PD-AAV-410 49565

A.I.D. EVALUATION SUMMARY PART I

(BEFORE FILLING OUT THIS FORM READ THE ATTACHED INSTRUCTIONS)

A. REPORTING A.I.D. UNIT (Mission or AID/W Office)

(ES # 86-4)

B. WAS EVALUATION SCHEDULED IN CURRENT FY ANNUAL EVALUATION PLAN?

yes [X] slipped [ ] ad hoc [ ]

C. EVALUATION TIMING

interim [ ] final [X] ex-post [ ] other [ ]

D. ACTIVITY OR ACTIVITIES EVALUATED (List the following information for project(s) or program(s) evaluated; if not applicable, list title and date of the evaluation report)

Project #	Project/Program Title (or title & date of evaluation report)	First PROAG or equivalent (FY)	Most recent PACD (mo/yr)	Planeed LOP Cost ('000)	Amount Obligated to Date ('000)
492-0294	Nonconventional Energy Development	1978	9/87	7150	7150

E. ACTION DECISIONS APPROVED BY MISSION OR AID/W OFFICE DIRECTOR

Action(s) Required	Name of Officer respondible for Action	Date Action to be Completed
1. Extend PACD with current funding to September 30, 1987 for six subprojects in order to allow orderly completion and the maximum impact from investment to date.	Richard Stevenson Project Officer	Dec. 30, 1986
2. Realign budget and develop new implementation plan for remainder of project.	Conrado Heruela OIC, BED-NCRD	Jan. 31, 1987
3. Negotiate local contract for project coordination services.	Conrado Heruela OIC, BED-NCRD	Jan. 31, 1987

F. DATE OF MISSION OR AID/W OFFICE REVIEW OF EVALUATION mo 12 day 15 year 1986

G. APPROVALS OF EVALUATION SUMMARY AND ACTION DECISIONS

	Project/Program Officer	Representative of Borrower/Grantee	Evaluation Officer	Mission or AID/W Office Director
Signature				
Typed Name	R.S.Stevenson	R. de la Paz	D. D'Antonio	F. W. Schieck
Date				

H. EVALUATION ABSTRACT (do not exceed the space provided)

This evaluation of the Philippine Nonconventional Energy Development Project (492-0294) was undertaken six months before its scheduled completion date (12-31-86) to recommend what further effort might enhance the achievement of project objectives, specifically with respect to the generation and dissemination of technical data and, in some subprojects, brief time extensions to bring them to a more useful endpoint. After a slow start in 1978 and considerable revision of scope during the next three years, the project began making steady progress in 1982, following lines proposed in its first evaluation, prepared in December 1981. The project consists of 26 subprojects, of which 16 are in the research, development, or demonstration of specific renewable energy technologies, and the remainder are project support activities such as training, information dissemination, and development of planning and technology evaluation methods. A significant achievement has been the formation and improvement of institutional staffs, notably in the Bureau of Energy Utilization, where the project is conducted, but also in other public and private organizations. Nonconventional energy resources already contribute 17 million barrels of oil equivalent (BOE), or 18% of total energy consumption, and this number is expected to rise to 23 million BOE (20%) in 1990. Cogeneration is the largest single measure to reduce dependence on imported oil, although gasification technologies can also have important impacts on rural energy needs. The evaluation report recommends time extensions of 6 to 12 months for subproject on wind, integrated village energy systems, direct-heat gasification, cogeneration, graduate training, and financial planning. It also recommends additional training to BED staff in project planning and analysis, and the development of a long-term, commercially-oriented program in gasification.

I. EVALUATION COSTS

1 Evaluation Team

Name	Affiliation	Contract Number OR TDY Person Days	Contract Cost OR TDY Cost (US $)	Source of Funds
SITECH	Consulting firm	AID-492-0249-C-00-6057-00	$13,500	Project
Allan Evans	ORAU	15	-	ST/EY funded Renewable Energy Applications Proj. (936-5730)
Garland Samuels	ORNL	15	-	

2 Mission/Office Professional Staff Person Days (estimate) 5

3 Borrower/Grantee Professional Staff Person Days (estimate) 10

A.I.D. EVALUATION SUMMARY PART II

J. SUMMARY OF EVALUATION FINDINGS, CONCLUSIONS AND RECOMMENDATIONS *(Try not to exceed the 3 Pages provided)*

Address the following items:

- *Name of mission of office*
- *Purpose of activity(ies) evaluated*
- *Purpose of the Evaluation and Methodology Used*
- *Findings and conclusions*
- *Recommendations*
- *Lessons learned*

Overview and Purpose

The USAID-GOP Nonconventional Energy Development Project (492-0294) began with the USAID Philippines in May 1978 and, at the time of this evaluation (Summer 1986), was scheduled to terminate on December 31, 1986. In this evaluation, the Mission was interested not only in the project performance to date but, more importantly, in what future effort might be undertaken to enhance the achievement of project objectives, specifically:

1. Generation of data to encourage further private-sector investment in nonconventional energy technologies;
2. Possible further time to bring some subprojects to a more useful endpoint; and
3. Arrangements for increased transfer of information from this project and other sources to potentital private-sector users.

Thus, the project evaluation was intended to be a broad and forward-looking study with recommendations rather than merely an ex haustive review of past project activities.

The evaluation was conducted by SITECH Resources Group of Manila, under contract to the Mission. Evaluation results are presented in a report, USAID-GOP NONCONVENTIONAL ENERGY DEVELOPMENT PROJECT: AN EVALUATION, dated September 30, 1986. Allan R. Evans (Oak Ridge Associated Universities) and Garland Samuels (Oak Ridge National Laboratory) also participated in the evaluation, under funding provided by S&T/EY. Their comments and recommendations are incorporated in the SITECH report.

As originally conceived, the project was an "applied research activity" consisting primarily of field demonstrations of currently available rural-based renewable energy technologies that could be applied in the short term. Emphasis was on substitution for imported oil. The original project plans included a wide variety of renewable energy applications, using solar, hydropower, wind, and biomass resources. As the project evolved, some of these were rejected and other were added or revised.

The project was last evaluated in December 1981. By that time most project activities were already delayed. Also, there had been a major revision of the project scope, with the dendrothermal and small hydropower elements removed and relocated in the Rural Energy Development Project (492-0375).

After much effort in the period following the first evaluation, the project has found more solid footing and has generally progressed. It has shifted in emphasis from being a "smorgasbord" of technology demonstrations to developing commercial technologies that address energy needs. It has also emphasized institutional development within the GOP and the Philippine private sector.

