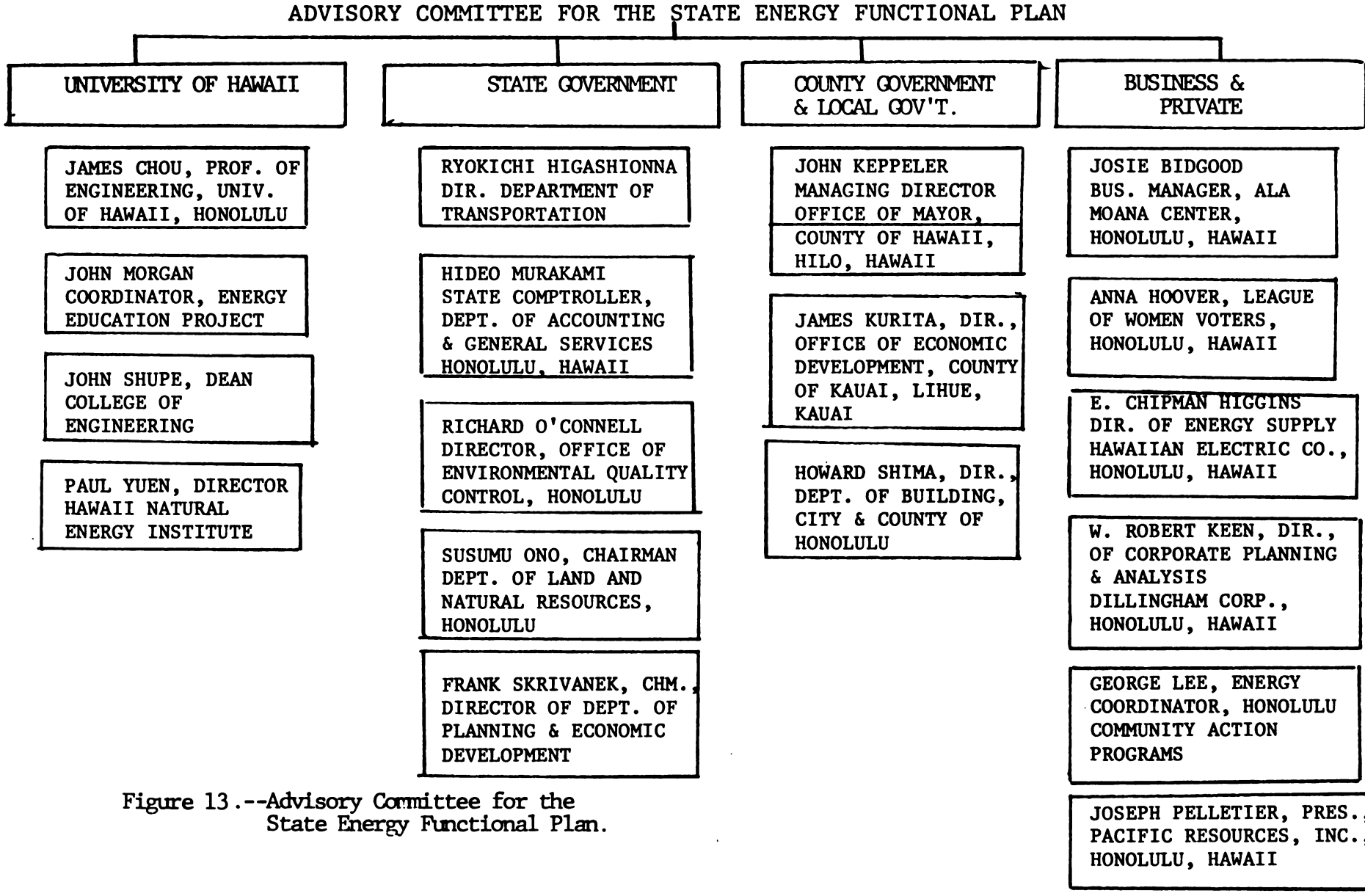

Figure 13.--Advisory Committee for the State Energy Functional Plan.

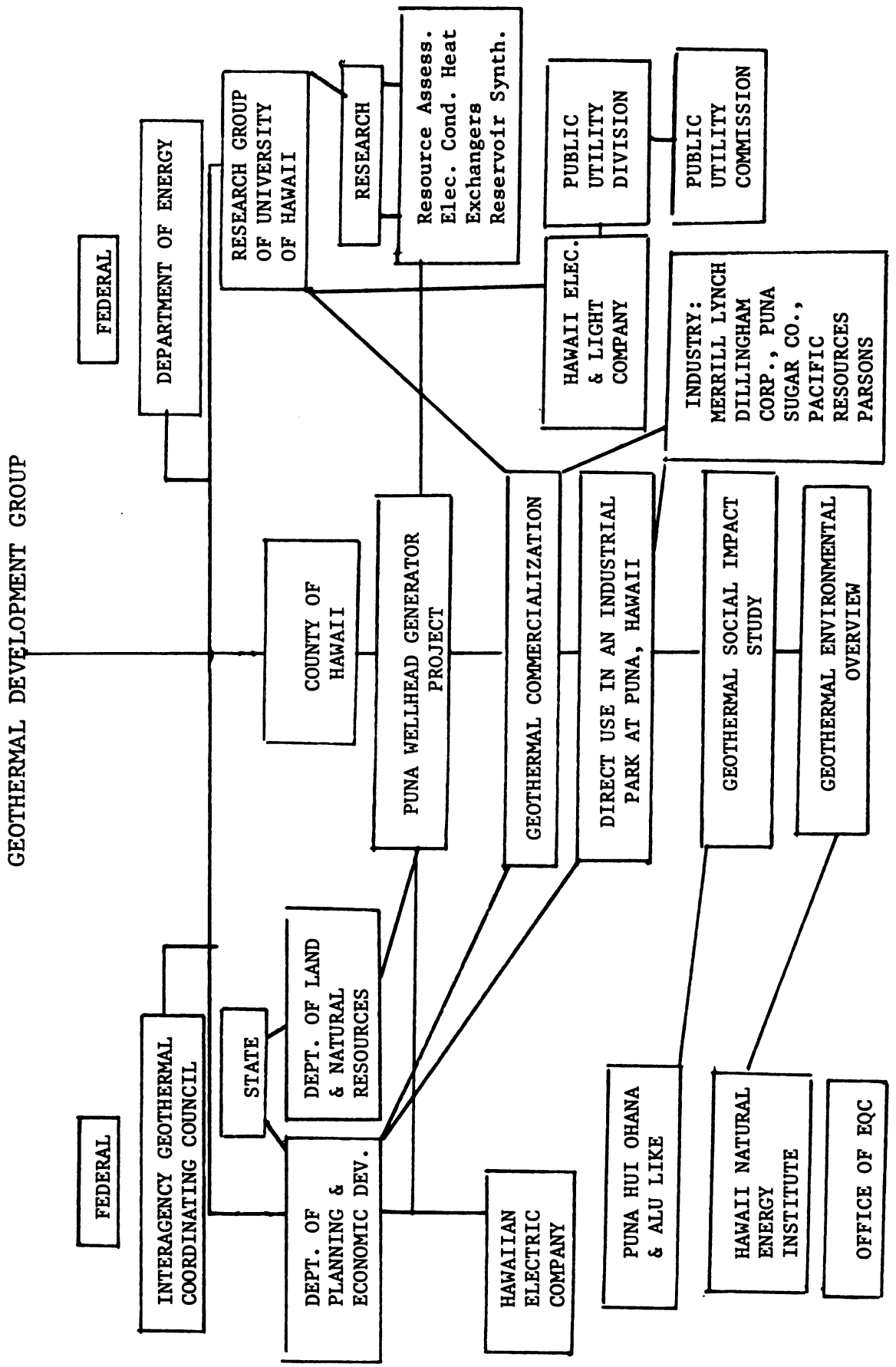

Figure 14. --Hawaii Geothermal Development Group.

Islands. The organization of this group is typical of the other alternative energy programs throughout the state.

Alternative Energy Development In Hawaii

At first glance, Hawaii's energy picture might appear bleak, with its overwhelming dependence upon petroleum. Fortunately, however, numerous energy producing options are available to Hawaii. The state is particularly blessed with abundant sunshine and wind. There is tremendous potential in the development of conventional solar water heating, photovoltic electricity, bioconversion, wind energy conversion, and ocean energy conversion. Geothermal and additional hydroelectric development contribute two more sources to the list of possible petroleum replacements. Numerous energy projects are underway throughout the state.

Wind Energy

The University of Hawaii's Department of Meterology has indicated that approximately 600 square miles, or about 10 percent of Hawaii's land area, have prime wind energy conversion potential. In 1978, the Hawaii Wind Energy Applications Network (WEAN) was organized by the State Legislature for investigation of this possibility. A wind energy applications test center was established and development goals set. The long-term goal of the WEAN program is to have a strong, self-sustaining, fully commercialized wind energy program in Hawaii, providing a significant level of the electrical and other requirements

in the state. A tentative goal has been suggested of 1000 MW of electricity per year by the turn of the century.[63]

The approach to this development includes, but is not limited to, financial support, zoning, and land use provision to allow wind energy conversion in prime wind locations, public financing if private funding is unavailable or too costly, and other incentives.

One key to this network is a close working relationship with the U.S. Department of Energy Wind Energy Program, the counties in Hawaii, the utilities, private industry, and the community.

A solar/wind Energy Coordinating Committee was created by HNEI in mid-1978 to provide guidance in insolation utilization and wind energy conversion RD&D programs. Thirty committee members meet regularly to deal with solar and wind energy conversion problems. Two wind energy task groups have been created by the coordinating committee to provide in-depth technical review to guide the decision-making process in wind energy conversion. The Solar/Wind Energy Atlas and Marketing Task Group's basic tasks[64] are:

1. To identify and map the primary (17+ mph) and secondary (14-17 mph) wind areas;
2. Reviewing of regulations of local, state, and federal agencies;

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[63]D. Richard Neill and Patrick Takahashi, A Report On A Wind Energy Applications Network for Hawaii, (University of Hawaii: Hawaii Natural Energy Institute, December 1978), p. 2-1.

[64]Ibid., p. 2-4.

3. Identifying steps to secure permits and determine government barriers to development;

4. Developing applications and marketing programs to identify and remove obstacles to commercialization of wind energy.

The establishment of this approach has led to the success of numerous small-scale private wind systems. As a result of the experience and knowledge gained through these projects, a major wind farm is being developed by Hawaiian Electric Company (HECO) on the Island of Oahu, with a goal of 80 megawatts production by the mid-1980's. This capability would be approximately 8 percent of HECO's generating capacity and would provide enough power for about 16,000 homes when operating at full capacity. Between 25 and 32 wind machines will be installed.[65]

Biomass Energy Program

Biomass resources have contributed significantly to the total primary energy supply. For a number of years, sugar plantations in the Islands have been producing electricity by burning sugar cane bagasse. For example, in 1978, five sugar plantations on Hawaii collectively produced 1.1 million tons of bagasse for boiler fuel. The gross heat value of 1.1 million tons of bagasse amounted to 8.700 x 10 BTU.[66] This provided 88.7 percent of the energy needs for the plantations. (Some petroleum is mixed with the

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[65]Barbara Hastings, "HECO Signs Pact For Wind Energy System," Honolulu Advertiser, August 15, 1980, p. 1.

[66]L. K. Hahn, Energy Self-Sufficiency Plan For County of Hawaii: Energy Demand Patterns and Projections, (Hawaii Natural Energy Institute, June 1979), p. 21.

bagasse.) The excess electricity produced is sold to the utilities, where it is fed into Hawaii's grid.

The Big Island uses approximately 7.6 trillion BTU's of energy in order to generate 1.8 trillion BTU's worth of electric power. Of this total, 70 percent comes from petroleum, 28 percent from bagasse, and two percent from hydropower. Less than 30 percent of the amount produced is consumed by the residential sector, with the remaining energy being used by the industrial and commercial sectors.[67] All of the other major islands, with the exception of Oahu, have similar production and use. Oahu has the major concentration of the state's population, thus the greatest for energy, yet it lags far behind in biomass development. The Hawaii Biomass Program at the Hawaii Natural Energy Institute has been organized to expand biomass use, not only in the production of electricity but in the manufacturing of ethanol.

Efforts have been made to identify issues, technical characteristics, and institutional barriers attendant to establishment of all on-going systems for storage, distribution, marketing, and use of ethanol additives to gasoline in the state. Also, investigation is underway regarding the feasibility of establishing a state-owned strategic reserve of ethanol for emergency use as a gasoline extender in Hawaii.

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[67] L. K. Hahn, Energy Self-Sufficiency Plan for County of Hawaii: Energy Demand Patterns and Projections, (Hawaii Natural Energy Institute, June 1979), p. 3.

Studies by the University of Hawaii have identified a number of potential sources for the ethanol production.[68] Beyond molasses, which is a bi-product in sugar processing, sweet potatoes, taro, and cocoyams have been identified as potential sources. Cooperation between the counties, private industry, and University agriculture specialists is leading to the solving of production problems.

The goal for the ethanol program is the replacement of five percent of total energy need by the turn of the century. The capability exists to provide approximately 21 million gallons of ethanol through utilizing all the molasses currently produced by the sugar industry.[69] Current gasoline consumption is 300 million gallons per year.[70] The Hawaiian Sugar Planter's Association has, for many years, been estimating the costs of producing ethanol from molasses. The Association established a task force to investigate technical problems, logistics, and the feasibility of constructing a plant for commercial production.[71]

It should be noted that wood chips and macadamia nut shells have been used on a limited basis as boiler fuel.

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[68]Evangeline J. Funk and Karen E. Shigematsu, Fuels From Biomass Technical Report #3, Hawaii Natural Energy Institute, October 1977).

[69]Donald Murata, Alcohol Production, Technical Report #5, (Hawaii Natural Energy Institute: Hawaii Biomass For Fuels Project, April 1978), p. 1.

[70]State Energy Plan, p. III-82.

[71]Ibid.

Expansion in the macadamia nut industry and the abundant commercial forest land offer promising potential. Both areas have task groups investigating the potential. The Department of Land and Natural Resources, Forestry Division, and private industry have on-going programs to produce forestry biomass from tree plantations. Another private firm is constructing a pelletizing facility for bagasse and wood chips that will increase energy content.[72]

Biomass is the only indigenous energy resource that can be used to produce liquid fuel directly, thus it will continue to be of high significance to Hawaii's future energy situation.

Hawaii has decided generally to exempt from Public Utility Commission jurisdiction and regulation those facilities which produce, transmit, or furnish power derived primarily from biomass for its internal uses, although excess power must be purchased by local utilities at rates to be arbitrated by the Public Utility Commission, if necessary. The State Legislature expressly intended to assist the sugar industry by allowing it to burn its waste product, bagasse, in an unrestricted manner.[73] By opening up competition in power production for the sugar industry, the evolution of bioconversion technology may be hastened.

