INTERNATIONAL ROUNDTABLE ON RENEWABLE ENERGY

POLICY BACKGROUND PAPER

Policy Framework: The Importance of Government Incentives in Renewable Energy Development

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EXECUTIVE SUMMARY

Policy Framework: The Importance of Government Incentives in Renewable Energy Development is a background paper prepared for the International Roundtable on Renewable Energy, held at RETSIE in June 1984. This document is a factual summary of worldwide experiences with incentives for renewable energy for use as a reference document by speakers and participants at the meeting.

Policy Framework is not intended to be a comprehensive summary of all experiences with incentive systems for renewable energy in the world. Its task is much narrower, to highlight those programs which have had the greatest impact, for good or bad, on the commercial development of non-conventional energy sources in the past five years. It gives primary attention to those instances where public investment has catalyzed private investment on a sustainable basis.

The paper is divided into three sections which present background information and a concluding section which raises points for discussion in the meeting:

SECTION I introduces the reader to the types of incentives systems that exist and why these are so critical to the commercial development of renewable energy.

SECTION II highlights California and is divided into two parts. The first part is a general review of the energy and energy policy situation in the state. The second part discusses in detail three important incentives that have been successful in promoting private investment in renewable energy in California. These include tax policies, regulations encouraging utilities to buy power from independent power producers, and government-backed loan programs.

SECTION III briefly reviews the experiences of other selected countries that have attempted to accelerate the commercial development of renewable energy by government incentives. These incentives range from regulations requiring installation of solar collectors in Israel to loan programs for biogas plants in India.

SECTION IV contains preliminary conclusions and points of discussion for the roundtable.

SECTION I

INTRODUCTION

Renewable energy has steadily progressed in the past ten years from its early position as a concern of appropriate technologists and social philosophers. Today, it has become an important policy and business consideration to governments, utilities, entrepreneurs, and consumers around the world.

As a tour of the Renewable Energy Technologies Symposium illustrates, progress in technology has not been confined to the laboratory. An economically viable industry to produce and distribute these technologies has progressed from its infancy to adolescence and is responding to the signals of a growing market.

The agents for change have been many, but it is undeniable that energy policy makers in governments and public and private utilities have played an important role in this change. Rising costs of conventional energy sources and consumer disgruntlement have forced a fundamental reexamination of the strategies employed by governments and utilities to ensure the delivery of affordable electric power, heat, and liquid fuels.

Ironically, the same local utilities and power generation authorities who at one time dismissed renewable energy have become key in the commercialization of solar collectors, wind machines, biomass-burning equipment, and other alternative energy technology.

In California the change in the position of local utilities and private investors has been dramatic. Nonconventional sources, which made practically no contribution in 1975, supplied more than 7 percent of California's electricity in 1983 and continue to grow at an increasing rate. Southern California Edison exemplified the new direction when it announced in 1981 that alternative energy sources would provide 30 percent of its new generating capacity in the coming decade. SCE board chairman William Gould explained:

> "It is the policy of Edison to devote our corporate resources to the accelerated development of a wide variety of future electrical power sources which are renewable rather than finite. These include wind, geothermal, solar, fuel cells, small hydroelectric, and continued emphasis on co-generation, conservation and load management. We now believe that some forms of power generation which a few years ago were speculative or unproven have progressed to the point that they can be aggressively developed and relied upon to provide a significant part -- perhaps about 30 percent -- of the electricity to supply the additional needs of our customers later this decade. We are convinced that our society in general, our customers and our company will benefit from the success of renewable and alternate energy sources. This policy shift should both improve the environment and reduce our dependence on expensive foreign oil."

What has caused this change in attitude on the part of California utility officials?

- Utilities, public and private, have been put under financial strain by the rise in fuel costs for existing generating stations and the high capital costs for new plants and transmission systems. This has led to a rapid rise in electric rates and widespread consumer opposition.

- Governments have limited utility options by imposing regulations aimed at safeguarding the environment from nuclear accidents and air pollution caused by burning fossil fuels.

- The economics and technical readiness of renewable energy have continued to improve as the costs for conventional generation have risen.

- Incentive systems, created to spur the commercial adoption of renewable energy in the late 1970s, are only now beginning to be effective. Though some of these incentives supported only research, development, and demonstration, a few persuaded utilities, governments, and investors to consider nonconventional technologies, and in fact made it financially advantageous for them to do so.

Why should a government consider the use of incentive systems for renewable energy?

- Rapid development of renewable energy can help a country reach its political and economic goals -- including increasing self-reliance in energy sources (and decreased foreign exchange requirements for oil), development of local enterprise and skilled workers, and distribution of benefits of electricity or other energy to rural areas.

- Incentives push people and institutions to take risks they might otherwise have avoided and to experiment with new technologies.

- Incentive systems properly employed are a way of leveraging private and semi-public capital with public money. In the past, renewable energy research and development was funded from the public treasury. Both for industrialized and developing countries, public expenditures have come under increased fire. Future government programs must therefore use small amounts of seed capital as leverage to move other money, for it is unlikely that the government sources will suffice to cover the whole bill.

- Incentives are a way of bringing new actors on board to assist in the promotion of renewable energy. Not only utility officials, but investment bankers, private developers, and households can play a critical role.

- Incentive systems can assist technology producers by stimulating adequate sales to justify investment and production facilities and lower price through economies of scale. By helping to lower prices incentives can reduce the price differential between conventional and nonconventional sources of energy.

What kind of incentives exist?

Tables 1-4 on the next four pages review the four major types of incentives:

- financial incentives - including grants, credits, subsidies, low-interest and long-term loans, loan guarantees
- fiscal incentives - including taxation exemptions, deductions, credits rebates
- regulatory/legal incentives - including laws, codes, and regulations
- promotional incentives

What are we trying to do in this briefing document?

- Provide policy makers in governments, utilities, and industry with a detailed description of how some of the largest commercialization programs worked -- and didn't work.
- Outline the conditions that seem to favor successful implementation of these incentives.
- Point out the relevant issues that have arisen in California, Europe, and elsewhere during the implementation of these incentive efforts. None of the descriptions or discussions in this paper are intended to suggest that any of the incentive systems applied in California (or anywhere else) can be transferred to any other country or state without careful examination of local goals and conditions.

Section II of this briefing document reviews California's experiences in greater detail, and particularly concentrates on those incentives that had the most impact. Section III contains several specific examples of incentives applied elsewhere in the world. Conclusions outlining broad themes and further points for discussion are contained in Section IV.

TABLE I

FINANCIAL INCENTIVES FOR RENEWABLE ENERGY DEVELOPMENT
BY INCENTIVE TYPE

FINANCIAL INCENTIVES -- Grants, credits, subsidies, low-interest and long-term loans, loan guarantees.

	DESCRIPTION	ACTORS	ADVANTAGES	DISADVANTAGES
Funding for Research Development and Demonstration (RD&D)	Support of basic research, product development, and demonstration aimed at commercialization	Governments, research laboratories, industry	Government shoulders risk for development of non-proven technologies and focuses R&D programs.	Requires well-developed RD&D establishment R&D programs without parallel market incentives for commercial sales may lead to stress scientific accomplishments rather than practicality
Procurement	Direct funding of equipment production; purchasing of equipment or product (e.g. alcohol fuels).	Governments	Supports industry while market develops and equipment is refined	May result in uneconomic and unmarketable product by guaranteeing purchase regardless of quality or efficiency. Potentially very expensive for developing countries especially if product is imported, not produced locally.
Guaranteed-purchase of non-commercial power (PURPA model)	Purchase of elec. from independent producers using renewable energy technology	Large utilities, independent producers	Puts financial and technical burden for renewable projects on private developers not on government or utilities. Is competitive with expensive new generation capacity.	Can effect consumer electricity rates as purchase of power is at rate higher than older generating plants. Limits exist on amount of non-baseload power which utilities can use. Assumes existence of integrated utility system that is able absorb and distribute power.
Capital expense relief to equipment purchasers	Up-front grants or loans to ease burden of capital investment in new equipment	Government (national, state, local) purchasers of equipment (institutional, commercial, homeowner)	Allows purchasers to replace fossil fuel equipment with renewable equipment in greater numbers	Requires careful and comprehensive administration to successfully process and evaluate grant/loan requests. Assumes expertise is available and properly utilized.
Export Promotion	Government support of product to make it more competitive overseas through such measures as trade fairs, commercial exchanges, grants to purchasing countries, special credit arrangements.	Governments, commercial sector, foreign governments	Gives local or national industry parity or competitive edge in export trade, thus increasing rate of growth of renewable energy exports. Relatively inexpensive to implement.	May protect inefficient or poor quality manufacturers. Distorts market by giving edge to countries with most favorable export assistance rather than best product
De-subsidization of conventional and traditional fuels.	Removal of government subsidies and price controls that keep energy prices artificially low	Governments	Makes renewable fuels more cost-competitive, encourages conservation of conventional fuels. Net revenue enhancer through increased profits on fuels or electricity	Politically unpalatable if not impossible in much of the world; creates hardships for consumers (particularly urban poor and middle classes) during transition. May encourage growth of black market in fuels.

Source: International Institute for Environment and Development, Worldwide Incentives for Renewable Energy Usage: A Selective Survey, IIED: Washington D.C. and London, 1983.

TABLE 2

FISCAL INCENTIVES FOR RENEWABLE ENERGY DEVELOPMENT
BY INCENTIVE TYPE

FISCAL INCENTIVES — taxation (including exemptions, deductions, credits, rebates) and tariff liberalization

	DESCRIPTION	ACTORS	ADVANTAGES	DISADVANTAGES
R & D Shelters	Allows write-offs for tax purposes of research and development expenses in combination with other business investment credits.	Government, commercial sector	Offsets cost of development of new products and alleviates risk for commercial firms	Abusive shelter schemes possible. Assumes existence of effective revenue authority. May become very expensive.
Support for end use purchasers and investors	Provision of tax credits or depreciation schemes by federal or state governments to partially offset investment costs. May be granted directly to user or to investor (purchaser of system	Governments, private consumers, builders, manufacturers, investors	Greatly reduces effective purchase price of renewable energy equipment. Third party credit allows investors to purchase large numbers of units for commercial operations	Can become legally complex if both local and national tax measures are applied. Abusive tax shelter schemes possible. Requires effective revenue or taxing authority
Taxation of Conventional Fuels	Increased sales tax on conventional fuels; reduction or elimination of tax on renewable fuel.	Governments, producers, distributors, consumers	Makes renewable fuels more cost-competitive with conventional fuels	May discourage cost-cutting developments in production of renewable fuels. Politically unpalatable. Important role of effective revenue authority.
Import Liberalization/ Concessions for Renewable Energy	Exemptions from import tariffs, tax holidays, strengthened patent protection, government financing, liberal repatriation of profits, reduction in paperwork.	Governments, Commercial sector	Encourage producers to locate in country granting concessions. Inexpensive to implement; gain in revenues easily offsets loss in taxes, etc.	Can hinder development of local industry. Equipment and material imports are foreign exchange drain without which renewable energy exports or oil substitution will not be recovered. Requires existence of organization with necessary expertise to monitor and evaluate incoming investments.

Source: International Institute for Environment and Development, Worldwide Incentives for Renewable Energy Usage: A Selective Survey, IIED: Washington D.C. and London, 1983.

TABLE 3

REGULATORY AND LEGAL INCENTIVES FOR RENEWABLE ENERGY DEVELOPMENT
BY INCENTIVE TYPE

REGULATORY AND LEGAL INCENTIVES --Laws, codes, regulations, legislation

	DESCRIPTION	ACTORS	ADVANTAGES	DISADVANTAGES
Zoning and access requirements	Legislation requiring use of certain renewable technology in certain locations or under specific conditions. Laws requiring access to sunlight.	National and local governments, courts	Creates ready-made market for required technology. Encourages conservation.	Enforcement of laws may result in excessive litigation or oppressive bureaucracy.
Consumer protection product certification	Creation of performance standards, rating codes, systems of certification, consumer protection systems, warranties	Government agencies, manufacturers associations, courts.	Develops consumer confidence in products and technologies Establishes uniform standards which the industry must adhere to. Virtually cost free to implement.	Too strict or unevenly applied codes can discourage manufacturers. Assumes existence of capable bureaucracy. Possibly very difficult to monitor.
Distribution, pricing and buyback rules for petroleum cos & electric utilities	Regulations governing utilities & petroleum companies on how they can set prices & contracts for buying and selling power and fuels.	Utilities, fuel producers, indep. power producers government	Sets limits on quantities and prices of conventional fuels allowing for market penetration of renewables	Requires diligent monitoring & enforcement
Transnational investment promotion	Encouragement or discouragement of investment by foreign-based corporations	Governments, foreign investors	Regulates amount of foreign ivestment in specific areas, allowing ideal mix between local manufacturing and foreign.	Too much outside investment can result in foreign control of country's energy sources.

Source: International Institute for Environment and Development, Worldwide Incentives for Renewable Energy Usage: A Selective Survey, IIED: Washington D.C. and London, 1983.

TABLE 4

PROMOTIONAL INCENTIVES FOR RENEWABLE ENERGY
BY INCENTIVE TYPE

PROMOTIONAL INCENTIVES

	DESCRIPTION	ACTORS	ADVANTAGES	DISADVANTAGES
Familiarization/ extension services for producers, financiers, bureaucracy, consumers	Programs that encourage producers and consumers to manufacture and use technologies that are locally relevant.	National and state governments trade associations, businesses	Raises awareness and acceptance of renewable technologies in areas where they were previously unknown.	Unless effort is monitored, inappropriate or potentially poor quality systems may be encouraged by interested businesses/trade associations. Requires coordinated policies and capability to publicize them.
Advertising and poster campaigns	Public relations programs that educated and encourage citizens to conserve energy or switch to renewable energy.	Government agencies, commercial sector	Relatively inexpensive and requires no institution to enforce this incentive.	Unless campaign is sustained, effects will be limited. Financial assistance must be available if campaign asks citizens to buy new equipment

Source: International Institute for Environment and Development, Worldwide Incentives for Renewable Energy Usage: A Selective Survey, IIED: Washington D.C. and London, 1983.

