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1985 INTERNATIONAL ROUNDTABLE
ON RENEWABLE ENERGY

POLICY BACKGROUND PAPER

Incentives for the Use of Renewable Energy:

The Experience in Brazil, Cyprus, India, the Philippines, and California

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—Chapter 1—
Introduction

The oil price shocks of 1973-74 and 1979-80 precipitated a search in virtually all countries for relief from dependence on imported energy. Much hope has been placed in renewable energy and the technologies that convert its various forms to human use. Renewable energy in most manifestations is indigenous; with some technologies it is already cheaper than oil; and by nature its use is sustainable over the long term, if the resource is managed prudently.

In the rush to find alternatives to imported oil, extensive activity has occurred in the field of renewable energy during the past dozen years--in research and development, demonstration, and diffusion. Evidence is mounting that renewable energy will grow increasingly important. In many nations, of course, renewable energy has always been an important part of the energy mix. The new element today is a search for more diverse ways to use a variety of energy resources.

This paper and the 1985 Roundtable will focus on measures taken by governments to encourage the more widespread use of renewable energy resources. These measures can take the form of "incentives" (spurs to positive action, such as the purchase of a new technology) or the removal of "disincentives" (for example, removing subsidies from conventional energy sources). In either case, the objective is to encourage the diffusion of new technologies and the use of renewable sources of energy.

Technologies exist that are technically and economically feasible. In several countries they are now used on a wide scale, and a number of governments have tried various incentives to encourage this process. It is now widely agreed, however, that many renewable energy technologies were promoted before they had been adequately developed or demonstrated (mainly because of the public pressure to achieve quick results). As soon as prototypes left the production line, pressure was mounted to encourage use on a wide scale. Indeed, some technologies were aggressively promoted before they were fully ready to leave the laboratory. During much of the 1970s, many technologies were not really ready for inclusion in promotional or incentives programs and a great deal of confusion has, at times, been created by the failure to distinguish among the various governmental roles.

The job of governments has thus been made more difficult by the rapidly evolving state-of-the-art of many renewable energy technologies. Governments are in the business of <u>developing</u> technologies, <u>demonstrating</u> them, and then <u>promoting</u> their use. Not all governments seek to act in all these areas, but the boundaries are rarely clear, and are revised by governments less rapidly than the fast-changing technologies themselves. Today, many governments have pulled back from scattershot promotion, but have not yet been able to settle on their most effective role.

Although the interplay between the development of new technologies and the encouragement of their use is a complicated and unavoidable subject, this

paper focuses mainly on the second topic. Enough experience has been accumulated in a few countries that it is now possible to look rigorously at what has been learned. Although every country has different needs, resources, and patterns of behavior, almost all nations are going through the transition to new energy regimes. There undoubtedly are valuable lessons to draw from the many experiences around the globe in this recent period. Some of the principal objectives of the Roundtable are, then:

- to explore some of these lessons;
- to ascertain the conditions that cause the use of renewable energy resources to grow significantly; and
- to identify governmental policies that are have proven to be most successful.

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To provide Roundtable participants with some details about actual experiences in developing countries, IIED solicited eight policy papers from authors in four countries: Brazil, Cyprus, India, and the Philippines. These four countries were selected because they all have considerable experience with governmental efforts to encourage renewable energy use, except Cyprus, where solar water heaters have been widely used without substantial government intervention. In each country, one paper was written by a policy maker or analyst affiliated with the government and one paper by a non-governmental policy analyst, so as to present different perspectives. The papers do not discuss all renewable energy resources in each country, but focus on those instances where the most substantial governmental programs were designed to encourage renewable energy development and use.

Chapter 2 of this paper summarizes the incentives and progress in each of the four nations, and also describes the situation in California, where an extremely ambitious package of incentives and broad diversification are found. Copies of the eight individual papers are included in each Roundtable participant's materials.

The four developing countries on which the Roundtable organizers chose to focus, plus California, have all witnessed major attempts to spur renewable energy use. All four of the developing countries have a relatively sophisticated modern sector with impressive technical skills. They differ greatly in average income per person, however, and therefore in the capacity of the private sector by itself to implement widespread diffusion of new technologies. India's average GNP in 1981 was $260; the Philippines - $790; Brazil - $2,220; and Cyprus - $3,740.

California's major incentives are generic in nature, applying to a number of eligible technologies or energy sources. In contrast, the developing countries have tended to be more technology-specific in their policy initiatives, on the grounds that limited financial resources must be used carefully. India chose to direct the largest portion of its government resources for renewable energy during the last decade to the diffusion of a specific technology, biogas digesters, that it hoped would be of great benefit to the rural sector. More recently, India has designed policies that it hopes

will result in accelerated diffusion of solar water heaters and improved cooking stoves, so some preliminary lessons may be available from the considerations that have been given to those plans.

Brazil has implemented a major national program to replace gasoline with ethanol, and this is perhaps one of the best-known energy programs worldwide. More than half of the total quantity of gasoline otherwise required in the country is now being supplied by alcohol derived from sugarcane.

The Philippines is one of several countries blessed with geothermal resources,[1] and in the past eight years the government has worked with the private sector to bring on line a number of electricity generating plants that exploit this resource and help reduce the need for imported oil. The government has also designed programs to encourage several biomass fuels.

In India, Brazil, and the Philippines the government has played a major role -- both catalytic and managerial. In Cyprus the government played only a very minor role. Private industry has installed solar water heaters on 90 percent of the houses in the country and on a significant portion of apartment buildings and hotels. Cyprus now has more solar water heaters per person than any other country in the world.

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In its simplest characterization, the diffusion of technology and the use of renewable energy resources require a willing consumer and a willing producer. The main body of this paper will examine the conditions that create those two principal categories of actors, and therefore the criteria that need to be considered by governments when contemplating the use of incentives. Chapter 3 will analyze incentives that have been used to motivate consumers, and Chapter 4 will analyze incentives for producers.

In any discussion of renewable energy the normal understandings of "producer" and "consumer" can become blurred. For example, a utility is a producer of energy, but may be a consumer of wood or geothermal steam.

In this paper, a consumer is any person or institution that controls the use and enjoys the direct benefits of a form of renewable energy or a renewable energy technology. Consumers may then include individuals using cookstoves or solar water heaters in their homes, communities using biogas plants, companies using gasifiers in their business, and utilities or a government agency using a renewable energy source to produce electricity. A producer is any person or institution providing a renewable source of energy to a consumer or a distributor, or manufacturing a technology that is provided to a consumer or distributor. For the purposes of discussing incentives in this paper, distributors, who play an intermediate role, are in some instances

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[1] According to the World Bank, the following developing countries have operating geothermal facilities: China, El Salvador, Indonesia, Mexico, Nicaragua, the Philippines, Turkey, Honduras, and the Yemen Arab Republic. The following countries have been assigned a priority for geothermal evaluation by the Bank: Cape Verdi, Costa Rica, Djibouti, Ethiopia, Guatemala, the Republic of Korea, Mauritius, Rwanda, St. Lucia, and Tanzania.

considered in the discussion of consumers and in other instances in the discussion of producers, depending on the circumstances.

Through a broad array of potential policies, a government may play either the role of consumer or producer, or both roles, or neither role. If a government offers a high enough subsidy, it may in effect create another intermediate role--that of a non-consuming buyer. It is also clear that the interplay between the producers and consumers can be critical. Each can shape the behavior of the other, and incentives for one serve as an incentive for the other.

Most of the incentives that will be discussed in this paper cost governments money. Serious constraints exist, of course, on the amount of revenue any government possesses, and so a government must choose its investments carefully. It is sometimes argued that the best incentive is one that is needed only temporarily, as an initial catalyst and that can be removed once familiarity and economics breed sustainability. But a government may believe that not all the benefits or costs of the diffusion of a particular technology or energy source are reflected in the prices paid by consumers. The concepts of benefit and cost may involve considerations beyond just the numerical proliferation of the use of a technology or energy source or the literal financial savings in reduced oil imports. A government may decide to judge its incentives or investments in any one area, such as renewable energy, within the context of its overall goals for economic and social development. Such a decision raises the issue of social benefit-cost assessments. Although this broader issue basically falls outside the scope of this paper, its potential importance to a number of governments must not be overlooked during the Roundtable discussions and several pertinent issues for consideration will be raised in the final chapter.

—Chapter 2—
Summaries of Experiences in Five Locales

Efforts at diffusion of renewable energy technologies in Brazil, Cyprus, India, the Philippines and California during the past decade are in varying stages of implementation and have met with varying degrees of success. The evidence suggests that government incentives have had an important effect in the case of at least one technology in all the countries except Cyprus. This chapter will describe briefly the energy sector in each of those locales and summarize the incentives and the spread of renewable energy use thus far, on a country-by-country basis.[2]

2.1 BRAZIL

Brazil experienced an impressive rate of economic growth during the 1960s and 1970s, but with this growth came dramatic increases in the use of oil. By 1979, 85 percent of the nation's petroleum was imported and in 1980, after the second round of oil price increases, expenditures on imported oil exceeded 50 percent of the country's total export revenues.

The Brazilian government decided to concentrate on three approaches to the oil problem: conservation; substitution, chiefly through hydroelectricity and biomass-derived fuels; and development of indigenous petroleum and coal resources. This paper will concentrate on the country's famous biomass program that is producing an alcohol fuel.

The ability to process sugarcane into varieties of ethanol (ethyl alcohol) fuel gave Brazil an opportunity to replace imported oil with an indigenous resource, and at the same time to help expand and stabilize an important segment of the agricultural sector that historically suffered from volatile prices on the world market. After the first oil price increases in 1973-74, the government placed heavy taxes on gasoline to encourage conservation, and announced the beginning of the alcohol program in 1975. The first phase of the program lasted until 1975 and concentrated on marketing a blend of 20 percent anhydrous ethanol and 80 percent regular gasoline, a mixture which could be used by existing automobile engines. The second phase, begun in 1979-80, required the production of automobiles with new engines that could use hydrated ethanol (93 percent ethanol and 7 percent water).

The Brazilian government offered financing incentives for investments by sugar producers and alcohol distilleries, and guaranteed those businesses a market by buying most of their production. Government control of the oil distribution process enabled it to replace all regular gasoline with the new

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[2]The information in this chapter is derived from several sources, including the individual country papers solicited for the Roundtable. A separate portion of the Roundtable binder includes more detailed profiles of the energy sectors in these five locales and of the energy sectors in all countries represented at the Roundtable. In addition, several of the individual country papers describe their overall energy sectors.

blend during the first phase of the program. For the second phase, the government adds whatever additional subsidies are necessary to set the price of the pure ethanol fuel at less than the price of the competition (the gasoline blend) and maintains a differential tax on vehicles that allows ethanol autos, which cost slightly more to produce, to be sold at final prices competitive with conventional autos.