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[72]State Energy Plan, p. III-80.

[73]Ibid., p. III-79.

Ocean Thermal Energy Conversion

A number of projects relating to ocean thermal energy conversion are on-going in Hawaii. Due to the nature of the development, major assistance from federal agencies is required, however, the Hawaiian approach has incorporated significant input from state, county, and private organizations to aid in development, marketing, and solving of environmental problems. Many aspects of OTEC have been tested at the Seacoast Test Facility, which is governed by the Natural Energy Lab Board. A consortium of private companies has been encouraged by the State Energy Coordinator to move ahead with OTEC development.[74] Early construction of a land-based plant designed to produce up to 40 MW of electricity is anticipated at the Keahole Point site. At the same time, a platform sited plant off the coast of the Big Island is in the process of being developed. A projection of 330 MW's of production by the turn of the century is the goal of state energy planners.[75]

The work subsequently completed includes an oceanographic and a socio-economic evaluation of the Keahole areas pertinent to OTEC. The oceanographic consisted of an attempt to describe the spatial and temporal changes in oceanographic conditions in the area and to determine the

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[74]Lockheed Ocean Systems and The Dillingham Corporation of Honolulu Combined In The Mini-OTEC Project; Global Marine and TRW are under contract for the Dept. of Energy OTEC-1 Project.

[75]State Energy Plan, p. 80.

environmental impact of an OTEC plant upon this area. The socio-economic program was concerned with examining the legal aspects of ocean thermal energy development. The applicable law, federal interests, legislative experience, licenses and permits, opposing interests, and site considerations were also factors taken into consideration. The existing socio-economic state of the region was characterized as well, by examining the population, labor force income and education, electrical demand and possible impact of a new power source.[76]

Geothermal Energy

The Hawaii Geothermal Project was organized by the Research Corporation of the University of Hawaii to locate and aid in development of geothermal energy resources in the state.

> In 1972, the Hawaii State Legislature allocated $200,000 for geothermal research, contingent on the University's also obtaining federal funds, which it did.[77] From the beginning, this has been a cooperative project, involving the federal, state, and county governments, the University, the electric utilities, and the private sector.

In 1973, separate programs were established for Geophysics, Engineering, and Environmental-Socio-economics.

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[76]Karl H. Bathen, An Evaluation of Oceanographic and Socio-Economic Aspects Of A Nearshore Ocean Thermal Energy Conversion Plant In Subtropical Hawaiian Water, (University of Hawaii, April 1975).

[77]Proceedings Of The Seminar On Geothermal Energy, October 18, 1977, (Sponsored by the Department of Research and Development, County of Hawaii: Geothermal Research Council, 1977), p. 3.

Later, an Experimental Drilling Program was added.

The HGP Site Selection Committee considered all geophysical, geological, and geochemical evidence that had been collected, and selected the Puna District site on the Big Island as the most promising.[78] Development of this reserve has begun. The initial wellhead generator is scheduled to become operational in the spring/summer of 1981. Its energy production will be about 3.5 MW of electrical power.[79]

A consortium of organizations called the HGP-A Development Group was given the responsibility of constructing and operating this generating plant. It consisted of the Hawaii Geothermal Project, the Department of Planning and Economic Development, and the County of Hawaii. Although not legal members of the HGP-A consortium, the Hawaii Electric Light Company and the Hawaiian Electric Company are active participants in the program.

Experts estimate that this geothermal reservoir has a capacity of 500 to 5000 Mwe for 100 years.[80] With this being only one of numerous identified sites throughout the islands, a tremendous potential exists. Development of this reservoir alone presents many possibilities. The Island of Hawaii presently consumes an average of 70 MW of electricity

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[79]"Geothermal Plant To Open In June At Puna, Hawaii," Energy Insider, March 30, 1981, p. 2.

[80]Proceedings of the Seminar on Geothermal Energy (County of Hawaii: Geothermal Resources Council, 1977), p. 6.

annually.[81] Power in excess of this amount could be diverted to other uses. One possibility is to connect the major islands in the chain by a submarine power cable. Another is to use the excess in the processing of deep sea mining areas. A program (Figure 15) has been established to determine the feasibility of a submarine power cable. It has concerned itself with both the geothermal energy transmission between islands and the OTEC transmission from a platform to an island.

Private industry, with federal assistance, has been exploring the potential of magnesium extraction off the coast of Hawaii and Maui, looking to the possibility of processing it with the excess power of either geothermal or ocean thermal energy.

Another use of the excess electricity may be the production of hydrogen by the hydrolysis of water. Hydrogen is a good, long-term possibility as a synthetic fuel. Its potential transportation uses adds a new dimension to Hawaii's goal of energy self-sufficiency.

The potential environmental impact of these projects is an on-going concern of the Environment Studies Program, which is a task group formed by the Hawaii Geothermal Project. Membership consists entirely of academic representatives of the University of Hawaii. The Botany, Chemistry, Oceanography, Public Health, Microbiology, Geophysics, Water Research, and Anthropology Departments

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[81] Seminar on Geothermal Energy, p. 7.

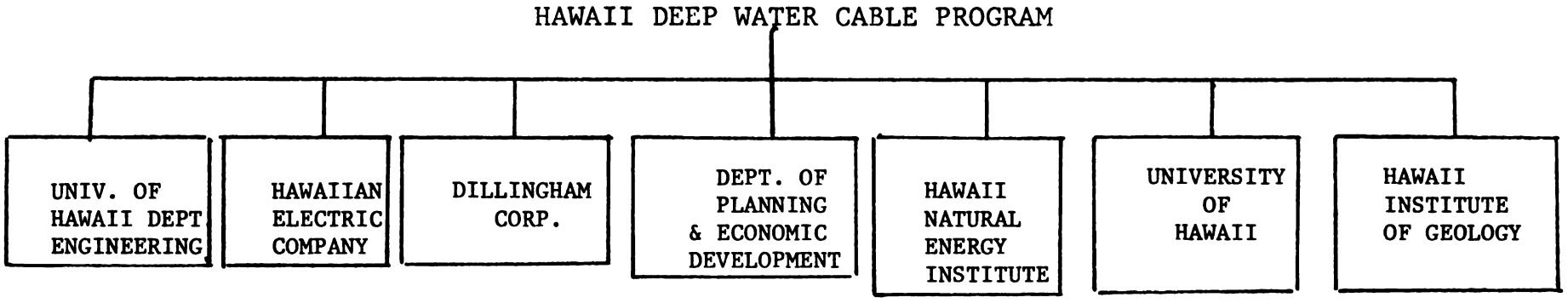

Figure 15. --Hawaii Deep Water Cable Program.

are represented on the task group.

Public hearings, as required by Chapter 182 and 91 of the Hawaii Revised Statutes, have been held throughout the state to consider the proposed rules and regulations governing geothermal exploration and the mining and leasing of government-owned geothermal mineral resources in the state.

As in all the other areas of energy development in Hawaii, public input is pursued and given considerable weight in any decisions made by state authorities. The approach throughout has been open, with committee positions and technical information available to the general public. Most Hawaiian citizens are involved in and aware of decisions relating to the energy future of the state.

Direct Solar Use

Direct solar energy is the energy that is obtained by collecting and/or focusing the sun's rays. Surveys of solar radiation in Hawaii indicate that the state registers the highest average amount of langleys per day in the nation. At present, the largest use of solar heat is for residential solar water heaters. However, as electrical power plants account for only 20 percent of the energy used in the state, and only six percent of this electricity goes to residences, should every residence in the state convert to solar water heating, only two percent of the energy used would be saved.[82]

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[82]George T. Koide and Patrick Takahashi, Wind And Solar Energy Applications Study, (University of Hawaii, August 1977), p. 48.

The use of solar power for industrial purposes, however, offers a much greater reward. Utilization in greenhouses and commercial processes such as drying coffee beans are examples of such application. Presently, the majority of effort in this area has been the presentation of information by state agencies. County and local community groups, however, have been working closely with private enterprise and individual homeowners in dealing with problems inherent in direct solar utilization. A number of state tax incentives have been initiated by local groups lobbying the State Legislature. Local and county land use laws have been adjusted to encourage solar development. Through the addition of industrial use and possible economic development of photovoltaic cells, state energy planners are projecting that direct solar will replace 14 percent of the total energy use of the Islands. This would be the equivalence of 450 MW of electrical power.[83] The means of achieving this goal are tax incentives, consumer education, and local demonstration of utilization. Each county presently has a committee which works closely with a state level committee formed by the University of Hawaii's Natural Energy Institute.

Conclusions

Hawaii has been aggressive in its pursuit of its stated goal to

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[83]State Energy Plan, p. 80.

> Accelerate research and development of new energy-related industries based on wind, solar, ocean, and underground resources and solid waste;

and to achieve

> increased energy self-sufficiency.[84]

The Administration, the Legislature, the business sector, the academic community, and local government and citizens have combined forces in a united effort designed to attain these objectives. The use of committees and task groups at all levels with a free exchange of ideas and an encouragement of outside input has led to the removal of barriers that might have impeded development well into the next decade. In actual fact, many of the programs are well ahead of schedule and preparing to move forward into the marketing stage. The quick acceptance of these alternatives by the Hawaiian citizenry has been largely due to the open approach of handling information and decisions by the developers. Education of the consumers and those to be directly affected by any changes brought about by development has been a major thrust from the inception of the energy self-sufficiency program. The majority of citizens through town meetings, have had the opportunity for input into the decision-making process of many of the projects, resulting in a generally positive feeling toward the state's ability to solve future energy problems. The soundness and alacrity of this course of action is verified by the resulting success of each of the demonstration programs.

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[84]State Energy Plan, p. 8.

CHAPTER IV

BARRIERS TO RENEWABLE ENERGY DEVELOPMENT

Several renewable energy systems exist today which have established the technological feasibility for production on a local or small-scale basis. Introduction of these systems into the marketplace is constrained by a variety of barriers to the integration of these alternatives with local existing conventional energy systems. The identification of these constraints is the first step towards the decentralization of the local communities' energy system.

Organizational and institutional problems and conflicts are major considerations in the determination of ways to adapt the current systems. Until quite recently, the Federal position has been to view obstacles to the adoption of new energy systems as purely technological. However, as T. S. Jayadev states in Basic Research Needs and Priorities in Solar Energy,[85]

> Important obstacles to the adoption of new energy systems or expansion of existing ones will increasingly be recognized to be to some degree political, sociological, economic, institutional, and environmental in character. In particular, it is crucial that analysis of the consumer decision process be conducted including the effect of external factors on consumer decisions, product attributes, risk and uncertainty, and value and use of information.

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[85]T. S. Jayadev and D. Roessner, Basic Research Needs and Priorities In Solar Energy Vol. 1, (Golden, Colorado: SERI, January 1980), p. 29.

With these considerations in mind, it is necessary to approach the introduction of alternative energies into the existing system with a broad perspective. The resulting organization of potential barriers and constraints into nine major groups is an attempt to address this variety of influences. The major groups are:

1. Educational
2. Financial
3. Marketing
4. Legal
5. Utility
6. Regulatory
7. Technological
8. Policy
9. Social

Each major group will be defined, the potential barrier identified, and possible solutions suggested. The determination of which level of government must resolve the barrier is reserved for the conclusion of this dissertation. It is sufficient to say at this point that the barriers exist at the different levels and must be resolved at those levels. Neither the Federal Government nor any single entity of the state, regional, or local levels is capable of eliminating all of the barriers obstructing alternative energy development. Action at all levels of government and by large numbers of individuals and groups will certainly be required to achieve significant alternative energy development.

Educational Barriers

Possibly the major hindrances to an expedient deployment of alternative energies fall within the realm of education. Most individuals and corporations are not aware of the renewable energy options that are becoming available to them. Those that are aware may not have enough information available to them to make informed purchase decisions. Dissemination of accurate, understandable information on a large scale is necessary to overcome this information gap.

Not only do barriers exist in the dissemination of energy information to the general public, but programs of educating and training the people involved in the production and delivery of the energy systems are being inhibited. The decrease in funding of public education has precluded the adoption of necessary energy training programs in many states. With exiguous research having been completed in the area of work opportunities within these energy fields, school administrators faced with dwindling resources have been slow to recognize the near-future needs. Thus, the first impediment to be overcome is the education of both legislators who control the financing, and administrators who have curriculum decision-making powers of the need for inclusion of these programs into the educational system. Once this has been accomplished, the problem of the availability of trained instructors for the programs will need to be solved. Presently, energy education is handled (in most cases) by adding one or more courses to a

curriculum, or providing short courses and seminars for practicing professionals. Special curricula, undergraduate, and graduate programs in alternative energy development are less frequent. If the decentralization of energy systems is to proceed at any significant pace, the increased development of educational curriculum in the alternative energy field is an indisputable need. Additionally, an evaluation of the quality of courses and programs is needed to determine if they provide the training necessary for the successful diffusion of these technologies into the present energy system. Methods must be devised to define the technology delivery systems of the various energy systems and identify the types of people who need to be involved in the education and training programs. These may include installers, building tradesmen, real estate developers, loan officers, and utility company planners as part of one system. Also, the policy making systems require consideration of programs offered. City planners, architects, and engineers will not only need to be prepared in the technological aspects, but in the legal, social, and environmental dimensions of these new developments as well. Little will be accomplished in decentralization of energy if the policy makers do not understand the mechanics and ramifications of the systems. In general, education and training are needed for the people involved in administration and legislation, in the manufacture and assembly, the marketing and communication, and the delivery and maintenance of the innovations.

Community Colleges and Universities should include in any alternative energy program three areas of involvement. These are:

1. Curriculum Programs
2. Special education events and workshops
3. Energy extension services

The curriculum programs must provide the technology and training necessary to incorporate the alternatives on a large scale. Standards of course content must be determined and state certification criterion established in technology, installation, and codes. Short-term programs need to be offered for educators. Each state department of education should develop a comprehensive plan for alternative energy development from kindergarten through the 12th grade. Teachers expected to incorporate this program into their curriculum must have the opportunity for training in workshops. The obvious placement of such workshops is within the Community College-University setting. Other uses of the workshop approach might be business and community groups, building contractors, financial officers of lending institutions, and legislators.

