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An Analysis of Philippine Renewable Energy Programs and Policies

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I. INTRODUCTION

The Philippine has the potential of deriving much of its energy needs from renewable sources. It is blessed with a wide range of such sources: hydro, geothermal, biomass (alcohol, coconut oil and shell, agricultural waste, wood), wind, and solar. The government has recognized the potential of the country's renewable energy resources and has implemented programs to exploit them. The Philippines' achievement in developing both renewable and nonrenewable sources of energy has been impressive. Dependence on imported energy, basically oil, has been reduced from about 86% in 1974 to about 58% in 1984 (Table 1).

Indigenous energy production increased four-fold from 10 million barrels of oil equivalent (MMBOE) in 1974 to 39 MMBOE in 1984. Non-conventional energy[1] accounted for the biggest contribution among the various indigenous energy sources. It contributed 14.9 MMBOE in 1984, representing 15.9% of total commercial energy consumption.

An analysis of Table 1 and the components of nonconventional (Table 2) reveals that renewable sources account for a substantial amount of Philippine energy consumption.

This paper describes and analyzes Philippine renewable energy programs and policies (with emphasis on the geothermal, dendrothermal, gasifier, alcogas and cocodiesel programs) with the end in view of providing insights on the implementation of the programs.

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[1]Refers to those energy resources in which the conversion or utilization technology for large-scale applications are not as well-developed and/or widely used as those for fossil fuels, hydro and geothermal. In general, those resources would include biomass, wind and solar.

Table 1

Primary Energy Consumption, 1974 and 1984
(in million barrels of fuel oil equivalent)

		1974		1984
Imported Energy Source		60.22 (85.6%)		54.28 (58.0%)
Oil	60.22		52.67	
Coal			1.61	
Indigenous Energy Source		10.15 (14.4%)		39.34 (42.0%)
Oil	--		3.54	
Coal	.18		4.06	
Hydro	3.84		9.05	
Geothermal	--		7.81	
Nonconventional*	6.13		14.88	
Total		70.37 (100.0%)		93.62 (100.0%)

* - Excluding consumption of households

Source: Ministry of Energy

Table 2

Contribution of Nonconventional Energy
to Primary Energy Consumption, 1984

	Million barrels of fuel oil equivalent
Bagasse	6.57
Wood/Woodwaste (Excluding Dendrothermal)	3.99
Coconut Husk/Shell	3.15
Rice Hull	.71
Others	.46
Total	14.88

Source: Ministry of Energy

II. RENEWABLE ENERGY PROGRAMS

Work in geothermal energy started in 1964 when pilot studies were conducted in the Tiwi geothermal fields. On the other hand, work in nonconventional renewable energy was begun by the Ministry of Energy (MOE) in 1977 through the Nonconventional Energy Resources Division (NCRD) of its Bureau of Energy Development (BED). The division developed a program of R & D activities, most of which were contracted out. Among the initial projects funded dealt with direct solar applications (hot water heating, air-conditioning, crop drying), biomass (alcogas, pyrolysis of waste, biogas, dendrothermal), wind and mini-hydro.

In 1979, the Ministry of Energy felt the need to develop in-house research and development capability to have a fuller control of the timing of certain important projects even as it continued to provide overall administration to projects farmed out to external agencies. Thus, NCRD was spun off BED and elevated to the status of a semi-autonomous Center for Nonconventional Energy (CNED). CNED is actually an expanded version of the old NCRD. Its responsibilities included research and development. A headquarters building with its complex of research laboratories was set up at the Diliman campus of the University of the Philippines.

In mid-1981 the R & D functions of CNED were transferred to the state-owned Philippine National Oil Company (PNOC), an energy conglomerate; and the Energy Research and Development Division (ERDD) was created within PNOC for this purpose. R & D in conventional energy was added to ERDD's functions. Meanwhile, CNED's tasks of developing a nonconventional energy development program and funding nonconventional research and development projects were returned to BED's Nonconventional Resources Division (NCRD). In 1982, NCRD instituted a plan to accelerate the commercialization of selected technologies. It prioritized the technologies it considered for funding based on the assessments made in the earlier years and the following criteria:

1. The technology is well developed and close to commercialization.

2. If commercialized, the technology can make a significant displacement of conventional fuels.

3. The social benefits of using the technology clearly exceed the social costs.

At present, NCRD identifies the following areas of nonconventional energy as priorities:

1. Utilization of agricultural wastes as boiler fuel;

2. Producer gas systems;

3. Large-scale solar water heating;

4. Large-scale biogas systems;

5. Biomass-derived fuel for internal combustion engines; and

6. Utilization of nonconventional energy in village and farms to enhance productivity.

IIA. INCENTIVES

To encourage the private sector to participate in the geothermal and nonconventional development programs, the government instituted incentives for program participants. The incentives under the non-conventional program are discussed in this section while those under geothermal are discussed in Section IIB.

In 1977, Presidential Decree (PD) 1068 was promulgated. It directed the Energy Development Board (now Bureau of Energy Development) to accelerate the research, development, and utilization of nonconventional energy resources. The decree also listed incentives for users of nonconventional energy. The more significant ones are:

a. Costs incurred in the establishment and construction of nonconventional energy conversion facilities or equipment duly certified by the BED may, at the option of the taxpayer, be directly chargeable to expense and shall be fully deductible as such from gross income in the year such expenses were incurred.

b. Exemption from payment of tariff duties and machinery compensating tax on the importation of machinery and equipment, and spare parts and all materials required in the establishment and construction of nonconventional energy facilities.