SECTION II

CALIFORNIA—A POLICY LABORATORY FOR RENEWABLE ENERGY

California is blazing the trail for alternative energy development in the United States. It has been a testing ground not only for the technologies themselves, but also for the policy initiatives to promote the development of new sources of energy. California's success results from the opportune combination of key policy actions with favorable resource and economic conditions. The forces that contributed to California's success include:

- financial incentives--to help consumers pay the high initial cost of an alternative energy system
- regulations that support small-scale independent power production
- energy resources--solar, wind, geothermal, biomass, small hydro, unused industrial process heat, waste
- available capital and risk-taking entrepreneurs
- increasing energy demand
- high energy costs
- open-minded (or coercible) utility officials

California's aggressive state government under Governor Jerry Brown took the reins in 1975 with the creation of the California Energy Commission (CEC) to guide energy development. The state legislature provided much of the regulatory and financial framework by passing tax credits and other incentives for alternative energy development. The state Public Utilities Commission (PUC), which approves rates and construction plans, pushed the utilities toward increased use of alternative energy strategies.

U.S. federal government policy underpins California's efforts. Federal tax credits are as important as the state credits to renewable energy projects, and federal depreciation allowances are more important than those offered by the state. It was federal legislation that required utilities to interconnect with independent power producers and set off the boom in cogeneration, wind farm, and small hydroelectric development. California has led the way among the states because of its interpretation and application of federal law.

The results of these innovative policy tools have been impressive. Retail sales of solar energy and wind energy systems in California now exceed $500 million a year--about half the U.S. total. Since 1980, more than $200 million has been invested in biomass energy projects in the state. More than fifty firms are involved in cogeneration, and more than 600 megawatts of capacity from cogeneration are already on line. Regulatory officials cannot keep up with the applications for hydroelectric facilities. Fifteen geothermal plants are already operating, eight more are under construction, and nine are in the planning stages. The 10 Mw Barstow solar thermal electric plant and the 6.5 Mw Carrisa Plain photovoltaic plant are the largest facilities of their kind in the world.

These achievements did not come easily. Battles were fought in legislatures, courts, and regulatory hearing rooms. And winning the battle was no guarantee that the programs would succeed. No one knew how to commercialize a new and diverse technology, and everyone made mistakes. Unanswered questions remain about the effectiveness of these policies, the cost to taxpayers and utility ratepayers, and the long-term social, economic, and environmental benefits of alternative energy production. Nevertheless, we do know that California has enjoyed more successes than anywhere else and can provide a standard by which to measure the efforts of government to promote the commercial expansion of alternatives to oil, coal, and nuclear power.

This section reviews the California energy situation, describes the institutions involved with energy policy and the actions each took, and evaluates the effectiveness of the various policy tools used. Although the interaction of the various policy initiatives is what stimulated rapid alternative energy growth in California, each initiative is evaluated separately to simplify the discussion.

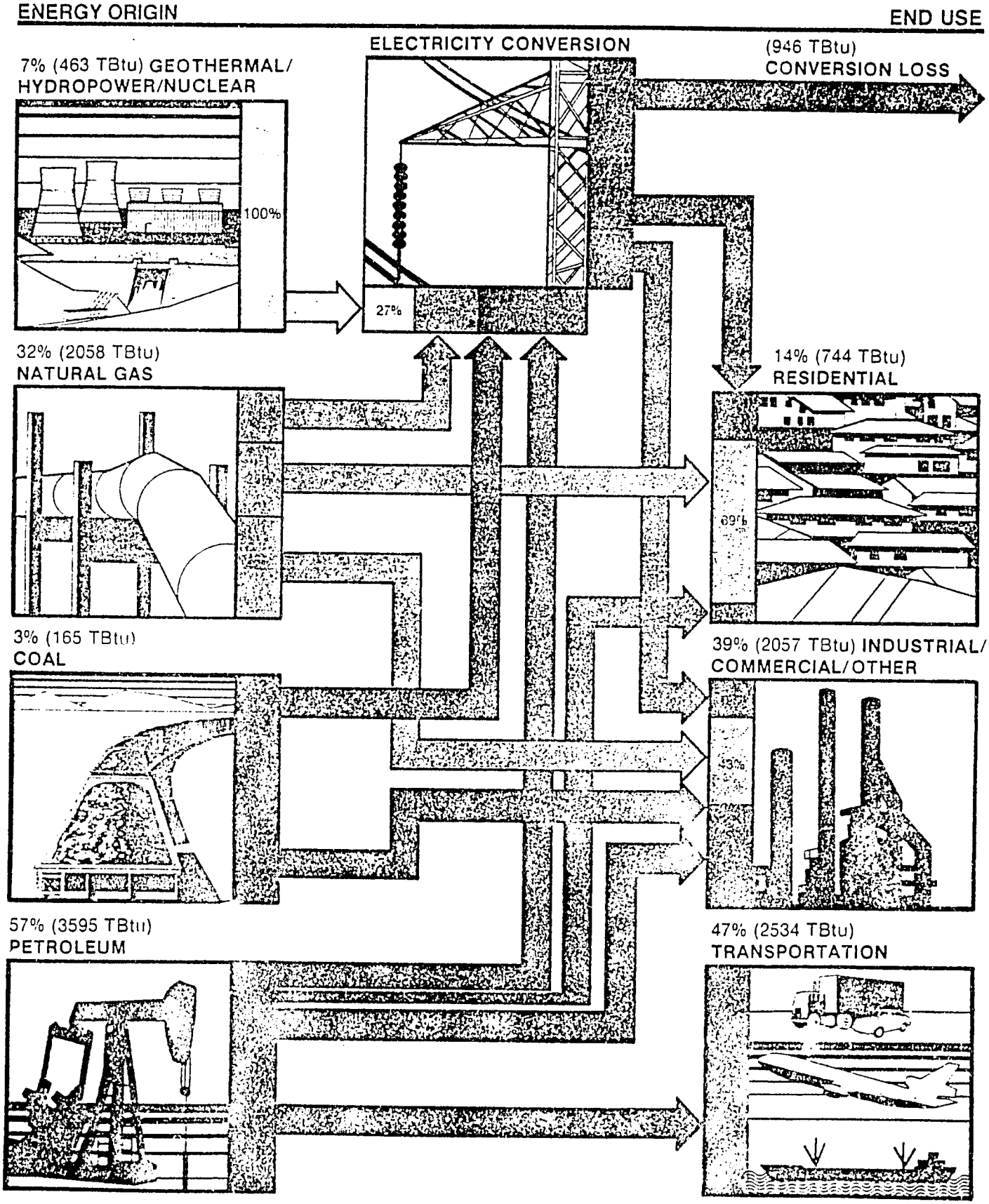
California Energy Today

By American standards, California uses an unusually large amount of oil and devotes a disproportionately large share of its energy to transportation. Oil provides 58 percent of the primary energy supply, and natural gas 32 percent. Transportation consumes 47 percent of the state's energy, compared to a national average of 25 percent. And while the nation devotes 28 percent of its energy to the residential sector, California uses only 14 percent of its energy in the home. Figure 1 summarizes the California energy picture.

Gas and Oil

California imports 90 percent of its natural gas from out of state, including 18 percent from Canada and 6 percent from Mexico. Two utilities distribute 95 percent of the gas. The average gas price has steadily risen from from $1.93 per million Btu in 1977 to $5.20 in 1982.

FIGURE 1
CALIFORNIA ENERGY NETWORK 1981



Note: Percentage numbers may not add to 100 percent due to rounding.

In 1976 California imported 40 percent of its oil from foreign sources. By 1981, ninety percent came from within the state or from Alaska.

Electricity generation consumes 24 percent of California's primary energy supply, but provides only 10 percent of the state's end-use energy. The rest is lost in conversion and transmission. Electricity satisfies 25 percent of residential energy needs and 19 percent of industrial and commercial requirements. Five investor-owned utilities -- Pacific Gas & Electric, Southern California Edison, San Diego Gas & Electric, Pacific Power & Light, and Sierra Pacific account for 95 percent of electric generation.

What sources produce electricity?

Oil and gas account for 50 percent of electric generation, and hydroelectricity for 21 percent. Nuclear power is only 3 percent of capacity, but that will increase when the Diablo Canyon plant is allowed to begin low-power operation in the near future.

Coal, which provides more than 50 percent of U.S. electricity, supplies only 6 percent of California's power, and two-thirds of that comes from plants outside the state. The desire to preserve air quality prevents greater use of coal plants in the state.

Figure 2

1981 ELECTRICAL GENERATION CAPACITY BY TECHNOLOGY

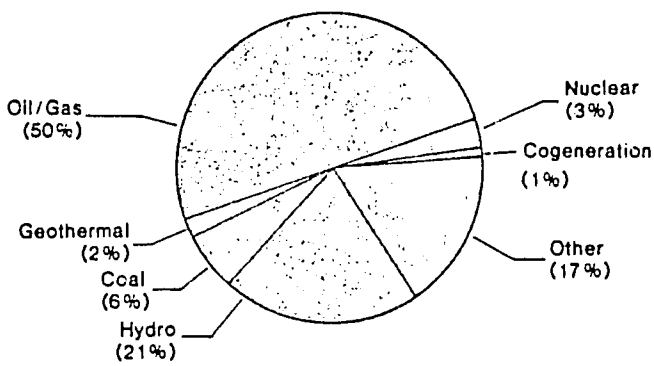
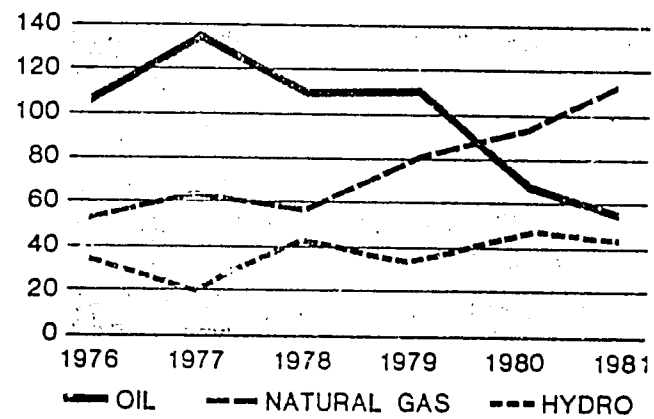


Figure 3

ELECTRIC UTILITY CONSUMPTION OF OIL, NATURAL GAS AND HYDRO
Million Barrels of Oil Equivalent



Source: Securing California's Energy Future. California Energy Commission. 1983

Alternative generating sources--geothermal, cogeneration, small hydro, wind, photovoltaics, and solar thermal--supply 7 to 8 percent of California's electricity detailed in Table 5 below..

TABLE 5

ALTERNATIVE ENERGY'S CONTRIBUTION IN CALIFORNIA
(In gigawatt hours/year)

	1975	1983
Geothermal	3,200	8,648
Cogeneration	NA	3,274
Small Hydroelectric	NA	1,505
Wind	Negl.	47
Solar	Negl.	2

Source: California Energy Commission

How fast is energy demand growing?

Peak electric demand in California increased 6.5 percent a year from 1965 to 1975. From 1976 to 1981, increased energy conservation helped slow the rate of increase to 3.2 percent, and it would have dropped below 3 percent except for an unusually hot summer in 1981. The commercial and industrial sector cut energy use by 12 percent from 1979 to 1981. Conservation measures helped the residential sector cut electricity use 5 percent and gas use 23 percent from 1979 to 1981. Nevertheless, household energy costs increased 33 percent.

California's Energy Policy

Like most of the world, California felt the shock of the 1973 oil embargo and suffered from the economic fallout of higher prices. To help the state adjust to the changing energy scene, Governor Jerry Brown proposed creation of the California Energy Commission (CEC) in 1975 to coordinate and control energy planning, and the legislature approved it. The Commission, composed of five people appointed by the governor (and approved by the state senate) for staggered five-year terms, immediately established four principles to guide state energy planning:

Reasonable cost	Supplies should be the lowest cost possible
Environmental protection	Supplies should be as environmentally benign as possible
Security	Supplies must be secure, not prone to disruption
Social equity	Supplies and costs must be equitably distributed among consumers

Working from these principles, the CEC departed from existing state and national policy by emphasizing a policy of energy conservation and alternative energy development.

> Increasing energy efficiency is preferable to conventional supply projects for displacing oil because it offers lower costs, speedier implementation, more reliable results, and minimal environmental impacts. Conservation was also judged the least expensive method of expanding the use of available energy supplies and consequently flattening the spiral of inflating utility costs. Alternatives and renewable resources were found to offer stable fuel prices, less environmental risk, and greater diversity and flexibility than their conventional counterparts. (Emphasis added) ---California Energy Commission

What does CEC do?

Having agreed that alternative energy development would benefit the state, the CEC members decided that market forces alone would not make this development happen quickly enough. They moved to offset market distortions that they felt favored conventional energy sources. The CEC efforts included:

- o Public information programs
- o Economic incentives
- o Mandatory efficiency standards
- o Changes in energy pricing policies

In this way, the Commission tried to create an economic climate more favorable to alternative energy development.

Underlying the CEC strategy is the fear that the market underestimates the danger of oil supply disruptions and other drawbacks of conventional energy sources. The commissioners want to avoid a rerun of previous disruptions with their attendant price leaps, government panic, demand reduction, and economic turmoil.

Looking ahead, the Commission sees continued instabilities. The CEC projects that oil and gas will supply as much as 79 percent of California energy needs at the turn of the century. Price increases for natural gas could stimulate oil demand. Although California oil production has increased, the mix of crude for refineries includes more heavy oil, and additional refinery capacity may be needed to handle the heavier mix. The resurgent economy could increase energy demand and national reliance on foreign sources of oil.

Created by the state legislature to provide independent analysis of California's energy needs and policies, the CEC does not have the power to change the structure of the market. That is the role of the legislature, and the most powerful tool for shaping the market has been the tax system. Table 6 summarizes major state and federal legislative actions.