The extension service aspect will provide an information clearing house. It may also incorporate student volunteers in demonstration programs on the campus, and extension assistance on a community level. Local community policy makers are in need of information in dealing with the incorporation of these new energy sources. As Simmons

relates in Distributed Energy Systems in California's Future,[86]

> The individual community embarking on the soft path will face a number of difficult questions:
>
> 1. Which technologies are really available and are they reliable and cost-effective?
>
> 2. Which types of land use in our community are big energy users or wasters?
>
> 3. What effects will conservation efforts have, and where should we aim our efforts in conservation: in homes, business, or industries?
>
> 4. On what parts of our program should we work alone; when is regional cooperation needed?
>
> 5. Should we treat energy from the grid as a scarce resource, i.e., disapprove a regional shopping center so that we may approve five thousand homes?
>
> 6. If we save, will others waste what we save, or worse, use it to our community's disadvantage?
>
> 7. What are our particular strengths and weaknesses in pursuing the soft path, e.g., climate, types of uses, sources of energy?
>
> 8. What specific changes should we make in organization, planning, and regulation to encourage growth along the soft path?
>
> Answers to these questions lies partly in policy and politics but in large measure they require factual information about land use and energy.

The extension service approach provides the mechanisms for answering these kinds of questions.

Another mode of providing information lies in the hands of citizen groups. The operation of local demonstration services are additional aids in reaching the objective of decentralized energy. The major barrier facing these groups

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[86]M. Simmons, p. 173.

is the inability of obtaining enough technical and financial support to operate effective programs. Most federal programs do not like to send quantities of material to local groups. In fact, expert advice on specific conservation and renewable resource applications is generally available only through expensive professional consultants. Many areas lack even this resource. The solving of these problems will be a major step towards the dispensing of information needed by the general populus to understand alternative energies.

Besides the traditional educational channels, like schools and libraries, the media is a huge educational tool that can reach large numbers of people. Convincing publishers and producers that energy development rates news time is a major step towards overcoming the educational gap. For example, persuading newspapers, radio and television stations to incorporate a "solar index" into their weather report which indicates either the amount of sunlight and wind received that day, or the amount of water that could have been heated that day, or the amount of money that could be saved, would be one method. Numerous potentials exist once the media is convinced of its role in the presentation of alternative energy information.

Development of educational programs, production of information materials, support of citizen group programs, and the incorporation of the media in information dissemination are methods of overcoming educational barriers. The levels at which these approaches should be pursued will be discussed later in this paper.

Financial Barriers

Financial barriers rank a close second behind education in their impact on alternative energy deployment. The initial expense as compared to standard systems and the long pay-back period of the alternative systems presently obstruct the onset of large-scale implementation. The first approach by many is to view this problem as one that must be solved by the free market system. The possibility of this happening in a reasonable period of time*, however, is unlikely without government incentives and policy changes. Markets as they exist are not free or natural, rather they are biased and influenced by a wide variety of circumstances. These include institutional arrangements, policies, and practices of both private enterprise and governnment. In addition, as Gerald Brannon asserts,

> There are three major problems with free market energy prices that must be faced:
>
> 1. A free market is likely to result in under investment in research on new technologies.
>
> 2. The decision makers are not the energy developers.
>
> 3. Reserves of energy are not provided for periods of interruptions of foreign sources.[87]

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*A reasonable period of time, in the author's view is as soon as humanly possible, so as to take into account the enormous effect of present energy prices on the poor in this country. Can we allow the free market to move at its pace or do we, out of conscious need to speed up the process towards more inexpensive energy?

[87]Gerald M. Brannon, Energy Taxes and Subsidies, Cambridge, Massachusetts: Bollinger Publishing Company, 1974.

A free market approach is thus unlikely to move towards the use of new systems of energy without a great deal of effort and change.

Although public opinion appears strongly in favor of the use of alternative energies and energy conservation over fossil fuels or nuclear energy, this potential public demand is at least partially thwarted by policies that prevent prices from reflecting the true marginal costs of fossil fuels and nuclear energy.[88] The subsidizing of the fossil fuels with depletion allowances, price ceilings, and the benefits of federal assistance and promotion has created an artificial market with regard to other energy sources. Through 1978, the fossil fuel industry has $124 billion in subsidies and incentives, while the solar industry has received less than $1 billion.[89] The present higher cost of alternative equipment is a result of this lack of effective competition. Alternative energies are not currently cost competitive with conventional energies, although many are approaching oil-generated electricity. As has been stated, this disparity in cost is widened by government policies

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[88] Energy in America's Future: The Choices Before Us, Edited by Sam H. Schurr, Resources For the Future (Baltimore, Maryland: John Hopkins University Press, August 1979).

[89] Solar Action Incorporated, Citizen's Solar Program: State Reports On Barriers and Strategies To Renewable Energy Development, (Washington, D.C.: U.S. Government Printing Office, October 1978), p. XI.

that have kept the price of conventional energy below replacement costs. Gradual decontrol of energy prices will mitigate this disparity. An effective alternative energy policy must be geared to achieving cost parity once technical feasibility is achieved. As long as this continues, the alternatives will be discriminated against and their market penetration slowed down. Economic energy conservation and a rising use of renewable resources should not be sacrificed to a short-term illusory policy to keep prices below cost. The alternative to this reform is continued distortion in the market and failure to exploit large sources of potential energy.

Philip J. Mause views the solution as,

> In general, the gap between marginal costs and current prices may be politically impossible to close. Instead, a combination of efforts to revise rate structure to provide more accurate price signals to consumers and various regulatory measures will probably have to be undertaken. Active utility involvement in energy conservation and alternative energy supply investments, appliance efficiency standards, building standards and mandatory industrial efficiency standards may all be necessary to ensure that those conservation investments, which are less costly than new supply, will actually be made.[90]

With an influx of adequate financing, increased production of alternative hardware should result in a

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[90]Philip J. Mause, "Price Regulation and Energy Policy" in Selected Studies On Energy: Background Studies for Energy: The Next Twenty Years, (Cambridge, Massachusetts: Bollinger Publishing Company, 1980), p. 182.

lowering of capital cost. However, presently there are few

grant programs available to local organizations for projects which demonstrate solar feasibility in local communities. Without these examples, few people are willing to invest their money into a costly system which they do not truly understand. Banks and lending institutions are even less likely to invest in systems with only limited track records. There are no incentives to extend mortgages or offer loans to cover the initial cost of these installations. Also, there are no standards for renewable energy hardware upon which consumers, financial institutions, and insurance companies can base decisions. There is presently no easy way for the average consumer to compare energy costs of alternative structures or systems before building or buying. This results in decisions based upon capital-cost rather than life-cycle cost.

In addition, land requirements for some renewable energy systems are large enough that the cost and availability of land in particular cases will be an important element in economic calculations.

Finally, many of the alternative technologies are viewed as risky because they are new. This perception is strengthened by the fact that many renewable applications have been designed for a specific site, which means that there may be reliable information for applications elsewhere. The risk of a lack of adaptability to a different site is a serious concern.

With these types of problems facing the alternative energy industry, financial institutions have been reluctant to invest in the new technologies, particularly when the economic advantages of the renewables depend on highly uncertain assumptions about the future cost and supply of other energy sources.[91]

The removal of barriers involves the elimination of laws, procedures, perceptions, and practices which prevent renewables from competing on an equal basis with conventional forms of energy. There are six basic solar financial incentives which are currently in use and aimed at lowering the price to the end consumer.

The six market price reduction strategies are:

1. Direct grants;
2. Income Tax rebates;
3. Income Tax credits;
4. Deductions from taxable income;
5. Sales tax exemptions;
6. Subsidized loan programs.[92]

The wide-spread perception that financing is unavailable has generated several loan guarantee programs. Either directly through utilities and governmental agencies, or through the existing network of banks and savings and

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[91]U.S. Department of Energy, Solar Energy Objectives: Calendar Year 1980, (Washington, D.C.: U.S. Government Printing Office, April 1980).

[92]John Ashworth, The Implementation of State Solar Incentives: Financial Programs, (Menlo Park, California: SERI International, February 1979), p. 6.

loan associations, subsidized loans for solar purchases are spreading rapidly. Various utilities have developed programs for financing energy systems.

> Portland General Electric has created a loan program which forwards 60% of the system cost to the solar purchaser as 'upfront' capital with which to buy a solar system. This sum is then due on July 1 of the following year, presumably after the purchaser has recouped his/her 60% through tax credit savings.[93]

The Southern California Gas Company has instituted a six percent loan to be funded through ratepayers' dollars.

Finally, one additional concept in renewable energy lending is gaining support and deserves mention. Municipal Solar Utilities are being established by communities with funds from the profits of the utility that serves the city with water, gas, and electricity. The MSU's are offering consumer loans for solar development.

Through the Windfall Profits Act of 1980, the federal tax credit was increased to 40 percent up to a ceiling of $4,000. Numerous states have enacted credits to supplement the federal incentive. Nationally, over 19 states have enacted credits of some sort to spur consumer interest in renewable energy systems.[94]

Subsidizing the cost of a solar system purchase through rebates has its problems. Because the rebate is an

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[93]Margaret C. Gardel, "Financing Solar Energy For The Consumer: An Overview of New Trends" Proceedings of The Western Sun 1980 Solar Update Conference, (Washington, D.C.: U.S. Government Printing Office, 1980), p. 107.

[94]Gardel, P. 105.

after-the-fact reimbursement, the solar purchaser must first be able to arrange financing in a conventional manner. Even with the rebate, in many cases the consumer incurs a substantial debt with payments greater than the anticipated fuel savings.

Which of these programs, if any, will lead to the solving of the financial barrier is questionable. The inclusion of local innovations will certainly be necessary if a speedy transition to renewable energies is to be accomplished.

Marketing Barriers

Marketing barriers include problems with standards, scales, licensing, and consumer protection. Most of them reflect the common issues affecting any young, growing industry. The lack of industrial performance standards and performance data, however, presents the largest problem. The dilemma of whether set standards may themselves become barriers to development rather than incentives is certainly legitimate. For example:

> Performance standards based on thermodynamic efficiency (energy collected per square foot of collector surface) instead of overall performances (energy collected per dollar spent) discriminate in favor of large corporations which tend to produce expensive, `high efficiency' systems. The evolving standards-setting program tends to discriminate against small businesses which cannot afford the cost of having their systems tested.[95]

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[95]Solar Action, Inc., p. XIV.

However, the other side of the argument has a legitimate position as well,

> Consumers would like to know exactly how much energy they will save and how long the systems will last. They also expect some protection against defects in design or workmanship, especially when the equipment requires a large investment and serves an essential purpose, when the technology is new, and where the manufacturer is a relatively small company. Standards are needed for both purposes; they provide information necessary for product choice, and they provide the basics for guarantees, which are desirable as a way to promote confidence.[96]

Thus, while standards are generally viewed as an obstacle to renewable energy development, they can be used to promote, as well as hinder, specific technologies. The establishment of a reputation of being an unreliable or poorly constructed product could hinder marketing to a much greater degree than setting reasonable standards would deter the development.

Setting standards involves many technical problems, such as the type of tests conducted and how much data suffices.

Because decentralized systems vary greatly from one locale to another, the standards need to be adapted to local requirements. Therefore, the parties responsible for setting the standards should come from the communities involved, and should consist of representatives of all interested parties. The problem with this approach is in providing the necessary information for correct

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[96]Alan S. Miller, "Legal Obstacles to Decentralized Solar Energy Technologies," Solar Law Reporter Vol. 1, No. 3, September/October 1979, p. 598.

decision-making. The educational extension and state energy offices may be one source of such guidance for the local communities. This consensus approach emphasizing involvement by all affected parties is preferable to government regulation. The principal legal issue raised about standard development by local groups is the possibility of violating anti-trust laws. The arbitrary or discriminatory withholding of a seal or certification of approval may well violate the anti-trust laws.

The requirement of a warranty on parts and labor in the solar field is an area of conflict and confusion. A number of states are considering requiring such warranties. Because of the fear that warranties from small firms may not be collectible, the states are also considering the use of performance bonds or state-backed insurance policies.[97]

Warranties and certifications may be most effective when supported by consumer protection laws designed to discover and penalize deceptive and fraudulent practices. Many appropriate state and local agencies exist, but the technical information needed to identify intentional deception has not been developed. In the absence of standards, consumer education may be one of the most powerful ways to protect consumers.

Product liability is another area of major concern in alternative energy marketing. Insurance rates are dependent upon the product safety practices of manufacturers and the

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[97]Miller.

product liability prevention programs being implemented by the firms seeking the insurance. Small firms may have problems meeting the product safety practices required by insurance companies. Assistance by states in setting reasonable standards and organizing insurance pool programs may provide an answer to this problem. Insurance for the consumer is another dimension of this question. With the limited present development of renewable energy systems, many insurance companies have not established rate structures. In doing so, determination will be made as to whether this activity is abnormally dangerous. Strict liability will be imposed upon an activity where there is the existence of a high degree of risk and an inability to eliminate the risk by the exercise of reasonable care. Therefore, it will be important for the renewable industries to show that a high degree of risk or harm can be avoided by the exercise of reasonable care.[98]

There is concern that these problems might frighten prospective manufacturers and especially retailers out of the energy market. There is a need to impose a statutory liability to encourage private industry participation.

Legal Barriers

New products, even when technically practical and economically competitive, must overcome many obstacles

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[98]Lyne Coit, Wind Energy: Legal Issues and Institutional Barriers (Menlo Park, California: SERI, June 1979).

before becoming successful. This is true for the renewable energy technologies. Consumers must be satisfied that systems are reliable and durable; the rates to be charged for auxiliary energy must be determined; building code practices must be settled; and a myriad of other potential problems must be overcome.[99] Many of these issues will arise as legal questions. Building codes, consumer protection laws, mortgage lending practices, public utility regulations and patent laws are among the significant legal technologies.[100]

L. H. Tribe[101] expressed the connection when he stated,

> It is the law in its commonest manifestation which, however inadvertently, supplies much of the context within which research and development are encouraged, permitted, or inhibited. And it is the law which forms a large part of the framework through which the fruits of such scientific and technical endeavors are disseminated or suppressed, and in terms of which the costs and benefits of their efforts are distributed. Legal structures of rights and responsibilities designed with wholly different ends in mind will thus influence the evolution and shape the consequences of science and technology--unless those who contribute to the design of such legal structures direct their attention to these issues in a timely way.

In many cases, laws will have to be amended to account for the special needs of new energy systems. Even where

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[99]Environmental Law Institute, Legal Barriers To Solar Heating And Cooling of Buildings, (Washington, D.C.: U.S. Government Printing Office, 1978).

[100]Miller.

[101]L. H. Tribe, Channeling Technology Through Law, (Chicago: Bracton Press, 1973), p. 48.

problems facing solar technology are not caused by regulatory requirements, legal solutions to such problems are often proposed.

Although energy problems are usually thought of as being in the sphere of decision-making by national authorities, many policies affecting the renewable energy industry are best handled by the state or local governments. Land use controls, building codes, property and sales taxes and utility rates are exclusively state/local functions. These areas of interest represent the major legal barriers to development and must, therefore, be handled by the state and local authorities, rather than through the establishment of federal directions which would be unable to consider all the local variations and needs.