Production of ethanol has grown steadily, from a half billion liters in the 1975-76 production year to an estimated 9 billion liters in the current year (75 percent of which is the hydrated form). This year's production has an energy value equivalent to 48 million barrels of oil, which displaces slightly more than half of the gasoline which would otherwise be required in the country. Within the next three or four years Brazil hopes to increase total production of ethanol to 14 billion liters. Meanwhile, in 1983 the Brazilian auto industry produced 590,000 vehicles with engines for hydrated ethanol fuel (as well as 300,000 vehicles with traditional engines for the mixed blend). Ethanol vehicles captured 90 percent of all internal sales (Brazil exports a significant number of autos).

By 1983, the country had reduced its dependence on imported oil from 85 percent to 65 percent.

The Roundtable collection of policy assessments includes a paper by Dr. Gil Eduardo Serra and Dr. Jose Roberto Moreira of the Energy Company of Sao Paulo, the electric utility owned by the state of Sao Paulo, and a paper by Professor Fernando Homem de Melo of the Department of Economics at the University of Sao Paulo. The first paper considers in depth the structure of incentives for the ethanol program and the pricing of gasohol and pure ethanol, and provides data on the progress of the program as it relates to the production of ethanol and of ethanol vehicles. It summarizes some of the criticisms that have been directed at the program and states that a legitimate controversy exists regarding the full costs of the incentives and the question of whether investments in other energy options might have been more cost-effective. Homem de Melo's paper agrees that the alcohol program has successfully raised production and displaced oil, but focuses on the issue of the program's cost-effectiveness and criticizes some of the distributive implications.

2.2 CYPRUS

Cyprus has no indigenous fossil fuels or significant hydroelectric potential, and has needed to import 95 percent of its commercial energy, all in oil. Slightly more than one third (36 percent) of the primary energy is converted into electricity, and the efficiency of the conversion to electricity is less than the world average. Electricity is thus relatively expensive, and is not subsidized.

Private companies in Cyprus began producing solar water heaters (SWHs) twenty-five years ago. The government levied small duties on imported models, and sales of the locally produced versions began to climb in the late sixties. The two oil price shocks of the seventies spurred sales, and as of early 1983 approximately 90 percent of all houses (which comprise 60 percent of all residential units in the country), 15 percent of all apartment

Table 1 Use of solar water heaters in Cyprus (January, 1984)

Type of residence	Number of units having SWHs	Percentage of units having SWHs
Houses	92,500	90
Flats (Apartments)	12,900	18
Hotels	3,200	57

Source: Information contained in the two Cypriot papers in the Roundtable collection.

buildings or flats, and 50 percent of all hotels and hotel apartments had solar water heaters (see Table 1). On a per capita basis, this represents the most successful diffusion of SWHs in the world. Energy supplied by the SWHs costs between one third and one half of the principal competition, electricity.

The SWHs provide about 4 percent of the total national energy needs. The tourist industry is important to Cyprus, and the active tourist season, which creates demand for hot water, coincides with the months when the sun supplies the most energy. Ten major and approximately twenty minor manufacturers employ about 400 workers and produce about 12,000 units per year.

For the past three years a major bank has offered loans at the normal market rate for the purchase of SWHs, and one third of purchasers since that time have availed themselves of this financing. Overall sales figures for 1985 indicate that in the detached housing market, 60 percent of SWH sales were for new houses; in the category of flats (apartments), 75 percent of new SWHs were installed on existing buildings. Recently, the government established a testing center to provide some public guidance for product quality and to enforce minimum standards. The government and the industry hope that improvement in quality will assist both the export market and the domestic market for replacing older models.

The two Cypriot papers prepared for the Roundtable are written by Iacovos Papadopoulos, the director of the energy office in the Ministry of Commerce and Industry, and by Kyriacos Hadjikyriacos, a private consultant and policy analyst. There appear to be no major controversies about the impressive diffusion of SWHs in that country. Papadopoulos' paper includes more technical information about the technology and economic data about the comparative costs of SWHs and their competition, and describes the testing and standardization program the government has been developing. Hadjikyriakos describes a number of areas in which the government has played a supportive role in what was fundamentally a strong effort by the private sector, and makes some suggestions of further positive actions the government could take.

2.3 INDIA

India, like many developing countries, has been suffering the "twin" energy crises, the high cost of oil and a decreasing supply of necessary non-commercial fuels, such as fuelwood.

In 1970-71, India imported 34 percent of its total supply of petroleum and petroleum products. Although India's pattern of industrialization has increased its total volume of oil use significantly, accelerated indigenous production of oil reduced the dependence on imports to 25 percent by 1983-84. The use of an important renewable energy source, hydroelectricity, doubled in that same period.

At least one third of India's total energy supply comes from non-commercial, renewable sources, mostly fuelwood but also agricultural waste and dung. Most of this energy is used in cooking, in both rural and urban settings. Numerous activities are depleting the sources of fuelwood while the demand for various uses of wood increases. A majority of India's efforts in renewable energy, therefore (other than hydroelectric development), are aimed at meeting the country's needs for domestic cooking.

The oldest program is concerned with the diffusion of biogas facilities, which use cow dung to produce methane for commercial or domestic use. Two basic sizes of plants have been promoted: family size for individual families, and community size for neighborhoods, villages, or commercial enterprises. The government has offered subsidies and concessional loans for consumers and training for installers. Manufacturers of nearly all renewable technologies qualify for enhanced depreciation and exemption from various taxes. The government established an extension program for biogas plants, which reaches to a majority of the districts in the country and which includes village functionaries who are paid commissions and play a pivotal role in diffusion of the technology. In the past four years, approximately 325,000 family-size plants have been installed, as well as 25 community-size plants, although some observers have claimed that a significant percentage of the family-size plants do not operate regularly. The government estimates that the plants will produce an amount of energy equivalent to 1.3 million tonnes of firewood annually. The government also suggests that from 16 to 22 million rural households, out of a total of 121 million, could be meeting their cooking energy requirements exclusively through biogas in the year 2005.

Research, development, and demonstration programs for solar water heaters, photovoltaics, windwills, and improved cooking stoves were given support in the most recently completed five-year-plan period, and producer and consumer incentives for these technologies have been included in the new five-year plan that goes into operation this year. The Indian papers in the Roundtable collection offer some preliminary description and assessment of the SWH and cook stove programs. The government hopes that 1,150 domestic SWHs, 390 industrial/institutional SWHs, and a half million cook stoves will be installed in 1985.

Two papers have been prepared for the Roundtable collection by Indian authors. The governmental paper, written by C.P. Malhotra, Undersecretary in the Department of Non-Conventional Energy Sources in the Ministry of Science and Technology, describes the organization of the relevant government agencies for energy policy-making, the incentives that have been established, and the diffusion of technology that has occurred and that is targetted. The second paper was written by A. Mubayi and R. K. Bhatia, policy analysts in the private sector. The latter paper reviews the economics of biogas plants and solar water heaters and conclude that with current relative subsidies of renewable energy technologies compared to conventional fuels there is little

hope for widespread diffusion. They non-governmental writers argue that only the higher income groups are using renewable energy technologies and that additional thought needs to be given to either the comprehensive design of pricing policies in the energy sector or to integrating the potential of renewable energy technologies into the overall development needs or goals of the country.

2.4 THE PHILIPPINES

Despite an increase in total commercial energy demand from 70.4 to 93.6 million BOE during the last decade, the Philippines has reduced its dependence on imported energy significantly. From 1974 to 1984, the portion of total energy supplies that were imported declined from 86 percent to 58 percent (in the former year imports were all petroleum, and in the latter year imports included a small amount of coal). Indigenous energy production nearly quadrupled, and renewable energy sources--biomass, geothermal, and hydro--accounted for 87 percent of the increased levels of national energy supply.

The largest increases were in biomass and geothermal. The two Philippine papers in the Roundtable collection discuss the geothermal, dendrothermal (wood-fired power plants), alcogas (a blend of alcohol and gasoline), and coco-diesel programs.

Geothermal development, which actually began in the sixties with scientific research and a pilot plant, occurred through a partnership between government agencies and the private sector. The private sector's participation was encouraged by a number of incentives, including exemption from tariff duties on the importation of necessary equipment, exemption from all taxes except income tax, and entry permission for alien technical and specialized personnel. The installed electrical generating capacity from geothermal steam has increased dramatically from the first 3 megawatts (MW) in 1978 to 894 MW today. Although the total is less than planned, principally as a result of demand growing more slowly than anticipated, the Philippines now has more installed geothermal capacity than any other country except the United States (all of the latter's capacity is in California).

Incentives for users of biomass were announced in a presidential decree of 1977 that covered a broad range of nonconventional energy sources. Producer incentives were initiated by a separate governmental decision two years later. The incentives for both consumers and producers included exemption from duties on equipment that needed to be imported, accelerated depreciation and tax credits on domestic equipment, exemption from capital gains taxes, permission to carry over net operating losses for tax purposes, soft loans, and in a couple of cases subsidies for consumers. In another presidential decree in October 1984, the consumer incentives were withdrawn as part of a comprehensive austerity program, but the producer incentives remained as part of a package for a number of "preferred" industries. Exceptions to the withdrawals can be approved by the President, but it is not known yet what restorative steps will be taken.

The government chose the nonconventional energy technologies which it considered candidates for commercialization. Priority was given to those

which were considered economically mature and ready for the market, and capable of making a significant contribution to the goal of displacing oil. These decisions in most cases led to the creation of an R&D effort in combination with user incentives.

Biomass-based energy sources and technologies promoted most heavily have included decentralized dendrothermal (wood-fired) power plants, gasifiers (engines or heaters run on gas that has been converted from wood or charcoal), and alcohol and cocodiesel fuels (coconut oil blended with diesel oil). Special incentives were offered for the commercialization of these fuels and technologies. The diffusion of all of them has fallen far short of the declared goals, due to economic recession and perhaps an initial error of expecting too much from technologies that were not fully tested in the market. Progress has been made, however, and extremely valuable lessons learned. There are now 12 MW of dendrothermal plants, which obtain their fuel from tree farms, and 980 gasifiers sold and in operation (mostly used for irrigation, powering small fishing boats and jeepneys). Five million liters of alcohol were blended with gasoline in 1984. The cocodiesel program was suspended within a year of its inception, when it was discovered that the government subsidies would have to be unaffordably high when the international price of coconut oil is in the upper half of its periodic cycle.

Most of the incentives available to geothermal producers and biomass companies were also available to developers of oil and coal, so the producer incentives for renewables in effect served to put them on the same level. But consumer prices for conventional fuels are not subsidized, and oil products are taxed heavily.

The two Philippine papers in the Roundtable collection were written by Gary S. Makasiar, chief of planning services for the Ministry of Energy, and by Dr. Bernardo Villegas and Pastor Lorenzo, policy analysts with a private consulting firm. Makasiar describes the strategy and tactics that were used by the government to elicit private sector activity with regard to geothermal resources and a variety of non-conventional technologies, with some focus on gasifiers and dendrothermal plants. Villegas and Lorenzo review the programs for geothermal, gasifiers, dendrothermal plants, alcogas, and cocodiesel. They commend the government's efforts, especially in geothermal development, but suggest that targets for diffusion of the other systems have been unrealistic.