SUMMARY

Date this summary prepared:

SUMMARY (Continued)

Project Status

The project has been financed by a loan of $5.5 million (originally $7.1 million) and a grant of $1.55 million. At the time of the evaluation (Summer 1986) it was anticipated that about $500,000 to $900,000 would remain by December 31, 1986, depending on how quickly ongoing activities progressed.

The project is conducted within the Bureau of Energy Development Nonconventional Resources Division, of the Philippine Ministry of Energy. Most of the laboratory work is done at the Energy Research and Development Center of the Philippine National Oil Company. Many other public and private organizations also participate in the project work.

The project has implemented a total of 26 subprojects, of which 19 were funded by loans, only 6 by grants only, and one by both grants and loans. Of these, 16 were on the research, development, and demonstration of nonconventional energy technologies, and the remainder covered support activities such as resource and demand assessments, public information, training, and project coordination. The evaluation report describes each of these subprojects but emphasizes the 13 ongoing subprojects:

Technologies

1. Rice hull-fed thermal power plant
2. Medium-scale wind-powered system for rural electricity and fertilizer production
3. Solar-powered pumping system for village water supply.
4. Integrated village energy system (IVES)
5. Gasification of densified rice hulls
6. Biomass assisted/powered rural refrigeration systems
7. Direct-heat gasifier
8. Cogeneration system and interconnection of independent power producer to the national grid
9. Establishment of a pilot scale fermentation/distillation facility at BIOTECH

Project-Support Activities

10. Establishment of an interdisciplinary graduate program in energy engineering and management
11. Biomass consultancy
12. Solar/wind consultancy
13. Development of alternative financial planning strategies for renewable energy utilization.

Recommendations on Subprojects

The evaluation report makes several recommendations concerning the subprojects listed above, as well as other aspects of project implementation and follow-on activities. Specifically it recommends that the subprojects on wind (2, above), IVES (4), direct-heat gasifier (7), cogeneration (8), graduate training (10), and financial planning (13) be extended, typically for periods of 6 to 12 months, to allow them to complete their activities and produce desired data.

Although one cannot expect this project to continue supporting this work and these institutions indefinitely, there are steps that can be taken as this project phases out that will assist the GOP and Philippine private sector in future activities. Specifically, these include the continued emphasis on a needs-oriented approach, further planning and policy work to lay out future Philippine activities in nonconventional energy, the development of analytical techniques to assess commercial success, the seeking and maintaining of institutional linkages, the packaging and dissemination of information, and additional staff training in areas such as R&D planning and management as well as the use and maintenance of some equipment. Specifically recommended is the development of a long-term, commercially oriented program in gasification, with the training and technical support needed to implement it.

Development Impacts

The major accomplishments of this project have been in the enhancement, or formation, of energy institutions and in the training of energy professionals in both the public and private sectors. Although it is impossible to estimate the full impact of project technologies on eventual energy supply, it should be noted that the Bureau of Energy Utilization expects nonconventional fuels to increase by nearly half in the next five years, an additional six million barrels of oil equivalent (BOE) per year by 1990, out of a total of 112 million BOE in 1990. Cogeneration could save 5 million BOE by 1990. Gasification technologies will contribute less than 1% of energy supply but can make an important contribution to rural energy needs as well as reduce problems of agricultural residues. Other technologies, although not having large impacts on oil savings, can be locally significant in rural development and improved quality of life.

ATTACHMENTS

K. ATTACHMENTS (List attachments submitted with this Evaluation Summary, always attach copy of full evaluation report even if one was submitted earlier)

USAID-GOP NONCONVENTIONAL ENERGY DEVELOPMENT PROJECT: AN EVALUATION. September 1986, SITECH Resources Group, Inc., Manila.

MISSION COMMENTS ON FULL REPORT

L. COMMENTS BY MISSION AID/W OFFICE AND BORROWER/GRANTEE

- The evaluation fully meets the demands of the scope of work, answering comprehensively the questions posed. It surfaces clearly an issue long discussed by the mission concerning the difficulty of effective dissemination of research findings, thereby influencing the focus of the project in its remaining nine months.

- The combined evaluation team included a high level and scope of expertise and had sufficient time in the field to effectively evaluate the project. None of the evaluation team showed any particular bias and there is no evidence that data gaps exist or that data was overlooked.

- The analytical techniques used were fairly conventional, but the approach of emphasizing the prospective rather than retrospective aspect of the evaluation and evaluation project impact as an element of the larger GOP program both yield a more useful product than the normal evaluation.

- Findings and lessons learned cited in the evaluation generally concur with conclusions reached by AID staff and GOP officials, and on the basis of these findings a decision has been made to grant a limited PACD extension as recommended.

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
BUREAU OF ENERGY DEVELOPMENT, MINISTRY OF ENERGY
MANILA, PHILIPPINES

USAID-GOP NONCONVENTIONAL ENERGY DEVELOPMENT PROJECT: AN EVALUATION

SEPTEMBER, 1986

SITECH Resources Group, Inc.

XD-AAV-410-A

49566

SITECH Resources Group, Inc.

September 30, 1986

United States Agency for
International Development
Ramon Magsaysay Center
1680 Roxas Boulevard
Manila

Attention : Mr. Richard Stevenson
Chief, EDD/ORAD

Mr. Robert A. Doucette
Contracts Officer

Bureau of Energy Development
Ministry of Energy
Republic of the Philippines
Merritt Road, Fort Bonifacio
Makati, Metro Manila

Attention : Atty. Wenceslao dela Paz
Director
Bureau of Energy Development

Gentlemen:

We are pleased to submit our report on the Evaluation of the USAID-GOP Nonconventional Energy Development Project.

The report presents our findings, comments, and recommendations on the progress to date of the USAID-GOP Project. It also provides recommendations on the future direction of the Project and on improving its chances for successful completion.

We have discussed our findings and recommendations with the key USAID and GOP officials involved in the project. We thank them, the staff of the Bureau of Energy Development (BED), and the project implementors for the cooperation they extended to us during the conduct of this evaluation.

SITECH Resources Group, Inc.; P. O. Box 241, Greenhills Post Office 3113, San Juan, Metro Manila, Philippines * Tel. 673-2619

SITECH Resources Group, Inc.

We sincerely appreciate the opportunity to have provided the USAID and the BED our professional services. We wish to reiterate our desire to be of further service on matters that require technical and social-science expertise--SITECH's specialization.

We shall be glad to discuss any question you may have on this report.