Filipino entrepreneurs were also encouraged by the government to manufacture nonconventional energy devices. As provided by a Letter of Instructions promulgated in 1979, an Energy Priorities Program[2] was included in the Board of Investments' (BOI) pioneer preferred areas of investments. Thus, manufacturers of nonconventional energy devices can avail themselves of the following incentives among others:

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[2]The program covered manufacture of mini-hydro turbine generators, alcohol production for fuel, manufacture of solar water heaters, manufacture of standardized biogas equipment, power production using nonconventional fuels including handling activities and facilities related thereto and conversion to coal, geothermal and other nonconventional fuel.

1. Deduction from taxable income of organizational and pre-operating expenses for a period of not more than 10 years from the start of operation.

2. Deduction of accelerated depreciation expense.

3. Carryover for the following six (6) years of net operating losses incurred in any of the first ten (10) years of operation.

4. Exemption from tariff duties and compensating tax on imported equipment, machinery and spare parts to the extent of 50% of taxes and duties payable within 7 years from the date of registration.

5. Exemption from all taxes (except income tax) under the National Internal Revenue Code. The extent of exemption is 100% for first five years, 75% for 6th through 8th years, 50% for the 9th and 10th year, 20% for the 11th and 12th year, 10% for the 13th through 15th year.

6. Tax credit on domestic capital equipment to 100% of the value of the compensating tax and custom duties that would have been paid on the machinery, equipment and spare parts had these items been imported.

7. Deduction of labor training expense to the extent of 1/2 the value of the labor training expense provided that the deduction does not exceed 10% of direct labor wages.

The incentives provided by PD 1068 have been withdrawn with the promulgation of PD 1955 on October 10, 1984. PD 1955, which was passed to help the government alleviate the continuing economic crisis, withdraws all exemptions from or any preferential treatment in the payment of duties, taxes, fees, and imposts and other charges heretofore granted to private business enterprises and/or persons engaged in any economic activity except: (1) those registered by the BOI, and the Export Processing Zone Authority (EPZA); (2) the copper mining industry; (3) those covered by international agreements to which the Philippines is a signatory; (4) those covered by the non-impairment clause of the Constitution; and (5) those that will be approved by the President of the Philippines upon the recommendation of the Minister of Finance.

Efforts are being made to restore the incentives of PD 1068 by seeking exemptions from the provisions of PD 1955.

The government also instituted incentives for the development of conventional energy resources. In December 1972, Presidential Decree (PD) 87 or the Oil Exploration Act of 1972, was promulgated adopting the service contract system in oil exploration. This system is based on a "profit-sharing" concept which upholds the sovereignty of the producer country over its resources. At the same time it assures the investing company of a share of the profit. The service contractor also exercises full management control, thereby enabling him to manage his interests without crippling restrictions. Among the incentives given to service contractors are: exemption from tariff duties and compensating taxes in the importation of

machinery, spare parts and materials for operations; repatriation of capital investments actually brought into the country; and the remittance abroad of foreign-exchange earnings in excess of operating requirements.

In July, 1976, PD 972 or the Coal Development Act of 1976 was promulgated. The decree introduced the service contract system, which was earlier proven to be successful in the oil sector. Under this system, the contractor has to perform certain minimum work commitments with corresponding expenditures for a definite period. To further ensure compliance with his obligations, he is required to post a performance bond. To attract qualified companies, PD No. 972 offers the following incentives:

- Exemption from all taxes except income tax;
- Exemption from payment of tariff duties and compensating taxes on imported machinery, equipment, spare parts and supplies;
- Accelerated depreciation;
- The right to remit the necessary foreign exchange to cover the payment on the principal and interest on foreign obligations arising from technological assistance contracts relating to the performance of the coal operating contract;
- Preference in the grant of government loans; and
- Entry of alien technical and specialized personnel including members of their families.

For assuming the exploration risk, the service contractor is entitled to a reimbursement of his capital and operating costs, and a share in the net proceeds from production based on the agreed split between him and the government. PD 972 was amended in July, 1977 to make coal mining even more attractive to private companies by increasing the cost recovery ceiling and the contractor's share of the net proceeds.

PD 972 also provides the following incentives to enterprises which convert their existing oil-fired plants to coal:

- Tax exemption on imported capital equipment for coal conversion;
- Tax credits on capital equipment bought domestically;
- Net operating loss carryover;
- Capital gains exemption; and
- Accelerated depreciation.

IIB. GEOTHERMAL PROGRAM

The Philippines embarked on a geothermal energy program long before the energy crisis of the early 70s. In 1964, the Commission of Volcanology (now called the Philippine Institute of Volcanology) started conducting scientific and pilot studies in Albay province. In 1967, a small turbo-generator was run for the first time by geothermal steam. In 1969, a 2.5-kw noncondensing geothermal pilot plant was set up. This showed the country the potential power capability of geothermal energy.