2.5 CALIFORNIA

California historically has depended on oil and natural gas for the bulk of its energy supplies--in 1983, the oil contribution was 58 percent and natural gas 32 percent, for a total of 90 percent. Although the state produces a significant volume of oil from internal sources, the demands of its economy and the unusually large proportion of total energy needs going to the transportation sector (47 percent) create a need for sizeable imports. In 1976, the state imported 40 percent of its total petroleum. Increased local oil development, shipments from Alaska, conservation, and substitution have reduced the import percentage to 10.

California has always derived much of its electric power from hydroelectric facilities, and 5 percent of its total energy needs are supplied

from that source today. The state has enjoyed significant success in the diffusion of several other renewable energy technologies in the past ten years. This success is the result of several fortuitous factors: an ample resource base of both energy sources and capital, abundant technical skills, and supportive incentives at both the national and state levels. Although some of the incentives have been technology-specific, the most important have been more general in nature.

Federal and state tax policies (credits and enhanced depreciation) for both producers and consumers, federal regulations requiring that utilities purchase power generated by small producers at "avoided costs,"[3] and state concessional loans have been the most effective of the government incentives. The first two categories have attracted risk capital from what are termed "third party" investors. Electric utilities themselves have played an important role, adjusting their attitudes about small power producers and nonconventional technologies in an effort to deal with the new economic realities of the energy sector.

Geothermal development, which has now reached 1446 MW of capacity (with an additional 574 MW under construction), has occurred mostly without the use of government incentives, although the mandatory purchase requirement imposed on utilities has been the catalyst for a couple of recent projects.

Dramatic activity in the construction of wind generators in the past four years has resulted in 609 MW of new capacity. In the category of solar-generated electricity, 8.6 MW of photovoltaics and 28.3 of solar thermal power are now installed. Finally, California's power generation facilities include 905 MW of cogeneration (from oil and gas), with another 504 MW under construction, 550 MW of small hydro plants, 257 MW that are biomass-derived, and a single 1.8 MW plant fueled by municipal solid waste.

Fifteen hundred firms, employing 11,000 people, produced 10.6 million square feet of solar collectors in 1982 (most of them for low-temperature water heaters).

The pricing of conventional fuels has varied. Federal price controls on oil existed during the 1970s but were removed in 1980 and 1981. Some price controls exist for natural gas, but are being phased out.

No new policy papers were prepared for the 1985 Roundtable regarding the California experience. Information on that state contained in this overview has been taken from the discussion paper prepared for the 1984 Roundtable, with an up-date of various data provided by the California Energy Commission. The 1984 policy paper on California is being included in the binder for this year's Roundtable.

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Details on all the programs in Brazil, Cyprus, India, and the Philippines can be found in the eight country papers prepared for the Roundtable, and also in the country energy profiles provided. One fact stands out about Brazil, India, and the Philippines. These three countries have been very ambitious

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[3]Avoided costs are the incremental costs of electricity production that a utility does not need to expend when it purchases electricity from an independent producer.

and active in their search for effective means to increase the use of their renewable energy resources. Cyprus, in contrast, illustrates what can occur when economic necessity -- still the mother of ingenuity -- dictates consumer behavior even in the relative absence of governmental involvement.

—Chapter 3—
Consumers—The Demand Side

What makes a consumer willing to purchase renewable energy or renewable energy technology?

Energy is used to fulfill human needs--for space or water heating, cooking, lighting, or a wide variety of electrical and mechanical processes that sustain our transportation, agricultural, industrial, and communications activities. To be successful an energy source or a technological system for converting energy must meet real needs in a way and at a cost that satisfy the consumer. Otherwise, the technology will go unsold or unused, or if forced upon consumers may result in social dissatisfaction.

This chapter suggests conditions that will influence a consumer's response to incentives and promotions, and that therefore need to be considered by the producer and, most important from the perspective of this paper, by a government that is contemplating the design and implementation of incentives. The policies and experiences of the five focus locales are examined as they relate to these conditions.

There are five general conditions that ideally must be satisfied. The first three, which pertain to the technology or energy source, are that it should:

(a) Be priced competitively with alternatives;

(b) Offer an acceptably long-term reliability of operation and supply;

(c) Be competitive with alternatives in non-economic costs

Two additional conditions pertain to characteristics of the consumer. He or she must:

(d) Be aware of the availability and uses of the energy or technology; and

(e) Have access to the necessary financing.

Sometimes, as in the case of Cyprus, all these conditions are met in the marketplace with little government intervention.

Most government incentives focus on lowering the cost to the producer or the price to the consumer. This usually, but not always, serves to satisfy the first criterion noted above, and this issue will receive more attention in this paper than the other criteria. Attention to the other criteria is more sporadic. Some governments claim that the process by which certain technologies were chosen for incentives has assured that the other conditions are met; others have tried specific incentives that attempt to address these criteria. In a few cases, evidence exists that insufficient attention to one of these other criteria has affected the success of more strictly economic incentives.

There is at least one other factor which determines whether consumers will purchase or use a new technology or product that a goverment is promoting with incentives: Does the product fit the consumer's needs as he or she perceives them? One of the early lessons of experience with renewable energy incentives, as with so many other technology promotions, is that incentives will not create demand unless consumers are truly interested in the service or product. This statement may seem self-evidently true, but misconceptions about the need to identify consumer demand have plagued the renewable energy field for years. One of the more long-winded debates among energy advocates and critics has been, roughly, about the differences and relative priority between technology promotion and demand recognition. Political and economic pressure in the 1970s led to the rapid introduction of new technologies into the marketplace, often on an experimental or "demonstration" basis. A rash of demonstration projects led quickly to the recognition that projects financed publicly (and frequently by foreign assistance) did not have to face one of the real tests of the marketplace, namely whether the product or project met a genuine need of consumers.[4]

The debate has now largely disappeared, replaced by the widespread recognition that promotional incentives cannot succeed if the product or service offered is not recognized as desirable. But the renewable energy field requires a deeper analysis because new technologies are being pushed so rapidly into the marketplace. It is not controversial to suggest that incentives should not be attached to products that consumers do not want. But it may also be important to involve consumers in the selection and design of technologies for research and development, simply because R&D funds are so limited that most countries cannot afford to subsidize the development of unwanted technologies. In other words, consumer interest in the product being promoted is so critical that it should influence not just the decision to subsidize purchase or use, but also the earlier decision whether to develop a new product for promotion in the marketplace.

Beyond these criteria, some additional nudge is often needed to persuade the consumer to switch from a familiar technology or energy source to an alternative--overcoming inertia, in other words. The balance of this chapter will discuss the experiences with incentives designed to satisfy the above five criteria and the marginal incentive some countries have added to overcome the factor of inertia. The "access to financing" criterion will be combined with the "competitive price" criterion because of their close relation in numerous instances.

3.1 COMPETITIVE PRICE AND ACCESS TO FINANCING

The comparative price of an energy system clearly is a crucial determinant of consumer behavior, and so a great number of government incentives are found in this area. A list of all the incentives in this category in the five focus

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[4]For descriptions of some of these negative experiences, see Todd Bartlem, Renewable Energy Investment in the Developing Countries, International Institute for Environment and Development, Washington, D.C., 1984; and Peter Dewees and Thomas Hoffmann, Trends in Development Assistance for Renewable Energy: A Report to the World Bank, International Institute for Environment and Development, Washington, D.C., 1983.

locales is given in Table 2. They include exemptions from taxes, concessional financing, direct subsidies of renewable energy technologies, and appropriate pricing of conventional fuels or technology.

There are two levels at which concern about the comparison of prices is relevant. The first is the total cost of a system, usually measured over its expected lifetime. The second is the division of costs between the initial outlay of capital for the technology and the payments over time for the energy source. The relative weight of these two categories of cost, as well as the existence of any distinction in regard to who pays for each category, can effect the ability of the consumer to pay and must therefore be considered when designing incentives. When the initial capital cost of a system is a problem, the common incentive used by governments is concessional loans.

It is important to remember that improving the relative price of a new energy product can mean either lowering its price or increasing the price of conventional systems. In some cases, for instance, significant subsidies already exist for conventional fuels or technologies. Many governments around the world are indeed reconsidering their overall pricing practices.

3.1.1 Cyprus

The Cypriot case is worth considering first, because with few government incentives the solar energy industry has offered a product at a competitive price and enjoyed unparalleled success.

In Cyprus, the solar water heater (SWH) industry introduced its first products twenty-five years ago, modelled on an imported design. Initially the locally produced collectors experienced technical problems and the prices were too high for commercial success. Refinements in the design improved the efficiency and lowered the price. The SWHs began proliferating in the late sixties, even before the first oil price shock.

The chief competition for SWHs is electric resistance heating. Today, an SWH with an electrical back-up heater costs approximately US$ 425, including installation, in Cyprus. An electric water heater by itself costs approximately US$ 135. Electricity is not subsidized in Cyprus. On a life-cycle basis, due to the zero cost of solar energy as a fuel, the solar system ends up delivering hot water to the consumer at one third to one half the cost of an electrical system--US$ 0.009-0.014 per megajoule (MJ) for the solar system compared to US$ 0.03 per MJ for the electric system.

The life-cycle cost of a Cypriot SWH, then, is extremely attractive to the consumer. What about the consumer's ability to pay the initial capital costs? First, average Cypriot income--US$ 3,740 in 1982--is relatively high and thus made the investment less in proportional terms than in many other countries. Secondly, a significant number of new houses have been constructed in the past dozen years, and the marginal difference to the total cost in having a SWH included, especially in the normal case in which a loan was taken out, was quite small. Thirdly, during the past seven years the government itself has purchased approximately 1,500 SWHs annually as part of a public housing program designed to meet the needs of the Greek Cypriots who have chosen to migrate from the Turkish-occupied northern part of the island (ironically, the government at first built houses without SWHs in order to

Table 2 Incentives and disincentives for consumers affecting the competitive price and access to financing*

BRAZIL

1. Better financing terms for purchase of alcohol vehicles.
2. Differential in annual license fee for automobiles.
3. Differential in automobile sales tax.
4. Lower value-added tax for alcohol vehicles.
5. Elimination of sales tax on purchase of alcohol taxis.
6. Differential in prices at the pump set by government for hydrated alcohol versus gasoline.
7. Heavy taxes on gasoline (pre-dating the ethanol program).
8. Increased taxes on diesel, to encourage substitution by ethanol.

CYPRUS

1. Conventional fuels priced at real cost.
2. Duties on imported solar water heaters.

INDIA

1. Direct price subsidies for solar thermal.
2. Direct price subsidies for biogas.
3. Direct price subsidies for improved chulhas.
4. Exemption from excise duties, state sales tax, and municipal duties for a number of renewable energy technologies.
5. Better financing terms for loans for renewable energy technologies.
6. Price subsidies for electricity, kerosene, and coal.