Sincerely yours,

CORAZON PE BENITO-CLAUDIO, Ph.D.
Chairman of the Board and
President

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

BUREAU OF ENERGY DEVELOPMENT, MINISTRY OF ENERGY

MANILA, PHILIPPINES

USAID-GOP NONCONVENTIONAL ENERGY DEVELOPMENT PROJECT: AN EVALUATION

SEPTEMBER, 1986

SITECH RESOURCES GROUP, INC.

EXECUTIVE SUMMARY

The USAID-GOP Nonconventional Energy Development Project (referred to in this report as the USAID-GOP Project or the Project) is scheduled to terminate in December 1986. It started at a time when it was most needed--in May 1978, when the Philippine government had to mobilize all the resources that it could to match its aggressive effort to reduce the country's dependence on imported oil. A few months earlier, the Philippine government had established the Ministry of Energy (and its Bureau of Energy Development [BED]) to spearhead a national effort to develop alternative and indigeneous energy sources. Within the BED, direct responsibility for developing and implementing the Project was assigned to the Center for Nonconventional Energy Development (CNED), and later on to the Nonconventional Resources Division (NCRD).

PROJECT OBJECTIVES, GOAL, AND STRATEGY

The Project, which was virtually the Philippine Nonconventional Energy Development Program (the Program) when it started, adopted the same objectives, goal, and strategy as the Program's. The main objectives were to accelerate use of non-conventional energy resources and to develop technologies appropriate for rural areas. The goal was to achieve a significant displacement of imported oil.

The original strategy emphasized the introduction of new, village-level technologies direct to rural areas. This was modified in 1982 to what it is now--a strategy that emphasizes commercialization of technologies. This new strategy requires, first, the creation of a viable market that can make the technologies eventually within the reach of the rural sector, while at the same time making a significant impact on the total energy mix. This means concentrating on well-developed technologies that have potential large-scale applications in either, or both, the urban and rural sectors. The new strategy also gives importance to energy and social systems, of which the technology is only a part.

The program approach is now needs-driven rather than what it was before, that is, technology-driven. The former determines first the needs of a community and then develops or adapts a technology that can address such needs. The latter starts with the development of a technology and then identifies a community that needs it. The risk in the latter is that a technology that is developed may never have any application or may not be adequate in answering local needs. The new strategy will, thus, avoid this risk.

Chapter 2 gives an overview of the Program; Chapter 3, of the Project. Section 2.3 (of Chapter 2) and Section 3.2 (of Chapter 3) discuss the objectives, goal, and strategy in more detail.

FUNDING AND SUBPROJECTS

To finance the Project, the USAID agreed to provide a loan fund of $7.1 million (later on brought down to $5.5 million), and a grant fund of $1.55 million. It is expected that, by December 31, 1986, the unexpended balance of the USAID funds will be about $500,000 to $900,000 depending on how well the remaining activities will progress.

As of the end of the second quarter of 1986, approximately 92.29% of the USAID funds, amounting to ₱87.7 million, have been committed. On the other hand, the GOP has also committed, through the BED, the total amount of ₱11.9 million. Thus, the total USAID and GOP fund commitment was ₱99.6 million. Total project allotments amounted to ₱75.4 million. Local peso expenditures have reached ₱22.5 million, of which 59% have been funded by the USAID. Total foreign exchange obligations have reached a peso-equivalent amount of ₱44.4 million. Of the USAID-loan fund commitments amounting to ₱85.6 million, ₱63.7 million or 74.4% have been allotted and ₱55.8 million, or 87.6% of the allotments, have been spent or obligated. Of the USAID-grant fund commitments amounting to ₱2.07 million, ₱1.94 million or 93.7% have been allotted and ₱1.92 million, or 99.0% of the allotments, have been spent or obligated. (Table 3-3 presents a funding summary.)

Since its inception, the USAID-GOP Project has provided funding for a total of 26 subprojects, (including participants' training, the Project Coordinator's position, and short-term consultancy): 19 with loans, six with grants, and one with both loans and grants. Sixteen of the subprojects (representing 73.22% of the total funding commitments have been devoted to research, development, and demonstration of nonconventional energy technologies; the rest, to project-support activities, such as training and education, technical assistance, planning, public information, and promotions. These subprojects have been implemented by government and private agencies. Eleven of them have been completed, one terminated, and 14 are still in progress (including the Project Coordinator's position). (Table 3-2 presents a summary of basic information on the subprojects; Tables 3-4 to 3-9, the funding status as of June 30, 1986; and Figure 3-1, a map showing the locations of the ongoing subprojects.)

The first set of subprojects on technologies included solar conversion (solar-drying units, solar-refrigeration system, and solar-powered irrigation pump), windmill, biomass conversion, small-scale hydropower, and dendrothermal. (The last two were subsequently transferred to another government agency.) The current set includes two subprojects that are focused on energy systems. One system, which is urban-based, is cogeneration (simultaneous production of electric energy and thermal energy using biomass as fuel); another is the rural-based Integrated Village Energy System (IVES) covering various technologies--gasifier, biogas, and photovoltaics.

MAJOR DIFFICULTIES

The original project period of five years has been extended to more than eight years by December 1986. The Project has experienced considerable delays due to numerous organizational, technical, and administrative difficulties, all of which have been discussed, in as much detail as possible, in the body of this report. The major difficulties include delayed releases of funds and equipment, and technical problems with equipment.

The first difficulty could be attributed mainly to (a) the inability of some project implementors to satisfy documentation requirements (due to lack of familiarity with the requirements, or reluctance to follow the laborious--but unavoidable--government requirements), (b) long clearing procedures for imported equipment, and (c) delayed releases of GOP counterpart funds--for lack of adequate funds, or just simply due to long processing time. On the other hand, the second difficulty could be attributed to the failures of some equipment to perform well. It appears that the purchasing decisions of the USAID-GOP Project management were based on the manufacturers' specifications and, generally, high reputation of both the firms and their products. Some of the equipment received, however, appeared or performed below the claims and reputations--reflecting poorly on their suppliers.

Judging the Project's overall performance, however, on the basis of the delays and the difficulties would be myopic and inappropriate, considering the nature of the Project.

THE NATURE OF THE PROJECT AND THE USAID'S CONTRIBUTION

The USAID-GOP Project is largely experimental. The USAID assistance is comparable to venture capital: the USAID took an uncertain path when it provided the assistance. Sharing in the risk of implementing a pioneering program is, perhaps, the USAID's most important contribution. The Project introduced new

technologies. These require, not only simple technology transfer, but also design and institution of new social arrangements which take years to develop. These have been shown clearly by the IVES and the photovoltaics subprojects.