An example of a land use and building code problem is the requirement of direct sunlight for some of the renewable systems. focusing collectors or passive designed homes are sensitive to shading. Thus, solar access becomes a legal question. Unless rights to sunlight are established, many potential users may decide to forego installation of collectors over potential shading problems. Legal means of resolving the issue would be of clear benefit. Studies of the existence of the problem in specific locales would help clarify the need for legal change, while at the same time alleviate unjustified concerns.[102]

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[102]George Hayes, Solar Access Law: Protecting Access To Sunlight For Solar Energy Systems, (Environmental Law Institute, 1979).

As it presently stands, there is no automatic or prescribed "right to light" in the United States. To eliminate any doubt, a number of states have adopted solar easement laws which clarify the requirements for express grants of easements to light for the benefit of solar collectors.[103] A recent study suggests that proposed solar access laws be evaluated in terms of:

1. Protection of appropriate amounts of solar access;
2. Clear and fair allocation of costs and benefits;
3. Compatability with other laws and policies;
4. Adequate notice;
5. Political acceptability;
6. Flexibility;
7. Compensation for loss of access protection;
8. Ease of implementation;
9. Protection of future access.[104]

Another approach would be solar zoning. A prototype solar zoning scheme has been suggested by W. A. Thomas in an American Bar Foundation Study.[105] The proposal suggests that,

> 1. Mandatory solar-energy use districts may be established where conditions are suitable for use of cost-effective solar energy systems as the

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[103]Stephen B. Johnson, "State Approaches To Solar Legislation: A Survey," Solar Law Reporter Vol. 1, No. 1, May/June 1979.

[104]Hayes.

[105]W. A. Thomas, Overcoming Legal Uncertainties, Chicago: American Bar Foundation, 2978), p. 20.

> primary energy source in all new or significantly altered structures.
>
> 2. Affirmative solar-energy-use districts may be established where conditions are suitable for use of cost-effective solar energy systems but where mandatory solar energy use would be impracticable because of prevailing conditions.
>
> 3. The boundaries of solar-energy-use districts shall be defined by the local government after consideration of topography and vegetation in the area, height, bulk, and location of structures; age and type of structures and present energy systems in them; extent and character of actual and proposed development provisions in the comprehensive plan; economic feasibility of using solar energy systems; and other relevant factors.

As in all approaches, zoning plans have their limitations and are open to legal challenge.

The control of vegetation is also a major problem when, through growth, it begins to shade existing systems. The proving of a nuisance as a basis for protecting solar access is questionable.[106] However, some states have enacted laws based upon this contention. As S. F. Kraemer states,[107]

> Declaring a shadow that shades a solar collector a public nuisance should be within the ambit of state legislators or local governments. Such an action would be for the public health, safety, and general welfare under the police power to alleviate growing energy shortage, reduce pollution, and preserve the local economy.

The requirement that planting be limited and surrounding trees be trimmed when they begin casting a shadow on existing solar systems is bound to bring court action. In

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[106] Alan S. Miller, "Legal Obstacles to decentralized Solar Energy Technologies; art II, Solar Law Reporter Vol. 1, No. 4, November/December 1979).

[107] S. F. Kraemer, Solar Law, (Colorado Springs, Colorado: Shepard's, Inc., 1978), p. 117.

defense of this approach, it is important to note that vegetation controls are already imposed to further other accepted public concerns, such as protection and utility power lines.

The New Mexico Solar Rights Act[108] is the first state law to declare solar access as a property right to solar energy users. The act states:

> A. The Legislature declares that the right to use the natural resource of solar energy is a property right, the exercise of which is to be encouraged, and regulated by the laws of this state. Such property rights shall be known as solar right.
>
> B. The following concepts shall be applicable to the regulation of disputes over the use of solar energy where practicable:
>
> 1) 'beneficial use' shall be the basis, the measure, and the limit of the solar right, except as otherwise provided by written contract. If the amount of solar energy which a solar collector user can beneficially use varies with the season of the year, then the extent of the solar right shall vary likewise;
>
> 2) 'prior appropriation' In disputes involving solar rights, priority in time shall have the better right except that the state and its political subdivisions may legislate, or ordain that a solar collector user has a solar right even though a structure or building located on neighborhood property blocks the sunshine from the proposed solar collector site. Nothing in this paragraph shall be construed to diminish in any way the right of eminent domain of the state or any of its political subdivisions or any other entity that currently has such a right; and,
>
> 3) 'transferability' Solar rights shall be freely transferable within the bounds of such regulation as the legislature may impose.

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[108] Solar Rights Act, Ch 169, 1977, New Mexico Laws, New Mexico Stat. Ann. Sections 70-8-2.

The transfer of solar right shall be recorded in accordance with Chapter 14, Article 9, NMSA 1978.

C. Unless singular overriding state concerns occur which significantly affect the health and welfare of the citizens of this state, permit systems for the use and application of solar energy shall reside with county and municipal zoning authorities.

The ability of this law to withstand legal tests may provide many solutions to the removal of legal barriers to renewable energy methods.

Many of the legal questions for solar access are related to wind generation systems. The blocking of wind by structures may present a barrier whose solution requires similar actions. Also, a frequent impediment to both solar and wind development is regulations governing the exterior appearance of buildings. These can arise from either privately created architectural controls or public ordinances. Limited research on this type of ordinance indicates a substantial degree of uncertainty concerning the likelihood of successful court challenges.[109]

One approach to overturning the restriction would be to pass laws on a state level forbidding unreasonable interference with the use of solar collectors or wind generators, except in cases of public safety. In the case of wind generation, the lot size might become a safety factor because of the distance a blade could be thrown in the event of an accident.

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[109]Environmental Law Institute.

It should be noted that laws designed to foster the development of solar energy, if unclear and ambiguous, may be strangled by the resulting web of administrative rules, procedures, and interagency conflicts, thereby adding further difficulties to the already present barriers to development of renewable energies.

The reverse side of the legal concern of obtaining right is the protection of the rights of developments. A number of the renewable energies can create a major impact upon a surrounding area. For example, geothermal and alcohol production may present problems of noise and odor, and ocean thermal energy may cause local weather modification. All may have aesthetic considerations. It is likely that legal attacks based upon nuisance and environmental impacts will have to be confronted. The environmental impact issues will need to be solved by technology. The non-health affecting nuisances will require zoning and local ordinances that recognize the need for such development.

Utility Barriers

Private, investor-owned, and municipally-owned utilities will have a significant impact on the commercialization of renewable energies. A number of issues have developed concerning utilities which must be solved by legislative control. The important questions of the price utility back-up to solar systems, the price paid to decentralized units for excess energy, feed into the electrical grid, discriminatory rate-making against solar-based customers, and

regulatory jurisdiction of the Public Utilities Commission all must be answered.

The issue of PUC jurisdiction concerns the propriety and extent of state regulation of renewable energy technologies. The question of whether a decentralized system which sells electricity to a utility is in fact a utility itself is the crux of the issue. If so, should such systems be controlled by PUC licensing, a process that involves lengthy hearings on site selection, rate-making and territorial jurisdiction? The state of Hawaii has decided to exempt from PUC jurisdiction and regulation,

> Facilities which produce, transmit, or furnish power produced primarily from non-fossil sources for its internal uses, although excess power must be purchased by local utilities, at rates to be arbitrated by the PUC if necessary.[110]

California also has shown concern for this issue. A 2978 law[111] states that its purpose is to

> Ensure that the solar energy industry develops in a manner which is competitive and free from the potential dominance of regulated electrical and gas corporations.

The range of utility involvement with renewable energy sources is the subject of intense concern. Many see decentralization as a means of gaining independence form large utilities and resist utility involvement. Others encourage utility participation because of existing service

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[110] Chapter 102, Sec. 1, 1977, Laws of Hawaii, Hawaii Rev. Stat. Sec. 269-1-27.

[111] Chapter 1102, 1978, Cal Stat., Cal. Pub. Utility Code Section 2775.5.

infra-structures and capital availability. The motivations of utilities are questioned. Greater profits can be obtained by providing the energy directly, rather than dispersing the knowledge and the systems on a one time profit basis. Therefore, are the utilities likely to develop and market the systems with the same speed and diligence a private business would? Turning the responsibility over to utilities while restraining private enterprise in the red tape of PUC restrictions is likely to result in a major barrier to speed development. Encouraging utility cooperation with private enterprise is, however, another story. A number of states have authorized their PUC's to allow utilities to invest in alternative energies. Provisions have been made to eliminate the possibility of monopolies.

Discriminatory rates for solar customers is a major barrier to marketing renewable systems. The utilities' position is that solar demand occur at cold or cloudy periods when peak generating load is greatest, thus requiring increased capacity above lower levels of fluctuating demand. Disregarding this argument, a number of states have moved towards forbidding discriminatory rates. For example, Iowa[112] has prohibited municipal, corporate, or cooperative electric or gas utilities from making 'discriminatory rates or charges" or otherwise causing "prejudice or disadvantage" to a user of renewable energy sources.

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[112]Chapter 1056, 1978 Iowa Act, Iowa Code Section 476.

Included in the issue of rate discrimination is the buy-back price paid to small system owners by the utilities. The provisions of the Public Utility Regulatory Policies Act[113] require non-discriminatory rates for sales to utilities by small systems, including solar systems. Voluntary guidelines for solar energy and renewable resources have been issued under the provisions of the Act by the Department.[114] In actual fact, however, the various utilities appear to have discriminated against renewable system owners. For example:

> Southern California Edison will pay 11 mils (one mil equals 1/1000 dollars) per kilowatt hour peak, 7 mils for mid peak, and about 3 mils for minimum peak power. These rates correspond to about 33 mils, 22 mils, and 10 mils in charges respectively.[115]

Also, many utilities continue to charge higher service rates for solar customers. Detroit Edison charges $6.50 per month for these customers, as contrasted to $2.50 per month for regular service.

The proper role of utilities within decentralized development, the fair treatment of renewable customers, and the jurisdiction of the PUC are issues that must be resolved. With utilities presently having a monopoly control over electrical and gas energy production, a transition to decentralized systems will possibly be perceived as a major

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[113] 16 USCA 824a-3, 1 Supp. 1979.

[114] 45 FR 12188 (February 22, 1980).

[115] Simmons, p. 221.

threat and is unlikely to be made voluntarily by the utility companies.

Regulatory Barriers

The four areas of concern that result in regulatory barriers are:

1. land use patterns and energy consumption;
2. building codes;
3. zoning regulations;
4. interagency policy interpretation.

Each individual jurisdiction develops and administers its own general land use plan. It sets its own densities and land uses, approves or disapproves the subdivision of land, administers building codes, and sets zoning restrictions. These important decisions are made by local government even though frequently the implications have regional or statewide significance. For example, in the San Francisco Bay area alone there are 93 cities and nine counties, plus 25 special districts, regional agencies, or other governmental agencies with land use powers.[116] Although for the most part direct regulations of land use is the province of local government, many levels of government are often involved. As noted in the San Francisco Bay area, as many as four or even five levels of planning and decision-making can be superimposed. The opportunity for problems is multiplied by this type of structure. Lovins has developed

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[116]Simmons, p. 162.

an approach for dealing with barriers created by such systems. He states,

> In order to estimate the potential for widespread utilization of DETS we must understand more fully how the employment of such technologies will alter current land use patterns and the trends that have been developing toward new varieties of land use development. We must also attempt to identify the
>
> organizational arrangements and administrative procedures of the various decision-making groups that will be necessary to accommodate these distributed energy systems. More specifically, we will have to consider:
>
> 1) designing new linkages between these groups and the energy industry and equipment manufacturers--current non-existent;
>
> 2) formulating new standards for `good' planning design criteria;
>
> 3) reevaluating current relationships between community and regional and state land use regulatory authorities;
>
> 4) reassessing trade-offs between land usage for energy support facilities and other needs (agriculture and recreation).[117]

This implies that major changes in both the ways we now choose to use land, and the manner in which its usage is allocated will be necessary. As such, energy considerations will compete with a broad range of economic, political, social, and institutional constraints traditional in governing the use of land.

A specific approach to energy-oriented land use planning designed by Simmons[118] is:

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[117] A. B. Lovins, Soft Energy Paths: Toward A Durable Peace Cambridge, Massachusetts: Bollinger Publishing Company, 1977), p. 84.

[118] Simmons, p. 174.

1) Draw a sample of areas within a region or entire state representing cross-sections of urban, farm, densities, traffic characteristics, climate, resource, availability, land use, mix of age of structures, wealth, etc.

2) Determine and map existing land uses in detail, using classifications that would be

energy-sensitive. Possible sources include zoning and land use maps, assessors' records, insurance information, utility information, and actual surveys.

3) Determine and map existing energy use (by land classifications) as to gross use, peak and off-peak periods, end-use demand and quality. Utility information and surveys would be required.

4) Analyze area plans and commitments to growth and estimate future energy requirements, reviewing land use, infrastructure and development proposals.

5) Analyze the implications of energy supply disruptions. Establish rationing and allocation schemes, energy conservation programs, and potential sources for augmenting supply.

6) Determine the energy conservation potential of existing and planned uses if changes were made in the transportation patterns, housing densities, and the spatial arrangement of shopping, work, recreation, and living areas.

7) Analyze the supply potential of soft energy sources in area noting the locational and area requirements and resultant environmental impacts.

8) Re-evaluate area plans and commitments to growth in light of conservation and soft energy supply possibilities.

9) Evaluate possible economics from regional entities, i.e., wind, pumped storage, solar, geothermal.

10) Evaluate local program in light of regional and state profiles and targets.

11) Prepare area planning package to ensure full consideration of energy in land use decisions. This might include an element of the General Plan, recommended ordinance changes, an

environmental impact assessment guide, and a system for evaluating the energy implications of the capital improvement plan.

The major step in dealing with land use problems will be the establishing of a system of coordinating the various levels of authority. Once accomplished, renewable energy systems will have a greater opportunity for contributing a meaningful portion of the energy supply.

Building codes regulate all aspects of building materials and design. Numerous studies of the building code process have emphasized its adverse impact on the adoption of new technologies in buildings.[119] Codes are administered by thousands of independent local code agencies. There are more than 30,000 building code variations. As a result, approval of new products is a community-by-community process inmost situations.[120] Despite the existence of at least five national building code organizations and many statewide codes, local communities do not always reflect recent amendments for accommodating new technology. Local groups will have to encourage adoption of these new measures if problems with codes are to be overcome. Once solar codes are developed, it is important that inspectors be trained and encouraged to enforce compliance. Contractors and builders must be made aware of the importance of inclusion of the systems in their construction projects.

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[119]Grant Thompson, Building To Save Energy: Legal and Regulatory Approaches, (Cambridge, Massachusetts: Bollinger Publishing Company, 1979).

[120]Miller, p. 774.