In 1970, the government declared 17,660 hectares of land in Tiwi, Albay as a geothermal reservation area and gave the National Power Corporation (NPC), the state-owned electric utility firm, the responsibility to administer the exploration/development of the Tiwi field through a service contract with the Philippine Geothermal Incorporated (PGI), a subsidiary of Union Oil Company of California--the principal operator in The Geysers geothermal fields in California. NPC and PGI under a joint venture agreement also undertook the exploration/development of Makiling-Banahaw (MAK-BAN) geothermal field in Laguna in 1974. In these undertakings, PGI and NPC shouldered 45% and 55% of the development costs, respectively. In the production phase, PGI sells steam to NPC under a contract agreement.

The success of NPC and PGI in the two geothermal fields enccuraged the government to proceed in the assessment of other potential geothermal areas in the country through foreign assisted projects. The Philippine government entered into bilateral agreements with New Zealand, Italy, and Japan which have the technical expertise in the use of geothermal energy. Through these bilateral agreements, two additional geothermal fields (Tongonan in Leyte province and Palinpinon in Negros Oriental province) were explored in 1976. The exploration was undertaken by the PNOC-Energy Development Corporation (EDC)[3] with the technical assistance of the New Zealand government and the financial assistance of the Japanese government.

The creation of the Ministry of Energy in October 1977 to coordinate and regulate energy development and utilization in the country further boosted the government's geothermal program. The Ministry, through its Bureau of Energy Development (BED) was tasked to administer certain policies and guidelines covering the development of geothermal resources. These geothermal operations, policies, and guidelines are embodied in Presidential Decree 1422 passed in June 1978. PD 1422 introduced the service contract system for geothermal exploration and development of potential geothermal resources in which the prospective developer enters into a service agreement with BED, for geothermal operations in a given area.

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[3]PNOC-EDC is a subsidiary of the Philippine National Oil Company (PNOC)--a government-owned company whose responsibilities include the exploration and development of indigenous energy resources. When PNOC-EDC was created, the function of geothermal development was spun off from NPC (except the ongoing projects in Tiwi and Mak-Ban) so that NPC would concentrate on its overall power planning and plant construction operations.

Under the service contract system, the contractor provides the necessary expertise, financing, and technology. In turn, it receives a maximum of 40% of the net proceeds for the selling of steam. The net proceeds would be the difference between the gross value of the geothermal operations and the necessary expenses incurred in the operations.

PD 1422 provides the following privileges to geothermal service contractors:

1. Exemption from payment of tariff duties and compensating tax on the importation of machinery and equipment and spare parts and all materials required for geothermal operations subject to such conditions as may be imposed by the Director of BED;

2. Entry, upon the sole approval of the BED which shall not be unreasonably withheld, and subject to such conditions as it may impose, of alien technical and specialized personnel (including the immediate members of their families);

3. Repatriation of capital investment and remittance of earnings derived from its service contract operations, as well as payments of interest and principal of foreign obligations subject to the regulations of the Philippine Central Bank; and

4. Exemption from all taxes except income tax.

The service contract system attracted several private companies (e.g., Caltex Philippines, Total Exploration/Philippine Oil, Geothermal Exploration Inc. (TOTAL/POGEI), and Ultrana Nuclear and Minerals Corporation [with Canada Northwest Energy, Ltd.]) to undertake geothermal exploration.

IIC. DENDROTHERMAL PROGRAM

Taking off from basic research done by the National Science and Development Board (NSDB) and the Forest Products Research and Industries Development Commission (FORPRIDECOM) in late 1977, CNED pushed the concept of energy plantations. Subsequently, the National Electrification Administration (NEA) was directed to disperse such systems all over the country.

The basic model of the program is a 3MW wood-fired steam thermal plant. The requirement of wood, estimated at 100 dry tons per day, will be met by developing ipil-ipil (Leucaena leucocephala) plantations in areas of about 1,000 hectares each. The plantations will be developed and harvested in such a manner that about one-fourth of the area will be used for wood supply every year after the four-year crop cycle is established.

The plantation will be developed in 10 modules of 100 hectares each run by a farmer's association comprising 10 to 15 farmers. This would require 100-150 farmers to be engaged in plantation activity. Combining power with rural development and settlement objectives, the program targeted "kaingineros" (slash-and-burn cultivators) as the tree farmers. They are

given soft loans initially for financing their tree-planting and living costs through the first harvest.

The land for the plantations is government owned, marginal and unused. It will be leased to the farmer's association for 25 years which is renewable for a second 25 years. A nominal fee of $2.70 per year is charged for a 100-hectare module.

The market is the rural electric cooperatives. There are over 100 such cooperatives spread all over the country. A typical cooperative has a demand in the 6 to 8 MW range. The dendrothermal plant is geared to supply the base load for a single cooperative.

Under the program, the rural electric cooperative owns and operates the dendrothermal plant. It coordinates and finances the development of the tree farms set up to supply the power plant.

Two loans are made by NEA to the cooperative. One loan is to cover the cost of purchasing and installing the power plant equipment. The second is to cover the costs of developing the tree farms through first harvest. The cooperative relends the second loan to the farmers.

The management structure used for project development is shown in Table 3.

It is estimated that the generation costs of dendrothermal power plants will be about $.056 per kilowatthour. This is lower than the marginal cost of generating electricity in Luzon which was calculated at about $0.08[illegible] per kilowatthour by a World Bank team in 1981.[4]

IID. GASIFIERS PROGRAM

The state-owned Farm System Development Corporation (FSDC) had been developing small, pump-fed irrigation systems for some number of years. Many of these irrigation systems relied on diesel-driven pumps to supply the required water. When the price of diesel continuously increased, pressure to develop cheaper fuel for the irrigation pumps was felt. In 1978, FSDC installed 3 pilot models, relying on the research conducted at the University of the Philippines on gasifier-fueled irrigation pumps at its demonstration center in Valenzuela, Bulacan.