TABLE 6

LEGISLATIVE ENCOURAGEMENT OF ALTERNATIVE ENERGY

	Federal Laws	California Laws
CENTRAL ENERGY AGENCY	• Created Federal Energy Office (FEO) (1973) • Created Federal Energy Agency (FEA) (1974) • Created Energy Research Development Administration (ERDA) (1975) • Created Department of Energy (DOE) (1977). Current administration has proposed to dismantle DOE	• Established the Energy Commission with broad authority covering power plant siting, energy planning, and forecast development of energy conservation standards and alternative energy resources (Warren-Alquist Act of 1975)
POWER PLANT SITING PROCESS	• Streamlined process for small hydroelectric projects under 5 MW (Federal Power Act)	• Streamlined process established for geothermal cogeneration, and coal gasification power plants (SB 2066 and SB 1805 of 1980
FINANCIAL INCENTIVES	• 40 percent residential solar tax credit -- does not include swimming pools or passive solar features (Energy Tax Act of 1978) • Business tax credits for biomass, cogeneration, small hydroelectric geothermal, wind, and solar • Federal accelerated depreciation • Alcohol fuel excise tax exemption	• 55 percent solar tax credit for all residential applications (AB 1558 of 1977) • 25 percent commercial tax credit for solar and wind only (AB 1558 of 1977) • Allow accelerated depreciation of alternative energy equipment (AB 1404 of 1979 and AB 2893 of 1980) • Gasohol tax exemption (SB 1324 of 1980) • Alcohol conversion tax credit (SB 178 of 1981) • Solar property tax exemption (SB 1306 of 1980)
GOVERNMENT SPONSORED FINANCING ENTITIES AND PROGRAMS	• Small business loans -- Small Business Administration • Solar bank • Synthetic Fuels Corporation • Wind commercialization (defunct)	• SAFE-BIDCO -- small alternative energy business loans (SB 16 of 1980) • CAESFA (AB 2324 of 1980) bonding authorities CPCFA (AB 2646 of 1980) bonding authorities • Sunny-Mac -- secondary mortgage market for solar loans (SB 921 of 1979) • Biomass demonstration. Agriculture and forestry residue as a source of energy (SB 771 of 1979) • Agricultural sector alternative energy demonstrations (AB 3048 of 1980) • Earmark annual funds from oil tidelands revenues for energy development (AB 2973 of 1980). Provided grants to local entitites for geothermal planning and development (AB 1905 of 1979)
ALTERNATIVE FUELS	• PIFUA -- Reduce use of oil and gas by encouraging use of alternative fuels (National Energy Act of 1976)	• Explore use of ethanol and methanol in motor vehicle fleets (SB 3048 of 1980) • Explore use of cleaning burning fuels in transportation and utility power plants (SB 771 of 1979) • Authorize the use of methanol fuel in motor vehicles (AB 1401 of 1979) • Gasohol exemption from gasoline volatility test for three years (AB 2004 of 1980)
ENCOURAGE ALTERNATIVE ENERGY DEVELOPMENT	• PURPA -- avoided cost rates for small power producers (National Energy Act of 1978)	• Accelerate wind commercialization (AB 2976 of 1978) • Establish standards for solar equipment and production of design tools for industry (AB 1512 of 1977) • Conduct passive solar design competition (AB 3046 of 1978) • Provide solar access rights and easements (AB 2984 and AB 3247 of 1978) • Define utility role in solar development (AB 2984 and AB 3247) of 1978) • Establish emission offset bank for cogeneration projects (AB 524 of 1979 and AB 1862 of 1981) • Give local government entities authority to generate small hydroelectric power (several laws in 1980 and 1981)

Source: Securing California's Energy Future. California Energy Commission. 1983

Tax Policies for Renewable Energy

Tax incentives are the most popular means of shaping economic choices in the United States. Through a uniquely elaborate system of deductions, credits, and allowances, federal and state governments seek to structure the market so that the economic choices most beneficial to the society will also be most attractive for the individual or company. The goal is to make social concern a factor in a free market decision.

For renewable energy investments, the government perceives a societal advantage in reducing dependence on conventional energy sources that entail environmental, safety, or economic liabilities. Tax incentives are a way for the society to assume the cost of the societal benefits of an individual decision, and the tax credit was the first initiative California's legislators took to promote alternative energy development.

Tax credits have effectively spurred residential and commercial alternative energy use in California. The combination of state and federal tax credits plus the energy savings enables a California homeowner buying a solar system to take in more money than he spends in the first year -- a powerful incentive to buy a system. For third-party investment in alternative electric generating facilities, the tax credits are undoubtedly the prime motivation. The package of tax credits and other tax benefits available for alternative energy investments is very attractive for high-income people -- and a wealthy population is one of California's prime resources. Although other conditions are necessary to grease the wheels of alternative energy development, tax credits are the force that set the wheels in motion.

When were the tax credits introduced?

California introduced a 10 percent solar tax credit in 1976 -- two years before the federal tax credit began. One of the first in the nation, it allowed individuals and businesses that purchased renewable energy equipment to produce heat or electricity to deduct 10 percent of the cost, including installation, from their state taxes. The tax credit legislation included no specific goals for the credit. The legislature simply wanted to encourage consumers to buy solar energy systems and thereby help start a new industry down its learning curve.

In its subsequent effort to justify the credits, the California Energy Commission has identified seven goals for the solar and conservation credits:

- To save energy and reduce energy bills
- To develop new jobs and businesses
- To accelerate cost effectiveness of energy saving measures
- To increase security and reliability of energy supplies
- To accelerate technological development
- To achieve environmental benefits
- To counter-balance subsidies to conventional energy sources.

In September 1977, after the federal solar research, development, and demonstration program was well underway and interest in the potential of solar energy utilization was growing, California passed additional legislation to increase the solar tax credit to 55 percent with a $3,000 maximum.* (The credit was cut to 50 percent in 1984). For non-residential systems costing more than $12,000, a 25 percent credit applied, with no upper limit. Wind energy systems became eligible for the credits in 1978, and similar credits for conservation were established in 1981. A California homeowner must reduce the value of his California credit by the value of any federal tax credits. If he claims the 40 percent federal credit in 1984, he will receive a 10 percent California credit. Business systems can claim the full state and federal credits.

How do the credits work for a homeowner?

The initial benefit of the tax credit to a homeowner is easy to see. Someone who buys a solar water heater that costs $4,000 installed can deduct 40 percent of the cost ($1,600) from his federal tax bill and $400 (50 percent California credit minus the federal credit) from his state tax bill. He thus saves $2,000 on the cost of the water heater.

The long-term benefits vary with each installation. The efficiency of the system, the cost of a conventional system, the price of fuel for a conventional system, the amount of hot water used, the homeowner's tax bracket, and the method of financing all affect the long-term economics of the investment. The interaction of these variables is evident in the following hypothetical example.

Assume that a homeowner in a 30 percent tax bracket buys a $4,200 solar water heater with a seven-year 15 percent home improvement loan, saves $275 in energy costs compared to a conventional heater in the first year, and energy costs rise 10 percent a year.

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* A tax credit allows an individual or corporation to reduce tax the bill by that amount. A tax deduction reduces taxable income. For someone in the 50 percent tax bracket for earned income, the highest in the U.S., a $1,000 tax credit would reduce his tax bill by $1,000. A $1,000 tax deduction (such as a depreciation allowance) would reduce his tax tax bill by $500.

TABLE 7

RESIDENTIAL WATER HEATER INVESTMENT PROFILE

Year	Solar Savings	Interest Deductions Earnings	Federal Tax Credit	Calif. Tax Credit	Total Earning	Debits Annual Payment	Balance Annual Position	Balance Cumulativ Annual Position
1	$275	$207	$1,680	$630	$2,792	$973	$1,829	$1,829
2	302	178	---	---	480	973	-493	1,326
3	333	163	---	---	496	973	-477	847
4	366	123	---	---	489	973	-484	365
5	403	90	---	---	493	973	-480	-116
6	443	58	---	---	501	973	-472	-587
7	487	23	---	---	510	973	-463	-1050
8	536	---	---	---	536	---	+536	-51
9	590	---	---	---	590	---	+590	+36
10	649	---	---	---	649	---	+649	+735

Source: California Solar, Wind, and Conservation Tax Credits, CEC. 1983.

As can be seen in Table 7, over the seven years the value of the energy savings increases with fuel price hikes, and the interest paid is tax deductible. The first year cash saving from the tax credit puts the homeowner ahead, so that the system doesn't cost anything until the fifth year. By the eighth year the loan is paid off, and the homeowner profits from energy savings. Net cash flow is positive in the ninth year, and savings should continue for the life of the system -- say an additional ten years. The owner could also choose to reinvest his tax savings to reduce the loan principal, and make his positive cash flow occur sooner.

What about a commercial project like a windfarm?

Commercial projects involve not only more up-front money but more players. A developer chooses a site and a technology, estimates costs, plans for operation and maintenance, and conducts negotiations with the utility to sell electricity. The utility agrees to a contract that specifies rates, terms, and other conditions. Individual investors provide the capital for the project, claim the benefits of the tax credits, and receive a share of the income from power sales. The following example, based on the prospectus of a major wind farm developer, illustrates the economics of a wind farm now operating in California.

A San Francisco-based developer buys land in Altamont Pass in the Bay Area of Northern California and plans a 60 megawatt wind farm composed of about 500 machines. Construction costs will run about $103 million, and related management expenses will cost an additional $9 million. The developer estimates that the project will produce 140 million kilowatt hours of electricity a year. The utility has agreed to pay $.09 a kilowatt hour for the power until 1991 and then to pay 82 percent of avoided cost. Until 1991, the developer is counting on a steady income of $12.6 million a year.

An investor agrees to put up $75,000, in effect buying about 40 kilowatts of wind capacity. The tax benefits for the first year are formidable.

Federal Incentives		
Energy tax credit	($75,000 at 15%)	$11,250
Regular investment tax credit	($75,000 at 10%)	7,500
Depreciation	(65,625 x 15% x 46%)	4,528
California Incentives:		
Solar tax credit	($75,000 at 25%)	$18,750
Depreciation (15 years)	($6,250 x 2 x 9.6%)	720
First year cash savings		$42,748

In subsequent years, the investor will continue to benefit from depreciation allowances and will receive about $4,000 a year net profit from electricity sales. Income from electric sales will increase after the fixed rate ends in 1991, and the developer projects that annual income will rise steadily to $11,000 by 1999.

Although this explains the essence of what happens, most investments are usually more complicated. Many investors will not actually put up the $75,000 in the first year. Instead they sign a five-year non-recourse note at 9 percent interest, and pay the developer in installments. The interest is tax deductible. This enables an investor to claim the tax credits and still have the cash in hand for other investments. By the time the investor pays off the $75,000 note, he will have earned more than $79,000 in tax benefits and income. At the end of ten years his cummulative cash flow should equal $93,000, according to the prospectus.

Why are tax credits necessary for wind farm development?

The cost of delivered energy from a medium-sized wind machine (20 to 50 Kw) costing about $1800 to $2200 per kilowatt of rated capacity ranges from 10 to 15 cents per kilowatt hour. Utilities are not directly buying such equipment because the cost of delivered energy exceeds by a factor of two what they are required to pay independent energy producers as avoided costs and capacity factor payments. With tax incentives, independent developers can generate power at a competitive price and make a profit. As many as fifty to seventy wind farm developers (three-quarters located in California) are putting together multimachine windfarm projects, selling them to investors, and managing them for power sales to utilities. The combination of tax credits, depreciation, and the income stream from a utility are enough to provide investors in high tax brackets with an attractive rate of return. They are frequently sold through investment firms, or by the developers. The entry price for an investor may be as low as $10,000 to $15,000, yet some projects exceed $50 million in total cost.

Who invests in alternative energy projects?

Thus far, individual investors are the most active in renewable energy projects. Doctors, lawyers, and movie stars, usually with net worth of at least $1 million, were the first to invest. As the business expanded and became more established, opportunities opened for individuals with $10,000 or $20,000 to invest.

The people investing in projects like the windfarm described above are probably in the 50 percent tax bracket (individuals earning in excess of $50,000 per year of taxable earned income) and want to "shelter" that income. The investment and renewable energy tax credits reduce their tax bills directly, and depreciation allowances reduce taxable income. You do not have to be a solar advocate to appreciate the economics of alternative energy investments under this tax code.

Several years of field experience have reduced the risk associated with wind technology, and the tax credits provide a reliable enough safety net so that wind farms are no longer as risky a venture as they first were. At present, wind farm investors expect a 25 percent rate of return to justify the perceived risk. Very high risk ventures for unproven technologies or new companies usually must offer a minimum return on investment after taxes of 40 percent, with a promise of much higher returns should the project succeed.

Institutions - investment funds, insurance companies, pension funds and venture capital pools - are another potential source of equity capital for renewable energy projects. Thus far, insurance companies have not been interested, and pension funds, which are tax-exempt, lack the major incentive. Investment funds and venture capital pools, which are essentially channels for individual investment, are becoming more involved.

Corporations are another source of equity capital for projects. Because corporations often have little or no tax liability, tax credits are not an effective incentive for them. They are most likely to invest in a facility they will own and use, such as a cogeneration system.

How does California justify the cost of the tax credits?

When George Deukmejian became governor of California in January 1983, he promised to eliminate the renewable energy tax credits. He claimed that the state had no business interfering in the energy market and that the tax credits were simply a tax dodge that helped the wealthy and hurt the state.

In response to this attack, the California Energy Commission identified the following justifications for the credits:

- State Revenue Losses. CEC argued that the state treasury losses from the credits were less than estimates by the Governor's budget officials. In 1983, state tax expenditures for solar and wind systems were estimated to be $78 million. CEC claims that of the $78 million in credits granted in 1983, $50 million eventually returned to the state in related business taxes, of which $25 million could be attributed directly to the tax credits.

Over the life of the systems installed in 1983, CEC calculated that all but $10 million of the $118 million lost to the state through tax credits and depreciation allowances will eventually end up in the state treasury. The CEC report concludes that ninety-two percent of the original expenditure for solar credits is projected to be returned to the state treasury through increased tax revenues directly caused by the credit. (See Table 8 below)

The ultimate net cost of the tax credits to California's treasury is a slippery issue, which depends on how strictly one defines their economic effects. Everyone agrees that increased tax revenue from sales, business profit, personal income, and property taxes related to renewable energy business should be at least partially counted to offset the cost of the tax credits. But deciding what level of business activity would have occurred without the credits -- and which therefore should not be considered in accounting -- is not easy.

TABLE 8

ESTIMATES OF REVENUE EFFECTS OF 1983 SOLAR AND ENERGY CONSERVATION TAX CREDITS FOR THE PERIOD 1983-2003 (In Millions of 1983 $)

	Amount of Monies Spent for Tax Credits or Alternative Purposes	Revenues Generated from Energy-Related Investments		Revenues Minus Spending on Credits		Revenues as a Percent of Spending on Credits	
		Total	Attributed to Credits	Total	Attributed to Credits	Total	Attributed Credits
Spending on Energy Credits							
Solar Credits	$118	$199	$108	$81	-$10	169%	92%
Energy Conservation Credits	49	63	19	14	-30	129%	39%
Total Energy Related Credits*	$167	$261	$127	$94	-$40	156%	76%
Alternative Use of Monies -- A General Tax Reduction	$167	$ 81	$ 37	-$86	-$130	49%	22%

*Detail may not add to totals due to rounding.

Source: California Energy Commission, California's Solar, Wind and Conservation Tax Credits, Dec. 1983, p.33.