As in most research and development efforts, the Project is characterized by uncertainty, long time horizon, and many potential alternatives competing for limited resources. The BED, through the NCRD, has tried to overcome the uncertainty with flexibility--one important characteristic of the program management.

The long time horizon of R&D projects, plus the inherent administrative difficulties of introducing new initiatives in a bureaucratic system, or in a new social environment, explain some of the delays. In addition, the overall Program underwent institution-building: When the Project started, the BED was a fledgling organization. The three added years to the Project could have easily been accounted for by institution-building--one of the major accomplishments of the Project that might be overlooked because it is not formally stated as part of the original project goal.

When the Project started, many potential alternative technologies were at once considered. Perhaps the project screening process was not tight enough or the optimism of the project managers was too high, such that some of the early subprojects did not match well the local conditions and needs. One example was the solar refrigeration subproject that was terminated before its completion date. Again, management flexibility to adjust plans and correct early mistakes saved the Project in this case.

MOST IMPORTANT PROJECT ACCOMPLISHMENTS

Behind the Project's delays and difficulties, one could read some of its most important accomplishments. These accomplishments are presented below:

(1) Enhancement, or Formation, of Energy Institutions

The Project has contributed to the enhancement of not only one (the BED/NCRD) but a number of important institutions in energy research and education. These include the Energy Research and Development Center, the University of the Philippines College of Engineering (Program on Energy Engineering), and the BIOTECH (alcohol fuels facility).

The Project has also encouraged the formation of new social organizations, such as those found in the IVES and photovoltaics subprojects.

(2) Development of Program Management

When the Project was first evaluated in 1981 (about three years after its establishment), one of the major findings was the lack of program management experience and institutional maturity during the early stage of the Project. The situation has changed significantly since then. Although additional staff training is still required in specific areas, one can say that the management of the Program and Project, especially at the top level, is capable and competent. The Project has provided them the opportunity to develop such attributes further.

In making such conclusion, we gave due consideration to the fact that the Project has lived through difficult times in the Philippines during the past years. The changes in the country's political and economic conditions had affected the Project--release of GOP counterpart funds, for example, was considerably delayed after the Aquino assassination in August 1983. The fact that the program implementors have managed to make the Project move, though slowly at times, is one proof of the program managers' capabilities.

3) Design of New Social Arrangements

The Project has introduced new social arrangements for the management of nonconventional energy technologies. One example is the collective management of the photovoltaics subproject.

4) Promotion of Nonconventional Energy Technologies

Although much work has yet to be done in this area, there have been some accomplishments. A measure of progress is the continuing interest of the private sector to participate in the Program--as shown by the members of the Renewable Energy Association of the Philippines. That interest has been enhanced by the Project's promotional efforts.

5) Completion of Eleven Separate Subprojects

Eleven subprojects, including the participants' training program and some short-term consultancies have been completed. This has been achieved in varying degrees of success. Some work is still needed to document both the experience and information obtainable from the subprojects.

The ongoing subprojects still require strict monitoring to enable them to fully reach their set objectives. Some project implementation problems have yet to be resolved; additional data-gathering needs to be done. But some important strides have been taken that now make the Program direction more strategically planned and focused than before.

PROJECT MANAGEMENT PERFORMANCE

We evaluated the overall performance of the project management in terms of major decisions made, rather than in terms of actual project outcomes. We used this approach, not only because realized outcomes are not a good measure of decisions--i.e., good decisions can produce bad outcomes--but also because there is some danger that focusing on outcomes in evaluating performance may lead to a short-term orientation to R&D efforts. Our criterion for evaluating a decision is to assess the consistency of the decision with the set of information, values, objectives, and preferences of the decisionmaker or of the parties he represents.

The two major decisions taken by the project management have been the selection of the first set of subprojects and the shift in project emphasis towards commercialization. Following our criterion, the first decision seemed weak because the information base was inadequate (for example, there was little knowledge on wind regimes to justify a large-scale windmill dispersal program) and the alternatives were generated more out of enthusiasm rather than based on adaptability to local conditions and needs. We have judged the second decision favorably because, based on information available and the expressed values, objectives, and preferences of the program management, a commercialization strategy is not only appropriate but also crucial to the attainment of the program goal. Our conclusion, therefore, is: the project management suffered from weak performance during the early part of the Project, but it appears that it is now in a strong position to lead the Program to the attainment of its goal.

LEARNING FROM PAST EXPERIENCE

The experience from the subprojects is valuable for the future of the Program. Based on such experience, we have identified the most crucial variables that influence the desired outcome, that is, oil displacement. Thorough consideration and analysis of these variables in the planning of future projects is necessary.

The variables are discussed in Section 6.8 and presented in Figure 6-2. In summary, the key decision variables for each technology are the research, demonstration, and commercialization decisions. It has been experienced that even so-called mature technologies may require further research to adapt the technology to local conditions. Thus, for most technologies, the analysis must start with the research decision. We recommend that all of the decisions, including the commercialization decision which could be far ahead into the future, be analyzed at the same

time, before resources are committed for the initial research effort. At such early time, many variables will be uncertain, but they have to be included nevertheless; their values will just have to be assessed probabilistically. The assessment could be updated as the development process progresses and the uncertainty is resolved.

The key uncertain variables are the results of these decisions--for example, research result--which in turn depend on other variables, namely: technical assistance (principally its quality), project implementor's capability, effectiveness of institutional arrangements, availability of funds or equipment, adaptation process, local sociopolitical conditions, availability of financing and other inputs (for example, fuel supply and spare parts of equipment), product cost and price, acceptability by end-users, government policies, energy demand, and energy price.

Other important lessons that could have potential use for the design and implementation of future projects include the following:

- In promoting nonconventional energy technologies, a needs-driven approach is more appropriate and effective than a technology-driven one. Furthermore, a technology must be viewed in the context of the development process of a community.

- A technology should not be demonstrated in the field unless it has already passed adequate research and pilot-test procedures.

- Performance monitoring and evaluation of technologies are essential aspects of demonstration projects. Proper documentation of results and sharing of information could avoid duplication of efforts and wastage of resources.

- The basic requirements for the successful implementation of rural-based projects are: (a) clear understanding of goals by all parties concerned, (b) sensitivity of project implementors to the needs of the locality, and (c) participation of the local people in the planning and implementation of the project.