The initial gasifier equipment was crude but its economics promising. It appeared that pumps, operating on a mixture of woodgas and diesel, had fuel costs about one third less than that of pure diesel operation. This experience convinced the government to go ahead with a large scale pilot operations program. Experimental work and development of prototypes continued at a rapid pace. In February 1981, the first demonstration model of a gasifier-fueled jeepney was driven to the presidential residence at Malacanang.

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[4]Frank H. Denton, Wood for Energy and Rural Development, The Philippine Experience (Manila, Philippines, 1983), pp. 202-203.

Table 3

Management Structure of
Dendrothermal Programs

Management Entity	Tree Farm	Transport System	Power Plant
Electric Cooperative	Technical Advice Plan and Coordinate Loan Releases	Final Review	Final Review
Engineering Consultant	Road Lay-out	Design Construction Supervision	Civil Works Design Construction Supervision
Contractor	Road Construction	Construction and Installation	Construction and Installation
Equipment Supplier		Installation Review	Certification and Test Run
NEA	Technical Consultation Audit	Oversight	Oversight Acceptance

Source: Frank Denton, Wood for Energy and Rural Development, The Philippine Experience, p. 36.

In the first half of 1981 some thirty government vehicles were retrofitted with gasifier units. In June, a rally for gasifier equipment vehicles was held. The rally covered a distance of 1,500 kilometers over a variety of roads. Many minor problems surfaced but the basic technology was proven workable.

In August 1981, the government set up the Gasifier and Equipment Manufacturing Corporation (GEMCOR) to encourage the development and use of gasifiers by manufacturing equipment and developing technology. Among the members of the Board of Directors are the First Lady and Minister of Human Settlements (Chairperson), Minister of Public Works and Highways (Vice-Chairman), National Food Authority (NFA) Administrator, National Electrification Administration (NEA) Administrator, FSDC Administrator and the National Irrigation Administration (NIA) Administrator.

A plant with a capacity of 2,000 units was constructed in Carmona in the province of Cavite. The plant's capacity was doubled to 4,000 units under an

expansion program conducted in late 1982. 1983 was a trying year for the corporation. Reduced government and private sector spending drastically limited the gasifier market. This forced GEMCOR to re-orient its priorities and develop gasifier products with strong market potentials in the private sector. Responding to the numerous inquiries from process plant owners and engineers on how gasifiers can be retrofitted to kilns and dryers, GEMCOR developed, tested and put on the market a Direct Heat System (DHS) gasifier model. The DHS model was used for process heating and is easily adaptable to drying ovens, kilns, furnaces and other industrial as well as agricultural applications.

The slash in GEMCOR's activities for 1983 resulted in a corresponding reduction in its workforce. From a year-end 1982 employee level of 242, GEMCOR's workforce plunged to 151 in December 1983.

In fulfillment of its mandated mission and in order to implement its programs, GEMCOR established institutional linkages with the following government agencies:

FSDC - FSDC, being GEMCOR's mother corporation, assisted the latter in program implementation by way of extending soft loans to Integrated Service Association (ISA) for the acquisition of gasifiers for their irrigation systems, bancas, ice plants and jeepneys. These loans are made through the KAISA's (Katipunan Integrated Services Association), the umbrella organization of ISAs. The KAISAs also serve as dis- tributors. The distributors are strategically located in each of the country's 13 capital regions.

NIA - Through a Memorandum of Agreement, NIA and GEMCOR jointly undertook a pilot project on the application of the gasifier to a bulldozer.

NEA - Linkages between GEMCOR and NEA had been established as early as 1982. Since then, NEA has been a cooperating agency of the corporation. The tie-up involved retrofitting bancas and pick-ups assigned to NEA's electric cooperatives all over the country with gasifiers.

NFA - In 1982 FSDC turned over to GEMCOR the responsibilities specified by its Memorandum of Agreement with NEA. As part of the implementation of this project, GEMCOR fielded one gasifier retrofitted into an 11 HP diesel engine-powered generator for a rice mill at the NFA in Quezon province. Through this demonstration, technical data was gathered for evaluation of the applicability of gasifiers for NFA's ricemills.

MNR - GEMCOR entered into a memorandum of agreement with FSDC and the Philippine Fisheries Development Authority (PFDA), a government-owned corporation under the Ministry of National Resources (MNR), to develop and improve the gasifier for full marine use.

To complement the national thrust of actively promoting the use of gasifiers to all possible applications specially in the low and middle income groups, GEMCOR, in coordination with FSDC has initiated efforts to make financing available to interested parties for gasifier acquisition. As mandated under Executive Order No. 673, GEMCOR coordinated with government-owned financing institutions e.g., Land Bank of the Philippines (LBP), Development Bank of the Philippines (DBP), and Philippine National Bank (PNB) in order to develop and implement liberal lending programs.

Presently, GEMCOR is manufacturing gasifiers for a number of uses:

Internal Combustion Engines for

- Small buses (jeepneys)
- Small fishing boats (bancas)
- Portable ice plants
- Irrigation pumps
- Ricemills
- Small electric generator sets

Direct Combustion Use for

- Lime kilns
- Crop drying

The R & D efforts of the Corporation are now focused on improvement of existing gasifier models and the design and fabrication of new prototypes.