- Energy Savings. CEC estimates that energy produced by renewable energy systems that claim the tax credits will be worth $2.6 billion over the life of the systems, with wind turbines and solar water heaters the major contributors.

- Environmental Benefits. The CEC estimated that increased investments in renewable energy will result in improved air quality for the state. The systems and equipment installed or expected to be installed because of the present solar and conservation credits should avoid environmental pollution by an amount equal to a 300 Mw natural gas electric generation facility operating for 20 years.

- Industry Growth -- The total number of solar-related firms grew 500 percent in California from 1977 to 1982, while in the rest of the United States the number only doubled. A 1982 survey estimated that 1,500 businesses were directly working in the solar field, with an additional 5,000 companies involved on a part-time basis. Table 9 on the next page provides a summary of data on solar industry growth in the United States and California.

  In 1982, solar heating and cooling applications led the industry with sales of $300 to $350 million. Wind was next with sales of $108 million. Large wind farm development has grown incredibly since it began in 1981, and early reports indicate that wind farm business in California could have taken the lead from solar heating and cooling in 1983.

  The California Energy Commission estimates that seventeen biomass projects sponsored by a state program since 1979 have stimulated $54 million in capital investment and generated $200 million in sales. The projects include direct combustion, methane fermentation, and gasification. Direct combustion in the forestry and agricultural sectors dominates the market.

- Employment. The number of direct employees in the low and medium temperature solar industry has increased from about 2,000 in 1977 to 12,300 in 1983. Employment in advanced high temperature solar thermal companies has increased from about 150 in 1977 to 400 in 1983.

  In the wind energy field, only a few manufacturers of wind equipment are located in Calfornia, so most of the work is in installation. Employment rose from 319 direct jobs in 1981 to 1,761 in 1983. Biomass projects created about 3,000 jobs.

  About one-third of the photovoltaic companies in the United States are located in California. Employment in California rose from an estimated 700 direct jobs in 1977 to an estimated 1,500 jobs in 1983.

TABLE 9

SUMMARY DATA OF SOLAR INDUSTRY GROWTH

UNITED STATES (Excluding California)	Number of Firms		Employment		Production		Sales (Millions of $	
	1977	1982	1977	1982	1977	1982	1977	1982
Low and Medium Temperature Solar Thermal	321[a]	325[a]	c	c	6,100,000 ft^2	9,100,000 ft^2	254	329
Advanced and High Temperature Solar Thermal	15[a]	21[a]	c	c	113,000 ft^2	209,000 ft^2	2.6	5.2
Wind Energy Conversion[b]	Insig.	473	c	c	Insig.	2,010	Insig.	15
Photovoltaics	5[a]	12[a]	400	1,100	200 kWp	1,600 kWp	11.6	23.4
SUBTOTAL	341	531	400	1,100	N/A	N/A	262.2	390
CALIFORNIA								
Low and Medium Temperature Solar Thermal	283	1,500	1,500	10,900	4,600,000 ft^2	10,400,000 ft^2	54	335
Advanced and High Temperature Solar Thermal	8	8	139	379	82,000 ft^2	235,000 ft^2	1.9	6.6
Wind Energy Conversion[b]	Insig.	25	Insig.	992	Insig.	1,000	Insig.	108
Photovoltaics	7[a]	6[a]	1,100[a]	2,300[a]	180 kWp	3,110 kWp	5.5	30.8
SUBTOTAL	298	1,539	2,339	13,471	N/A	N/A	62.5	535
TOTAL U.S	639	2,070	2,733	14,571	N/A	N/A	324.7	925

a. Manufacturers only
b. Number of Firms data equals dealers and manufacturers only. Production data equals the number of installations.
c. No data is available for this category

Source: California Solar, Wind, and Conservation Tax Credits (CEC, 1983), p. 67

What are the arguments against the credits?

The renewable energy industry has relied heavily on the solar tax credits to propel development of its markets. While they have enjoyed broad support, the credits have not been immune to attack. The major criticisms include:

- Revenue Losses. In a period of mounting concern over the large federal budget deficit, any policy that costs the Treasury revenue is likely to be scrutinized. Treasury analysts estimate that the solar and conservation tax credits cost the federal government $1.1 billion in 1981 and will cost billions more in 1982, 1983, and 1984.

- Tax Code Complexity. Critics contend that the tax system has become overly complicated, and that government should seek alternative ways to promote new technologies.

- Free Market Impact. Valuable talent and resources are being devoted to a technology incapable of supplying energy in the near or mid-term in any quantities meaningful to national needs or security. The free marketeers propose decontrolling conventional energy prices rather than providing assistance to new technologies.

- Uneven Business Development. Both sides in the debate agree that the beginning and end of the tax credits disrupt the normal growth pattern of solar businesses, making planning difficult. Businesses suffered in the 1970s as Congress debated the credits and consumers waited for the outcome.

- Consumer Protection Costs. When the federal and state governments provided incentives for new technologies, they also took on the responsibility to implement consumer protection regulations, increasing government and industry expenses.

- Industry Dependence. A subsidized industry can become too dependent on the subsidy and will avoid investing funds necessary to become competitive without the subsidy.

- Incentives Hold Up Prices. Some of the most strident criticism facing tax credit proponents is that the credits artificially inflate the price for the technologies that are already competitive.

- Incentives Are Abused. A Texas contractor reportedly sold a $4,000 solar water heater for $8,000 by offering a free air conditioning system worth $4,000 as a bonus. He told consumers they could claim a $3,200 tax credit (40 percent of $8,000) and thus pay only $800 for the solar system. Developers of commercial generation projects have also been accused of overvaluing their projects to boost the tax credits. Such schemes are illegal and can damage the industry's reputation.

Regulation: The California Utilities and PURPA

Producing energy won't do you any good if you can't use it or sell it. In the United States and virtually everywhere else, electricity is produced and sold under strictly regulated conditions. This leaves little opportunity for entrepreneurial pioneers to introduce new technologies, and the lack of competitiveness leaves electric utilities with little incentive to innovate.

Recognizing this, the U.S. Congress passed legislation in 1978 to promote independent power production using alternative sources of energy. Though a crucial step, the legislation in itself was not sufficient to guarantee alternative electric generation, and many states have seen little progress in expanding their sources of electricity. California, however, is enjoying dramatic alternative power growth thanks to aggressive state regulators, open-minded utility officials, growing electric demand and other favorable conditions. As a result, California has become the world leader in alternative electric generation interconnected with utilities.

How is the U.S. utility industry structured?

In the United States production and delivery of electrical power is principally a private sector enterprise. Four hundred investor-owned utilities generate 78 percent of U.S. electrical power. Publicly owned utilities and municipal utilities provide the rest.

Government has granted utility companies a controlled monopoly, under state and federal regulation. State public utility commissions, elected or appointed, set rates and approve construction. The Federal Energy Regulatory Commission (FERC) implements and administers federal law and executive orders. The Nuclear Regulatory Commission, the Securities and Exchange Commission, and the Environmental Protection Agency also control aspects of utility operation.

What led to the enactment of PURPA?

Although gasoline and heating oil prices were the most evident sign of skyrocketing oil prices in the 1970s, electric rates soon followed. Even though electric utilities relied on petroleum for only 9.9 percent of their energy needs in 1976, oil price increases pulled up prices of other conventional fuels, and electric rates rose. Their climb was not immediate because long-term contracts and the regulatory process build in a delay, but as soon as utilities won the right to pass through fuel price increases to their customers as a surcharge, an upward price spiral began. Consumers saw their electric rates rise for the first time in decades.

At the same time, nuclear power was coming under attack for being dangerous and more expensive than anticipated. Construction costs rose as regulators found many plants wanting in adequate safety measures. Public protests intensified, creating further delays. The combination of inflating interest rates and longer construction times put many utilities in a bind. Then rising prices encouraged conservation and a switch to other energy sources, thereby cutting electricity demand and rendering utility growth forecasts useless. Utilities found themselves in the unhappy position of financing and building very expensive new plants that were not needed.

At the same time, businesses were discovering that they could economically generate their own electricity with cogeneration, and renewable energy entrepreneurs were eager to produce electricity from wind turbines, photovoltaic cells, and small hydroelectric facilities and to sell this power to utilities. However, a number of hurdles stood in the way of developing these alternatives:

- the reluctance of utilities to tie independently-produced power into the grid
- low purchase prices offered by the utilities for their electricity
- high costs of auxiliary power from the utility
- uncertainty about state public utility regulation.

PURPA was designed to remove these hurdles.

What is the Public Utility Regulatory Policies Act (PURPA)?

The federal government enacted the Public Utility Regulatory Policies Act (PURPA) in 1978 as one of five major legislative energy initiatives of the Carter administration. This bill ordered all state utility commissions to "consider" by November 1981 the implementation of standards to promote "conservation, efficiency, and equity" in utility policies through voluntary changes in rate structure and other practices. Utilities were directed to publish detailed statistics on their cost of providing electricity, a requirement essential for determining their marginal costs for providing additional energy.

PURPA sections 201 and 210 have had the most impact on alternative energy production and raised the most controversy. These provisions require utilities to buy power from small power producers that meet certain qualifications and to sell them auxiliary power at nondiscriminatory rates.

The original purpose of PURPA section 210 was to provide an incentive to cogeneration as a means of improving the efficiency of the electric utility system. The forestry, petrochemical, and oil refining industries were already producing some of their own power, and energy planners estimated that a great deal more potential existed if cogenerators could receive a price for their energy that reflected more closely a utility's marginal rather than average cost of power.

PURPA addressed these impediments to alternative power production by:

- Requiring state public utility commissions to remove constraints and establish requirements under which any qualifying independent power producer (of less than 80 megawatts) can tie into the utility grid

- Streamlining the licensing process by exempting all qualifying cogeneration and renewable energy facilities of less than 30 megawatts from certain regulatory procedures

- Requiring the Federal Energy Regulatory Commission to publish rules governing establishment of "just and reasonable rates" for the buying and selling of power to utilities by qualifying facilities, specifying that, "no such rule...shall provide for a rate which exceeds that incremental cost to the electric utility of alternative electric energy."

Before changes could begin to occur under PURPA, the Federal Energy Regulatory Commission (FERC) had to establish rules implementing the major provisions of the act. Then it was up to the states to establish specific procedures and guidelines for the utilities under their jurisdiction.

How did the utilities respond?

When FERC published its PURPA rules in 1980, the utility industry responded by challenging the rules in court. Many utilities objected to mandatory interconnection with independent power producers and to FERC's decision that utilities must buy the power at "full avoided cost" -- what it would cost the utility to produce the additional power by conventional means. Most states, meanwhile, began establishing their rules and criteria for implementing PURPA according to the FERC rules.

Utility objections were based on the belief that:

- Full avoided costs establish a false price for renewable energy systems

- It would burden states and utilities to make them have to justify other than full avoided costs

- Mandated full avoided costs are not necessary to induce development of cogeneration or small power production facilities

- Mandatory interconnection would preclude FERC interconnection rules that protect the utility system and customers

- Just and reasonable rates are needed, but should also serve the interests of consumers, who deserve equitable electric power rates

- Empowering states to determine rates of purchase and to be involved in interconnection issues to a greater degree will cause unequal and inconsistent implementation of federal policy.

The Edison Electric Institute, the utility trade association, went even further and charged that full avoided cost rate would raise costs to consumers, allow states to establish rates above avoided costs, reduce the reliability of the electric utility grid, and inhibit full development of alternatives. Its spokesmen contended that 100 percent of full avoided costs failed to balance the interests of the public, ratepayers, and qualifying facility developers.

Proponents of FERC's rules defended full avoided costs by pointing out that the utility system would benefit from development of small scale power resources the utilities would overlook and that a more efficient system would result because independent power producers:

- Use no fuel or use it more efficiently
- Disperse sources of power supply, thereby creating more system security
- Allow utilities to add power in smaller increments
- Reduce financing costs by shortening lead times.

While the court battles raged, independent power producers waited. FERC received only seven small power applications totalling 187 megawatts in 1980 in California and seventeen totalling 796 megawatts in 1981.

Did PURPA make a difference?

In spring 1983, the Supreme Court upheld the Federal Energy Regulatory Commission rules implementing PURPA. With the uncertainty removed, the pace of alternative energy development accelerated. In California alone, alternative energy capacity almost quadrupled from 1981 to 1983. In 1981, cogeneration supplied less than 200 Mw of capacity in California. By summer 1983, 379 projects totalling 751 Mw were on line, and an additional 5,500 Mw were in some stage of project conceptualization, development, or negotiation. Existing and planned projects included:

Oil/gas cogeneration	28 percent
Biomass and waste-to-energy	23 percent
Wind	23 percent
Small hydro	8 percent
Solar electric	4 percent
Geothermal	3 percent

The rise in wind energy utilization after 1981 is one of the most dramatic indications of the impact of PURPA. Total installed capacity of wind energy systems in the U.S. tripled from 1982 to 1983, and output quadrupled from 15,000,000 to 60,000,000 kwh. Applications for new facilities rose at a similar pace.

The potential for alternative energy utilization remains strong, despite an apparent slowdown due to the decline in oil prices, which is reducing avoided cost rates. The California Energy Commission still projects that over 2,000 Mw of cogeneration systems, 2,000 Mw of wind systems, and 1,400 Mw of small hydro could be on line by 2002 in California.

What else contributed to PURPA's impact?

Crucial as it is, the PURPA legislation was only the first step in stimulating independent power production. Implementation of PURPA varies considerably from state to state, and nowhere has its effect been more pronounced than in California. While availability of capital and extensive alternative energy resources explain some of California's progress, aggressive regulatory pressure is the most significant cause of growth.

The California Energy Commission saw the utilities, and hence their state, in a particularly vulnerable position. Likewise, the California Public Utility Commission (PUC) was pushing the utilities to tap alternative energy sources even before PURPA was passed. In March 1976 the PUC ordered utilities to report on current waste heat use and plans for future use. In January 1978, it ordered utilities to publish rates and policies for purchasing power from small power producers and cogenerators. Then at the end of 1979, the PUC directed Pacific Gas & Electric Company to file price offers to 11,000 potential cogenerators and small power producers at full avoided costs. This was two months prior to promulgation of the FERC rules on interconnection and purchase rates. All regulated utilities in California were required to file offers by July 1, 1980. By the time it was passed, PURPA simply gave California agencies more authority to do what they were already doing.

How does one determine purchase rates for privately produced power?