SUMMARY OF RECOMMENDATIONS

Chapters 4 and 5 discuss each USAID-GOP subproject and present our findings and recommendations (under the last section of each discussion). Section 6.8 presents a summary of our

recommendations on the future direction of the subprojects. The major recommendations are summarized below:

- Of the USAID-GOP subprojects on nonconventional energy technologies, the ones on cogeneration and gasification are the most promising in terms of achieving the program goal. These subprojects should be given long-term support that may extend beyond the termination of the USAID-GOP Project. The ongoing subproject on cogeneration should be extended to complete the demonstration results. Experience from the subproject should be shared with others as part of a continuing promotions and training program on cogeneration. On gasification, a long-term research and development program is necessary. The program should focus on (a) improving the design of gasifiers to make them more cost-effective and efficient, and (b) determining the most suitable fuel. Rice hull (the resource that draws the most interest because of its abundance), compared with charcoal, is still difficult to use as fuel for existing gasifier designs.

- Whenever applicable, the body of this report identifies for a subproject the available data, the additional data that have yet to be gathered, the recommended time for extended monitoring, and the level of support required before termination. The ongoing subprojects on nonconventional energy technologies should be monitored until adequate data have been collected from them. It will be worthwhile to document the experience and results of each subproject into individual case studies that could be shared with present and future project implementors, private investors, researchers, policymakers, and other interested parties.

- The following subprojects should be extended to enable them to complete their activities and produce desired data: Medium Scale Wind-Powered System (AID 7805.1-L), IVES Phase II (AID 7807-L), Direct-Heat Gasifier (AID 8301-L), Cogeneration System (AID 8402-L), UPCE Graduate Program (AID 8201-L), and Alternative Financial Planning (AID 8401-G/L). The extension period and level of support recommended for each subproject vary; they are presented in the discussion of each subproject in Chapters 4 and 5, and in Section 6.8.1. The other subprojects should be completed soon.

- The program management should continue to implement its needs-driven approach. This approach should continue to be complemented with a systems view that focuses on energy systems within the context of the larger socioeconomic system of a community, as in the IVES subproject. This program implementation strategy should apply not only in promoting the use of nonconventional resources in both urban and rural areas, but also in designing training programs.

- The NCRD's multiphased program approach for technology development (Appendix A-2) should be supported with an analytical approach or tool that assesses the probable attainment of the commercialization goal at the first stage of the technology development process, before resources are committed. Such an approach should analyze the decision and uncertain variables presented earlier for a technology under consideration. The features and general steps of the suggested approach, which should be developed still, are outlined under Section 6.8.2 of the report.

- Of the three newly proposed subprojects by the ERDC, the two on gasification should be evaluated as part of an overall plan for gasifiers that needs to be developed soon. The proposals merit the serious attention that we have proposed for the gasification program. The other proposal, on fuel-saving devices and alternative fuels, requires further technical and socioeconomic development and justification.

- Two of the proposed areas for further work by the BED/NCRD are beyond the scope of the USAID-GOP Project, but they are worth investigating. The three other proposals are related to some of the USAID-GOP subprojects. Section 6.8.2 presents our comments on these proposals. All three still require clearly-defined methodologies and implementation strategies. The Program and agencies concerned (principally, the BED/NCRD, ERDC, and BIOTECH) can benefit from the assistance of one or more technical experts in developing and implementing these proposals.

- Considering the anticipated changes in the management of the Project and Program, the termination of the USAID assistance in the immediate future, and the new policy directives on energy from the new government of the Philippines, it will be worthwhile for the BED/NCRD to host soon a planning and policy workshop involving different institutions and individuals concerned with or interested in nonconventional energy development. The objective of such a workshop will be to review the Program and, if necessary, to come up with a revised Program that will take into account the current national energy policies and that will be consistent with the current national development strategies of the new government.

- The three information centers that have received assistance from the Project--the BED/NCRD Data Bank, the ERDC Information Center, and the UPCE Library--can provide some of the information requirements of interested private investors. However, these centers require continuing upgrading, and linking with each other and with other similar information centers outside of the Philippines. Some of the available information should be packaged in forms that are suitable to specific audiences. Related to this point, the BED/NCRD should encourage

and promote better information exchange among USAID-GOP subprojects, between them and other subprojects, and between the Program and the private sector. The sharing of information is especially important in ensuring that there is no duplication of research efforts.

- The Program should continue to seek and maintain linkages with institutions involved in nonconventional energy research in other countries. Perhaps, the USAID Mission might be able to extend continuing help in identifying and facilitating contacts for this purpose. The viability of any long-term linkage, however, will depend on what the Program can share with such institutions. Thus, the program management will have to continue maintaining a high level of activity and performance to be able to gain experience and produce results that are worth sharing with other institutions.

- Additional training and technical assistance should be extended to the staff of the BED/NCRD and the ERDC. For the former, we recommend training on project design, evaluation, and management. The training is particularly needed now that some of the staff will assume greater responsibilities with the anticipated change in the top management of the NCRD. This training will also support the desire of the NCRD to initiate the design of R&D projects. For the ERDC, we recommend training on R&D planning and management especially for the middle-elevel staff, and training for some staff members on the installation, testing, and maintenance of some equipment. Both agencies can benefit from the assistance of one or more technical experts, as mentioned above.

- The Program has received various equipment and instruments from the Project. The program management should ensure that these will continue to be maintained and operated well, even after their turnover to project implementors. In one project, at least--the solar/wind mapping subproject--the instruments are already suffering from poor maintenance procedures.

FUTURE CONCERN AND CHALLENGE

A major concern expressed about the future of the Program arises from the government's recent pronouncement--to reduce funding for energy development, at a time when the phase-out of the USAID assistance is imminent. The issue is: who will share in underwriting the risk of nonconventional energy development? The private sector, on which the government depends, does not have the capital for research and development; neither does it have the motivation to invest in R&D,due mainly to the current relatively low price of oil.

There is no denying the fact that the USAID-GOP Project has contributed greatly to making the Philippines a leader on nonconventional energy in the developing world. The challenge now to program implementors is to maintain such leadership despite the constraints. The high level of management capabilities might yet enable the program implementors to answer that challenge favorably. The prospects are encouraging: Before the Project started (1976), the share of imported oil in the energy mix was 79.59%. That has been reduced to 50.68% in 1985. Part of the reduction is attributed to nonconventional energy resources which accounted for 18.17% of the total energy supply in 1985. Ninety-nine percent of this portion came from biomass energy, particularly bagasse and agriwaste. Both the Program and the private sector could be credited for this accomplishment. The Program's attention to nonconventional energy and promotional efforts have helped in encouraging increasing usage of nonconventional energy resources by the private sector.

ACKNOWLEDGMENT

We gratefully acknowledge the cooperation and assistance of the officials and staff of the USAID-GOP Nonconventional Energy Development Project. It is not easy to single out any individual in the Project for special recognition, but we feel we should single out the group of project monitorers at the BED/NCRD who provided us their full support.