PHILIPPINES

1. Exemption from import duties for non-conventional technology.
2. Accelerated depreciation for non-conventional technology.
3. Tax credits for non-conventional technology.
4. Exemption from capital gains taxes and net operation loss carry-over for non-conventional technology.
5. Better financing terms on loans for purchasers of gasifiers.
6. Direct price subsidies for alcogas and cocodiesel.
7. Conventional fuels priced at real cost.

CALIFORNIA

1. Tax credits for a number of renewable energy technologies.
2. Accelerated depreciation.
3. Exemption from excise taxes for alcohol fuels.
4. Exemption from property tax for value added by solar technology.
5. Required purchase by utilities of electricity generated by users of non-conventional energy and technologies.
6. Federal price controls on oil until 1980; price controls on natural gas being phased out; electricity sold at real cost.

* Not all of these policies are necessarily still in effect today; in most cases, the distinction is clarified in the text of the paper.

keep the capital expense to a minimum, but widespread complaints from the beneficiaries who had to pay the electric bills led to a quick change in policy). Fourthly, beginning in the fall of 1981 a major bank offered two-year loans for purchase of SWHs at the market interest rate (9 percent), and this program has been used by about 20 percent of all buyers (7,000 loans) since that time. The industry now considers the market for SWHs in single-family homes virtually saturated (90 percent coverage).

The only government action taken that would affect prices of SWHs has been maintenance of a duty of 10-15 percent on imported SWHs. This theoretically, reduces a competitive element in the marketplace and might have led to higher average prices for consumers, but the high level of diffusion of the technology is evidence that the effect was negligible. Cyprus has exempted from tariff duties the importation of those renewable energy technologies for which no indigenous industry exists, in order to encourage useful new products, but such imports are negligible.

3.1.2 Brazil

Brazil's large and ambitious ethanol program has included a number of incentives designed to make the price of the fuels (one ethanol fuel is a mixed blend of anhydrous alcohol and regular gasoline, and the second is an almost pure ethanol) and the technology (automobiles that could use the pure ethanol) attractive to the consumer.

Phase I (1975-79) concentrated on selling the blend of gasoline and ethanol that could be used in conventional engines. Government subsidies to the sugarcane producers and alcohol distilleries (which will be described in a section of Chapter 4), along with control of the blending stage through the national oil company, allowed the government to set the price of the blend to the consumer. It was set at the same price as regular gasoline. Actually, the government switched all gasoline to the blended version within a fairly short period, and so the questions of consumer choice and of price competition did not arise.[5]

Phase II (1979 to the present), involving the marketing of hydrated ethanol and the new automobiles that were required to use that fuel, was more ambitious and complicated. Consumers had to be attracted to the price of both products--the fuel and the auto--as a package. Because the entire stock of vehicles on the road obviously could not be changed overnight, both kinds of fuel remained on the market; and because the government decided it would not and could not restrict the sale of new autos only to those with engines appropriate to ethanol, the consumer also faced a choice of technology.

First, what incentives were designed for the fuel? The Brazilian government purchases all ethanol from the producers and controls distribution of auto fuels to consumers, and so it uses this control to set the price of hydrated ethanol lower than the price of the gasoline blend. The ratio has

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[5]Although this point makes the pricing of conventional gasoline irrelevant for this particular discussion, it is perhaps of interest to point out that Brazil raised the consumer price of gasoline significantly above cost in 1974 (after the first oil price shock) in order to encourage conservation. This general pricing policy, subsequently applied to the blend, has remained in effect.

varied since hydrated alcohol was first put on sale in early 1979 (between 40 and 70 percent), but to allay consumers' fears about long-term competitive price and government commitment, the government announced in the spring of 1982 that the ratio would not be allowed to go above 64 percent. This gives the consumer a clear price incentive to prefer the hydrated fuel.[6]

The fuel savings might not be sufficiently attractive, however, if the car with the newly designed engine were too expensive. At the beginning of the program in 1979, the new auto prices were roughly competitive. From 1979 to 1980 sales increased dramatically from 4,600 to 254,000. But some initial technical problems combined with fear about the long-term stability of ethanol prices to produce consumer doubts. Sales began to plummet in late 1981. In the spring of 1982, Brazil established three incentives related to the price to deal with this situation:

(a) The sales tax on automobiles was differentiated so that the final price of ethanol automobiles was less than that of gasoline autos (the difference originally was 5 percent, but this has decreased to 1 percent);

(b) The annual licensing fee was also differentiated, so that owners of ethanol vehicles pay 3 percent of the vehicle's price while owners of gasoline vehicles pay 7 percent; and

(c) Consumers taking out loans for the purchase of ethanol vehicles were given a 36-month payment period compared to the 24-month period required of purchasers of gasoline autos.

These incentives, and a couple of others described in other sections of this paper, appeared to have had a reassuring effect on consumer preference. Sales increased again, and in 1984 more than 90 percent of all new autos sold in Brazil were of the ethanol variety.

An additional incentive was aimed at one particular audience of consumers in 1982, taxi owners. All taxes on new automobiles, which in total almost double the manufacturers' price, were suspended for eighteen months in the case of any purchase by a licensed taxi driver. Nearly the entire fleet of taxis was replaced during that period, representing 70,000 ethanol cars. This action cost the government approximately US$150 million. This incentive, as well as the several others established that year, was justified by the government as a response to (1) the build-up of ethanol stocks resulting from the slump in sales of ethanol cars during late 1981 and early 1982 (which incurred storage costs); (2) the economic recession; and (3) the serious balance of payments problem and its effect on Brazil's ability to import more oil.

One final item in the context of fuel prices was changed to encourage ethanol sales. In the government's complicated pricing structure for oil

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[6]Ethanol fuel does not provide as much energy per liter as regular gasoline, although it does burn more efficiently. The net result is that the consumer must use approximately 20 percent more volume of ethanol than of gasohol for the same amount of useful energy. When ethanol sells at 64 percent of the price of gasohol, then the actual ratio of cost per unit of useful energy is about 0.77.

derivatives established in 1974, gasoline had been priced relatively high (significantly above cost), to encourage conservation, and diesel oil was priced relatively low (below cost), to encourage use of the more efficient diesel engines. But as gasoline demand declined as a result of the ethanol program, demand for diesel came to drive the need for petroleum and the profit structure of the oil industry was threatened. To entice diesel users to shift their use of fuel (either through purchasing an ethanol vehicle when replacement time came, or as a result of research and development on a diesel engine that could use ethanol), the government raised the relative price of diesel. It is currently 70 percent of the price of the gasoline blend (its efficiency of combustion, however, is better than the blend or pure ethanol, so that the diesel cost per calorie is still relatively better than ethanol).

3.1.3 India

Most of the Indian national government's incentives for consumers are technology-specific (a number of incentives for producers, on the other hand, are more generic, as a later section will describe). A majority of state governments in India, however, have exempted a broad array of renewable energy technologies from state sales taxes and central sales tax, and several of them have exempted these systems from municipal duty.

India recently designed an incentive program for solar water heaters. The consumer incentives include soft loans and subsidies ranging from 33 percent to 50 percent for private sector buyers and up to 100 percent for purchases by government facilities. The cost of a family-size SWH is between US$ 500 and US$ 575, and the cost of an electric system, the principal competition among upper income groups, is about half as much. The general intent of the subsidy is to make the capital investments approximately equal, hoping that the long-term savings in fuel will serve as an extra inducement. Mubayi and Bhatia, authors of the non-governmental paper contained in the Roundtable collection, anticipate several problems. They state that alternative fuels for the majority of Indians--fuelwood and dung--are usually free (except for gathering costs, which vary) and alternative fuels for the upper economic classes--kerosene, electricity, and coal--are subsidized. They claim that these conditions seriously undercut the competitiveness of the SWHs. They suggest that even with the subsidies, only about 3 percent of Indian families have sufficient capital to purchase the SWHs. Finally, they predict that the heavy subsidies will be a disincentive for manufacturers to design less expensive models. They suggest that money spent on subsidies would be better spent at this stage in R&D on smaller and cheaper models.

A second relatively new program in India is designed to encourage the adoption of a new cooking stove that uses wood more efficiently (old models have an efficiency of 2 to 12 percent; the improved models have efficiencies between 15 and 35 percent). Because cooking stoves are traditionally homemade and thus involve no direct economic costs, the government has decided to subsidize from 50 to 100 percent of the cost of the new units, depending on the geographical area and whether the stove is fixed or portable. It is hoped that the prospect of a reduction in the drudgery of wood-gathering, as a result of lower fuelwood needs, will provide the additional necessary incentive to purchasers.

For several years India has had a major program for the commercialization of biogas plants. Although a number of different sizes of biogas technology are available, the two chief categories are family-size plants, capable of producing about 2 cubic meters of gas per day and costing approximately $300 (the most common model), and the much larger institutional and community-size plants (the latter must be capable of producing more than 45 cubic meters per day), the prices for which were not cited in the Indian papers. For the first category, direct subsidies range from 25 to 60 percent, depending on the exact size and the location of the plant and certain economic characteristics of the beneficiary. Community plants are subsidized 100 percent, and institutional plants up to 75 percent if they are for public sector use and 33 percent if they are for private sector use.

In addition to the direct subsidies, the government has urged commercial banks to offer concessional loans for biogas plants (the response has been spotty), has organized "biogas cells" in all state headquarters and in one fourth of the nation's districts to encourage the technology, and has organized training courses in construction and maintenance. The government provides a grant of about $2 for each biogas plant promoted and supervised by selected village functionaries.

A number of observers, including Mubayi and Bhatia, state that most of the family-size plants are purchased by relatively richer households, because the capital requirements are too high for an overwhelming majority of Indians and because only a small percentage of households possess sufficient cattle to generate the necessary volume of dung. The family-size plants are used mostly for cooking fuel, and Mubayi and Bhatia argue that the technology is competing principally with a free fuel, wood, and in those less common cases where some of the biogas is used for lighting it competes with heavily subsidized electricity.

Mubayi and Bhatia state that the same competition is faced by community plants, and that the reluctance of villagers to pay for biogas to replace the wood they obtain free has resulted in the fact that most community plants cannot meet their operating expenses (the initial capital costs are 100 percent subsidized).

3.1.4 The Philippines

The Philippines established incentives separately for geothermal development, on the one hand, and for a variety of what were termed "nonconventional" energy technologies, on the other, although there are many similarities. Within the latter category some incentives are generic and others are technology-specific.

The nation began its geothermal development in the sixties. A collection of incentives were established over the years for this energy source that were modeled on those available for oil and coal. Because the consumer of geothermal steam is the National Power Corporation (NPC), the state-owned electric utility firm, and the NPC was one of the chief agencies used by the government from the beginning to develop this resource, consumer incentives were irrelevant. The NPC claims that the cost of generating electricity from

geothermal steam is higher than hydroelectricity but cheaper than from oil or coal, which would indicate that the NPC and the ultimate consumers of electricity are getting a good deal, effectively unsubsidized. All incentives were on the producer side, to attract private sector involvement, and these will be discussed in the next chapter.