High avoided cost levels are a sine qua non for substantial market penetration of cogeneration and independent power production. Furthermore, capacity credits, amounting to about 10 percent of the income an independent energy producer earns from a utility, often provide the margin of profit. FERC rules provided considerable latitude to states in determining avoided costs and capacity credits. No prescribed calculation method was set forth, nor does anything prevent utilities and qualifying facilities from negotiating their own rates and contract terms. The FERC rules merely require that certain factors be taken into account.

California has been one of the most aggressive states in its implementation of PURPA. Unlike most states, which rely on utility filings for determining avoided costs, the California PUC established its own methodology and closely supervises utility compliance. The avoided cost rates in California include fuel cost, operation and maintenance costs, line losses, administrative expenses, transmission and distribution investment costs, and capacity costs.

As a result of this procedure and their reliance on oil and gas, the utilities in California had the high avoided cost rates -- more than $0.07 per kilowatt hour -- needed to stimulate independent energy production.

California also has a continuing need for new electric generating capacity. In many other states, the utilities have too much capacity and want to discourage more production.

What role did the utilities play?

Another key element supporting alternative energy production under PURPA is the evolving attitude of the state's major utilities. While state regulators have applied pressure from without, utility staff economists encouraged their management to consider conservation and alternative energy resources.

Utility economists recognized that deferring capacity expansion under the general economic conditions in the late 1970s and early 1980s was a clear advantage to utilities. Nuclear construction delays and cost overruns were a headache. Credit was tight and interest rates high. Regulatory scrutiny made it uncomfortable to propose continued rate increases and business as usual. Alternative energy projects met a friendlier reception and were often a valuable public relations tool. Adding capacity in small increments gave the utility more flexibility, and the utility did not have to raise capital to expand capacity.

Who else was important?

Private investors have been critical to development of alternative energy. When the national administration changed in 1980, the federal philosophy towards introduction of new energy technologies shifted to support of long-range, high-risk research, leaving commercialization to the private sector. In California, an aggressive, forward looking industrial sector accepted the risk of entering a new energy era. California's healthy economy, with a GNP larger than all but six countries in the world, provided the economic surplus the entrepreneurs needed. Capital has been forthcoming for financing new energy companies, creating alternative energy divisions in existing companies, and for financing projects.

What does an independent power producer have to do to sell power?

Once a private producer has created and prepared a preliminary finance package for a project, he must negotiate an agreement with a utility company. The difficulty and expense of negotiating a contract with the utility discouraged many potential independent power producers. To overcome this problem, the California Public Utilities Commission required utilities to draw up "standard offer" contracts to simplify negotiations. Now the major California utilities have several standard contracts that specify prices, terms and conditions for various cogeneration or renewable energy projects. A small power producer who is not satisfied with the standard offers is free to negotiate an individual contract, and most large projects choose to do so.

For the independent power producer, the key items in the contract are:

- the price per kilowatt hour paid by the utility;
- the amount of the capacity payment, which is determined by the size and reliability of the project;
- the interconnection fee.

California Energy Commission chair Charles Imbrecht identifies the negotiation of a long-term contract for utility sales as the "premier issue" for attracting private investment for alternative energy projects. But even this may not be enough to get a bank loan because most of the contracts involve a variable electric rate tied to the utility's estimate of avoided cost. The banks usually prefer a long-term fixed rate so that they can estimate precisely the project's future income.

Should independent power producers pay for transmission systems?

The latest controversy raging between the California Public Utility Commission and Pacific Gas and Electric Company (PG&E) is an excellent example of the issues surrounding PURPA. PG&E wants to modify its standard offer to independent power producers by including charges to upgrade the PG&E transmission system to accommodate the growing number of independent generation plants. Some electric lines have already become incapable of handling the power available from cogenerators and alternative energy power plants.

At issue is who should pay for new transmission capacity. The power producers are arguing that PG&E was ordered to plan on having 2,000 MW of cogeneration on line by 1985 and should be better prepared. The independent power producers worry that PG&E will hit them with unexpected charges, creating damaging uncertainty in the minds of potential investors. The Public Utilties Commission is upset that PG&E is tampering with a standard contract offer that took four years of wrangling to create. As independent power production grows, utilities are certain to want to pass on some of their infrastructure costs.

Who pays for promoting independent power?

Another unanswered question raised by PURPA is who should bear the cost and who should reap the advantages of turning to alternative energy sources. With mandated full avoided costs, the independent producers are receiving a greater share of the advantages from their entrepreneurial ventures than they probably would otherwise. The utility pays the same cost for new independent energy sources as it would for additional conventional sources, in spite of its doubts about the reliability of small independent power units. The stockholder's dividends remain unchanged, and no capital is spent. The ratepayer sees new capacity come on line for the same ostensible cost with or without PURPA. Arguing on behalf of ratepayers, utilities argue that 80 or 90 percent of avoided costs should be the standard so that ratepayers would benefit economically. Thus far, ratepayers and taxpayers have borne most of the cost for alternative electric power generation.

In some cases, utilities themselves have offered to pay rates higher than avoided costs. In these cases, they point to a need for extra incentives to advance technolgies still in the development stage. They contend that ratepayers can be legitimately asked to help cover the risk associated in commercializing unproven technologies. The California PUC has approved rates above avoided cost, but with the provision t after a certain period a project will "repay" the utility by receiving less than avoided cost for its electricity. Other state commissions have denied such requests outright.

Are avoided cost rates fair?

At the root of this debate is a difference between long-range and near-term perceptions. Some observers point out that current procedures for determining avoided costs really understate the value of independent capacity to a utility. They argue that many hidden costs of conventional technology are not reflected in the FERC guidelines or in state procedures.

Many utilities have had to write off the cost of partially built nuclear plants that were cancelled. Public Service of New Hampshire and the Long Island Lighting Company risk imminent bankruptcy as they try to complete construction of the Seabrook and Shoreham nuclear plants. Avoiding capacity investment may be worth more than just the value of deferred investment and all associated regulatory and environmental considerations. Such calculated risks as potential bankruptcy are hard to quantify in dollars, but regulators cannot ignore them in avoided cost calculations.

Most utilities now set avoided cost at the price of power from their most expensive operating plant. Many independent power producers argue that avoided cost should be set at the price of power from a conventional plant it would start building now. The cost of any new power plant is dramatically higher than existing capacity. For example, one California utility with an avoided cost of 6 cents per kilowatt hour is considering construction of a new pulverized coal plant that would deliver energy starting in 1992 at 12 cents per kilowatt hour ($1983). If this latter figure were the avoided cost rate for an independent power producer, many more alternative systems would become competitive, and independent entrepreneurs might be building a significant portion of California's energy capacity for the 1990s.

Why are California utilities not investing in alternative energy facilities on their own?

For the most part, California's utilities are not investing in alternative energy facilities on their own. One reason is that PURPA limits utility ownership of cogeneration and renewable energy small power facilities to a 49 percent share. The limit is meant to prevent utilities from unfairly competing against the new energy companies and from increasing avoided cost rates to benefit themselves at the expense of ratepayers. Furthermore, utilities are not eligible for the tax incentives or favorable depreciation schedules private investors enjoy. They have to finance and operate alternative energy facilities at regulated rates of return, and the technological risk remains too high.

What can we conclude from California's experience with PURPA?

The lesson of PURPA is that legislation to promote independent power production will succeed if regulators implement it aggressively, utility officials approach it with an open mind, financial and energy resources are available, entrepreneurs are willing to take risks, and electric demand is growing. Other states have not made the same progress as California.

While we can see that PURPA stimulates independent energy production and attracts capital that otherwise would not be invested in electric generation, it is too soon to evaluate the long-term benefits of alternative energy development.

We can see that cogeneration facilities are more energy-efficient than power plants that do not use waste heat, that renewable energy is more environmentally benign than conventional fuels, that adding generating capacity in small units makes the electric system more flexible and less dependent on long-range forecasts, that reducing energy imports frees capital for other uses. But all of this does not guarantee that independent power production using alternative sources of energy will ultimately be beneficial or that the incentives used in California are the most sensible way to guide energy choices.

Entrepreneurs could reap all the benefits and ratepayers bear all the costs. The reliability of the electric system could diminish. Business and industry could produce all their own electricity, leaving residential consumers paying higher rates for utility-generated power.

While all of these undesirable results are possible, California provides one unambiguous success story. While utilities in other states with ambitious conventional power construction programs are asking for dramatic rate increases this year to cover escalating costs, and some utilities even face bankruptcy, Southern California Edison, which is three years into an ambitious alternative energy development program, is decreasing its rates this year.

Loan Incentives: Tapping Biomass Resources

Biomass energy development does not respond to the same stimuli as other alternative energy sources. Residential tax credits are not effective because, except for wood stoves, biomass technologies are not useful for homeowners. And because biomass resources are so diffuse and transportation is so expensive, only small facilities that use local resources are economically justified. These small facilities are not able to attract venture capital. Biomass energy systems make the most sense for agricultural and forestry operations that have biomass residue that they have to dispose of in some way. Most of these businesses do not pay enough taxes to be interested in tax credits. For them, the barrier to alternative energy investment is lack of capital.

The California Energy Commission estimates that biomass could satisfy up to five percent of California's energy needs in the year 2000. Even more telling, by using biomass residue, the forest and agricultural industries could produce 89 percent of the 53 million barrels of oil equivalent they use each year. In its fuel price projections for 1985, the Commission estimated that the cost of biomass fuels transported less than 50 miles will range from $1.40/Mbtu for forestry residues to $2.60/Mbtu for orchard prunings. Coal, gas, and oil are expected to range from $3.62 to $5.95 per million Btu. In spite of the apparent advantages of using biomass, California uses only 2 percent of its biomass residue for energy.

Why is biomass ignored?

The major impediments to biomass energy development are uncertainty about the technology, the lack of infrastructure to harvest and deliver the material, the high cost of converting to a biomass system, and the seasonal nature of the resource. Farmers and foresters need capital and technical assistance to minimize the risk of trying a new technology. Biomass systems are eligible for a 10 percent federal investment tax credit, a 10 percent federal energy credit, accelerated depreciation, and several other tax incentives, but the California Energy Commission decided that tax credits were not the best approach. The Commission recommended a program of loans to help build demonstration projects.

What was the policy response?

The California legislature passed the State Agricultural and Forestry Residue Utilization Act of 1979 (SAFRUA) to fund demonstration projects to examine the feasibility, efficiency, environmental acceptability, and reliability of biomass systems and equipment in commercial applications. The program focused on direct combustion, fermentation, and gasification.

The state created a $10-million revolving fund to provide interest-free loans for up to 50 percent of the cost of a biomass facility. The state and project developer negotiate performance criteria, and the developer promises to pay back the loan ninety days after meeting the performance test. To minimize the risk, the state agreed to negotiate a reduced repayment of the loan or to accept the equipment for resale in lieu of repayment if a project fails. When a loan is repaid, the funds are loaned to another project.

What projects have been funded?

In California, orchard and vineyard prunings were the first residues chosen for energy production because of their high cost of disposal. Residues from cotton stalks, corn stalks, and rice, wheat, and barley straws also have potential, but collection and conversion efficiencies are too poor to justify significant activity. Nut shells and fruit pits are already used by the food processing industry as fuel.

The SAFRUA loan fund has already granted loans to direct combustion, collection, and methane fermentation projects, most of which are under construction or in preliminary operations.

- The Farmers Cooperative Gin in Buttonwillow burns cotton gin trash and wheat and barley straw to cogenerate heat and electricity. The state provided a $970,000 loan toward the $3.3 million facility, which should produce 10 million kilowatt hours of electricity and 47 billion Btu of process heat a year. If early technical problems can be solved, the cooperative could generate all its energy from its own waste and residue of local farmers.

- A $2.1 million state loan helped the Superior Farming Company in Bakersfield purchase a $10 million cogeneration system fueled by orchard prunings and almond shells from its 37,000 acres of land. The 26 million kilowatt hours of electricity and 60 billion Btu of process heat produced each year provide the energy for the company's hydrator and cold storage facilities, saving the equivalent of 56,000 barrels of oil a year. Superior expects to earn a net profit of $420,000 a year from the system by selling excess electricity to Pacific Gas and Electric.

- An $85,000 loan enabled the Marindale Dairy in Novato to solve its waste disposal problem and become energy self-sufficient. Marindale purchased a $142,000 system to capture fermented gas from manure and burn the gas to produce electricity. The 50 kilowatt generator produces 330,000 kilowatt hours of electricity a year. Waste heat from the generator heats water for the milking parlor. Fermented solids are used for animal bedding and have a potential market as soil additives and animal feed supplement. Remaining liquids may be added to animal feed as a protein supplement for heifers and nonlactating cows. Marindale expects to recover its investment in four years.

What impact has the loan program had?

The project has succeeded in its first goal: to leverage private sector investment in biomass conversion demonstration projects. The state has loaned $8.8 million to energy projects, and the private developers have contributed $45.6 million for an impressive 5-to-1 leverage rate. The projects have produced $200 million in gross sales and $68 million in gross income and created 3,000 new jobs. But at this stage, the experience with new technology for harvesting and using biomass residue is more important. Although many of the projects are producing energy, they are still being operated on an experimental basis. Their commercial potential cannot properly be evaluated until they are operating full-time.

Has the program had any other effects?

In the process of managing this and other alternative energy programs, the California Energy commission has accumulated valuable expertise in resource evaluation, technology assessment, and economic planning. The Commission began in late 1983 to offer the benefits of its experience to local communities in their negotiations with project developers. Local governments use energy in buildings and other operations and need help in contracting for energy services. In addition, local communities often control energy resources, such as geothermal reserves, that they want developed. Yet they often lack the expertise to take advantage of alternative technologies or negotiate contracts with developers. Under the new public/private partnership program, the state serves as a "friendly broker" between local government officials and private project developers by providing:

- Technical assistance to review alternative energy and conservation opportunities with local government entitities, helping them understand what potentail resources they possess and the technical and economic feasibility of particular projects

- Assistance in negotiations between local governments and third party investors

- Direct financial incentives for smaller projects to help overcome their transaction cost overhead burden and enhance their attractiveness to investors.

SECTION III

EXPERIENCES WITH INCENTIVE SYSTEMS ELSEWHERE IN NORTH AMERICA AND THE WORLD

California is by no means the only place to use incentives for renewable energy development. Most other states in the U.S., nearly every industrialized country, and an increasing number of developing countries have incentive programs to promote research, development, and demonstration of renewable energy technologies. A number of countries have also attempted to accelerate the commercial development and purchase of marketable systems of new energy equipment.

Not all experiences have been happy ones, and some incentives have been so poorly planned and implemented that they had a short-term detrimental effect on the market for renewable energy services and hardware. Others have succeeded admirably. The brief descriptions of various incentive efforts in this section illustrate the range of possibilities that seem to have had the greatest impact, for good or bad, in the past five years.