Unfamiliarity with solar technology has created more delays than code requirements. This delay will diminish as code officials and builders get more experience.

In California, existing statewide codes are being reviewed to identify sections which might hinder the use of solar systems. It is also planned to train building officials in the use of the new information to reduce delays at the local level.[121]

The changing of these codes and training of the officials will not be an easy task.

> Around these standards have grown a massive bureaucracy of interrelated decision makers that includes the Federal Government, the financial institutions, including the assessors, and the appraisers, contractors, home builders, material suppliers, codes, zoning ordinances, to say nothing of the attitudes and values that people have developed. It is the social acceptability of an idea and these attitudes that are so important and do become such an impediment to change.[122]

Local zoning may present serious obstacles to renewable energy development. Aethetics, height restrictions, orientation, density and setback controls may all present difficulties to be resolved.

A city with valid aethetic zoning controls must decide whether harmonious architectural styles are more important

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[121]Robert Odland and Julie Riley, Standards, Building Codes, and Certification Programs For Solar Technology Applications, (Golden, Colorado: SERI, 1979).

[122]David M. Scott, "The Earth Shelter Experience of Codes, Ordinances, Financing, Incentives, and Attitudes," Proceeding of the Western Sun 1980 Solar Update, (Washington, D.C.: U.S. Government Printing Office, 1980), p. 73.

than the use of solar energy. There will be applications where on-site solar technology fits and others where the decision is made to control this type of development. Other renewable methods may be more acceptable and information should be made available concerning these choices.

One common type of zoning ordinance that could be an obstacle in certain situations is the height restriction ordinance. However, special exceptions to height restrictions are spires, belfries, cupolas, antennas, water tanks, ventilators, chimneys, or other appertures usually required, to be placed above the roof level and are not intended for human occupancy. A solar collector would seem to be a type of appurtenance.[123] This may be one method of solving height restrictions.

Methods of avoiding rigid siting and lot size requirements are currently available in many localities. In such areas, a developer may apply for a planned-unit development which allows greater flexibility in laying out streets and siting buildings.[124]

Another method of handling zoning barriers may be for the property owner to request a special exception. A special exception is a statutory provision that allows an otherwise unlawful land use, when the specific statutory

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[123]Fred Bair, A Model Zoning Ordinance, (Chicago: American Society of Planning Officials, 1976).

[124]Paul Spivak, Land Use Barriers and Incentives To The Use Of Solar Energy (Solar Energy Research Institute, August 1979).

requirements have not been met.[125] From a community's perspective, the special exception may be preferred to changing zoning legislation to allow solar devices in all cases. By placing guidelines on special exceptions for the use of solar collectors, a community can fulfill the goals of its zoning regulations, while allowing enough flexibility to solar collectors regarding exact compliance with those regulations.[126]

Technical Barriers

The major impediments to technological development of the renewable energy sources have been financial. The Federal Government has not placed a major emphasis with regards to money, upon the decentralized systems, but rather has encouraged the development of large-scale fossil fuel alternatives. The decentralized funds that have been made available have gone to large companies for research and development rather than to local communities and small companies. The tendency has been for these large companies to concentrate their efforts upon large-scale, centrally-located solar designs because of their greater potential for profit. The small-scale methods, conservation techniques, and passive solar designs have received little active support form either the Federal Government or big business.

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[125]Anderson, American Law of Zoning, 19.01-1932.

[126]Spivak.

These areas of development do not offer either large profits or central control and thus are not candidates for major emphasis. Without proper funding, the technological development of systems or approaches must move slowly. The limitation of research monies halts many projects that would provide needed information to aid system development and creates problems in large-scale dissemination of information. Thus, community-scale applications and low-cost systems have not received adequate support.

A new system must go through four stages of development:

1) Technology development

2) Engineering development

3) Demonstration

4) Commercialization[127]

Many of the small power systems are in the demonstration stage of the development cycle. The engineering feasibility of these systems has been proven and will be well established for regular operating conditions in the course of the demonstrations. Before these systems can achieve acceptance in the marketplace, their long-range performance characteristics must be determined. A system life of 20 years is considered acceptable form a standpoint of users. However, without funding, these demonstrations

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[127]U.S. Department of Energy, Solar, Geothermal, Electrical And Storage Systems Program Summary Document, (Washington, D. C.: U.S. Government Printing Office, June 1980).

cannot proceed in any meaningful fashion, thus the barrier of finances to technological development.

A major problem requiring technological advances is the structural barrier to retrofits. Many structural and design characteristics essential to use of certain solar systems in residential buildings are not adaptable to many existing buildings. For example, east or west facing homes, inadequate weight support or lack of attic space, small usable roof areas, or sunlight limitation from tall buildings create problems that will require new answers. Approximately 77 percent of existing residential buildings will still be in use in the year 2000.[128] A sizable number will need special adaptation and design if they are to take advantage of solar energy.

The individual decentralized energy systems all contain technological problems that must be removed prior to large-scale marketing. Large-scale federal and state funding is necessary to overcome this barrier if solutions are to be developed in the near future. The large financial requirement of the systems cannot be ignored or placed upon small businesses and local communities. The work should be accomplished through them, but the funding must come from the outside.

Policy Barriers

The policy barriers deal with the attitudes and approaches of authorities and decision makers who are in

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[128]Doe Solar Energy Objectives, p. 43.

positions of aiding or hindering alternative energy development. Much of the problem stems from federal and state government. Three typical problems encountered in policy and decision making are:

1) Inadequate statutory definitions of key terms

2) Unclear delegation of responsibility to administrative agencies

3) Lack of a requirement of intergovernmental coordination[129]

As Michael Warren explains,

> The creation of adequate definitions before much experience has been gained with solar technology is not a simple task. Some legislatures have purposely kept definitions of solar systems vague. It is feared that definitions which are too precise and limited to known technology will result in two unwanted outcomes. First, new technological developments would be excluded from incentives which were tied to outdate definitions of solar systems. Second, precise definitions, outdated or not, would mark the boundaries of solar energy, thereby hindering further development and advancement of solar technology.[130]

Such definitions cause a lack of the flexibility that solar laws need in order to be able to keep abreast of future designs and uses of renewable energy systems, especially at this early stage of the industry's development.

The unclear assignment of role or authority is a major concern in state governments. In some cases, the spreading of authority has created serious problems of coordination

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[129] M. Warren, "Common Problems In Drafting State Solar Legislation, Solar Law Reporter Vol. 1, No. 4, November/December 1979, p. 159.

[130] Warren, p. 160.

and results in administrative immobility. The establishment of a chain of command and specific responsibilities will lead to expanded development of alternative energies with a region.

The need for intergovernmental coordination is obvious. Duplication of effort is not only expensive, but also confusing. In many cases, definitions, building codes, standards, and administrative guidelines vary to such a large degree from one region to another than small businesses faced with the task of insuring that their equipment meets numerous criteria in numerous regions or states, some of which conflict, may be unable to expand to the degree necessary for serious implementation of these renewable systems. The needed expansion will put increasing pressure upon legislatures to provide for efficient administration of energy policy.

Legislation that attempts to deal with such an immense range of problems will touch many different departments and agencies in state government. Thus legislative tools allowing for proper administration of renewable energy legislation become essential to the effectiveness of the legislation. The first step will be the identification of barriers to the establishment of these procedures.

Two major problems are:

1) A "centralize energy" bias of some policy-makers.

2) The resistance to public input.

Both will need to be addressed before meaningful change can

result. The "new" energy options will require adjustment of attitudes and inputs from many authorities not normally associated with the system. Out of necessity, renewable energy development in many locations has been a grass roots approach. Thus, the experienced people will come from these levels in many cases. Acceptance of their views and approaches may be difficult for some lawmakers.

Peter Pollack[131] has established four approaches to administering renewable energies,

> 1) Initiatives should be analyzed by each state with an eye toward their compatability with state politics and political structure. Such choices as enabling versus mandatory or general versus specific programs will depend upon local attitudes and expertise and the level of energy saving desired from solar energy uses.
>
> 2) Legislation should be carefully drafted so as to clearly indicate lines of administrative authority and the basis upon which administrative rulings must be made.
>
> 3) Coordination of state-level bureaucracies with jurisdiction over land use and energy should be performed early in the adoption of a particular initiative. This is especially important in the transfer of technical information from the state to the local level.
>
> 4) In order to assist local jurisdiction in the implementation of state-level initiatives, technical information such as design handbooks, model ordinances and easements, and baseline energy information should be provided as early as possible.

Once governmental approach is established, the numerous policy barriers can be dealt with. These include:

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[131]Peter Pollack, The Implementation of State Solar Incentives: Land Use Planning To Ensure Solar Access, (Golden, Colorado: SERI, March 1979), p. 25.

1) The large subsidies for fossil fuels which place renewable energies at an economic disadvantage.

2) The little support or funding going to local community groups to develop renewable resources.

3) The inadequate installation of solar design and equipment in government buildings for demonstration purposes.

4) Needed incentives such as tax credits and loan programs for solar equipment.

5) Limited funding of State Energy Demonstration and Energy Education Programs.

6) Incorporation of energy development into regional and local planning.

7) Building Codes and zoning restrictions making renewables unfeasible in many locations.

8) Undue restrictions on small contractors and do-it-yourselfers.

9) Misunderstanding of renewable concepts by inspection officials.

10) Non-availability of funds for energy conservation program studies.[132]

A final concern must be the restraining of ill conceived, hasty action. Laws designed to foster development of renewable energies, if ambiguous or unclear, may be strangled by the resulting mass of administrative rules, procedures, and interagency conflicts.

Social Barriers

"Energy is a social, not a technological issue. A basic flow in all energy discussions is

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[132]Solar Action Incorporated, p. 218.

> that the cultural and social content tends to be left implicit. Yet the major choices in energy paths are being made in the context of different and often conflicting social and cultural systems."[133]

Our present centralized energy system permeates all aspects of our society and culture. A change to a decentralized system will result in many changes in our society. The pervasive desire to preserve the status quo is a strong barrier to decentralizing energy. Once citizens are convinced of the advantages of decentralized energy control, however, many will begin participating in developing the systems. Herman Koenig[134] raises a number of issues that need to be resolved as this change takes place:

> 1) What will or should be the social and productive roles of the family unit in the context of anticipated changes in the physical and social organization of human settlements?
>
> 2) What are the attitudinal and perception factors involved in motivating families and communities to assume a leadership role in shaping their future?
>
> 3) At what point in the future are specific components of community and family adaptation likely to become economically and socially motivated and to what degree can or should the timing be influenced by policy incentives and disincentives?
>
> 4) What are the forms, amounts, and timing of public and private investment and disinvestment required to support these adaptations and what are the alternative institutional arrangements for providing the necessary capital?

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[133] Simmons, p. 49.

[134] Herman E. Koenig, Industrial Societies in Transition: The Role of The Family Unit, prepared for American Home Economics Association, 71st Annual Meeting, Dallas, Texas, June 1980.

5) To what extent should the technical efficiency and physical performance of future developments in transportation, district heating, deployment of local renewable resources and other elements of community form be tempered by more subtle social and cultural considerations?

Studies must be completed in a relatively short time span. Shifts in employment, real income, and family security are all impacted by the present energy situation. Development of new systems will likely result in many new problems. Approaches to a smooth transition of social expectations and needs is as important as many of the technical problems facing decentralization of energy. Life-styles and energy use habits are likely to be changed dramatically. The people involved must understand the reasons for such change and the future benefits they will obtain. Of all the barrier fields, social barriers are the least understood and researched and yet in many ways, the most important.

Conclusions

Introduction of decentralized renewable energy systems are constrained by a variety of barriers to the integration of these alternatives with local existing conventional energy systems. The identification of these constraints is the first step towards the decentralization of the local communities' energy systems. The resulting organization of potential barriers and constraints into nine major groups is an attempt to address this variety of influences. The major groups are:

1. Education
2. Financial
3. Marketing
4. Legal
5. Utility
6. Regulatory
7. Technological
8. Policy
9. Social

Neither the Federal Government nor any single entity of the state, regional, or local levels is capable of eliminating all of the barriers obstructing alternative energy development. Action at all levels of government and by large numbers of individuals and groups will certainly be required to achieve significant alternative energy development.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this dissertation has been to perform policy research and analysis of existing programs to identify barriers to regional, state, and local energy development. The aim in completing the study has been to provide local authorities the organizational structure to:

1. Establish policies and devise strategies for replacing dwindling fossil fuels with renewable resources.
2. Promote the incentives that will encourage alternative energy development.
3. Determine the barriers to and necessities for the development of renewables.
4. Formulate the strategies that would reduce those barriers.

The identification of barriers, and the steps to be taken to remove them, help create an efficient, effective program. Therefore, research capability was aimed at determining how man's decisions and activities either assist or block proposed development. The comparison of established programs in decentralized energy development provided the mechanism for such a determination. Hawaii's programs surfaced. The State of Hawaii, due to its present overwhelming dependence upon petroleum, has recognized the need for the development of its indigenous energy sources. While an

alternative energy program for any region must be unique and site-specific, the experience gained in Hawaii may have positive spinoff to other areas deficient in conventional energy supplies. Being a state with numerous potential energy resources and a receptive populus, there has been a rapid development of new technologies. The rate and degree of development achieved by Hawaii may help provide some insight to other regions in their attempts to develop their own resources.

An analysis of the Hawaiian system, coupled with methods and approaches from other state and local programs has led to the following conclusions. A successful program must begin with three steps:

1. The education of the public concerning potential alternatives and the possible means to develop them.
2. The organization of committees to involve the community in problem solving and development of the resources.
3. The procuring of funds to finance research and development of the alternatives.

The education of the general public requires a great deal of advance preparation. Universities and Community Energy Self-Sufficiency Program contributed the major portion of information necessary for this study. The recommendations section of this chapter contains a model program which has been designed from information selected from the Hawaii experiences, along with contributions from other state and local programs.

Conclusions

The huge variety of climatic, economic, and demographic settings, and the many potential ways of adapting renewable energy to local conditions are creating a rich diversity of methods from which to choose. In deciding how best to meet energy demands in a particular setting, it is important that the decisions take into consideration the differences in performance, economic attractiveness, and impacts--environmental, social, legal, and political--of a particular renewable energy. Since these considerations can vary considerably in different settings, the development and control of these systems must be accomplished in a decentralized fashion. In actual fact, however, few state and local systems are organized to deal with the problems relating to alternative energy development. Therefore, the first step in the decentralization of energy production must be the planned establishment of these systems. Various approaches have developed across the country to deal with aspects of the problem, but only a few cases have total Colleges within the region must determine the available potential options, prepare the information specialists, and train technicians. As the economic situation changes and traditional energy costs increase, the mood within a community is likely to become receptive to new ideas. Information can then be dispersed through homeowners' groups, media releases, libraries, state agencies, and academic institutions. Community Colleges and Universities should include

in their alternative energy program these three areas of involvement:

1. Curriculum programs.
2. Special educational events and workshops.
3. Energy extension services.

Initially, short-term programs need to be offered for educators, school administrators, and school board members to convince them of the value of incorporating alternative energy information into school curriculum. Other offerings of the short course approach should be for business and community groups, building contractors, financial officers of lending institutions, and legislators. Once the key people in the community have been appraised of the feasibility of the local alternatives, implementation of large-scale efforts to educate the general public can proceed. The methods used in this education process would be:

1. Development of educational programs.
2. Production of information materials.
3. Support of citizen programs.
4. Incorporation of the media in information dissemination.