A number of incentives for most other renewable energy technologies were established generically by Presidential Decree (PD) 1068 of 1977, which attempted to accelerate the research, development, and diffusion of nonconventional energy. A majority of incentives were oriented toward producers, but for users of nonconventional energy the incentives applied to the purchase of the necessary technology, and included exemption from tariff duties on imported equipment, accelerated depreciation, and tax credits. These incentives were aimed at companies using nonconventional energy more than at individuals. They were repealed as part of a comprehensive austerity program in October of 1984. Restoration of any particular incentive is possible with the approval of the President, but no action has been taken yet.

Three renewable energy sources or technologies that have featured incentives for individual consumers have been gasifiers, alcogas (a blend of 15-20 percent alcohol with 80-85 percent gasoline), and cocodiesel (a blend of 5 percent coconut oil and 95 percent diesel oil):

(1) The state-run Farm System Development Association (which oversees one of the nation's largest manufacturers of gasifiers) extends soft loans to farmers' associations throughout the country for the purchase of gasifiers for irrigation systems, bancas, ice plants, and jeepneys.

(2) Alcogas is sold for US$0.02 less at the pump than regular gasoline, and this discount requires a government subsidy.

(3) The cocodiesel program, which ran for a little more than a year, required only a very small subsidy at the beginning (in late 1981) when the international price of coconut oil was very low. But by early in 1983 the export price of the oil had risen nearly 20 percent, and the subsidy necessary to purchase it for the blend with diesel and sell it competitively on the internal market was prohibitively high. The government suspended the program at that time. Apparently, the government had begun the program to help the coconut growers during a slump, but had set targets for use of the oil that failed to take into account the cyclically probable upward shift in the export value. Fortunately, the growers had nothing to lose by the program's failure, and neither the national oil company nor consumers had established any dependence on the blend.

In the dendrothermal program, rural electric cooperatives purchase fuelwood from tree farms. Because they are required by the government to make the purchases, the cooperatives are not freely acting consumers, but studies indicate that the cost of wood-fired electricity generation has been roughly competitive with marginal costs of generation from other sources.

3.1.5 California

Two categories of incentives have dominated the influence of government policies on renewable energy in California--tax breaks, federal and state, and a unique federal law, the Public Utilities Regulatory Policies Act ("PURPA").

California was one of the first states in the U.S. to establish tax credits for renewable energy technologies, in 1976. Consumers (individuals or businesses) were given credits on their state income taxes equal to 10 percent of the cost of any solar energy equipment that produced heat or electricity. The following year, the credit was increased to 55 percent (in 1984 it was cut to 50 percent), with business systems costing more than $12,000 limited to a credit of 25 percent. Wind energy systems were made eligible in 1978 and conservation measures (such as insulation) in 1981.

Meanwhile, the federal government in 1978 established its own credit on federal income taxes of 40 percent for residential uses and 10 percent for businesses. Businesses can use both the California and the federal credits; residential users must reduce the value of their California credit by the amount of the federal credit, so their total claimed credit is no greater than the California maximum. To date, 780,000 individuals or businesses have claimed the California tax credit.

Both the federal and the California governments allow accelerated depreciation for renewable energy equipment. The state, which has authority over property taxes, allows an exemption from such taxes for any value added to a property by the addition of any solar technology.

Fuels for motor vehicles are taxed by both levels of government, and alcohol fuels have been exempted in both cases.

Perhaps more important than all the tax credits for renewable energy development, especially for renewable energy sources converted to electricity, is the federal Public Utilities Regulatory Policies Act (PURPA), passed by Congress in 1978. Although PURPA is used by <u>producers</u> of electricity, electricity producers in this case are the <u>users</u> of renewable energy and of renewable energy technology. For this reason, this paper will consider PURPA a consumer incentive, to remain consistent with the definition stated in the Introduction.

PURPA was designed to respond to the major problems facing entrepreneurs who wished to begin producing power from non-conventional sources: utilities were very reluctant to distribute any electricity not generated in their own facilities and thus lose their monopoly, and so they would (1) refuse to let independent producers tie into the system, (2) offer them extremely low prices for the electricity, or (3) charge them high prices for auxiliary power needed by the small producer for operations. PURPA:

(1) Requires that state public utility commissions design guidelines requiring utilities to allow small (less than 80 MW) producers to tie into the utility grid if they meet certain criteria;

(2) Exempts the small producers from certain regulatory procedures; and

(3) Requires that the Federal Energy Regulatory Commission (FERC) establish "just and reasonable rates" for the buying and selling of power to utilities by qualifying facilities.

FERC has since required that utilities pay the qualifying facilities for their power at a rate equal to the utilities' avoided cost of production. Although different state regulatory commissions dealt with the concept of avoided cost in different ways and a legal battle kept much of PURPA in the federal courts until the spring of 1983, the relevant California regulatory agency acted aggressively to draw up implementing rules and began promulgating regulations on its own authority that would serve to meet the same purpose even if PURPA had remained in the courts for a longer time. Simultaneously, the major utilities in California were changing their attitudes about non-conventional energy production, and recognized the benefits of adding small increments of power at a time when financing for the traditional large generation plants was becoming more and more difficult to arrange.

A couple of independent geothermal developers have taken advantage of PURPA to plan their own 100 MW power plants, and some mini-hydro, solar electric, and biomass projects have sprung up. But the biggest breakthroughs to result so far from this interesting law have been the surge in cogeneration facilities (mostly fueled by oil or natural gas, but much more efficient than conventional use of those fuels) and the profusion of wind generators grouped together in what are termed "wind farms." Since 1980, the installed capacity of wind farms in California has increased from zero to 609 MW. The financial attraction of the tax breaks and the PURPA requirements has elicited significant risk capital from so-called "third party" investors--doctors, lawyers, businessmen, and others looking for a tax shelter for their income.

3.2 RELIABILITY OF OPERATION AND SUPPLY

Even if the technology and the energy source fit a need and are priced competitively, the consumer may still be wary about the reliability of the technology and at least the mid-term supply of the energy. This is especially true if the uses of both the technology and the energy source are unfamiliar, as they are in most cases with renewable energy technologies.

The consumer wants the technology to perform as promised and not to break down too soon or too often. This factor of product quality is extremely important with regard to a new product, because negative experiences can have a long-term effect on consumer attitudes and the news can spread throughout the potential market.

A few examples of problems in this area are described in the Roundtable collection of papers. In the Philippines, the cocodiesel program ran into some trouble when use of the fuel resulted in clogged fuel filters in a number of buses. Subsequent investigations determined the reason for the phenomenon and an alternate coconut oil product was proposed for use, but for unrelated economic reasons the program was terminated after little more than a year.

When the alcogas program was introduced in one district in the Philippines, unjustified rumors about the effects of the fuel caused

misperceptions among the public. The alcogas was blamed for everybody's car problems, including flat tires. In response, the government offered free tune-up services in a major city within the district (this government incentive and others in this category are listed in Table 3).

Brazil also experienced some problems with consumer confidence in the performance of engines using pure ethanol fuel. Before ethanol vehicles were first produced in 1980, people were encouraged to adapt their conventional

Table 3 Incentives and disincentives affecting reliability of operation and supply

Reliability of technology:

BRAZIL

- Extended guarantee and free tune-ups offered to purchasers of alcohol vehicles.

CYPRUS

- Standards and testing for solar water heaters.
- Training of installers/maintenance technicians by the government.

PHILIPPINES

- Free tune-ups for users of alcogas.

INDIA

- Training of installers.
- Testing of solar water heaters.

CALIFORNIA

- State and then federal standards for solar water heaters.

Predictability and sustainability of energy source:

CYPRUS

- Monitoring solar and wind regimes.
- Solar access laws.

CALIFORNIA

- Solar access laws.

engines to use the pure alcohol. In many cases, the adaptation was done by unqualified mechanics and a nominal government program of quality control was inadequate. Even when the new autos were introduced, the specially-designed engines experienced a number of technical problems. After dramatic first-year sales, business slumped significantly. The automobile industry resolved the technical problems with re-design, but the government also took a number of steps in 1982 to regain consumer confidence. One of these steps was to offer a warranty on the autos that was longer than that offered with non-ethanol cars and to provide free tune-ups during the first six months after purchase.

One set of measures for addressing the potential problem of quality and reliability is to establish standards that all manufacturers must meet, test products before they are put on the market to determine if they meet those standards, and, as in Brazil, include guarantees with the sale. Standards are not, however, considered appropriate for all renewable energy technologies.

Both California and Cyprus have promulgated standards for solar water heaters. California's standards were actually withdrawn when federal standards, based on California's, were later announced for the whole country. Testing and certification are done by the industry itself. Cyprus set up a voluntary testing facility in 1980, run by the Ministry of Commerce and Industry, and all manufacturers have submitted their models. Experience with the testing has led to the establishment of some minimum standards.[7] Although it is clear that the recent testing and certification had nothing to do with the impressive success of the industry prior to 1980, the government and industry hope that this program will induce the improvements in product quality that will help promote two of the few areas remaining for industry growth: replacing older models in the domestic market and increasing the export market. India has recently opened a testing facility to which all manufacturers of solar thermal technology must submit their products, and the government is deliberating on the establishment of standards.

Some governments offer training courses for the persons who will be assembling, installing, or maintaining technology. Cyprus trains solar technicians and India trains people for installing solar water heaters, biogas plants, and chulhas.[8] Consumers in Cyprus discovered that installation and service by retailers was not satisfactory, and now depend on the manufacturers' trained technicians for both.

The consumer also needs to feel confident that the energy supply will be available in sufficient quantities and for a reasonable length of time. With solar energy, we all have faith that the source will not go away, but questions regarding the effects of local average cloud cover or seasonal variation are important in determining the useful energy to be anticipated.

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[7]The country paper on Cyprus by Papadopoulos (Section 3.1.3) in the Roundtable collection describes a number of considerations that entered into that country's establishment of standards.

[8]A survey of household consumers of renewable technology in the Philippines indicated that an important factor in a number of instances is the ease with which equipment can be repaired in the home or with local assistance (see Chapter II of the Makasiar paper in the Roundtable collection). This may be a factor which some governments will wish to consider in R&D work, or in choosing technologies as candidates for incentives for commercialization.

Similar questions about average wind speed and daily or seasonal variation in that speed are critical for potential users of wind energy. In some cases, this type of information falls into a category of R&D that the private sector does not feel capable of undertaking, and so the government may wish to take action. The Cypriot government, for instance, is setting up a network of instruments to monitor wind and sun regimes around the island.