Table 10 on the next three pages shows in greater detail some of the incentives that have been put into place in a number of countries in the past five years.* In very few cases have these programs for commercialization been in place long enough to allow a full evaluation of whether or not they will be effective either in their short-term goal of expanding the market or in their long-term goal of altering national energy consumption patterns.

Section III presents short summaries that seem to have had the greatest impact, for good or bad, in the past five years.

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* Table 10 was compiled by IIED from the sources used in the preparation of its Worldwide Incentives briefing paper and does not purport to be exhasutive. Many countries with incentive programs are not listed, and not all programs of the listed countries are included.

TABLE 10

SUMMARY OF INCENTIVES IN PLACE FOR ENCOURAGING USE OF RENEWABLE ENERGY, BY INCENTIVE TYPE AND COUNTRY, 1983

	FINANCIAL INCENTIVES						FISCAL INCENTIVES				LEGAL/REGULATORY INCENTIVES				PROMOTIONAL INCENTIVES	COMMENTS
	F	Pc	G	K	E	D	R	S	Tx	I	Z	C	DI	Tr	Pr	
CANADA	F	Pc			E		R	S							Pr	Two interlocking programs, PUSH (Purchase and Use of Solar Heating and PASEM (Program of Assistance to Solar Equipment Manufactures) established by government to support development of national industries, guarantee markets and encourage exports.
FRANCE	F			K	E		R	S							Pr	Agence Francaise pour la Maitrise de l'Energie (AFME) has $143 million (1983) for development and demonstration of French renewables. Major focus of program is export incentives (over 10% of national solar energy budget devoted to renewables). France is biggest per capital spender of state funds on renewables.
WEST GERMANY	F		G	K	E		R	S							Pr	Germany's program for RD&D is similar to France's although its export promotion activities are not as extensive. Germany has an extensive program in the development of biogasification technologies. Its development of a local market for solar collectors has been less successful.
ITALY	F	Pc		K			R	S				C			Pr	In 1982, Italy passed Public Law #308 which provided substantial incentives to producers and consumers of renewable technologies in various sectors of the economy. The National Energy Plan (1981/82) established a 10-year $1.1 billion budget for R&D of various renewable technologies and purchases of the equipment.
SPAIN	F	Pc		K				S		I					Pr	Spain's modest program includes incentives for large industrial firms to install renewable energy/conservation systems, a 95% import duty reduction for government approved equipment, and money set aside for procurement.
GREECE				K				S								The Greek incentive system has been criticized for being applicable only to high income brackets. To gain concessions, an investment of at least $43,000 is necessary.

KEY

FINANCIAL INCENTIVES

F - Funding for R & D
Pc - Procurement
G - Guaranteed Purchase of Non-Conventional Power
K - Capital Expense Relief to Equipment Purchasers
E - Export Promotion
D - Desubsidization of Conventional Fuels

FISCAL INCENTIVES

R - R&D Shelters
S - Support for End-Use Purchasers and Investors
Tx - Taxation of Conventional Fuel
I - Import Liberalization

LEGAL/REGULATORY INCENTIVES

Z - Zoning and Access Requirement
C - Consumer Protection, Product Certification
DI - Distribution & Pricing Regulations
Tr - Transaction Investment Promotion

PROMOTIONAL INCENTIVES

Pr - Promotion/Outreach

	FINANCIAL INCENTIVES						FISCAL INCENTIVES				LEGAL/REGULATORY INCENTIVES				PROMOTIONAL INCENTIVES	COMMENTS
	F	Pc	G	K	E	D	R	S	Tx	I	Z	C	Di	Tr	Pr	
UNITED KINGDOM	F	Pc	G												Pr	Britain phased out its R&D support for solar energy in 1981, feeling the private sector could do a better job. Virtually all the nation's incentive programs are focused on wind and [illegible] and biomass system. The government has a goal of establishing a Mw-scale wind power park by 1990, if the technologies prove viable.
SWEDEN	F	Pc		K												Sweden has a large grant/loan program designed to encourage district heating schemes, renewable energy technology and conservation measures. A large part of the research budget goes towards biomass technology.
ISRAEL	F			K	E	D	R	S		I	Z	C			Pr	Israel actively promotes the use of solar energy through a wide range of incentives. This includes the mandatory use of solar water heaters in all new construction under 12 stories. In addition, loan/grant programs, tax relief and intense public information programs are in place. Israel has reduced its electricity demand over 4 percent since the incentive laws were enacted.
AUSTRALIA	F		G	K	E			S			Z	C			Pr	Australia is the second largest user of photovoltaics in the world, after the U.S. Since 1978, the Australian government has been deeply involved in supporting RD&D, as well as setting up a comprehensive program of tax and investment incentives, standards and zoning requirements.
JAPAN	F			K	E		R								Pr	Japan is aggressively promoting RD&D of photovoltaics through its "Project Sunshine." This program, a combination of public information, investment incentives and export promotion, is aimed at developing a commercially viable and diversified renewable energy industry in the near future.
BRAZIL				K		D		S	Tx						Pr	Brazil has perhaps the largest single organized renewable energy promotion program in the world. Over $5 billion has been invested in the PROALCOOL program which is aimed at replacing some 45% of the country's petroleum consumption with locally produced alcohol. While recently plagued with economic and technical problems, the program has been extremely successful in bringing about large scale production of the fuel.

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	FINANCIAL INCENTIVES						FISCAL INCENTIVES				LEGAL/REGULATORY INCENTIVES				PROMOTIONAL INCENTIVES	COMMENTS
	F	Pc	G	K	E	D	R	S	Tx	I	Z	C	DI	Tr	Pr	
SOUTH KOREA	F			K				S		I	Z				Pr	Korea instituted a massive-scale solar housing program in the late 1970s. The program aimed at building huge numbers of solar heated houses through a system of tax incentives, loans/grants and tariff reductions. The program has not been very successful due to poor quality equipment and a smaller market than anticipated.
INDIA	F			K				S		I					Pr	India's main experience with incentives has been a program aimed at assisting purchasers of biogas digestors through a loan/grant program. The program has been somewhat successful, although it has been plagued with a default rate of up to 95%. More recently, import liberalization programs have been enacted for solar technologies.
PHILIPPINES	F			K		D		S	Tx	I					Pr	The Philippines has decided to focus its incentive plan on solar thermal, biomass, geothermal and small hydro applications. Included in the scheme are very liberal producer incentives, consumer incentives, desubsidization of commercial fuels and liberal import incentives.
UNITED STATES	F	Pc	G	K	E	D	R	S	Tx	I	Z	C	DI	Tr	Pr	Virtually every type of incentive available is being used in the United States. Among the more noteable are: PURPA (Public Utilities Regulatory Policies Act) -- its major incentive is the requirement that utilities must purchase power from and sell power to small independent producers. Energy Tax Act (1977) -- Established federal tax credits for the installation of renewable energy systems. State incentives including: tax credits, public information activities, zoning and installation laws, consumer protection laws, loan guarantees, design competitions, etc.

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FINANCIAL INCENTIVES

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- Z - Zoning and Access Requirement
- C - Consumer Protection, Product Certification
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- Tr - Transaction Investment Promotion

PROMOTIONAL INCENTIVES

- Pr - Promotion/Outreach

Source: International Institute for Environment and Development, Worldwide Incentives for Renewable Energy Usage: A Selective Survey, IIED: Washington, D.C. and London, 1983.

Other Incentives in North America

State programs in the U.S..

Most other states in the United States have passed legislation favoring increased utilization of renewable energy. The programs for solar energy are the most widespread, and tax provisions for promoting its use are detailed in Table 11. In all cases, these are add-ons to the federal programs (such as the federal tax credits and PURPA) that were described in Section II.

The Tennessee Valley Authority's Solar Water Heating Program

The Tennessee Valley Authority (TVA) is one of the largest electricity production and distribution systems in the world. Covering all of Tennessee and parts of Kentucky, Virginia, North Carolina, Mississippi, Alabama, and Georgia, TVA is publicly owned and is administered by a federally appointed board. Realizing that deferral of new capacity through the use of conservation and alternative energy strategies has significant benefits, TVA instituted a wide range of research and commercialization efforts to promote alternative energy development. The programs were introduced in an area not known for social or technical innovation and not particularly interested in new energy sources. Indeed, solar companies in the region have acknowledged that TVA created markets where none existed.

One of its first initiatives was a solar water heating program, which provided utility customers with a solar assessment of their homes and offered low-interest loans to install a solar water heater. The customers repay the loan through their utility bills. TVA inspectors visit the home after system installation to ensure that the work was done properly. Originally available only in Memphis, Nashville, and Middle Tennessee, the program now extends to all TVA customers through an Energy Package program that also offers loans for energy conservation efforts.

The TVA solar assessment is an extension of the Residential Conservation Service, a federal program that requires gas and electric utilities to provide energy audits of their customers' homes and to recommend economical energy-saving home improvements. The state-implemented program has met with resistance from some states and from many utilities. TVA, however, not only set up its audit program quickly, but used it to aggressively promote renewable energy improvements as well as conservation measures.

TVA tests all solar systems before making them eligible for the program. If a system passes the test, TVA includes the company on a list of approved suppliers from which customers must buy their equipment in order to qualify for a loan. The list includes the average installed price of each system and the estimated annual energy output. Many solar companies objected to this aspect of the program because it gives the "best" system on the list an unfair marketing advantage. TVA listened to the criticism but maintained the list in order to protect its consumers.

TABLE 11
U.S. STATE TAX INCENTIVES FOR SOLAR, 1983

STATE	FOR RESIDENTIAL SOLAR SYSTEMS*			FOR NON-RESIDENTIAL USERS OF SOLAR ENERGY		
	PROPERTY TAX EXEMPTION	INCOME TAX INCENTIVE	SALES TAX EXEMPTION	PROPERTY TAX EXEMPTION	INCOME TAX INCENTIVE	SALES TAX EXEMPTION
Alabama	no	up to $1000 credit	no	no	no	no
Alaska	no	up to $200 credit	not applicable	no	35% credit; $5000 maximum	not applicable
Arizona	exemption	up to $1000 credit	exemption	exemption	election of 35% credit with $1000 maximum or 36 month depreciation	exemption
Arkansas	no	100% deduction	no	no	100% deduction	no
California	no	up to $3000 credit per application	no	exemption	election of 25% to 55% credit or depreciation over 12 or 60 months	no
Colorado	exemption	up to $3000 credit	no	exemption	30% credit; $3000 maximum	no
Connecticut	local option	not applicable	exemption	local option	no	exemption
Delaware	no	$200 credit for DHW systems	not applicable	no	no	not applicable
Florida	exemption	not applicable	exemption	exemption	no	exemption
Georgia	local option	no	refund	local option	no	refund
Hawaii	exemption	10% credit	no	exemption	10% credit	no
Idaho	no	100% deduction	no	no	no	no
Illinois	exemption	no	no	exemption	no	no
Indiana	exemption	up to $3000 credit	no	exemption	25% credit; $10,000 maximum	no
Iowa	exemption	no	no	exemption	no	no
Kansas	exemption; refund based on efficiency of system	up to $1500 credit	no	exemption	30% credit with $4500 maximum; 60 month depreciation	no
Kentucky	no	no	no	no	no	no
Louisiana	exemption	no	no	no	no	no
Maine	exemption	20% credit; $100 maximum	refund	exemption	no	refund
Maryland	exemption statewide + credit at local option	no	no	exemption statewide; credits at local option	no	no
Massachusetts	exemption	up to $1000 credit	exemption	exemption	no	no
Michigan	exemption	up to $600 credit	exemption	exemption	no	exemption
Minnesota	exemption	up to $2000 credit	no	exemption	no	no
Mississippi	no	no	exemption for colleges junior colleges and universities	no	no	no
Missouri	no	no	no	no	no	no
Montana	exemption	up to $125 credit	not applicable	exemption	no	not applicable
Nebraska	yes	up to $2500 credit	refund	yes	up to $5000 credit	refund
Nevada	limited exemption	not applicable	no	no	no	no
New Hampshire	local option	not applicable	not applicable	local option	no	not applicable
New Jersey	exemption	no	exemption	exemption	no	exemption
New Mexico	no	up to $4000 credit	no	no	up to $4000 credit	no
New York	exemption	up to $2750 credit	no	exemption	no	no
North Carolina	exemption	credits from 10-20% for various renewables; $1000 max.	no	exemption	credits from 10-20% for various renewables; $1000 max.	no
North Dakota	exemption	5% credit for three years	no	exemption	5% credit for each three years	no
Ohio	exemption	up to $1000 credit	exemption	exemption	10% credit against corporate franchise tax; 10% for individuals and partnerships	exemption
Oklahoma	no	35% credit; $3500 maximum	no	no	30% credit	no

TABLE 11
U.S. STATE TAX INCENTIVES FOR SOLAR, 1983

	FOR RESIDENTIAL SOLAR SYSTEMS			FOR NON-RESIDENTIAL USES OF SOLAR ENERGY		
STATE	PROPERTY TAX EXEMPTION	INCOME TAX INCENTIVE	SALES TAX EXEMPTION	PROPERTY TAX EXEMPTION	INCOME TAX INCENTIVE	SALES TAX EXEMPTION
Oregon	exemption	25% credit; $1000 maximum	not applicable	exemption	35% corporate tax credit	not applicable
Pennsylvania	no	no	no	no	no	no
Rhode Island	exemption	10% credit; $1000 maximum	refund	exemption; local option on any locally imposed tax	10% credit; $3000 maximum	refund
South Carolina	no	25% credit; $1000 maximum	no	no	25% credit; $1000 maximum	no
South Dakota	exemption	not applicable	no	partial credit	no	no
Tennessee	exemption	not applicable	no	exemption	no	no
Texas	exemption	not applicable	exemption	exemption	60 month depreciation for corporations	exemption
Utah	no	10% credit; $1000 maximum	no	no	10% credit; $3000 maximum	no
Vermont	local option	25% credit; $1000 maximum	no	local option	25% credit; $3000 maximum	no
Virginia	local option	25% credit; $1000 maximum	no	local option	25% credit; $1000 maximum	no
Washington	exemption	not applicable	no	exemption	no	no
West Virginia	no	no	no	no	no	no
Wisconsin	exemption	18% credit for retrofits; $1800 maximum	no	exemption	18% credit for retrofits; $18,000 maximum	no
Wyoming	no	not applicable	no	no	no	no

*Source: U.S. Department of Energy, Franklin Research Center, Renewable Energy Inquiry and Referral Service; David Goodphin, "Current Status of the State Tax Credits", in Solar Age, May 1983, pp. 46-47.