As public awareness and acceptance of the potential options develops, the next step, that of organization, can begin. The organization of efforts in developing an alternative energy program to compliment the established traditional energies will require a much greater public involvement.

The devised approach utilizes a pyramid committee system. (Figure 16) With the large number of barriers obstructing implementation plus the variety of possible alternatives, a sizable number of people at all levels will be required if the system is to accomplish the goal of expedient alternative energy development. Committees at all levels of government: state, regional, county, and local, dealing with the nine barrier issues[134] must be organized. A liaison between levels must established with procedures developed for an orderly flow of information.

A State Alternative Energy Coordinator, appointed by the governor, will be responsible for overseeing the state-level subcommittees and reporting to the State Energy Committee. The State Energy Committee should be composed of representatives of the private sector, business and financial interests, academic and technological segments, government figures, and environmental concerns. This wide spectrum approach should insure consideration of all sides of each issue in the development of a functional plan.

The implementation of the functional plan through the removal of barriers at their appropriate levels is the responsibility of the subcommittees. Each subcommittee should develop means and methods of encouraging a wide range of input from all aspects of the community. Without this cooperation and participation from large numbers of the citizenry, a meaningful contribution from alternative energy

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[134]Education, Marketing, Financial, Legal, Utility, Regulatory, Technological, Policy, and Social.

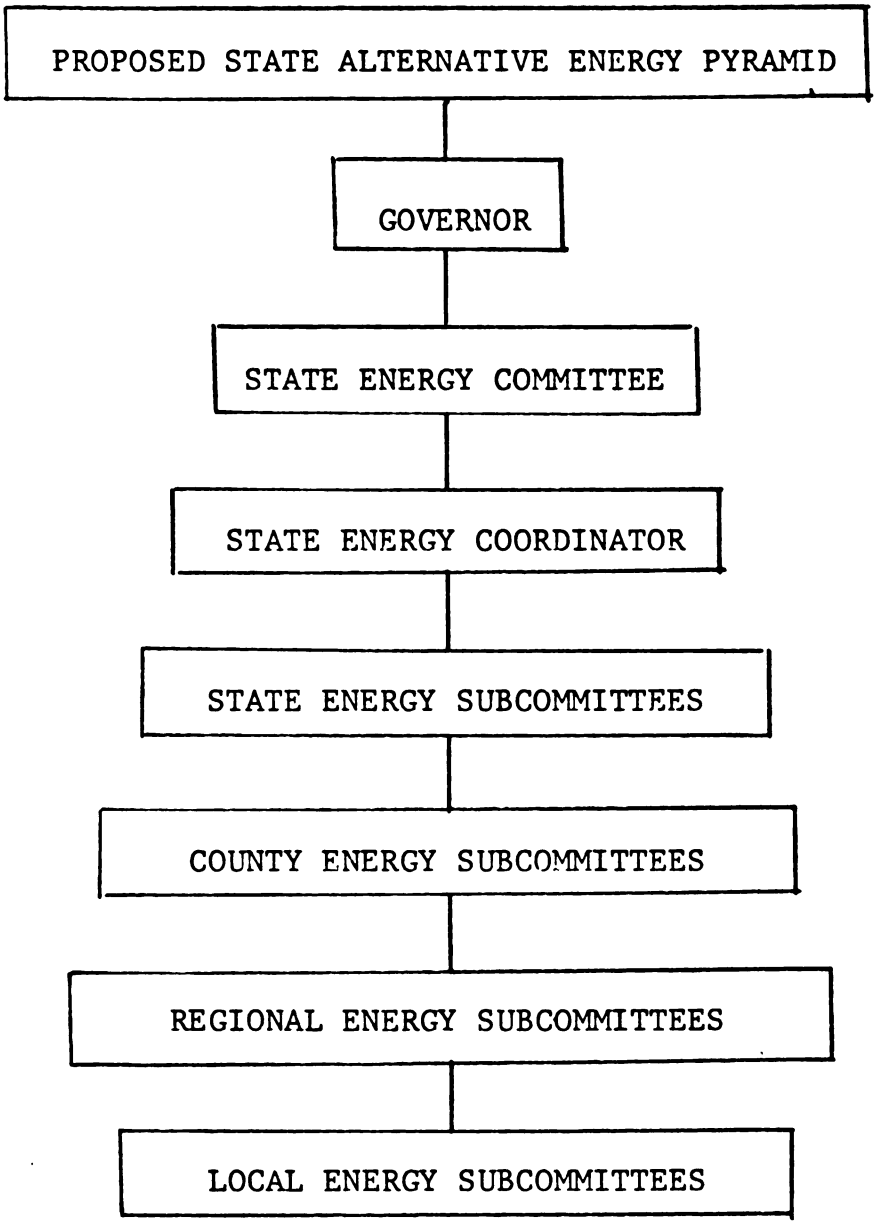

Figure 16.--Proposed State Alternative Energy Pyramid.

sources is unlikely. The local committees provide the most appropriate level for the great majority of interaction. In the organization of the committees, a mechanism must be established to transfer information up and down through the levels to facilitate their inclusion in any planning. Possibly the serving of one member of a lower committee on the next level committee would accomplish such a purpose. With a free flow of information, problems and solutions can be matched at the level of need.

Once the pyramid is established, numerous public meetings should be held throughout the system for the release of information developed by the committees, to the populace. Demonstration Centers and Information Clearing-houses are important aspects of this approach. If people are to become involved, they must have easily available, clear information explaining the alternatives. Misinformation and contradictory facts can only add to the difficulties of development. The major goal of the state level committees will be the establishment of procedures that move clear, precise information down through the system to the local level.

The model of alternative energy development presented in this dissertation delineates a flow of responsibility from the state level down into the local communities (Figure 16). Each level contains committees designed to deal with the constraints and barriers best handled at that level (Figures 17 thru 20). The components of the pyramid are headed by the state governor who appoints a state energy committee and state energy coordinator. The purpose of the

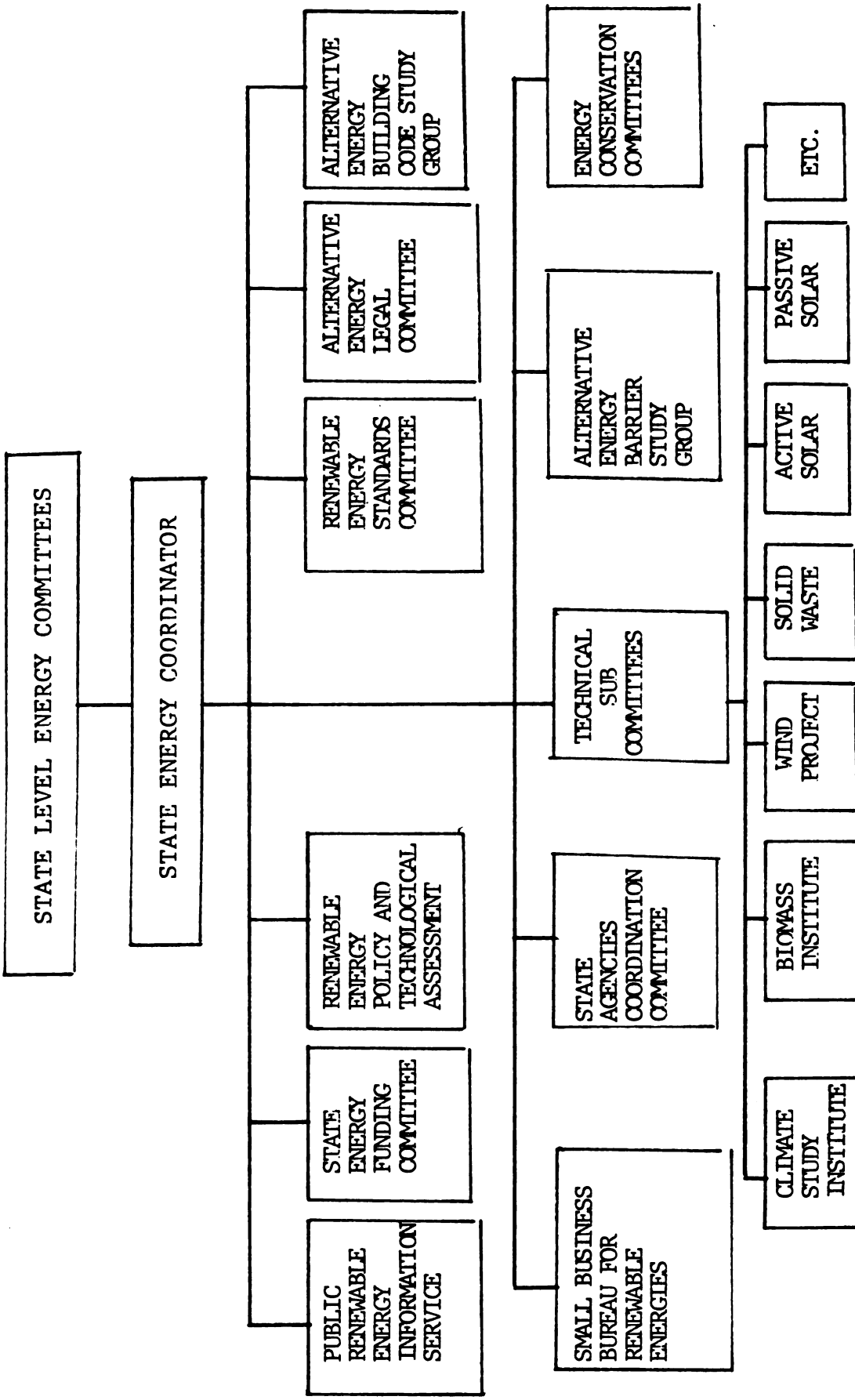

Figure 17.--Proposed State Level Energy Committees.

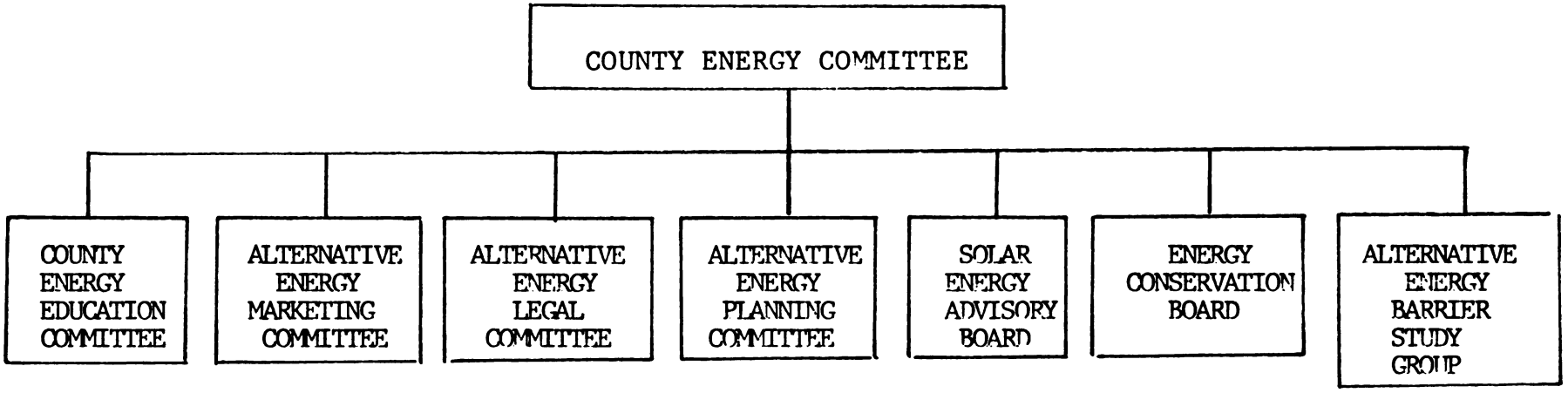

Figure 18.--Proposed County Energy Committee.

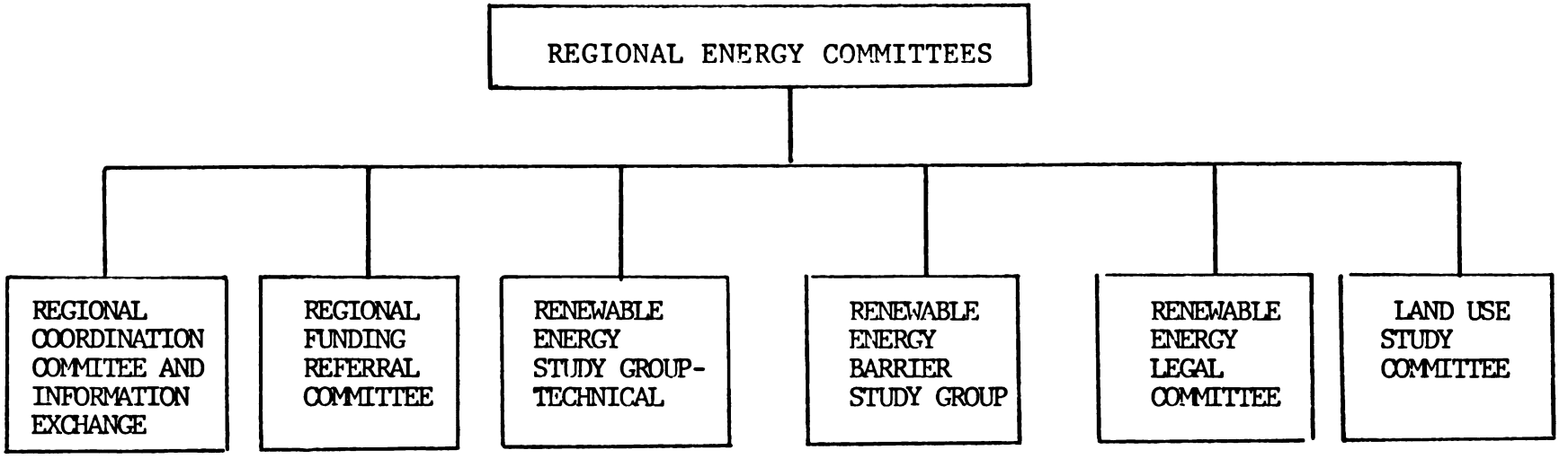

Figure 19.--Proposed Regional Energy Committees.