Although the consumer knows the sun is not going to go away, access to the sun's rays is another question. What is the value of a solar water heater if next month somebody builds a taller building next to yours and blocks out the sun for half the day? This is a difficult issue, touching upon potentially conflicting categories of property rights. Both Cyprus and California have passed laws that attempt to deal with the problem.

The availability of the energy source has been a partial obstacle to widespread diffusion of family-size biogas plants in India. Approximately ninety percent of rural households own fewer than the five cows necessary to provide sufficient dung for the equipment.[9]

With some renewable energy sources, the renewability itself is threatened if the consumption per unit of time goes beyond the sustainable yield. There is a controversy about whether geothermal energy is renewable, but if it is, then it is important not to draw out the steam at a rate faster than the water source is replenished (a difficult determination). Makasiar points out in his paper on the Philippines that the government possibly encouraged the overdevelopment of two geothermal resource areas, and the steam output from some wells has dropped.

When the energy source is delivered through a series of organized activities over which the consumer has no control (most sources except sun and wind), a question might arise concerning the long-term commitment of those who make it available. Homem de Melo, in his paper for the Roundtable, reports that technical problems with the first ethanol cars in Brazil combined with popular fears that the government might not be firmly committed to the program to produce the dramatic drop in sales of the autos in late 1981. When the government took action in the spring of 1982 to show its commitment, sales rebounded.

3.3 AWARENESS

The best product in the world will go unsold if consumers don't know about it or understand it. Information is an important incentive. In some countries it is assumed that disseminating this information is the responsibility of the producer who wishes to sell the product. A government must judge whether this education and advertising function will be sufficiently carried out by the manufacturers or distributors in the private sector. If the government is the manufacturer, then the job is the government's. Otherwise, the government may decide that it has a role if either (1) the private sector does not possess sufficient capital or expertise; or (2) the government has a particularly appropriate network for

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[9] The State of India's Environment, 1982, Centre for Science and the Environment, New Delhi, 1982. P. 156.

disseminating information. Because government action may be substituting for a normal cost of production and selling, promotion activities could also be considered an incentive for producers.

Advertising and education can take place through all the available public media (radio, television, newspapers, magazines, and posters), through direct delivery of information to decision-makers (for example, at an industry conference), and through other channels. Brazil used all of these for its ethanol program (see Table 4 for a list of the various actions taken by the five focus locales that attempted to increase public awareness). The government of Cyprus has promoted the purchase of SWHs through advertising campaigns aimed at both the general public and more targetted audiences such as hotel owners.

A second method of informing potential consumers is through demonstration projects. During its sixth five-year plan (1980-85) India concentrated on these activities with regard to all the renewable technologies it wanted to encourage. The Philippines sponsored a rally for automobiles powered by gasifiers in 1981 to involve the private sector in gasifier design and to publicize the technology (despite the rally and other promotional efforts, however, gasifiers have not sold very well for mobile uses; they have been more popular for stationary uses). California has funded demonstrations of several renewable energy technologies, including a number of biomass pilot projects within the agricultural community, and purchased or adapted special ethanol and methanol automobiles for a portion of the state-owned fleet.

Demonstration projects sometimes have doubled as field trials, but excessive publicity for what really is an experiment can have a adverse effect on the public's attitude toward a new technology.

Table 4 Policies affecting public awareness

1. Brazil: promotion of ethanol program included use of television, radio, newspapers, and posters.

2. Cyprus: solar water heaters were advertised through several media and extension programs.

3. India: extension program for biogas, and more recently established extension programs for solar thermal and others.

4. India: a financial "reward" for extension workers each time they facilitated a purchase of a biogas unit.

5. India: training of women in construction and installation of improved cookstoves.

7. India, Philippines, and California: demonstrations of numerous technologies.

A third method, potentially the most educational and in the case of India perhaps directly responsible for most actual sales of a technology, is extension programs. These programs may combine the first two approaches (use of media and demonstration projects) with more person-to-person contact between the paid and trained personnel and the individuals or organizations that are the potential market for the product. India's extension program for biogas plants involves an extensive network of village functionaries in many areas of the country who search out prospective purchasers of biogas plants and then help them make all necessary contacts with banks, masons, and others. These personnel are given a commission for each installation they facilitate, and many observers believe that they play the principal role in the diffusion of this technology. India has recently begun additional extension programs to promote improved cookstoves, solar thermal systems (including domestic and industrial water heaters, solar driers, and solar timber kilns), wind energy, solar photovoltaics, various forms of energy-related biomass, gasifiers, and waste recycling.

Other portions of India's extension programs emphasize training people in the construction, installation, and maintenance of renewable energy systems, and concentrate on women in particular for the cookstove program (this training also is supposed to increase consumer confidence in the reliability of the technology and in his or her ability to maintain it, as mentioned in an earlier section of this paper).

3.4 COMPETITIVENESS WITH NON-ECONOMIC ASPECTS OF ALTERNATIVE ENERGY

A variety of non-economic costs may be implied by the use of a particular technology or energy source. Sometimes these costs (or a reduction in them) are inherent to the technology or energy source, and other times they are affected by government action. These costs may be very difficult to identify or anticipate and, if identified, difficult to place a value on. The importance of these costs of course can vary: in a majority of cases they may be minor and can be neglected; at the other end of the scale, they may be crucial to successful diffusion.

A simple example, in which a government attempted to make a new technology preferable by reducing the consumers' non-economic costs, was the case of ethanol in Brazil. After the second oil crisis the government prohibited gasoline service stations from being open on Saturdays and Sundays (as a conservation measure), but beginning in 1981 ethanol fuel (but not the competing gasohol) was made available on Saturdays. This action made the purchase of ethanol cars more attractive to those people who wished to do a lot of weekend driving.[10]

A second and more complicated example is the question of the costs of gathering fuelwood. Biogas plants in India compete with wood as a fuel for cooking, and improved cookstoves reduce the volume of wood needed for the same activity. A reduction in the costs of gathering wood is thus inherent to both these technologies. Some rural households have an ample supply of fuelwood in

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[10]Three years later, in 1984, the government allowed service stations to sell both kinds of fuel on Saturdays.

close proximity to the residence, but others have a more arduous task to face. In one village studied, women walk at least 10 kilometers three out of every four days to obtain the fuelwood necessary for the family.[11] When children are the gatherers, it often means that alternative educational possibilities suffer. Placing a value on the costs of gathering can be an important factor in determining the attractiveness of a new technology. At the same time, pre-judging that determination is difficult in a society where there is an abundance of people but a shortage of capital.

A still more complicated example also pertains to biogas plants in India. Recent studies of tests of community-sized plants suggest that village politics may play an important role in determining the success of each project. Even if the plant is technically feasible and its economics theoretically feasible, successful operation may constitute a redistribution of community wealth that is resisted in a number of ways by the elite.[12] This political resistance may result in economic or non-economic costs. Overcoming these obstacles may not be easy.

Because these factors often resist anticipation and quantification, it is usually difficult to include them in adopting incentives. But to the degree that they may prevent the diffusion of energy sources or technologies that are otherwise viewed as beneficial, they must be taken into consideration.

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[11] The State of India's Environment, 1982, Centre for Science and the Environment, New Delhi, 1982. P. 148.

[12] Michael Maniates, "Community Biogas Plants: Social Catalyst or Technical Fix?", in World Resources Institute Journal, 1985. World Resources Institute, Washington, D.C., 1985. Pp. 71-78.

—Chapter 4—
Producers—The Supply Side

As the old saying goes, it takes two to tango. The previous chapter talked about what it takes to create a consumer who will respond to promotional incentives. What does it take to create a willing producer?

For the purposes of this discussion the category of producer includes the manufacturers of renewable energy technology, in several cases those performing an intermediate function of distribution, and in at least one case (Brazilian distilleries) the companies converting one energy source into another more usable form.

At its simplest, an attractive rate of return creates a willing producer, when the ratio of benefits to costs is perceived as better than alternative investments. In the private sector, the rate of return is more narrowly financial and more simply defined than in the public sector. The producer is looking for a profit. This chapter will discuss the incentives that governments have used to apply leverage to the private sector.[13] In some cases, such as the Philippines geothermal program, the government has acted as a co-producer, but still needed to determine appropriate incentives for private sector participation.

To obtain a healthy rate of return, a producer needs to keep costs as low as possible and income as high as possible. Incentives can be divided into those two categories, and so this chapter's discussion will be divided in that manner. Included within each of those categories are incentives specifically aimed at some assurance to the producer that the ratio between the two can be sustained over the long term.

4.1 KEEPING COSTS DOWN

Many renewable energy technologies are new and consequently a prospective producer has to deal with a significant amount of uncertainty regarding the anticipation of costs. Governments have taken several types of actions and established a variety of incentives to mitigate risk. Prior to commercialization, R&D is a crucial first step for many technologies, and the private sector in many countries does not possess the necessary risk capital. The government is looked to for leadership. One country has provided help at an intermediate stage, taking market surveys to give the private sector some early guidance in designing and marketing products. When a technology is perceived as ready for commercialization, governments have offered a number of tax breaks and promotional programs to reduce the costs of production and advertising for the private sector and to encourage widespread diffusion (see Table 5 for a list of incentives described in this section).

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[13] As mentioned in the Introduction, the ultimate justification for an incentive, or for the level of an incentive, is the government's accounting of the full social rate of return, which may include economic and non-economic benefits and costs not reflected in the commercial market. The importance of the social assessment will be discussed in Chapter 5.

Table 5 Government policies or incentives that keep producers' costs down

BRAZIL

1. Subsidized terms of financing for investment in the growing of sugarcane.
2. Subsidized terms of financing for investment in distilleries.
3. Refunds to producers for storage costs and evaporation losses.
4. Subsidized electricity rates for distilleries.
5. Permission to distilleries to use their own product (and not have to purchase it on the market, after taxes) for their truck fleets. This was actually the "carrot" part of a "carrot and stick" approach; the "stick" was a requirement that distilleries gradually replace a significant portion of their diesel-fueled truck fleet with ethanol-fueled trucks.
6. Elimination of high octane gasoline and shift of use of gas tanks and pumps to hydrated alcohol.

CYPRUS

1. Improved access to loans for solar water heater industry, and government guarantees for those loans.
2. Training of solar water heater technicians.

INDIA

1. Enhanced depreciation for manufacturers of renewable energy technologies (RETs).
2. Exemption from customs duty for equipment needed by manufacturers of RETs.
3. Exemption from excise duty for equipment needed by manufacturers of RETs.
4. Discounts on financing for manufacturers of RETs.
5. Exemption from licensing requirements for use of RETs.
6. Training of installers for several RETs.
7. Government extension programs for a number of RETs.