More than 3,000 TVA customers have bought solar water heaters through the program, a small number compared to the almost 200,000 systems installed through the California utility program. Numerous reasons explain TVA's limited success:

- TVA did not mandate an installation goal as California did
- The program was voluntary and lacked the effective advertising necessary to stimulate consumer interest
- State governments did not cooperate in the effort and did not offer tax incentives
- Cultural patterns in the TVA service area tend to be more conservative and less prone to change than in California
- Large hydroelectric capacity in the area has kept electric rates low and stable.

Georgia: A Slow and Uncertain Program

In Georgia, the largest state east of the Mississippi River, early market development has been very slow, with only about $1.4 million in sales in 1983. One of the major reasons for this was the lack of political support for renewable energy. The small solar industry in the state had been trying for years to convince the legislature to adopt a tax incentive, but a state solar tax credit did not go into effect until January 1, 1984.

A solar industry spokesman in Georgia has pointed out a number of reasons for the slow growth. First, Georgia has two major utility companies, which produce over 90 percent of the electricity, but more than thirty municipal companies, which distribute half the power. Consequently, there is no coordinated state-wide policy or program at the utility level. Indeed, since the companies that distribute half the power do not produce it, they have little interest in conservation or alternative energy production.

A second factor discouraging solar use is the availability of relatively inexpensive natural gas for water heating. Over 40 percent of Georgians live in the Atlanta area. They typically use natural gas for water and space heating, and solar heating is much less competitive with gas than with electricity. There are about 300,000 to 500,000 electric water heaters in the state, but electric rates are usually less than 6¢ per kilowatt hour. Furthermore, most of the electric water heating service is in outlying rural areas, which are harder to reach for the solar industry. As local solar company representatives admit, there has not been sustained, quality, aggressive solar salesmanship in the state, due in part to the low costs of conventional power. Solar water heaters, without a state tax credit, had to sell for $3,000 to $3,500 a system. This price is so close to the margin that solar installation companies have not been able to finance more aggressive marketing campaigns.

Housing characteristics and topography pose two additional problems. Unlike Californians, upper-income homeowners in Georgia tend to own traditional, two-story "colonial" homes and are much more reluctant to place solar collectors on their roofs. In California, most homes are single-story ranch styles with easy access. New construction in Georgia also remains largely traditional in nature and the state is densely forested. Thus, many homes cannot be equipped with a solar energy system without the added cost of cutting a sunpath through surrounding vegetation.

Canada's Government Procurement Program

The Canadian government began to support development of a solar energy industry in 1978 and has spent upwards of $60 million in this effort. Its approach differs fundamentally from the U.S. strategy. Instead of using the tax system to provide incentives for consumers of solar equipment, Canada chose to support the industry with research funds and direct purchase of hardware.

Under the Ministry of Energy, Mines and Resources, two interlocking programs were created, PASEM and PUSH. PASEM, Program of Assistance to Solar Equipment Manufacturers, provided grant assistance to ten Canadian companies, chosen from 150 applicants on the basis of their stated requirements for plant expansion, product development, and marketing capabilities. The government worked very closely with these companies in refining company business plans and manufacturing projections. For each firm, PASEM provided 50 percent of capital and 75 percent of noncapital expenses up to $300,000 over a 14 month contract period. Companies were required at the end of this period to deliver three production prototypes of each product developed under PASEM to the government for testing.

PUSH, Purchase and Use of Solar Heating, appropriated $125 million to buy solar heating systems for federal government buildings, including one of the Parliament buildings in Ottawa, a fish hatchery in New Brunswick, a Canadian National Railways train car washing facility, and the Halifax airport. Sales under PUSH enabled the PASEM companies to generate the revenue for their portion of expansion expenses under the cost-sharing terms of the PASEM contracts.

The PUSH program aimed to provide an initial market for Canada's solar industry in order to increase the scale of solar manufacturing in Canada and to accelerate the development of competitive products for export. Almost 500 solar hot water, space heating, and industrial process heat installations have resulted from PUSH. To accelerate the private market, Canada provided grants to consumers toward the purchase of solar heating equipment.

Despite four years of heavy government investment, the Canadian solar industry remains small. In 1981, Canadian companies sold $7.7 million worth of solar equipment and earned an additional $3.1 million for research, consulting, and installation of hardware.

The fundamental reason why this incentive package has not succeeded is that Canada has cheap electricity. Hydroelectricity supplies all the power at a very low cost everywhere except in Alberta, which uses some oil and gas, and Ontario, which is 30 percent nuclear. Canada has no legislation to encourage independent power production. All the utilities are publicly owned and have strongly resisted any initiative to encourage independent power production.

Europe

Nearly all European countries and the European Economic Community have set up programs for renewable energy research, development, and demonstration. Few countries, however, have commercialization incentives.

Italy

Heavily dependent on imported oil, Italy is eager to develop alternative energy sources. Total energy consumption in 1981 was 135 million tons of oil equivalent (mtoe), 86 percent of which was imported. Aware of how vulnerable this made the country, the Italian government prepared a national energy plan in 1981 to limit energy consumption to 155 mtoe in 1985 and 165 mtoe in 1990. To reduce oil dependence, the plan calls for an increase in the use of coal (especially for electricity generation), gas, nuclear power, and renewable energy.

Ente Nazionale Elettricita (ENEL), the national electric utility, has a central role in implementing the national energy plan. As a start, ENEL planned coal-fired power stations for Brindisi (Puglia) and Gioai Tauro (Calabria) and 2,000 Mw nuclear plants for Lombardia, Piemonte, and Puglia.

In June 1981, the government passed a law (# 309) that authorized ENEL to promote and offer incentives for more rational energy use. ENEL decided to strengthen its solar water heating research program at the Phoebus research center in Southern Italy. Phoebus staff developed technical specifications for all solar components and a methodology for testing collector performance and durability.

ENEL was eager to encourage the widespread adoption of solar water heating with financial incentives and promotional advertising but could not afford incentives. Instead, it borrowed money from the European Investment Bank to finance solar installation loans. Customers repaid the loan and interest.

For the first stage, which began in June 1983, ENEL set a goal of encouraging the installation of 100,000 square meters of collectors for water heating, 55 percent in the south of Italy and 45 percent in the north. ENEL tested and approved components and registered installers.

A potential customer could go to his local ENEL business service and relations office for information on solar systems and a list of approved installers. The loan given for each approved system depended on the useful area of collector and the type of application. For a system put into an existing residential building, ENEL loaned up to £55,000 ($332) for each square meter. For a system put into a new building, it loaned £450,000 ($272) per square meter. In practice, the loan amounted to about 70 percent of the cost of the installation. The customer was then able to pay back the loan (plus interest) in installments through his electricity bill to ENEL. The repayments amount to between £15,000 and £30,000 ($9-$18) every two months.

The program was a great success in the north of Italy, where it sold out within a few weeks, but less successful in the poorer (but sunnier) south. ENEL plans a revised second stage this year.

The ENEL program, coupled with the general government backing for solar systems, has enabled the industry to get back onto its feet following a drop in sales in 1981 and 1982 (see Table 12 below).

Table 12

Sales of Solar Collectors in Italy

Year	Thousands m2
1976	5
1977	10
1978	20
1979	40
1980	100
1981	50-60
1982	30-40
1983	100

ENEL's success is due not only to the imaginative planning of its directors and its strong research capacity, but also to its clear management line from headquarters to local offices that allowed for timely implementation.

By contrast, an Italian government grant program had difficulty getting off the ground because of lack of cooperation and understanding between the central government and the regions. In May 1982 the Italian government passed law # 308, which required the Ministry of Industry, Commerce and Crafts in conjunction with other relevant ministries to ensure that conventional forms of energy are saved and to encourage energy conservation and the use of renewable resources and techniques such as heat recovery and cogeneration. The government set aside £405,000 million ($245 million) for these activities in 1981 and £475,000 million ($280 million) in 1982.

To encourage energy savings in buildings, the government developed a three-year program whereby they gave a 30 percent grant for approved energy conservation (including solar energy) measures, with a limit of £50 million ($30,800) on the total value of the system. Applicants were to submit proposals to regional government departments for assessment using a computer program developed by Italian Alternative Energy Agency (ENEA). The proposals would be ranked according to their energy saving potential. Two years after it was begun, the grants program is just going into operation in a few regions. The delay was caused by the difficulty of developing an assessment method that all officials could use and the need for regional governments to approve regulations for distributing grants.

Spain

Spain has initiated a series of renewable energy incentives similar in intent to those of the Italians. As in Italy, the Spanish electric utilities are playing a major role in delivering solar water heating systems to the residential sector.

The Spanish government set aside $622,000 in 1982 to pick up 30 percent of the cost of solar installations. Perhaps more important for the encouragement of commercialization than this direct subsidy to consumers is the Spanish government's support of the domestic solar industry. INISOLAR, a state-owned collector manufacturer, has installed half the solar systems operating in Spain. ENHER, the national utility, designed and built Spain's largest solar water heating system at the Barcelona Hospital. Spain also reduces by 95 percent the import duty on any equipment not manufactured in Spain that is required for renewable energy projects approved by the Ministry of Industry and Energy.

Greece

The Greeks have three major renewable energy incentive programs.

Tax relief for solar systems. In 1978 Greece introduced a tax deduction of up to 30,000 Drs ($290) for home or office solar installations. This plan, coupled with a promotional program by the government, encouraged individuals to purchase solar water heating systems. Unfortunately, the tax incentives have only been used by people in the higher tax brackets.

Table 13
Greek Sales of Solar Collectors

Year	Thousand m^2
1975	2
1976	5
1977	10
1978	20
1979	40
1980	70
1981	90
1982	80
1983	100

Eight-five percent of collector sales were for residential water heaters for dwellings, 10 percent for commercial buildings, and 5 percent for public buildings. The Greek solar industry itself admits that without incentives sales would have been reduced 15 to 25 percent.

Bank loans for individuals purchasing solar systems. Greek banks are allowed to give loans only for the purchase of certain approved goods. Solar systems were added to this special list in January 1980. Banks could then give an individual purchasing a solar system a three-year loan of up to 30,000 Drs ($290) at 17 percent interest (attractive for Greece, where the normal commercial rate is 24 percent). Because the program was not keeping up with inflation, the loan ceiling was changed to 70 percent of the system cost.

Neither the industry nor the National Energy Council considers this incentive successful. Banks rarely grant loans, and no loan has exceeded 30,000 Drs. The willingness of banks to grant loans varies from branch to branch. Most institutions feel that such small loans are not worth the paperwork.

Grants for renewable energy and energy saving industrial and commercial investment. The general motive of these investment incentive laws is to increase industrial investment in Greece and promote industrial productivity. Extra help is given for energy saving investments.

Law #849, passed in 1978, authorized low-interest loans for all industrial or commercial development. Law #1116 of 1981 added grants of 20-30 percent of the cost of solar water heating systems. This incentive was seldom used and was rescinded in 1981.

In 1982 law #1262 authorized grants of 30-35 percent of the cost of conservation and renewable energy investments. The size of the grant depends on the industry and geographical location. Applications are submitted to a government review committee, which rules on the proposal in two to six months. Grantees are also eligible for low-interest loans.

Only a few hotels and industrial companies have applied for the grants. The solar industry and government officials agree that the lack of interest stems from the unstable economic and political climate that discourages investment of any kind.

France

The French offer residential solar tax deductions for homeowners and purchase solar equipment for new government housing. The tax deduction equals about 80 percent of the installed cost of a solar system. Low income occupants of government-subsidized housing are eligible for a 20-year, 7 percent loan for up to 40 percent of the cost of a solar system.

In addition to these tax relief measures for individual consumers, the French government provides subsidies to solar manufacturers and state funding of new housing fitted with solar equipment. The government distributed $28.5 million in 1982 to 29 accredited solar collector manufacturers to underwrite product development and capital costs. The Agence Francaise pour la Maitresse d'Energie (AFME) has signed an agreement with industry, environmental ministries and residential builders' trade associations to equip at least 10 percent of new French housing with solar water heaters. The government funded the construction of 5,000 solar heated homes in large housing complexes in 1981-82. AFME is negotiating solar use agreements with the national meteorological department, the defense ministry, the health ministry, and the parks authority.

France also wants to involve regional governments in solar development. AFME splits the cost of solar feasibility studies of public buildings with regional, provincial, and municipal authorities These regional solar plans will be implemented by twenty-two new local solar administration offices directly concerned with the installation of solar equipment in public buildings.

West Germany

The Federal Republic of Germany has ambitious large-scale renewable energy demonstration projects and an aggressive export promotion program, but the government has failed to stimulate consumer interest. Domestic solar collector sales are declining in spite of government incentives.

In the late 1970s, the Modernization and Energy Conservation Act set aside DM 4.35 billion (US$1.6 billion) for grants to cover 25 percent of the cost of energy conservation or renewable energy measures. The grant had to be at least DM 4000 ($1500) and not more than DM 12000 ($4500) per household. The funds were quickly claimed, primarily for weatherization and efficiency improvements to conventional heating systems. Only 6 percent of the total went to solar systems and heat pumps because the public doubted solar efficiency in the German climate. Faced with the task of reducing public spending, the government replaced the grants with a 10 percent solar tax credit each year for ten years.

Under the revised Investment Subsidy Law, industrial and commercial firms can apply for a 7.5 percent grant toward the purchase and installation costs of energy saving equipment such as solar collectors, heat pumps, improved wall insulation, or double windows. In lieu of the grant, a firm can take a tax deduction of 10 percent of the energy investment each year for ten years.

Perhaps the German program's relatively low refund rate and tax deduction allowance are accountable for the lack of noticeable public or commercial response. Another factor is certainly the German regional states' enactment of regulatory statutes affecting the local administration and the application of the federal Modernization Law. Whereas in the United States, state-legislated programs in the great majority of cases add incentive benefits to the federal programs, in Germany the state administrations have interpreted and applied the federal law in widely varying ways, usually involving limiting provisions. Some states have introduced an income ceiling, others a maximum monthly rent. While these local measures are no doubt egalitarian in intent, in practice they eliminate an effective solar incentive for high-income families.