We also thank Dr. Allan R. Evans of the Oak Ridge Associated Universities and Engr. Garland Samuels of the Oak Ridge National Laboratory for working with us during the conduct of the evaluation. We enjoyed our interactions with them and benefited from their additional insights. Their comments and recommendations have been incorporated in this report. We take responsibility, however, for the final product.

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CHAPTER 1

INTRODUCTION

1.1 HIGHLIGHTS OF THE USAID-GOP NONCONVENTIONAL ENERGY DEVELOPMENT PROJECT AGREEMENT

The original five-year USAID-GOP Nonconventional Energy Development Project (the USAID-GOP Project, or the Project) agreement was signed in May 1978. Its primary objective was to develop alternative energy sources for use in the Philippines that allow the Government of the Philippines (GOP) to decrease its dependence on foreign fossil fuels.

The agreement provided for a loan of $7.1 million and a grant of $1.55 million from the USAID, and a counterpart funding of $3.6 million from the GOP. The loan component of the USAID assistance was intended to finance various subprojects aimed at testing the economic and technical feasibility of selected nonconventional energy technologies. Particular emphasis was to be given to those technologies using resources that are available in rural areas. The grant component was for participants' training and funding of support activities such as assessment of resources.

The executing agency of the USAID-GOP Project was identified to be the Bureau of Energy Development (BED) under the Ministry of Energy (MOE). Within the BED, the Center for Nonconventional Energy Development (CNED), and subsequently the Nonconventional Resources Division (NCRD), was made directly responsible for the implementation of the Project. Implementors of subprojects were expected to consist of various government agencies, academic institutions, local organizations, and private firms.

Since 1978, the original project agreement has underwent a number of revisions in scope and duration. The latest revision has extended the project up to December 31, 1986. By then, some objectives may still remain unaccomplished due mainly to delays encountered in the early part of the Project. Project funds remaining at that time are estimated to be anywhere from $500,000 to $900,000, depending on how quickly certain equipment can be installed and operated.

1.2 OBJECTIVES OF THE EVALUATION

The main purpose of this consultancy engagement is to evaluate the USAID-GOP Project. The specific objectives, as defined in the Statement of Services from the USAID, are to

evaluate the Project in terms of progress made to date, research and development priorities and practices, financial and manpower commitments, and management strategies; to identify any problems and to recommend changes that will enhance the capability of the Project (and consequently, the Philippine Nonconventional Energy Development Program) to provide measurable, positive impacts on the national energy supply; and to make recommendations for changes in the implementation of the USAID-GOP Project for the purpose of improving its chances for successful completion and for increasing its net positive impact on national supply of energy from nonconventional sources.

The last two objectives state as well the goal of the evaluation: recommendations (a) for successful completion of the USAID-GOP Project and (b) for increasing its net positive impact on the national supply of energy from nonconventional sources. The former (Item [a])includes an assessment of whether the Project should be extended beyond its currently scheduled completion date of December 31, 1986 and, if so, an identification of which subprojects should be supported further. The latter (Item [b])includes the identification of processes, mechanisms, and institutional relationships that can increase transfer of information to the private sector so that the commercialization of nonconventional technologies could be facilitated.

The engagement also aims to evaluate the Philippine Nonconventional Energy Development Program (the Program) to the extent necessary for developing recommendations that will enhance the success of the USAID-GOP Project and, consequently, of the overall Program.

1.3 SCOPE OF WORK

The evaluation focuses on the USAID-GOP Project--its past performance, current operations, and future direction. It covers aspects of the overall Program to the extent necessary and relevant for attaining an effective evaluation of the USAID-GOP Project. It addresses a number of issues spelled out in SITECH's scope of work (Appendix A-1) as defined in the engagement contract. The issues may be grouped under the following topics:

1.3.1 Program and Project Objectives, Goal, and Strategy

The issues raised include the realism, relevance, viability, and practicality of Program and Project objectives, goal, and strategy.

1.3.2 Relevance of USAID-GOP Subprojects to Local Conditions and Needs

The main issue raised is how relevant the USAID-GOP subprojects are to local conditions and needs. This topic also includes the issue on the integration of USAID-GOP subprojects with other projects.

1.3.3 Institutional Arrangements and Project Management

The issues are on the institutional arrangements, management capabilities, and project management performance at both the executing agency and implementing agency levels. Questions are raised on the planning and implementation aspects of the Program, particularly at the subproject level. This topic also includes probing into the role and appropriateness of the Project Coordinator's contractual arrangement.

1.3.4 Financial Requirements and Management

The issues raised include the adequacy of funding support and channels used for fund releases.

1.3.5 Program and Project Support

This topic covers the administrative, logistical, and technical support to the Program and Project. The interest is on the adequacy and effectiveness of the support, including the quality of technical support through short-term consultants.

1.3.6 Training Program

The concern is on the cost-effectiveness and relevance of the Program.

1.3.7 Information Capability and Transfer

The interest is on identifying data generated by the Project which may be valuable for guiding private sector investment decisions. It also asks for identification of processes, mechanisms, and institutional relationships--established or could be established--that could enhance the transfer of information to nonconventional energy technology users.

1.3.8 Project Extension and Future Direction

The main concern is on which subprojects could cost effectively benefit from an extension of time. To this issue we have added our comments on the future of the Project.

1.4 EVALUATION APPROACH

1.4.1 Concepts and Principles

SITECH's project evaluation approach is based on the following concepts and principles:

- The evaluation must use a proven approach; but it must also apply innovative analytical techniques that can address difficult issues.

- The evaluation must recognize the special characteristics of a project and apply analytical methods that treat such characteristics appropriately.

- The evaluation must be both retrospective and prospective.

- The evaluation must produce recommendations that will guide the project's future direction.

- The evaluation must consider the causative linkages between project inputs, outputs, purpose, and goals. These linkages, however, depend on the features of the system itself. For example, the capabilities of a system to process inputs in order to produce the desired outputs are important determinants to consider.

- The performance of a project implementor is best evaluated by focusing on how important decisions were made and implemented.

A decision must be evaluated based on the information available to the project implementor and on how consistent the decision is with his values, objectives, and preferences or of the parties he represents.

The outcome of a decision is not a good measure of its quality: a good decision based on the information, values, objectives, and preferences of a decisionmaker may produce an outcome that the decisionmaker may regard unfavorably.