PHILIPPINES

1. Geothermal survey and exploration work performed by government.
2. Exemption from duties and a number of taxes for geothermal developers.
3. Free electricity for geothermal development operations.
4. Transfer of knowledge and technology for surveys and technology through bilateral and multilateral aid.
5. Government co-funding of commercial geothermal production and offering of profit sharing with foreign companies or governments.
6. R&D and commercial surveys for a number of technologies.
7. Tax deductions, credits, and loss carry-overs for manufacturers of nonconventional technologies.
8. Accelerated depreciation for manufacturers of nonconventional technologies.
9. Soft loans and first-year living costs for tree farms.
10. Nominal fee and long-term lease for rental of land to tree farmers.
11. Credit and commissions to dealers of alcogas.

4.1.1 Brazil

Brazil's ethanol industry actually includes three different categories of producers or manufacturers: the sugarcane growers; the distillery owners who convert the sugarcane to ethanol; and the automobile manufacturers who produce the cars that can run on pure ethanol.[14] This section will describe the incentives that pertain to each category, plus one government action taken in regard to distributors to ease the transition to alcohol fuels.

At the beginning of the program in the mid-1970s, generous credit conditions were available to the entire agricultural sector, including sugar growers, for investments in new productive capacity. These included:

(a) Credit up to 100 percent of an investment;

(b) 7 percent annual interest rate on loans (because the inflation rate was much higher than 7 percent, this actually represented a negative real rate of interest and therefore a heavy subsidy);

(c) A grace period of two years before the first loan payment was due (the last payment was due within three years).

The generosity of the loan conditions was scaled down over the years without losing private sector interest, and currently a full inflationary correction is made to the loans and a real interest rate of 3 percent is charged. Beyond the incentives common to the agricultural sector, particular inducements to sugar growers have been (1) a preference offered to the latter by the financing institutions; (2) a financing of a larger portion of the required capital; and (3) a lower interest rate on larger loans.

Generous terms were also offered to the industrial sector for investments in alcohol distilleries. During the first year, the incentives were:

(a) Credit up to 100 percent;

(b) Interest rates of 15 to 17 percent;

(c) Three-year grace period before first payment of principal; (the last principal payment was due within 12 years).

As with the agricultural sector, the terms were made stricter over the years, and today are similar to the normal credit market. In the most developed areas (businesses in less developed areas are given better terms), a full inflation correction is made and a real interest rate of 5 percent is charged.

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[14]During the first phase of the alcohol program a majority of the ethanol was produced by expanding the distilleries at existing sugar mills. In the second phase, independent distilleries have been established to provide the bulk of the additional ethanol. In some cases, therefore, the two stages of production--growing sugar and distilling ethanol--are owned by the same people.

A number of additional incentives are provided to distillery owners, including (1) refunds for alcohol lost during storage due to evaporation; (2) subsidized electricity rates; and (3) permission to use their own product as a fuel in their operations (normally they would have to purchase fuels through the market). This last item both reduces production expenses and provides an incentive to develop technology to replace diesel use with ethanol use in the relevant machinery.

One final incentive worthy of mention pertains to the petrol stations. Pure ethanol represented an additional fuel to be sold at the stations, and therefore might have required a significant investment by the station owners in new tanks and pumps. The government ordered the cessation of the sale of high-octane gasoline (which, according to Serra and Moreira, was experiencing only meager sales anyway) and the use of that product's tanks and pumps by hydrated ethanol.

Neither of the Brazilian papers in the Roundtable collection described any incentives provided by the government to lower production costs for manufacturers of ethanol vehicles (a government policy that offers these manufacturers some assurance of income, rather than a reduction in costs, will be explained in the next section).

4.1.2 Cyprus

Since the mid-seventies, the government of Cyprus has offered fiscal and financial incentives to all industries, including SWH manufacturers, as part of a comprehensive attempt to encourage development.

Commercial banks provide loans to industrial firms at an interest rate of 9 percent. The SWH industry is among a more select group of industries for whom the government guarantees such loans. In addition, the Central Bank of Cyprus operates a special Fund for Financing Priority Projects that grants speedier access to loans at the market rate for preferred industries, and again the SWH industry is included.

Several tax incentives are also offered to all industries, including investment allowances of up to 45 percent, immediate depreciation, and the carrying forward of losses for an indefinite period.

4.1.3 India

Whereas the Indian government's consumer incentives are technology-specific, its producer incentives tend to be more generic. India offers some incentives that are applicable to manufacturers of nearly all renewable energy technologies:

(1) Enhanced depreciation can total 100 percent in the first year -- on top of the normal depreciation rate of 30 percent, manufacturers can get an additional 15 percent during the first year, an additional 25 percent as an "investment allowance," and an additional 30 percent if they run a triple-shift operation.

(2) The manufacturers of most renewable energy products need not acquire the business licenses normally required under the national "Industries Development and Regulation Act," and they can obtain institutional credit preferentially and at concessional rates.
(3) For R&D work, research institutions are exempt from customs duties, and the manufacturers are exempt from excise duties.

Two aspects of the incentives described in the preceding chapter on consumers also serve as producer incentives in the sense that they perform functions that the manufacturers might otherwise have to perform--the training of installers and maintenance personnel, and the organization of village functionaries who help to sell the products.

4.1.4 The Philippines

As with consumer incentives, the Philippine government established some producer incentives that applied only to geothermal energy, and then promulgated both generic and technology-specific measures for the "nonconventional" category.

Geothermal development is a relatively expensive undertaking, because it requires geological surveying, exploration, and the drilling of test wells prior to commercial exploitation, and then includes the installation of large and costly technology at the commercial stage. Significant risk is involved before the productive capacity of a potential field can be estimated, and few companies have the necessary capital. The Philippines government, confident that parts of its territory were likely to yield this energy source but aware that the private sector would not yet take the risk, began surveys and tests in the sixties. After some promising results, a foreign firm with expertise in geothermal (Union Oil) was persuaded to establish a Philippine subsidiary and join the government in further exploration, which led to the first production well in 1974 and a 3 MW pilot plant in 1977. The government began arranging for various bilateral and multilateral assistance grants in the mid-seventies with Italy, New Zealand, Japan, and the United Nations to pursue exploration in others parts of the islands. These cooperative efforts led to the transfer of both technology and expertise, developing local skills and capacity for expansion of the industry.

This R&D effort attracted private sector interest, and the experience with the first foreign firm provided guidance for the legal and financial framework of government-private sector cooperation that has since been used quite successfully. The contracts negotiated between the government and private companies for geothermal development have included incentives that both reduced costs and assured some income to the companies (the income assurances will be discussed in the next section of the paper).

The service contracts state that the two entities cooperate in the geothermal development itself, but the government is soley responsible for the accompanying power plant. The principal terms for a joint project are as follows:

(a) The government pays 45 percent of all expenses and the contractor pays 55 percent.

(b) The contractor pays corporate income and contractor's tax, and the government absorbs all imposts, duties, and other taxes.

(c) The government provides all power-related infrastructure and electricity required at the site free of charge.

Since the Union Oil subsidiary signed the first contract, one other company has signed a second and an additional four have been negotiating with the government. Four of the companies are Philippine-owned.

A number of renewable energy technologies are handled separately from the geothermal program. The manufacturers of these were encouraged by a decision in 1979 to include them in the government's "preferred areas of investments." This classification granted manufacturers of nonconventional technologies:

(a) Exemption from all taxes except income tax, phased out over fifteen years (100 percent the first five years, 75 percent the next three years, etc.);

(b) Exemption from tariff duties and compensating tax on imported equipment and spare parts;

(c) Accelerated depreciation;

(d) Carryover for the following six years of net operating losses incurred in any of the first ten years of operation;

(e) Tax deduction for organizational and pre-operating expenses for a period up to ten years;

(f) Tax credit on domestic capital equipment up to 100 percent of the value of the compensating tax and customs duties that would have been paid on the machinery, equipment, and spare parts had these items been imported.

(g) Deduction of labor training expense to extent of one half the value of the expense, provided that the deduction does not exceed 10 percent of direct labor wages.

The cancellation of most tax preferences by the presidential decree of October 1984 (described in the preceding chapter) did not effect the "preferred areas of investment," and so these remain in effect.

As in the case of geothermal development, the government funded numerous R&D efforts in nonconventional technology, as well as research on commercial applications. In addition, the government tried to reduce both technical and economic risk by sponsoring surveys of the energy resources on the one hand and of the potential market for the technologies on the other.

A few additional incentives are offered to producers in specific programs. For example, the tree farms that are organized to provide fuelwood to the dendrothermal power plants are managed by farmers' associations. These associations receive concessional loans to set up the enterprise, are granted

their first-year living expenses, and are given long-term leases (25 years and renewable) on the land, for which they pay a very small yearly rental fee.

The gasifier industry in the Philippines was started by a government company, GEMCOR, in 1981 after several years of research principally at the University of the Philippines. Recently, two private companies have been inspired to enter the business, with cooperation from GEMCOR, but no special tax incentives have been established beyond the generic ones mentioned above.

4.1.5 California

Most of the incentives in California are for the users of renewable energy or the appropriate technologies, and were described in the previous chapter. But one final program, oriented toward producers, will be addressed here.

The State of California has a special loan program for small businesses that manufacture renewable energy or conservation technology. Many of these businesses have a difficult time obtaining a loan from a conventional lender or else are required to pay too high an interest rate. The state program charges them interest rates above the prime rate (the rate banks charge their best customers) but below what the banks would charge them. Approximately $3 million has been loaned since the program began in 1981.

4.2 MAINTAINING INCOME

No matter how many costs are kept down, a potential manufacturer or energy producer will not want to enter the business unless the prospect of a healthy and sustainable income exists. Revenues are created by the consumers or through subsidies from the government, and this section describes the chief incentives that have been established in the five focus locales (see Table 6 for a list).

4.2.1 Brazil

All incentives (with one partial exception) that fall into this category for the Brazilian ethanol program pertain most directly to the ethanol producers, but an incentive that serves to assure some income to the distilleries serves that same role, by extension, for the distilleries' suppliers, the sugar growers.

Brazilian sugar and ethanol producers are assured a market for their products, because the government contracts to purchase a substantial amount of the ethanol each year in concert with its target for production and use. During phase I the government fortified its role as a middleman offering a guaranteed market by requiring that all gasoline sold to consumers include 20 percent ethanol.

During phase II the confidence in the market was bolstered first by a requirement that all government-owned automobile fleets (state and federal) be composed of ethanol vehicles, and then secondly by agreements the government made with the automobile industry whereby the industry promised to manufacture a certain number of ethanol vehicles each year. The requirement concerning government fleets represented an assurance to the auto industry that there

Table 6 Government policies or incentives intended to assure or encourage income to producers.

CYPRUS

1. Duties on competing imports in Cyprus.
2. Government purchased limited, but significant, number of solar water heaters for several years.

BRAZIL

1. Annual guarantee of alcohol purchase by the government.
2. Long-term guarantee of market through government agreement with auto companies for manufacture of alcohol vehicles.
3. Long-term guarantee of market through requirement that all government-owned fleets be alcohol vehicles.
4. Long-term guarantee through government requirement that all gasoline include at least certain percentage of anhydrous alcohol.