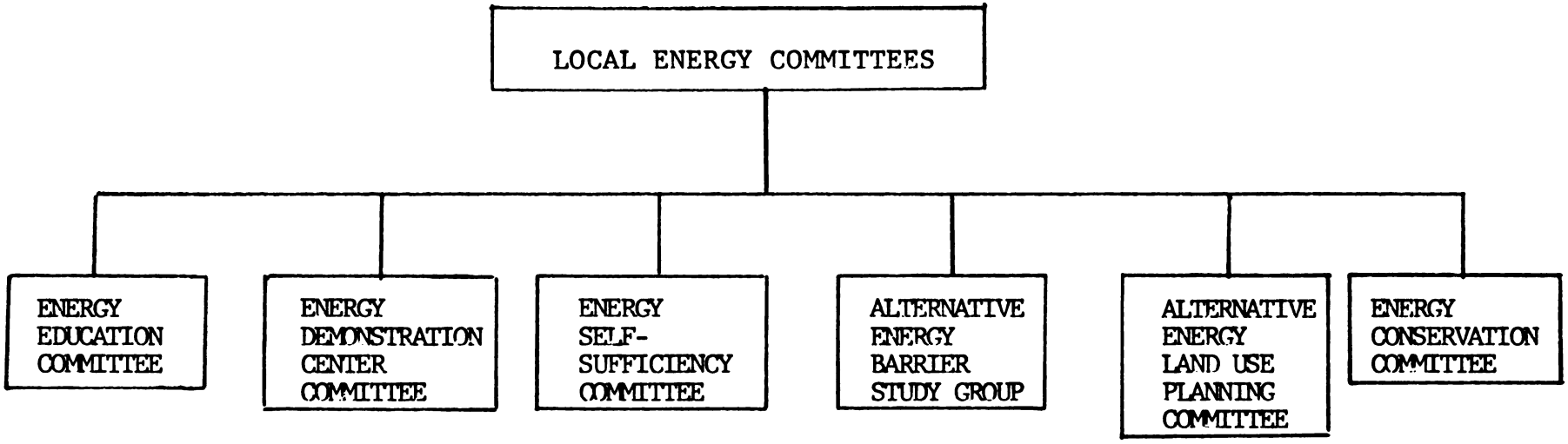

Figure 20.--Proposed Local Energy Committees.

state energy committee is to establish policy and procedures in a state energy plan. The subcommittees at the state, county, regional and local levels are all organized by the state, county, regional and local levels are all organized by the state energy coordinator. Each subcommittee level is organized to deal with all the barrier groups. Identification of problems and the development of their potential solutions is the major goal of each level. A selection of problems and solutions organized by level and barrier groups is included in the appendix.

The model presented here is applicable in every region of the United States and its adaption could accelerate decentralized alternative energy development for the nation.

Financing becomes the major hurdle to the development of local efforts. Two methods have been discussed by proponents of alternative energy programs:

1. The establishment of a fund from the profits of utilities and/or a gasoline tax on excess profits.
2. The use of Federal Grant monies.

The use of profits from utilities for energy programs has been attempted successfully in Palo Alto, California. Its feasibility in meeting local needs has produced an enthusiastic constituency of supporters. Taxing of the excess profits of gasoline sales could offer a source of funds that would not put an additional burden on the general public. This method would be likely to receive public acceptance but would face serious objections from the companies. The second option offers more promise of success.

Many Federal agencies offer programs and services which can be of assistance to individuals, businesses, communities, state governments, and others interested in utilizing alternative energy. Some of the programs are especially designed for renewable energy technologies. Others are general programs that can be applied to different initiatives in energy development, such as:

1. The use of renewable resources and the conservation or nonrenewable resources.
2. The needs of local communities and the enhancement of community self-reliance through the use of available resources.
3. The use of existing technologies applied to new situations use.

Federal agencies or programs which have funded energy-related projects in the past include the:

1. Department of Housing and Urban Development
2. Department of Energy
3. Federal Housing Administration
4. Farmer's Home Administration
5. Economic Development Administration
6. Small Business Administration
7. National Science Foundation
8. DOE Technology Transfer Program
9. Appropriate Technology Small Grants Program
10. Community Development Block Grant Program
11. Comprehensive Employment and Training Act
12. NBS/DOE Energy-Related Invention Evaluation Program
13. Solar Energy Research Institute
14. Department of Education

15. Community Services Administration

An unsolicited proposal may be submitted to most of the agencies listed above. Program Opportunity Notices (PON) may be obtained from the agencies to determine what monies are available and where. Each PON contains detailed instructions for the preparation of proposals.

Hawaii has very effectively used the second method, relying on Federal grants to finance most of their program components. Education of the general public in Hawaii is ongoing and many of these committees are in place. As a result, the state's alternative energy program is developing quickly. Whether other states and regions will be able to match the successes of Hawaii is questionable, but there is much that can be learned by closely analyzing its progress.

Further Recommendations

There remain numerous unanswered questions about the development of alternative energy. In order to establish workable systems that are applicable to all regions of the country, further research is necessary. The Hawaii program offers numerous opportunities to provide such research. With much of the energy development being recent many long range studies are feasible. These include:

a) The social acceptance of geothermal energy as it develops into a large scale industry.

b) Changes in social attitudes as other energy sources are developed on a wide scale.

c) The environmental effect of OTEC development.

d) The technical problems of large scale wind generation.

e) A study of OTEC bi-product development such as increased fishing potential, manganese processing and kelp farming.

f) The acceptance, by the public, of electric cars.

g) Alternative biomass schemes and their affect on the sugar cane industry.

h) The history of change in state law as the energy program develops.

i) The tourist industries acceptance of alternative energy innovation.

j) Evaluation of Hawaii's successful approach to obtaining federal funding of their energy projects.

These are only a few of the possible topics. With the scale and speed of development Hawaii has demonstrated, the potential for research gain is large. Hawaii may not only become the nations innovator of alternative energy but also the research center for such development.

APPENDIX

EDUCATIONAL BARRIERS

STATE

Barrier	Suggested Solutions
1. Idea that Federal Government will solve any energy problems that may exist or arise.	1. Educate the public about their ability to control their own energy needs through decentralized systems.
2. Communities lack technical and financial support from state.	2. Set up community committies with direct contact with state energy offices.
3. Lack of manpower.	3. Fund training programs at universities for policymakers.
4. No energy extension service.	4. Set up visible Public Information Service Centers throughout the state.
5. No statewide curriculum development.	5. Fund pilot programs in the schools.
6. No effective solar lobby in most state capitals.	6. Establishment of private organizations from grass roots groups interested in renewable energies.
7. The public believes that solar energy is too diffuse and simplistic to adequately meet their energy demand.	7. A widespread information release through schools, newspapers, demonstration centers.
8. Statewide demonstration programs lacking.	8A. Funding of community demonstration programs. 8B. Placement of solar demonstration at roadside rest areas. 8C. Sponsor a traveling van, set up booths at fairs.

EDUCATIONAL BARRIERS, cont'd.

STATE

Barrier	Suggested Solutions
9. Publications often inaccurate and lack detail.	9A. Fund university programs to prepare updated, correct information.
	9B. Publish a statewide newsletter or renewable energies for the general public and the press.

REGIONAL

Barrier	Suggested Solutions
1. Lack of manpower trained to manufacture, install, and maintain solar systems.	1A. Set up training programs at community colleges.
	1B. Organize workshops for businesses that may be able to offer these types of services.
2. Coordination and information exchange lacking among existing renewable energy education and training programs.	2. Set up regional coordination committee and information exchanges.
3. Limited interest of administrators of school programs to the incorporation of renewable energy classes.	3A. Provide information on feasibility, employment needs, area demand to administrators.
	3B. Workshops for administrators on renewable technology.
4. Lack of known usage in renewable energy field.	4. Persuade businesses to incorporate renewable energies into new construction for P.R.
5. Lack of renewable energy knowledge.	5. Sponsor an energy fair.

EDUCATIONAL BARRIERS, cont'd.

COUNTY

Barrier	Suggested Solutions
1. Understanding of alternatives.	1. Establish County Energy Education Committee.
2. Consumer concern about reliability.	2A. Release information about reliability to newspapers.
	2B. Sponsor information nights.
3. Lack of land for biomass production.	3. Establish tax cut incentive to owners of land use for biomass.
4. Inability to reach the general public with renewable information.	4. Incorporate information centers and demonstration projects in county parks.

LOCAL

Barrier	Suggested Solutions
1. Media handling of solar overly shallow and often inaccurate.	1A. Solar groups should establish contact with editors to develop concern and maintain information update system.
	1B. Persuade media to incorporate a "solar index" . . . amount of sunlight and wind received that day.
2. Community groups not aware of available funds.	2. Establish close contact with state energy offices.
3. Community understanding of renewable energy systems is incomplete.	3A. Workshops for community builders.
	3B. Incorporation of energy education into public schools.
	3C. Demonstration projects.

EDUCATIONAL BARRIERS, cont'd.

LOCAL

Barrier	Suggested Solutions
4. General public not aware of the seriousness of energy situation.	4A. Releases to newspapers. 4B. "Energy Explanation Night" at local schools.
5. Lack of awareness of conservation methods.	5. Establish demonstration centers.
6. Inability in obtaining adequate technical and financial support to operate effective programs.	6. Local committees working through state energy funding committee.
7. Most federal programs do not like to send quantities of materials to local groups.	7. Establish state clearinghouse for local groups interested in releasing bulk material.
8. Expert advice on specific conservation and renewable resource applications is generally available only through expensive professional consultants.	8. State provided energy advisors established as part of energy plan to work with local energy committees.

FINANCIAL BARRIERS

STATE

Barrier	Suggested Solutions
1. Perceived price advantage of fossil fuels.	1. Include in calculations the direct subsidies and unpaid environmental costs of fossil fuels.
2. Difficult to obtain liability insurance coverage.	2A. Develop State Insurance coverage for those experiencing difficulties in obtaining insurance.

FINANCIAL BARRIERS, cont'd.

STATE

Barrier	Suggested Solutions
	2B. State insurance commissions to require insurance companies to provide insurance.
3. Investment tax credit.	3A. Development of programs to encourage financial backing of renewable energy sources.
	3B. Residential tax credit.
4. Heavy subsidization of depletable fuels--unfair advantage.	4A. Turn emphasis toward development of locally-based, decentralized energy systems.
	4B. Establish state energy trust fund to financial research and development, funded by 2% tax on liquid fuels.
5. Tax credits and loan programs are stalled in the legislature.	5A. Develop a Solar Bank Act.
	5B. Refund of sales tax for solar devices.
6. Private mortgage market not tuned to solar housing.	6. Encourage Federal Housing Authority and the Farmer's Home Administration to change regulations which prohibit them from making solar loans or insuring mortgages.
7. No financial incentives for solar.	7A. Solar Energy Demonstration Loan Program.
	7B. Maximum loan available to veterans for home mortgages increased if home equipped with solar energy system.

FINANCIAL BARRIERS, cont'd.

STATE

Barrier	Suggested Solutions
8. Lack of encouragement for gasohol.	8A. Reduce state tax on gasohol by 2-3 cents per gallon.
	8B. Fund study of feasibility of biomass conversion in state.
9. Tax rebate on after-the-fact reimbursement problem for some buyers to arrange financing.	9. Arrange a rebate to companies for units sold lowering the purchase price.

REGIONAL

Barrier	Suggested Solutions
1. Lack of funding for independent research and development activities not associated with large corporations.	1. Organize subcommittee to Regional Energy Committee for the purpose of discriminating state and federal monies acquired for this purpose.
2. Lack of regional capabilities in many states.	2. Coordinate local communities in attracting industrial capabilities in renewable energies to the region.

COUNTY

Barrier	Suggested Solutions
1. Attitudes of private lenders.	1. Education of the bankers through workshops and publications.
2. Lack of information on systems adaptability to area.	2. County should gather and disseminate information to banks.
3. High interest rate on loans precludes many interested potential investors.	3. Establish special break in county taxes to encourage use.

FINANCIAL BARRIERS, cont'd.

LOCAL

Barrier	Suggested Solutions
1. Availability of credit.	1. Educational programs for members and officers of financial institutions should be developed.
2. Undervalued solar homes.	2. Educate real estate agents and appraisers of the value of renewable energy sources.
3. Clarity of eligibility guidelines is essential to the success of a financial incentive.	3. Statewide standards determined by a financial committee.
4. No available funds for research and begin programs to encourage conservation and the use of renewable resources.	4. Encourage state funding programs.
5. Bankers innate conservatism because of limited track record for renewable sources.	5. Provide technical and performance information to bankers.
6. Initial cost of solar energy high.	6. Make available flexible loans--pay-back amount is lower in the beginning and rises later on.
7. Few people are willing to invest their money into a costly system which they do not truly understand.	7. Release accurate information and encourage highly visible demonstration.
8. No incentives to extend mortgages or offer loans to cover the initial cost of these installations.	8. Encourage participation in state program of guaranteed loans financed by fossil fuel taxes.
9. There is presently no easy way for the average consumer to compare energy costs of alternative structures or systems before building or buying.	9. Release information on life-cycle cost.

MARKETING BARRIERS

STATE

Barrier	Suggested Solutions
1. Patent Law Procedure.	1. Set up regulations to aid the small investor.
2. Standards and Licensing.	2. Performance standards should be set on the basis of overall performance (energy collected/ dollar spent) and not on the basis of thermodynamic efficiency (energy collected/sq. ft.) of collector surface.
3. High prices due to lack of mass production.	3. Temporary financial encouragement.
4. Lack of consumer protection.	4A. An energy efficiency label should be developed and applied to all buildings so that the consumer could compare the energy efficiency of different structures.
	4B. Warranties and certifications supported by consumer protection laws.
5. Lack of solar trade associations.	5. Encourage the establishment of trade associations on a state level.
6. Difficulty and cost of certifying solar power systems.	6. Establish a certification board to simplify and expediate the process.
7. If warranties required by state, small firms may not be collectible.	7. Use of performance bonds or state-backed insurance policies.
8. Small firms may have problems meeting the product safety practices required by insurance companies.	8. Assistance by states in setting reasonable standards and organizing insurance pool programs.

MARKETING BARRIERS, cont'd.

REGIONAL

Barrier	Suggested Solutions
1. Some renewables have extremely high capital costs.	1. Provide information of pay-back period and projected life-span.
2. Public unaware of energy options.	2. Develop an energy yellow pages.
3. Different renewable energy sources are more promising from one region to another.	3. Regional study to determine renewable energy potentials.