GEMCOR has also entered into a licensing agreement with two private companies for the manufacture of gasifiers. The private companies manufacture gasifiers using GEMCOR's designs.

IIE. ALCOGAS PROGRAM

The large amount of energy it consumes prodded the government to find alternative fuel for the transportation sector which is both indigenous and renewable. This led to government efforts to develop alcohol as a possible alternative.

As early as 1976 the Philippines, through PNOC, conducted experiments in the use of alcogas (alcohol/gasoline) blend. Data were gathered in road tests and the results pointed on the need to use anhydrous (waterless) alcohol instead of locally available hydrous alcohol. Technical information was also exchanged with countries which were technologically more advanced in the development of alcogas, particularly Brazil.

The alcogas program was formally launched in mid 1979 with the creation of an inter-agency Presidential Alcogas Committee whose chairmanship was shared by the Ministry of Energy and the Chairman of the Philippine Sugar Commission. This committee was given the task to design and recommend a suitable alcogas program for the country for immediate implementation.

In early 1980, the Philippine National Alcohol Commission (PNAC) was organized to implement the alcogas program. It was chaired by the Minister of Energy and included the Chairman of the Philippine Sugar Commission (as Vice Chairman) and the Ministers of Agriculture, Industry, Finance and National Resources, and private sector representatives as members. The implementation of the alcogas program was envisioned to be the responsibility of the following agencies concerned as directed and coordinated by PNAC:

Philippine Sugar Commission - Shall promote the establishment of alcohol distilleries, whether public or privately owned, and insure the adequate supply of sugar cane for the production of alcohol;

Ministry of Energy - Through the Philippine National Oil Company, shall be the exclusive buyer of alcohol produced for use as motor fuel and shall be responsible for the distribution of alcogas;

Ministry of Agriculture - Shall study the technical aspects and problems of alcogas production from agricultural crops such as cassava, corn and sorghum, including the economic cost analysis thereof;

Ministry of Industry - Shall promote the manufacture of car and truck engines that can most efficiently accommodate the use of alcogas as motor fuel; and through the Board of Investments, process and approve applications for establishing projects related to the implementation of the alcogas program;

Ministry of Finance - Shall study and make recommendations on the extent of reduction or elimination of sales tax on alcohol, to enable alcogas to compete effectively with gasoline prices at the pump stations;

Ministry of National Resources - Shall identify new land areas of the public domain that can be made available for the production of agricultural crops such as sugar cane, corn, cassava and sorghum to be used as feedstock for the production of alcohol.

Moreover, the private sector was expected to provide the bulk of the investment and managerial resources in both the industrial and agricultural aspects of the program.

On September 11, 1980, alcogas (15% alcohol, 85% gasoline) was launched in Negros Occidental province using the anhydrous alcohol production of the Victorias Milling Company's distillery in the town of Manapla. Alcohol was blended into both grades of gasoline. The alcogas mixtures were sold at the same price as the pure grades of gasoline. The sale of pure grades of gasoline in Negros Occidental was stopped when alcogas was launched.

The following incentives were implemented to promote the use of alcogas:

1. Extending 60-day credit to gasoline dealers for first order of alcogas.

2. Granting commissions to gasoline dealers to improve availability of alcogas.

3. Enlisting vehicles to an Alcogas Demonstration Run Program. Participants were given fuel rebates for a maximum alcogas consumption per day per vehicle over a period of three months.

Initial resistance brought about by information dissemination problems was encountered. The communication and marketing problems were so serious that motorists were blaming alcogas for everything that went wrong with their cars, including flat tires.

In May, 1981, a Motorists' Assistance Program which provided free clean-up and tune-up services in Bacolod City was implemented. In August, 1981 the sale of pure premium gasoline was resumed due to the clamor of consumers. Also the alcogas sold was limited to the regular grade and its price reduced making it about 25 centavos (US$0.03) per liter lower than pure regular gasoline.

In October, 1981, regular alcogas was introduced in Negros Oriental, the other province in Negros Island. Then in April, 1982, alcogas was launched in the four provinces (Iloilo, Capiz, Aklan and Antique) of Panay Island. A while later, in December, 1983, the alcohol content in regular alcogas was increased from 15% to 20%. And in November, 1984, the alcogas discount was increased to 37 centavos (US$0.02) per liter.

In support of the alcogas program, the National Institute of Biotechnology and Applied Microbiology (Biotech), a research and development agency which mobilizes and trains Filipinos in genetics, microbiology, chemistry and engineering in order to provide technological support to national development objectives such as energy and food production, is undertaking research and development activities on how to produce alcohol from various raw materials and cut time and costs required in the fermentation process.

IIF. COCODIESEL PROGRAM

The use of crude coconut oil and blends of this with diesel oil has been proven technically feasible in many experiments conducted in the Philippines from 1976 to 1981.

The cocodiesel program was conceived in 1981 when the export of coconut oil went as low as US$0.37/kg. At that price, hardly any government subsidy was required to implement the program.

In September 1982, a nationwide coconut oil-diesel program using a blend of 5% crude coconut oil and 95% diesel oil was implemented. In these proportions, the specifications of the blend hardly differed from those of pure diesel fuel. When the program was implemented, the export price of coconut oil increased to US$0.44/kg. and a small government subsidy became necessary.