PHILIPPINES

1. Government purchases all geothermal steam.
2. Government shares profits from sales of electricity with geothermal developer.
3. Government purchases all alcohol (although in limited amounts).
4. Guaranteed markets for wood from tree farms.
5. Guaranteed markets for gasifiers.

would be at least a small market for the autos, but in general that industry proceeded with its larger commitments on the faith that the government was determined to make the program work and that the incentives extended to consumers and ethanol producers would lead to success. The serious downturn in auto sales in late 1981 was met with new incentives by the government and technical improvements by the industry, and the commitment of both appeared confirmed.

4.2.2 India

No incentives that serve to assure a steady income to renewable energy product manufacturers in India are described in the two Indian papers in the Roundtable collection.

4.2.3 The Philippines

The Philippines provided guaranteed markets for geothermal steam, fuelwood produced on tree farms, alcohol fuel, and a portion of gasifier production.

In the case of geothermal steam production, the developers of the geothermal fields are guaranteed a market in the service contracts because the

state-owned National Power Corporation is committed to buying all the steam for use in its power plants. The contractor is paid a fixed fee per KWh generated plus 40 percent of the net proceeds from the whole operation.

The farmers associations that manage the tree farms are assured a market for the wood because they have entered into a contract with a rural electric cooperative that operates a dendrothermal plant. The cooperative, in fact, is responsible for assisting each association establish its farm and serves as a conduit for the financial assistance provided by the government to the association. The association is not, however, assured of an income separate from its production of wood, and for reasons related to poor forestry planning some of the Philippine farmers associations experienced some difficulties with production, as explained in the paper by Villegas and Lorenzo.

The government also purchases all alcohol produced as motor fuel and is responsible for its distribution in a blend with gasoline (alcogas). This governmental involvement does not offer as strong an assurance of a market as enjoyed by geothermal steam, however (or as strong an assurance as the alcohol program in Brazil), because the government does not have the resources to provide the subsidies that are necessary for a consistent and growing market.

Finally, gasifier manufacturers (until recently, a single government-owned corporation--GEMCOR) have been assured a captive market in part of the agricultural sector, because GEMCOR's parent agency is the Farm Systems Development Corporation (FSDC). The FSDC helps connect manufacturers with the agricultural market, and thus the latter has been a captive market for GEMCOR. This market has been crucial, because total sales have fallen far short of original targets and 80 percent of GEMCOR's clientele has been the government itself, serving as a middleman for farmers and fishermen.

4.2.4 California

The State of California does not offer any incentives that serve as a guarantor of significant income for any energy converters or technology manufacturers, with the possible exception of its recent purchase of 200 methanol automobiles for the state fleet and its establishment of a limited number of methanol pumps at service stations in a few major cities. The state has, however, purchased solar water heaters for a number of state buildings, wind generators to provide power needed to lift water at certain locations of California's massive aqueducts, and photovoltaics for use in remote locations.

—Chapter 5—
Issues for the Roundtable Discussion

Drawing out the lessons of experience with particular incentives and policies in Brazil, Cyprus, India, the Philippines, and California is the job of each individual Roundtable participant, and can only be a very tentative task for the authors of this overview paper. But the eight country papers deliver one inescapable conclusion to these authors: those who have written off renewable energy for developing countries as a development assistance and technology fad that has inconsequentially passed are refusing to look at the evidence which has accumulated. In a few locations, at least, progress is measurable in hundreds of megawatts and millions of barrels of oil equivalent.

Likewise, the introduction of ethanol fuel in Brazil and wind generators in California, to cite two examples that may be discussed during the Roundtable, has occurred in a time frame that was astonishingly compressed. Thus, governmental initiatives and promotional packages have worked very well in some cases. Indigenous resources and talent have been harnessed to deliver needed energy, and dependence on foreign sources of fuel has been reduced. Equally instructive, however, should be the programs abandoned, targets not met, and numerous more subtle or complex indications that perhaps a wrong path was pursued. And with limited resources, most governments will exercise caution.

But all the accomplishments -- or failings -- of the renewable energy field cannot be reiterated here. This short and final chapter will briefly summarize several key themes running through the eight country papers, and then raise for discussion a few questions pertinent to the broader rationale for government policy making.

The types of incentives put into effect by Brazil, Cyprus, India, the Philippines, and California fall broadly into two categories. Some incentives are aimed at stimulating consumer demand, while others are designed to reduce the risk or enhance the profitability of producers.

Five principal categories of consumer incentives have been established in this paper relating the incentives to their immediate goals. The dominant efforts in the five locales have been economic and financial, to make alternate energy sources and technologies economically and financially competitive with consumers' other options and to improve consumers' access to financing. Other types of incentives have been created to assure long-term reliability of technology operation and resource supply, to reduce non-economic costs of renewable energy, and to make consumers aware of the potential uses of a new technology or energy source.

The early rush to promote renewable energy use sometimes overlooked one key variable: the wishes of the energy user. The literature of renewable energy overflows with case studies of projects that failed because governments, aid agencies, manufacturers, and consultants all forgot to find out what the consumer really needed and wanted. Promotions that were technology-driven, as opposed to needs-driven, have usually misfired.

In response to the mood of crisis created by skyrocketing oil prices in the 1970s, the promotion of new energy technologies frequently raced ahead not only of consumer awareness, but also of the technology's capacity to deliver consistent, acceptable performance. In the past five years, however, many of the new technologies have closed this gap. And the recognition is increasingly widespread that premature promotion breeds excessive expectations which invariably cannot be met. Thus, many field tests of new energy technologies should never have been conceived or publicized as "demonstrations", with the implication that the technology was nearly ready for widespread use. Bona fide demonstrations of technically proven technologies are needed, it seems, but many countries have resisted financing them with public money.

Incentives to stimulate rapid introduction of a new technology, or efficient management of a resource, are perhaps simpler than demand-side incentives. Producer decision-making seems less burdened with ambiguity than consumer decision-making. Private sector producers want to reduce the risks of not being profitable, and they want to maximize their return on investment.

One of the primary concerns regarding producer incentives seems to be not whether they work, but whether they sometimes work too well, in the sense of encouraging the continued production of a product that would never succeed in the market place without permanent subsidies. The solution to this potential problem may be the gradual withdrawal of producer initiatives, preferably on a schedule that is publicized along with the original announcment of the incentives' availability.

A noticeable difference between the programs of incentives in Brazil, India, and the Philippines on the one hand (Cyprus has relatively minor financial incentives that are specifically for renewable energy), and California on the other, is the technology-specific nature of the developing country programs. Critics say this means that government bureaucrats and scientists control investment options, and that the most interested party -- the consumer risking his money -- has too little freedom. On the other hand, it is usually countered that California in particular, and the industrialized countries in general, have much discretionary capital floating freely, "looking for investments," whereas the developing countries cannot afford to encourage misdirected and expensive mistakes.

All countries' financial resources are limited and every decision or investment involves trade-offs. The full national benefits and costs of an investment in incentives for renewable energy programs have barely been addressed in this paper, but several aspects of this subject are mentioned in the Roundtable collection of individual country papers. Among the collection, the question is covered most directly in the debate about the ultimate value to Brazil of that country's national ethanol program. The Serra and Moreira paper raises the issue initially and cautions against any easy answers, and then the Homem de Melo paper aggressively focuses on what that author considers the relevant topics.

Technological success in the marketplace cannot be a government's only standard with which to evaluate possible incentives. The large wind farms in California, for example, would never have been built without tax incentives

(as well as other complementary laws and regulations), and few would be built in the foreseeable future if the incentives were removed. Larger benefits to the state were expected: principally the reduction of additional investment that might otherwise be required in conventional energy supplies.

Indeed, the starting point for determining whether to create renewable energy incentives may be the integration of governmental policies for renewable energy with policies governing conventional energy resources and use. Without this review, a government can hardly expect to create renewable energy policies that are consistent with and supportive of overall energy policy.

Beyond that basic sectoral consideration, every country will emphasize slightly different economic, social, or strategic factors in attempting to calculate the true social and economic benefits and costs of a national program to encourage the production and use of new energy sources. The ultimately political decision whether to bear the costs of establishing incentives, and what form the incentives will take, will be affected by many considerations broader than the effectiveness of the incentives. Some of these larger issues may include:

- To what extent is energy policy integrated with other development goals of the country? At one of the most aggregate levels, for instance, are poverty and the quality of life of the rural sector, particularly of communities living outside the "modern sector," high on the nation's political agenda? Does energy policy affect only the higher income groups?

- At a less aggregate level, is policy in the energy sector integrated with policy in other sectors such as industry, agriculture, and transportation? Different energy options may affect employment in one of those sectors, for instance, as Brazil's ethanol program affects the agricultural sector.

- Is integration between sectors actively reflected at the governmental level? Are policy makers in energy linked purposefully with policy makers in ministries of industry, agriculture, transportation, and trade? These links are valuable not only for the sake of governmental consistency, but to benefit from the other departments' knowledge of various user needs and their access to networks that can provide both advice and promotional possibilities.

- Have the relative advantages and disadvantages of encouraging the importation of technology been fully considered? How do various options affect the speed at which changes in the energy sector can occur? How does each option affect foreign exchange or domestic employment? Does a country wish to encourage joint ventures in order to facilitate the transfer of technology and skills, and what incentives would encourage or discourage such activities?

- How much disposable capital is available to be allocated to risk-taking, both by the private sector and by government?

- What is the ability or willingness of a country to undertake additional long-term debt to finance conventional energy projects, versus the opportunity (i it exists) to finance smaller projects where economic payback is measured in shorter periods?

This list is not meant to be all-inclusive but rather illustrative of the issues raised in the eight country papers that could not adequately be summarized here. For although the description of the technical content of incentives programs is instructive, Roundtable participants may benefit equally from gaining an understanding of the social and economic pressures that have caused some incentives programs to fail while others have succeeded.

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#1 The Brazilian National Alcohol Program: Incentives and Subsidies 1-1
Gil Eduardo Serra
Jose Roberto Moreira
Energy Company of Sao Paulo, Brazil

#2 The Brazilian Energy Policy and the Alcohol Program 2-1
Fernando Homem de Melo
Professor, Department of Economics
University of Sao Paulo
and Associate Researcher, Foundation-Institute for
Economic Research, Sao Paulo, Brazil

CYPRUS

#3 Utilization of Solar Energy in Cyprus 3-1
I. Papadopoulos
Senior Industrial Officer
Ministry of Commerce and Industry
Nicosia, Cyprus

#4 The Interaction of Governmental and Free Market Forces in the Development of Renewable Sources in Cyprus 4-1
Kyriacos Hadjikyriacos
DKA Kittis Associates, Ltd., Nicosia, Cyprus

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#5 Policy Measures for Promoting New and Renewable Energy Sources in India 5-1
C.P. Malhotra
Under Secretary
Department of Non-Conventional Energy Sources
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Center for Research and Communications (private sector)
Manila, Philippines