1.4.2 Overall Approach

Prior to the consultancy engagement, SITECH conducted a project scoping work. This was performed directly by Dr. Corazon Pe Benito-Claudio, SITECH's Chairman and President. This pre-contract work involved interviews with key USAID and BED officials and preliminary review of basic documents. Based on this work and on SITECH's familiarity with the Philippine

Nonconventional Energy Program, SITECH developed an evaluation approach that is appropriate for this engagement (Figure 1-1). In implementing the approach, we (the SITECH Evaluation Team) were guided by the foregoing concepts and principles.

Task 1 of the overall approach started with the organization of a team whose members have the proper analytical skills and other qualifications for the work. Appendix A-18 presents the final composition of the team. Dr. Leopoldo Abis and Professor Nestor Raneses did not participate in the evaluation of the U.P. Graduate Program in Energy Engineering and Management (AID 8201-L) because of their past involvement in this subproject. This task also involved meetings with key officers of the USAID and the BED/NCRD to refine the team's understanding of the evaluation objectives, scope, concerns and issues, and expected deliverables. During the first meeting, we explained our approach, each task, and the requirements. This task produced a refined workplan and a questionnaire for Task 2.

Task 2 involved a thorough review of the relevant documents (see References), visits to project sites, and interviews with key project personnel. The review was organized to cover all the issues in the scope of work. During this phase of the engagement, Dr. Allan Evans of the Oak Ridge Associated Universities and Engr. Garland Samuels of the Oak Ridge National Laboratory joined us in most of the meetings and interviews. This task produced field reports and organized information on the past and current operations of the subprojects. Dr. Evans and Engr. Samuels prepared their separate individual reports which were subsequently incorporated in this report.

This evaluation covered all subprojects with emphasis on the ongoing ones. Since it is expected to be the last comprehensive evaluation, the report includes completed and terminated subprojects for completeness. The evaluation of the completed subprojects, however, mainly involved review of past progress and evaluation reports.

Task 3 entailed interviews with technology specialists, current suppliers and users of nonconventional energy technologies in the private sector, and key program officers. The task also involved a review of the latest available literature and observation of developments in the environment of the Project (for example, developments in the private nonconventional energy sector). This task produced field visit reports, list of suggested references on nonconventional energy technologies, and a perspective on possible Project direction in the future.

Task 4 involved an analysis of all collected information, including the clarification of perceived institutional relationships, problems, and opportunities for successful project

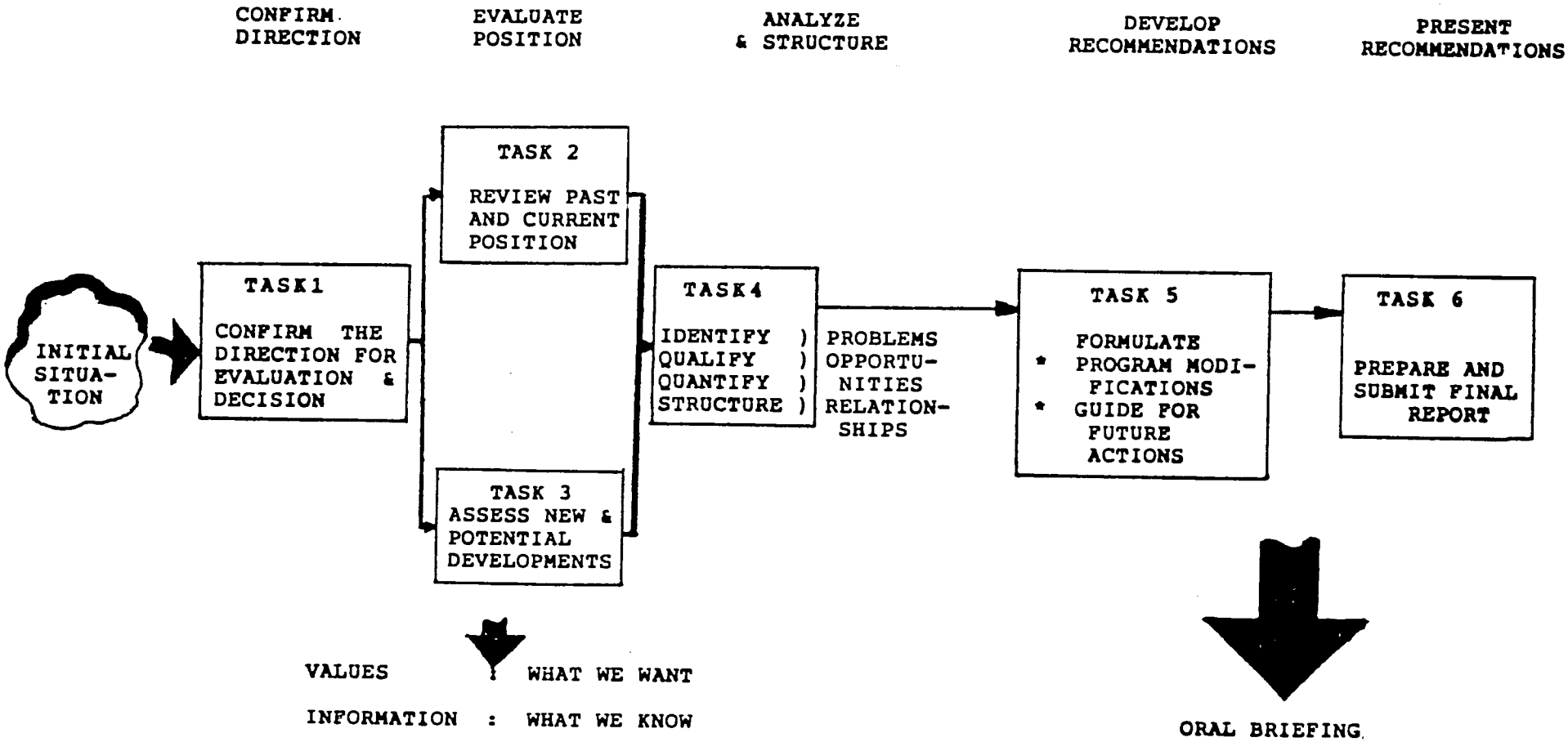

FIGURE 1-1

SITECH'S EVALUATION APPROACH

completion. This task allowed us to understand institutional arrangements and to identify problems and opportunities. It also enabled us to have a refined understanding of the Project's past operations.

Task 5 required us to validate our findings and recommendations, which we subsequently discussed with key USAID and BED officials. We benefited from their added insights and clarification of some issues.

Task 6 involved the preparation and submission of this report. The report includes, as appendixes, aspects of the Program that we feel are worth sharing with readers of the report from other USAID missions with similar programs. These appendixes include, for example, the NCRD's multiphased program approach for nonconventional energy technology development (Appendix A-2).