Unlike its alcogas counterpart, the cocodiesel program lacked an institutional back up and a more concrete scheme of implementation. The ad hoc nature of the cocodiesel program depended on domestic coconut production and the international market price of coconut oil. Unlike the alcogas program, which is coordinated by several government agencies, the cocodiesel program is under the sole administration of the Philippine Coconut Authority.

After about two months of the program, operational difficulties appeared when complaints of fuel-filter clogging were received from some bus operators. A cocodiesel task force was formed to look into the problem. Investigations revealed that a gelatinous substance which appeared to be a form of micro-organic growth was causing the problem. Examination of the storage tanks, from which coconut oil-diesel was supplied to the complaining bus operators, indicated a build-up of this gelatinous substance in the bottom of the tanks. This was analyzed to be a combination of normal diesel sludge and accumulated dirt, as well as fungal and bacterial growth. It appeared that the presence of water at the bottom of the tanks was providing a good environment for micro- biological growth.

A decision was then made to stop blending crude coconut oil with diesel fuel and to use instead a type of semi-refined coconut oil called "cochin oil." However, the high price of coconut oil in early 1983 made the cabinet suspend the program. Continuing the program would have required a substantial government subsidy.

In April 1983, a ten-month monitoring program for the cochin oil- diesel blend was started with 168 passenger buses of the state-owned Manila Metropolitan Transit Corporation (MMTC). The findings showed that a blend of 5% cochin oil in diesel did not result in the same microbial-growth problem previously encountered with crude coconut oil.

III. PERFORMANCE OF GEOTHERMAL, DENDROTHERMAL, GASIFIERS, ALCOGAS AND COCODIESEL PROGRAMS.

A. Geothermal

The exploration and development of geothermal resources have advanced rapidly since the first well was drilled in 1971. Geothermal installed capacity increased from 3 MW in 1978 to 894 MW in 1984 (Table 4).

Table 4

Geothermal Installed Power Capacity, 1978-84
(in megawatts of electricity)

Geothermal Field	1978	1979	1980	1981	1982	1983	1984
Tiwi	-	110	220	220	330	330	330
Mak-Ban	-	110	220	220	220	220	330
Tongonan	3	3	3	3	3	115.5	115.5
Palinpinon	-	-	3	3	3	118.5	118.5
T o t a l	3	223	446	446	556	784	894

Source: Ministry of Energy

In 1984, geothermal energy accounted for about 8% of total energy consumption and 24% of power generation (Tables 5 and 6). It is competitive with other sources of electricity in terms of production cost per kilowatt hour and investment requirement per megawatt (Table 7).

Table 5

Share of Geothermal to Total Energy Consumption
(in million barrels of oil equivalent)

	1979		1984	
	MMBOE	%	MMBOE	%
Imported Energy Source				
Oil	70.50	78.62	52.67	56.26
Coal			1.61	1.72
Indigenous Energy Source				
Oil	7.81	8.01	3.54	3.78
Coal	0.82	.01	4.06	4.34
Hydro	4.80	5.36	9.05	9.67
Geothermal	1.06	1.18	7.81	8.34
Nonconventional	5.31	5.92	14.88	15.89
Total	89.67	100.00	93.62	100.00

Source: Ministry of Energy

Table 6

Share of Geothermal Energy to Power Generation
(in gigawatthours)

	1979		1984	
	GWH	%	GWH	%
Hydro	2,868	20.64	5,167	27.68
Oil-based	10,368	74.63	8,536	45.73
Coal-thermal	-	-	423	2.27
Geothermal	657	4.73	4,540	24.32
Total	13,893	100.00	18,666	100.00

Source: NPC

Table 7

Capital Investment and Production Cost of Various Electricity Sources, 1984

Source	Capital Investment per Megawatt (million US$)	Production Cost per kilowatthour* (US cents)
Geothermal	1.41	2.70
Hydro	1.73	1.41
Coal	1.24	4.32
Oil	.70	6.49

* - Including interest

Source: NPC

Although the achievements in geothermal energy development are very impressive, they fall short of the original targets. For example, the 1981-85 Energy Program targeted 1,726 MW of geothermal generating capacity by 1985 while the 1982-87 Energy Program targeted 1,554 MW by 1987. Based on present and programmed activities, geothermal generating capacity is projected to reach 1,004 MW in 1988 with the expected operation of Bacon-Manito (Bac-Man) in Albay and Sorsogon provinces.

Achievements could have been higher if the original plans for Tongonan and Palinpinon were implemented. The geothermal development program was scaled down because the expected demand for power in the two islands where the geothermal fields are located did not materialize--the mining companies in Negros Island where Palinpinon is located stopped operations while the industrial complex in Leyte where Tongonan is located did not attract as many industries as expected. These two sites have large proven field capacities: 390 MW (115.5 MW installed capacity) for Tongonan and 218 (118.5 MW installed capacity) for Palinpinon which could be tapped. The feasibility of linking through submarine cable, the two islands to other islands where there are substantial power demands is still being studied.

The success of the geothermal program can be mainly attributed to the strong political will to develop indigenous energy sources and the vigorous government support for the program. The strong leadership of the Ministry of Energy and PNOC with the help of other countries like Japan and New Zealand who shared not only their technical expertise but also their financial resources, are the other important contributing factors to the success of this undertaking.