COUNTY

Barrier	Suggested Solutions
1. Some renewables require large land usage.	1. Designate areas as energy park.
2. Consumer concern about reliability warranties.	2A. Establish standards and encourage media articles on different options.
	2B. Write understandable warranties that are available for comparison by the public.

LOCAL

Barrier	Suggested Solutions
1. Shortage of qualified installers, manufacturers, and other distributors.	1. Fund studies documenting need and work opportunities.
2. Decentralized systems vary greatly from one locale to another.	2. The parties responsible for setting the standards should come from the communities involved.
3. Consumers must be satisfied that systems are reliable and durable.	3A. A warranty must be required by state.
	3B. Highly visible demonstrations of systems.

LEGAL BARRIERS

STATE

Barrier	Suggested Solutions
1. Solar access and other sun rights legislation.	1. Legislative protection by Solar Rights Act.
2. Unresolved questions of who owns energy resources.	2. State Legislation.
3. Unresolved question of whether utilities may own, sell, lease, finance or service solar devices for utility customers.	3. State Legislation.
4. Important question of whether a solar-reliant power system may itself become a utility subject to PUC jurisdiction and control.	4. State Legislation.
5. Lack of political acceptability.	5. Development of grass-roots organization to encourage renewable energy development.
6. Privately created architectural controls.	6. Pass laws on a state level forbidding unreasonable interference with the use of solar collectors or wind generators.

REGIONAL

Barrier	Suggested Solutions
1. Problems with renewable energy rights protection.	1A. Establishment of mandatory solar energy use districts wherever possible.
	1B. Affirmative solar-energy-use districts where mandatory solar energy use would be impracticable because of prevailing conditions.

LEGAL BARRIERS, cont'd.

COUNTY

Barrier	Suggested Solutions
1. Procedure of establishing solar access rights confused.	1. Counties should establish a permit system for the use and application of solar energy.
2. Transferability of solar rights in question.	2. Set up a recording system on a county level--establish by prior appropriation.

LOCAL

Barrier	Suggested Solutions
1. Solar Rights litigation.	1A. Devise building codes and regulations that protect solar access--solar easements.
	1B. Use rules of prior appropriation in solar access cases.
2. Aesthetic zoning.	2A. Develop systems that fit the code.
	2B. Test the law in court arguing public need.
3. Height restriction ordinances.	3. Special exceptions--classify with belfries, antennas, chimneys, etc.
4. New construction orientation problems.	4. Amend regulations so they require east-west streets wherever practical.
5. Rigid siting and lot size requirements.	5. Developers may apply for a planned-unit development (PUD).
6. Restrictive Covenants.	6A. May be terminated by agreement.
	6B. Court action--Changing Conditions Doctrine.

LEGAL BARRIERS, cont'd.

LOCAL

Barrier	Suggested Solutions
7. Vegetation control necessary for solar.	7. Vegetation controls are already imposed to further other accepted public concerns such as, protection of utility power lines.

UTILITY BARRIERS

STATE

Barrier	Suggested Solutions
1. Discriminatory rate structures. High rates charged to co-generation for backup capacity and low rates paid for surplus power.	1. Rates must be revised to encourage more renewable production. Possible state subsidized programs to make up the difference until greater participation.
2. Rates discourage conservation--low with heavier use.	2. Revise rate structure to reward lower usage of energy.
3. Utilities usually dominate the state's energy planning process.	3. Allow PUC only one position on State Energy Board.
4. Public Utility Commission Regulations.	4. Revised to include consideration of renewable energy.
5. Many state Public Service Commissions have not required utilities to cut back on the building of new fossil generating facilities and vigorously pursue conservation.	5. Encourage a legislative directive of renewable involvement by PUC's.

UTILITY BARRIERS, cont'd.

STATE

Barrier	Suggested Solutions
6. Prevention of lending of state credit and billing through monthly payments.	6. Legislate right of utilities to become involved in weatherizing and conservation programs.
7. Utilities committed to average cost pricing.	7. Require total cost calculation to be used in decision-making.
8. Public utilities not interested in solar methods.	8. Exempt public utilities from the public service company tax and public utilities franchise tax if they produce energy from local biomass sources.

REGIONAL

Barrier	Suggested Solutions
1. Lack of participation in renewable programs.	1A. Encourage participation in buying of energy from private renewable energy companies.
	1B. Allow local utilities to develop decentralized systems.
2. Lack of cooperation with renewables.	2. Make a state requirement that utilities provide an information source of renewable possibilities available to customers.
3. Some utilities discourage renewables by pessimistic forecasts of renewable energy feasibilities.	3. Require single source information released throughout the state to be provided by state energy office.

UTILITY BARRIERS, cont'd.

COUNTY

Barrier	Suggested Solutions
1. Utilities control most energy decisions in counties without concern for local needs.	1. Counties need to establish committees to deal with local problems in a coordinated way to counter these decisions when necessary.

LOCAL

Barrier	Suggested Solutions
1. Resistance by utilities to generation alternatives outside their control.	1. Encourage cooperative exchanges between utilities and community-based organizations.
2. Profit potential of cogeneration and other decentralized energy systems is small or non-existent to utilities.	2. Encourage the elimination of existing prohibitions against private individuals selling electricity except to utilities--development of neighborhood or small-scale electrical systems.

REGULATORY BARRIERS

STATE

Barrier	Suggested Solutions
1. Unclear delegation of responsibility.	1. Establish State Energy Plan.
2. Inadequate statutory definition of key terms.	2A. Establish Statutory Definition Committee.
	2B. Incorporate suggestions into energy legislation--an Energy Terminology Act.

REGULATORY BARRIERS, cont'd.

STATE

Barrier	Suggested Solutions
3. Lack of a requirement of inter-governmental coordination.	3. Establish a chain of authority by appointing a State Energy Coordinator and use a pyramid committee system.
4. Consumer lending laws.	4. Study and incorporate recommendations of financial committee.
5. Many state insulation standards not strong enough.	5A. Follow National Standards.
	5B. Establish consistent inclusion of all factors--building materials and construction techniques.
6. Government Granting procedures take too much time and too much paperwork.	6A. Establish clearinghouse to assist grant application.
	6B. Simplify terminology and information requirement.
7. State housing laws do not require investments by landlords in energy conservation.	7A. Establish a tax incentive to landlords and renters for energy weatherizing and conservation.
	7B. Require landlords to deduct renter's cost of permanent energy conservation methods from rent.
8. State grants are biased toward high efficiency and high cost systems.	8. Emphasis should be changed to lower-efficiency systems which are cheaper and more available to average person.

REGULATORY BARRIERS, cont'd.

STATE

Barrier	Suggested Solutions
9. Licensing and certification not consistent throughout state.	9. Established a consistency in Licensing Committee to arbitrate differences.

REGIONAL

Barrier	Suggested Solutions
1. Conflicting laws and criteria in surrounding area.	1A. Committee to remove inconsistencies.
	1B. Clearinghouse of area laws to aid local lawmakers in attempts to comply with region.
	1C. Reevaluating current relationships between community and regional and state land use regulatory authorities.
2. Poor coordination between various decision-making groups.	2. Design new linkages between these groups and the energy industry and equipment manufacturers.
3. Conflict between land used for energy production and agriculture.	3. Establish committee to assess trade-off between land usage for energy support facilities and other needs.

COUNTY

Barrier	Suggested Solutions
1. Building permits issued by Building Department of County.	1. Consideration must be given to do-it-yourselfers and small contractors by simplifying procedure.

REGULATORY BARRIERS, cont'd.

STATE

Barrier	Suggested Solutions
2. No established system of maintaining solar access.	2. Registration of access rights to establish prior appropriation.
3. Unclear transfer rights of solar access.	3. Established procedure for transferability by prior appropriation.
4. Unclear and ambiguous local laws designed to foster the development of renewable energies.	4. Provide a medium for locally-staffed study committee to remove and clarify such barriers.

LOCAL

Barrier	Suggested Solutions
1. Restrictive zoning ordinances.	1. Variances and special exceptions.
2. Building codes make solar, wind and biomass installations unfeasible in many areas.	2. Modification of codes to remove barriers by use of committee study of other community systems.
3. Encouragement of solar lacking.	3. New buildings shall be constructed in a manner that permits the installation of solar heating.

TECHNOLOGICAL BARRIERS

STATE

Barrier	Suggested Solutions
1. Not enough money put into small companies.	1. Establish Small Business Bureau for Renewable Energies.

TECHNOLOGICAL BARRIERS, cont'd.

STATE

Barrier	Suggested Solutions
2. Small investors have trouble disseminating their ideas.	2. Organization of a State-operated Agency designed to assist small inventors through commercialization.
3. Not enough data on climate, such as, wind speeds, amounts of sunlight, etc.	3. Set up Climate Study Institute at State University.
4. Research into biomass land use.	4. Establish Biomass Institute.
5. Lack of energy storage technologies.	5. Fund University programs through State Energy Project Board.

REGIONAL

Barrier	Suggested Solutions
1. Lack of research into building materials.	1. Develop a project using the Regional Building Associations, University, and private business.
2. Safety hazards of renewable energy in urban areas.	2. Regional Energy Boards should compile nationwide information from on-going renewable energy projects--accident records, material failure, problem solutions, etc., and make information available to public.
3. Each region has different renewable energy requirements.	3. Solutions should be sought at the regional level with funding from state and federal.

TECHNOLOGICAL BARRIERS, cont'd.

COUNTY

Barrier	Suggested Solutions
1. Ineffective use of industrial waste heat.	1. Coordinate industrial study by private enterprise to deal with problem.
2. Lack of available land for development of reasonable energy sources.	2. Include into county energy plan the establishment of energy parks--available for demonstration purposes.
3. Lack of capability to research and develop local systems.	3. Funding for local involvement in technological development.

LOCAL

Barrier	Suggested Solutions
1. Many decentralized energy systems have local requirements and needs.	1. State funding assistance of local energy development projects.

POLICY BARRIERS

STATE

Barrier	Suggested Solutions
1. Lack of receptiveness to public input.	1. Encourage "grass roots" participation by funding local committees.
2. Government-assisted fuel bills reduce incentive to conserve and become a subsidy to the utilities.	2. Money should be earmarked instead for weatherization of home.
3. Centralization bias.	3A. Workshops and technical reports for decision-makers.

POLICY BARRIERS, cont'd.

STATE

Barrier	Suggested Solutions
	3B. Encourage the use of Centralized Energy only where decentralized will not work.
4. Failure to administer new solar programs.	4. Lobby politicians to develop new solar programs and properly fund existing ones.
5. Many state solar staffs are extremely small and underfunded.	5. Emphasis by increased funding.
6. States not requiring solar to be used in new public building.	6. Develop a policy that solar technology will be considered in all state development.
7. Lack of planning.	7. Establish a State Energy Plan.
8. Government decision-making responds to special interests over the general welfare.	8. Encourage media to publish all votes on energy subjects.
9. Lack of assistance in local jurisdiction over land use and energy.	9. Technical information such as design handbooks, model ordinances, and easements and baseline energy information should be provided by the state.
10. Non-availability of funds for energy conservation program studies.	10. Legislation set aside portion of state gas tax for conservation programs.

REGIONAL

Barrier	Suggested Solutions
1. Different approaches used throughout area confusing and conflicting.	1. Formation of a Regional Energy Board to evaluate and coordinate.

POLICY BARRIERS, cont'd.

REGIONAL

Barrier	Suggested Solutions
2. Lack of cooperation between local governments resulting in duplication of effort.	2A. Encourage regional governments to share in the implementation of alternative energy programs.
	2B. Coordination of plans through Regional Energy Board.
3. Distrust between local governments	3. Coordination of efforts through Regional Energy Board.

COUNTY

Barrier	Suggested Solutions
1. Solar Advisory Boards dominated by businessmen and academic--lack sufficient input.	1A. Encourage membership from the areas of society--construction industry, financial.
	1B. Open meeting approach.
2. County assessors rating solar energy units higher than conventional systems.	2A. Set policy that solar will not be assessed higher than conventional systems.
	2B. Assess property using solar lower than conventional.
	2C. Twenty-year exemption for solar from property tax.
3. Energy development not incorporated into land use planning.	3. Encourage this action by the use of a county committee designed to analyze and make suggestions of incorporation.

POLICY BARRIERS, cont'd.

LOCAL

Barrier	Suggested Solutions
1. Lack of enforcement of solar building codes by building inspectors.	1. Educate inspectors in renewable systems.
2. Renewables not included in zoning plan.	2. Incorporate renewable energy parks or zones.
3. Undue restrictions on do-it-yourselfers and small contractors.	3. Require only that they meet health and safety standards.
4. Lack of encouraging solar technology.	4. Changes in licensing, siting, insulation, aesthetic restrictions, materials and plumbing to encourage solar technology.
5. Many local governments do not have programs to save energy in their own buildings and operations.	5. Institute a city energy policy.
6. No encouragement of solar implementation in private building.	6. Local property tax saving--no greater assessment than what a conventional system would cost.

SOCIAL BARRIERS

STATE

Barrier	Suggested Solutions
1. Job displacement and new energy employment needs.	1A. Sponsor training programs.
	1B. Encourage industry to retrain workers.
	1C. Do future need studies.

SOCIAL BARRIERS, cont'd.

STATE

Barrier	Suggested Solutions
2. Attitude that the government will take care of energy problems.	2. Educate the public of the options and needs.
3. Human inertia and the tendency to follow ingrained patterns of thought and behavior is an important psychological barrier.	3. Funding of energy education curriculum for all levels of education.
4. Diverse value systems cause different perceptions and weighting of environmental, economic and social impact.	4. Develop a pyramid of committees from state level to local to include opportunity of input into planning.

REGIONAL

Barrier	Suggested Solutions
1. Diverse values and social attitudes concerning recreation and travel.	1. Encourage development of local recreation options.
2. Dependence on auto for work travel.	2A. Establish mass transit systems.
	2B. Establish bike paths connecting all areas of region.
3. Disbelief in any energy crisis.	3A. Educational programs.
	3B. Release of accurate information to local media.

COUNTY

Barrier	Suggested Solutions
1. Attitude that energy crisis not real.	1A. Release information on County government energy use.

SOCIAL BARRIERS, cont'd.

COUNTY

Barrier	Suggested Solutions
	1B. Establish a county government energy conservation plan.
2. Unsure of practicability of renewable energies.	2A. Sponsor energy science fair for county schools.
	2B. Incorporate highly visible renewables into county-operated recreation parks.

LOCAL

Barrier	Suggested Solutions
1. Fear of changing lifestyle.	1. Mass release of information removes fears of unknown.
2. Don't want to take responsibility for own needs.	2. Emphasis of economic aspects of energy alternatives--lifespan costs.
3. People do not understand the comparative costs of present and alternative energy sources.	3. Establish a wide-based community involvement program.
4. People are crisis rather than future oriented.	4. Release information on the effects of energy costs on lifestyle through schools.

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