The Rest of the World

Israel

Israel is almost totally dependent on imported oil and gas for its energy demands (imports equalled 98 percent of demand in 1980). The Israelis have used a more direct approach, imposing requirements for solar water heating in all buildings. These requirements were introduced in stages. First, it was mandatory that all new blocks of flats of up to eight stories have a communal solar water heating system with storage tanks in the cellar, rather than on the roof. This was later extended to all new dwellings. In 1983, new regulations obliged all hotels, hospitals and educational institutions to install solar water heating equipment. The regulations specified the size of the installation and, in contrast to previous legislation apply to buildings up to 12 stories. Since the law was enacted, over 500,000 units have been installed, saving the country approximately 4 percent of its overal electricity demand. As an incentive to use solar water heating, the government will finance 10 percent of the installation costs of both new and recrofitted solar units. Further, taxes, which amount to some of the 60 percent of the installation cost, will be cancelled.

This approach has been very successful. In fact, because of the legislation the Israeli market is quickly reaching saturation, and solarcompanies are having to seek export markets to maintain their sales.

The Philippines

The Philippines has established one of the world's most comprehensive legislative programs to encourage renewable energy use. In the last three years the Philippines' renewable energy program has undergone considerable changes. Concerned about its unfocused demonstration program, the Ministry of Energy redefined the program around some clearly identified priorities. Officials decided that the most promising technologies for their country were biomass, geothermal, solar thermal for commercial and industrial applications, gasifiers, small-scale hydro and energy conservation. In early 1983, the government began a new commercialization program based not on the promotion of a particular technology but on a survey of energy users' needs and finances. As part of the package, electricity price controls are set so as to discourage "affluent consumption" (above 650 kWh per month). In addition, gasoline prices have been pushed up, reducing private travel and causing a widespread conversion to diesel fuel. On the energy production side, the Philippines has set up various programs to guarantee markets for producers of alternative energy systems and supplies and to encourge potential alternative energy producers (such as sugarmill owners) to enter the marketplace.

Tax concessions and concessional credit for renewable energy investments. The Philippines offers renewable energy tax deductions, grants, and loans. Presidential decree #1068 was issued in 1977 to establish complete tax deductions of expenses to those "who would install nonconventional devices for use in their houses or business establishments." Unfortunately, there is no concrete statistical information available on the effects of this incentive.

The Energy Research and Development Center (ERDC) provides grants and loans for a variety of renewable energy demonstration projects that have ranged from a solar water heating installation at a hotel to a biogas installation at a pig farm. Though called demonstrations, however, these projects are widespread enough to be deemed "incentives."

Incentives for Producers. To attract local and foreign investment in new energy industries, the Philippines government introduced the following incentives:

- Deduction of organizational and preoperational expenses from taxable income over a period of not more than 10 years from start of operation
- Deduction of labor training expenses from taxable income equivalent to 1/2 percent of expenses, but not more than 10 percent of direct labor wage
- Accelerated depreciation
- Carry-over as deduction from taxable income of net operating losses incurred in any of the first 10 years of operation, deductible for the six years immediately following the year of such loss
- Tax credits equivalent to 100 percent of the value of compensating tax and customs duties that would have been paid on machinery, equipment and spare parts (purchased from a domestic manufacturer) had these items been imported
- Right to employ foreign nationals in supervisory technical or advsiory positions within five years from registration
- Deduction from taxable income in the year investment was made of a certain percentage of the amount of undistributed profits or surplus transferred to capital stock for procurement of machinery and equipment and other expansion
- Protection from government competition
- Exemption from all taxes under the National Revenue Code, except income tax on a gradually diminishing percentage
- Post-operative tariff protection
- Concessional loan rates ranging from 8 percent to 16 percent depending on the technology.

In late 1981, the government tightened somewhat its renewable energy incentives program through executive Order 860 and Presidential Decree 1853. EO 860 imposes an across-the-board 3 percent tariff duty on all imports except those filling governmental contracts. PD 1853 establishes that letters of credit will not be granted until such duty is paid.

In addition to the specific incentives mentioned above, the government has established two programs to force the production of particular renewable fuels. The first of these was the "alcogas" program, set up in 1979 to encourage sugarmill owners to switch excess plant capacity to the production of alcohol fuels. The program never got off the ground because sugar prices rose, encouraging mill owners to stay with sugar production, and consumers were dissatisfied with fuel from a pilot plant.

More recently, the government has started a program to blend diesel fuels and coconut oil. The "coco-diesel" program actually does not entail a complicated change in production (as the alcogas program had did). Rather, it simply requires the Philippine National Oil Company to buy a fixed amount of coconut oil production at a guaranteed price and to blend it with diesel fuel.

One underlying virtue of the Philippine program is the government's willingness to try new ideas and to drop programs that do not produce results.

Brazil

Brazil has perhaps the largest organized government program to promote the widespread use of a single renewable fuel. The government has invested more than $5 billion since 1973 in the nationwide alcohol fuels program called PROALCOOL. Between 1970 and 1979, the alcohol fuels industry in Brazil grew 31.9 percent annually. A substantial idle productive capacity in the sugar industry prior to 1970 allowed business to profit handsomely when a series of government incentives for alcohol production became effective shortly after the Arab embargo in 1973.

Brazil has heavily subsidized the alcohol fuels program by providing tax benefits and direct financing aid of up to 80 percent of a project's cost. But government actions have not always been enough to assure alcohol's successful introduction as a transport fuel and have even been counterproductive in some cases.

Demand for alcohol and alcohol-fueled vehicles was growing so rapidly in the late 1970s that the government raised prices to decrease demand and prevent a supply crisis. Consumer fear of shortages, compounded by reports of poor performance of alcohol-fueled vehicles and the higher alcohol price, created disastrous drop in demand for the cars. Between January and May of 1981, sales of alcohol-fueled automobiles dropped from 42,000 vehicles per month to 12,000 per month. The feared shortage actually became a glut, and sugar and alcohol surpluses filled storage facilities to capacity.

The PROALCOOL program has been remarkably successful in stimulating production and use of a renewable fuel, but that is not the only measure of success. Indirect social and economic impact -- on land ownership, plantation and distillery management, labor distribution in the sugar cane/alcohol industry, and the environment -- need closer examination before reaching a verdict on the program's success.

South Korea

Among developing countries, South Korea has the dubious distinction of having the coldest winter climate. Energy consumption, especially in the domestic sector, has traditionally been high because of space heating requirements. Its renewable energy industry has grown in fits and starts, hindered in part by the severity of the climate.

South Korea began what is probably the developing world's largest solar housing program in the late 1970s. The government introduced a number of sweeping incentives to promote active solar water and space heating systems. Active solar homes were exempted from all local taxes, including registration and property purchase taxes. Solar home builders were not required to purchase the normally mandatory housing bonds, and solar houses were exempted from certain building-size regulations that are usually strictly enforced because of a shortage of space in South Korea's major cities. Twenty-year low-interest loans were made available -- 14 percent if the floor area was less than 540 square feet and 16.5 percent for larger homes. A generous loan program was instituted for manufacturers that produced at least 64,000 square feet of collectors a month. Duties on imported components and raw materials for solar collectors were reduced to 25 percent of their previous levels. Duties on complete solar collectors were similarly reduced from 60 to 15 percent.

The effect of these incentives has been disappointing. The 1980 target was to complete 2,200 active solar homes, 1,500 independent units, and 500 multifamily buildings. By the end of 1980, only 173 houses had been built, and another 859 were under construction.

The primary reason for the disappointing results was that the government had not tested the viability of the technology in South Korea's climate. Seasonal temperature extremes were particularly wearing on solar water heating systems. In the summer, the systems often overheated and developed extensive leaks. In the winter, below freezing temperatures caused breakage. The need for back-up systems during the colder months made it doubly expensive for householders to go solar.

One of the conditions of the low-interest loans that were awarded to solar manufacturers was that repairs on the systems would be guaranteed for a period of two years after installation. Widespread system failures made any comprehensive maintenance program virtually impossible. Many companies went out of business, and the solar industry gained a terrible reputation. The incentive system clearly backfired. Perhaps more than anything, the Korean experience emphasizes the need to assure the technical and economic soundness of new and untested technologies. In Korea's case prematurely offered incentives ended up hindering the commercialization process.

India

India has extensive experience with alternative energy incentives, particularly for biogas technologies. The state-funded Khadi Village Industries Commission (KVIC), had been primarily responsible for the promotion of biogas digesters. In 1974 commercial banks and state agriculture departments assumed the KVIC's grant and loan disbursing role. From 1974-1980 the following incentives were provided for biogas plants:

- Individual Subsidies. Capital assistance was arranged through the Ministry of Agriculture. A 25 percent subsidy was provided for the construction of small 2-3 cubic-meter plants installed by subsistence or small-scale farmers. A 50 percent subsidy was provided to individuals installing gas plants in hilly and lesser developed areas. A 20 percent subsidy was available to all other individuals.

- Institutional or Cooperative Society Subsidies. Capital assistance in the form of grants from the KVIC was available. The KVIC provided between 25 and 100 percent of installed plant costs.

- Commercial Loans. Both the KVIC and some commercial banks provided loans to individuals, cooperative societies, and institutions that passed technical assessments. Loans were repayable over a period of four years in half-yearly installments. The banks accepted mortgages of land, animals, and other personal property as security.

- Additional Financing. Commercial loans were available for financing the construction of latrines (Rs 400 per unit), for purchasing gas-powered equipment (at a rate of Rs 1200 per horsepower), and for obtaining other gas utilization equipment such as additional pipes and fittings. State-level financial assistance was also available in some cases. The state of Uttar Pradesh, for instance, provided subsidies of Rs 550 to Rs 1000 for the installation of 2-6 cubic meter plants.

This program of loans and subsidies met with only limited success. Between 1962 and 1980, over Rs 80 million was disbursed by the Ministry of Agriculture through the KVIC for biogas plant construction. Of this amount, 75 percent was in the form of direct grants and subsidies. No adequate data has been kept by the KVIC on loan repayment but the rate of default has been estimated to be nearly 95 percent.

The main drawbacks with the loan program were mostly procedural problems associated with loans drawn on personal property, third party guarantees, or on other securities. Many banks insisted that borrowers should own at least 5 or 6 animals and have a minimum of 5 acres of cultivated lands. Farmers also had to undergo the time consuming process of obtaining clearance certificates from their local cooperative societies. There was also dissatisfaction with the high interest rates and the four to six month waiting time in negotiating loans. Advances and subsidies were based on official cost estimates and did not take into account regional cost variations in construction materials. All these limitations of the credit system have produced inequalities in the degree to which access to biogas technologies has been available. The program of subsidies has also had its share of problems. There is some evidence that problems involved in the disbursal of subsidies prevented them from becoming a major incentive.

SECTION IV

CONCLUSIONS AND POINTS FOR DISCUSSION

That renewable energy has undergone a remarkable renaissance in California is clearly documented in this background paper. The renewable energy boom in that state has taken technologies from laboratories to the marketplace at a pace nearly unparalleled in history. Even more impressive than the technological progress is the fact that the investment capital that has flowed into these risky new ventures has come in large part from the private sector, although there is no denying that it was enticed with substantial state and federal government subsidies to these new energy sources.

Less clear still is whether or not California can serve as a model for other national, state, or local governments in the rest of the world. Incentive systems and access to some public funds themselves do not seem to be enough, as was found in a review of other commercial incentive systems in Europe and several developing countries. California has managed to pioneer this field because of a coincidence of favorable circumstances (political, economic, and social) that are quite unique in the world. Will such fertile conditions be necessary to get renewable energy into the market in every case? If this is so, it means that the spread renewable energy technology will be limited to the most affluent and entrepreneurial societies. Or with California having broken the ground, will these technical and commercial advances allow other countries or regions to popularize and disseminate renewable energy on a substantial scale? And particularly will it allow other countries to do this without substantial expenditures of public funds?

There are four factors at work in California that seem to be relevant to how effectively incentives--financial, fiscal, regulatory or promotional--might work elsewhere.

- An interventionist government with political commitment to new energy options is needed to get the ball rolling. The reasons for this commitment will vary, but usually are related to long-term development planning to assure self-reliance in energy sources, to protect the environment (air, water and land), to defer investments in very capital-intensive generation plants, and in some cases to provide for growth in rural areas. To make these incentives work, however, there must an institutional structure in place to handle the increased bureaucratic work load, particularly when regulatory or tax incentive systems are employed. For private investors, the clarity of purpose, application, and continuity of these incentives is a foremost consideration in whether or not to enter the market.

- A physical resource base (sun, water, biomass, wind, wasted industrial heat, etc.) must exist and should be clearly identified before specific technical solutions are suggested. Any incentive programs that are put in place should be strucured so as to use available resources to meet the needs of end-users. The most successful programs have identified users (utilities, households, agricultural processors) and then specifically structured the incentives to deliver the products they needed (electric power or power displacement, hot water, process heat.) Thus the technology only becomes a means to an end, not the end itself.

- Utilities faced with increased demand for electric power or with a need for restructuring their generation capacity can be critical partners in the development of alternate energy, although often unwilling ones. Those which are not facing growth or change will not be so likely to reexamine their investment policies as those that are.

- Entrepreneurship and the Ability of Consumers to Adapt to New Technologies were critical elements in California's role as groundbreaker. These elements could become less critical as the technologies become better known and accepted.

- The Availability of Capital was no problem in California, but for much of the world it is the central problem. The difficulty is compounded in countries where private investors are very risk averse (often with good reason) and government spending is the only recourse. Yet past experience has shown that "solar technology giveaways" have yielded as many disappointments for the receivers (who had no stake in the investment in the first place) as they did for the donors.

Three points are important for government and utility policymakers to consider as they evaluate whether or not incentives might be useful in their countries:

First, what are the country's resources and end-use priorities?

What renewable energy resources are available for exploitation in the country or region? For what end-use applications, e.g. where does conventional or traditional fuel use need most to be alleviated? What technologies are commercially available in the country and from the outside to satisfy these needs with these resources?

Second, who is to benefit from the incentives?

Once the needs, end-uses, and technologies are identified, the key targets or "beneficiary groups" of incentive programs must be identified -- not only the users (villagers, small commercial establishments, etc.) but also the potential manufacturers of renewable energy equipment and prospective investors, local and foreign, whose capital could help catalyze domestic production of such systems. How shall the costs be shared and who shall receive immediate benefits from any incentive system that might be imposed?

Third, what about implementation?

When program objectives and incentive beneficiaries are identified, which agencies should implement the various incentive systems? How comprehensive should the incentives be? With what government/ private sector roles? With what degree and kind of international support or involvement? All incentive programs should include mechanisms for monitoring the cost-effectiveness of the incentives themselves: What is the appropriate life-cycle for each incentive measure, e.g. when is the commercialization threshold achieved and phase-out of the incentives in order?