IIIB. Dendrothermal

A review of the areas planted to ipil-ipil from 1980 to 1984 reveals that there has been a marked decrease in hectarage in the last two years (Table 8). This is basically due to the reduced government funding for the program.

Table 8

Status of Plantation Development

	Area Planted (hectares)	Area Surviving (hectares)	Survival Rate,%
1980	1,544	405	26.23
1981	6,050	1,821	30.01
1982	6,090	3,024	49.66
1983	3,801	2,495	65.64
1984	342	272	79.53
T o t a l	17,827	8,017	44.97

Source: NEA

Table 7 also shows that survival rates have improved through the years. The low survival rates in the early years were mainly due to:

1. Little knowledge about the habitat and growing requirements of ipil-ipil. Soil was not suited for ipil-ipil at some sites yet this was not fully realized until after planting had taken place.

2. Institutional problems caused delays at a number of locations which resulted in planting being undertaken too late in the rainy season to ensure survival during the dry season.

The survival rates improved in the latter years because NEA became more selective in the sites to be planted.

With regard to the dendrothermal power plants 4 with a capacity totalling 10 MW have been commissioned, 4 are nearing completion although the construction of 6 has been halted because of funding problems. Of the 4 operating dendrothermal power plants, 2 are still undergoing modifications and adjustments.

Based on its performance to date, the program is way below its original target of 114 MW capacity by 1985 and would be hard pressed to meet the revised target of 200 MW installed capacity by 1990. The delay in the program can be attributed to the technical difficulties encountered in the development of the tree farms and in the operation of the dendrothermal power plants. These were compounded by the reduced funding made available by the government because of budgetary constraints.

IIIC. Gasifiers

As of December 31, 1983, GEMCOR had sold 980 units of gasifiers (Table 9). The sales trend from 1980 to 1983 does not augur well for the Seven-Year Gasifier Development Program which tasks GEMCOR to manufacture about 72,000 units from 1983-1989.

Also, about 80% of GEMCOR's sales have been accounted for by the government. Institutional sales for projects of various government programs for farmers and fishermen constitute the bulk of sales closed.

Table 9

Gasifiers Sales, 1980-83

Application	1981	1982	1983	Cumulative
Irrigation	57	247	125	429
Power Generator	-	8	24	32
Rice Thresher	-	2	2	4
Bancas (small boat)	-	301	18	319
Jeepney	20	119	47	186
Truck	-	4	3	7
Direct Heat System	-	-	3	3
T o t a l	77	681	222	980

Source: GEMCOR

With regard to profitability, GEMCOR realized profits in 1982 and registered losses in 1981 and 1983 (Table 10).

Table 10

GEMCOR's Sales and Profits, 1980-83
(in million US$)

	Sales	Profits
1981	.15	(.07)
1982	.87	.05
1983	.40	(.30)

Source: GEMCOR's Annual Reports

Presently, stationary type gasifiers are gaining acceptance in the market. More and more private companies are turning to gasifiers because of the spiraling costs of fuel oil. The same cannot be said with regard to mobile type gasifiers. Despite the reputed attractive economic benefits of installing gasifiers in vehicles, very few private users have done so. It is estimated that of the 186 gasifiers installed from 1981 to 1983 (mostly on government vehicles) only about 10% is still in use. The low usage can be attributed to the following disadvantages of gasifiers for vehicles:

1. loss of power for spark ignition engines (about 25 to 30%).

2. inconvenience (20 minutes warm-up period).

3. some increased maintenance (cleaning of ash twice a week and of filters once a week).

4. some loss of payload (10% for small vehicles, 2 to 3% for larger buses and trucks.

These disadvantages were voiced by some quarters before but gasifiers for vehicles were launched nationwide despite forebodings on their feasibility.

IIID. Alcogas

A review of the sale of alcogas in the last five years reveals that they are much lower than initial targets (Tables 11 and 12).

Table 11

Alcogas Sale, 1980-84

	Alcogas Volume (kiloliters)	Equivalent Alcohol Volume (kiloliters)	Share of Alcogas of Gasoline Market in Project Area, %
1980[1]	19,980	2,573	30
1981[2]	46,081	6,912	67
1982[3]	32,874	4,931	29
1983[4]	28,327	4,249	28
1984	25,226	5,045	26

[1]Alcohol blended with both grades of gasoline in Negros Occidental beginning September, 1980.

[2]Alcohol blending limited to regular gasoline in Negros Occidental effective August 1981.

Regular alcogas introduced in Negros Oriental in October 1981.

[3]/Regular alcogas introduced in Panay Island in April 1982.

[4]/Alcohol content in regular alcogas blend increased to 20%.

Source: PNAC

Table 12

Philippine Alcogas Program--Original and Revised Targets

	Targeted Anhydrous Alcohol Production (kiloliters)	
	Original	Revised
1980	22,000	-
1981	55,000	-
1982	144,000	10,000
1983	244,000	13,500
1984	400,000	18,600

Source: Armas & Joyce, "Economic Evaluation of the Philippine Alcogas and Cocodiesel Programs."

The poor performance of the alcogas program vis-a-vis targets is purely due to economic reasons. The government had to subsidize the alcogas program from 1980 to 1983 due to the higher cost of anhydrous alcohol vis-a-vis regular gasoline. Because of this subsidy, the government was forced to scale down the alcogas program. However, the large increase in gasoline prices in 1984 have resulted in cheaper anhydrous alcohol vis-a-vis gasoline prices enabling the government to increase the alcogas discount.

In terms of fuel economy and power alcogas is claimed to be at par or even better than regular gasoline because of:

- more complete combustion - It requires less air to burn alcohol than gasoline. This gives the gasoline component in the blend extra amount of air it needs for burning. This results in more complete burning of the fuel charge thus, eliminating the build-up of carbon; and

- better anti-knock property - Alcohol when added to gasoline has been found to reduce its knocking tendency. The octane number of regular alcogas is 90 while that of straight regular gasoline is 83.

A bright prospect in the alcogas program is the present study being conducted by PNAC, PNOC-Alcohol Corporation and an Oil Industry Committee on the technical and economic feasibility of substituting anhydrous alcohol for tetra-ethyl lead, an octane-enhancing additive in gasoline. The results of the study are expected to be issued shortly.

III-E. Cocodiesel

A review of the performance of the cocodiesel program reveals that its achievement is very much lower than initial targets (Table 13).

Table 13

Actual and Targeted Consumption of Coconut Oil as Fuel
(thousand barrels of oil equivalent)

	Actual	Targets
1982[1]	30	343.27
1983[2]	*	343.27
1984	*	343.27
1985		343.27
1986		343.27
1987		343.27

*Minimal

[1]The nationwide coco-diesel program was launched in September, 1982.

[2]The program was suspended in February 1983.
Cochin oil-diesel blend tested in April, 1983.

Source: Ministry of Energy

Like the alcogas program, the poor performance of the cocodiesel program is purely due to economic reasons. The program was suspended after only a few months of implementation because of the high price of coconut oil. Continuing the program would have required a huge subsidy (about $60 million annually) from the government.

In terms of fuel economy, cocodiesel (5% crude coconut oil and 95% diesel oil) is at par with pure diesel oil.

The fluctuating price of coconut oil in the world market (Table 14) dictates that the cocodiesel program can only be pursued when coconut oil prices are low. A positive development is the ongoing government program of replanting coconut farms with high yielding varieties. This is expected to increase the productivity of coconut farms and supply of coconut oil.

Table 14

International Price of Coconut Oil
(US cents/lb.)

	Annual Average
1975	18
1976	19
1977	26
1978	31
1979	45
1980	31
1981	26
1982	21
1983	33
1984	49

IV. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The Philippine renewable energy program that was implemented in response to the energy crises is now bearing fruits. Geothermal energy now accounts for a substantial percentage of power generation. Several dendrothermal power plants are now in operation and some more are nearing completion. Gasifiers are now used to power irrigation pumps and their use for other purposes is gaining acceptance. Alcogas is presently sold in 5 of the country's 73 provinces. Cocodiesel has been proven to be technically feasible as substitute for diesel fuel. These sources are expected to increase their share in total energy usage in the coming years.

The success of the Philippine renewable energy program can be attributed to the strong political will exercised to develop indigenous energy resources in order to lessen the country's dependence on imported energy. Moreover, the provision of massive financial and institutional government support for the program is noteworthy. Government institutions and enterprises like the MOE, PNOC, NFC, NEA, FSDC, GEMCOR and PNAC are in the forefront of the renewable energy program.

The government also set the right environment for the private sector to go into renewable energy development by providing incentives to users and developers of renewable energy.

Although the renewable energy program is generally successful, its performance is below the targets set for it. The variance can be explained by the fact that the initial targets set were quite ambitious especially for those that involved new technology e.g., gasifiers and dendrothermal. Also, the alcogas and cocodiesel programs were scaled down and suspended respectively because of economic reasons--the government would have incurred huge deficits if the programs were pursued as originally planned.

The Philippines is presently under difficult economic conditions. The further development of renewable energy could help alleviate the situation. A more intensive use of renewable energy would result in lower importation resulting in foreign exchange savings.

The government's policy of maintaining high prices for petroleum products and the recent move to gradually phase out the subsidy to the small customers of the Manila Electric Company (Meralco)[5] point to the further development of renewable energy. The price of petroleum products in the Philippines is quite high because of high taxes imposed on them. On the average, taxes account for about 35% of petroleum product prices. Tax from oil and petroleum products is a major source of government revenues.

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[5]Meralco is the country's biggest private utility engaged in electric distribution. Its socialized pricing policy enables its small customers (residential customers whose consumption is less than 200 kwh and commercial customers whose consumption is less than 90 kwh) to pay only about 20% of the costs of serving them.

The government's continuing reliance on petroleum products' taxes and the continuing depreciation of the peso would result in higher prices of petroleum products in the coming years. This will make renewable energy sources more competitive.

Also, Meralco's subsidy reduction program initiated in February, 1985, which seeks to completely remove subsidy to small customers by 1990, would result in higher electric rates. This would lead the affected customers to conserve and/or shift to renewable energy sources.

Faced with financial constraints in the coming years, the government should encourage more private sector participation in the development of renewable energy sources. It should continue giving incentives to companies which develop and/or use renewable energy. With the general economic conditions favoring the development of indigenous resources and with support coming from various sources, the widespread use of renewable energy and the realization of the economic benefits derived therein may become a foreseeable reality in the near future.

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