In the evaluation, we took into account the fact that many of the USAID-GOP subprojects are applied research and development (R&D) projects. Such projects have special characteristics which make their evaluation more difficult, but challenging, than other projects. The characteristics that hold true in the USAID-GOP Project are:

a) Uncertainty. Some important uncertain variables are: technical research result, demonstration result, and commercialization result. In the course of our evaluation, we identified other important uncertain variables which could influence the success of the Project.

b) Long time horizon. The research process and subsequent commercialization of a technology entail a long time horizon.

c) Many potential alternatives competing for limited resources. Oftentimes, the success of an R&D program depends greatly on how effective the alternative generation and screening processes are. Resources, including qualified R&D institutions, are limited.

The challenge to the SITECH Evaluation Team was: given the foregoing characteristics, how should we interpret the findings and develop recommendations that explicitly take those characteristics into account? In assessing individual subprojects, we employed traditional evaluation techniques that tend to be retrospective and to focus on outcomes. However, in developing the overall conclusion and recommendations, we adopted an approach that takes the foregoing characteristics into account.

CHAPTER 2

OVERVIEW OF THE PHILIPPINE NONCONVENTIONAL ENERGY DEVELOPMENT PROGRAM

2.1 INTRODUCTION

Nonconventional energy development in the Philippines became a serious national concern beginning in 1976, after the government issued policies directed at making the country self-reliant in energy. The policies were developed in response to the economic and social hardships that the country experienced after the 1973 oil embargo. The principal policy aimed to diversify energy sources by developing alternative energy supplies so as to reduce dependence on imported oil.

The 1976 National Energy Plan defined the role that nonconventional energy resources would play in the country's future energy supply. The plan envisioned an accelerated utilization of these resources using technologies that had already been developed in other countries. Heavy emphasis was placed upon using existing technologies by adapting them to local needs and conditions.

Nonconventional energy resources, in particular, solar, wind, and biomass energy, were expected to generate a significant contribution to the country's aggregate energy supply, because of the Philippines' assumed rich natural endowment in these energy resources. The development of local energy resources fitted well with the government's rural development thrust; it was, therefore, attractive to policymakers.

The Philippine Nonconventional Energy Development Program (the Program) was launched sometime in 1977. At that time, the definition of nonconventional energy included geothermal, dendrothermal, minihydro, and many other renewable energy technologies.

Geothermal energy showed great potential, hence, a separate program was later on developed for it. Dendrothermal and minihydro systems were found to be closely related to the government's rural electrification program; they were, thus, subsequently incorporated in that program under the National Electrification Administration. The remaining renewable energy forms, therefore, constituted "nonconventional energy" in the context of the Program.

The first major boost to the Program came in the form of a USAID loan and grant assistance in early 1978. Since then, the Program has attracted other donors, although the USAID remains to be the source of the largest external assistance received to date.

2.2 PROGRAM OBJECTIVES, GOAL, AND STRATEGY

The objectives of the Program are (a) to accelerate use of nonconventional energy resources so as to make a significant impact on the mix of energy sources, particularly in displacing imported oil, and (b) to develop and propagate nonconventional energy technologies appropriate for rural areas. The goal is to displace imported oil and attain a diversified energy resource base mainly for economic and security-of-supply reasons.

In carrying out the objectives, the Program implementors started out with experimental village-level technologies, paying little attention to those which could potentially have short-term commercial large-scale urban applications. The strategy entailed carrying out subprojects in remote areas that have limited or no access to conventional energy sources. However, after assessing results from past projects, the implementors shifted the Program's direction to achieve a more balanced program design--balanced in terms of accelerating the commercialization process (thus, going closer to the goal of displacing imported oil) and servicing rural needs.

The Program's emphasis, starting only in 1982, is now on the commercialization of nonconventional energy technologies. "Commercialization" as defined by the BED/NCRD, is a situation that exists when there is a significant number of actual buyers and that there is at least one seller making a profit. Furthermore, while there may be some form of government subsidies, the price of acquiring the technology must not be lower than the cost of production. The new strategy is to adapt existing nonconventional energy technologies that could generate significant displacement of conventional fuels in the immediate future.

At present, the strategy is pursued by following these criteria in project selection:

a) The technology must be well-developed and close to commercialization;

b) If commercialized, the technology can make a significant displacement of conventional fuels; and

c) The social benefit must exceed the social cost.

An important component of the Program is research and development (R&D) on adaptable technologies. The R&D approach focuses on four activities:

a) conduct of energy resource assessments to ascertain energy demand and supply factors;

b) development of appropriate and viable technologies to make indigenous resources usable;

c) development of prototype units for demonstrating the feasibility of the nonconventional energy technologies developed; and

d) determination and implementation of procedures for replicating results and for providing market analysis as a prelude to the widespread propagation of the technologies.

At present, individual technology-focused subprojects undertaken under the Program involve any one, or a combination, of the above activities.

2.3 INSTITUTIONAL ARRANGEMENTS AND PROGRAM MANAGEMENT

The Energy Development Board was created in 1976 with a mandate to develop the country's conventional and nonconventional energy resources. The Board was later reorganized and expanded into what is now the Bureau of Energy Development (BED) under the Ministry of Energy. The BED was granted both policy and regulatory functions and was given the responsibility to develop and implement the Program. Within the BED, the Nonconventional Energy Resources Division (NCRD) is directly responsible for the Program. It takes charge of receiving and allocating funds from both the GOP and external donors. The organizational structure of the BED and the NCRD are shown in Figures 2-1 and 2-2 respectively.

In 1979, and prior to the creation of the NCRD, a Center for Nonconventional Energy Development (CNED) was formed within the Ministry of Energy. The CNED was charged with undertaking research and development on renewable energy technologies and served as the executing unit for the Program. In 1982, the CNED was reorganized into the existing Energy Research and Development Center (ERDC) and transferred to the Philippine National Oil Company (PNOC), a government-owned corporation. The ERDC's research and development tasks were expanded to cover both conventional and nonconventional energy technologies. The transfer of the ERDC was prompted by concerns over the effective management of R&D projects. It was believed that the PNOC, being an independent government-owned corporation, could be in a better position than that of the BED, a line bureau, to provide the financial management flexibility that is necessary for the smooth implementation of R&D projects. The transfer of the CNED prompted the organization of what is now the NCRD within the BED. The roles in the Program are thus delineated: the ERDC undertakes R&D subprojects, the NCRD formulates and implements

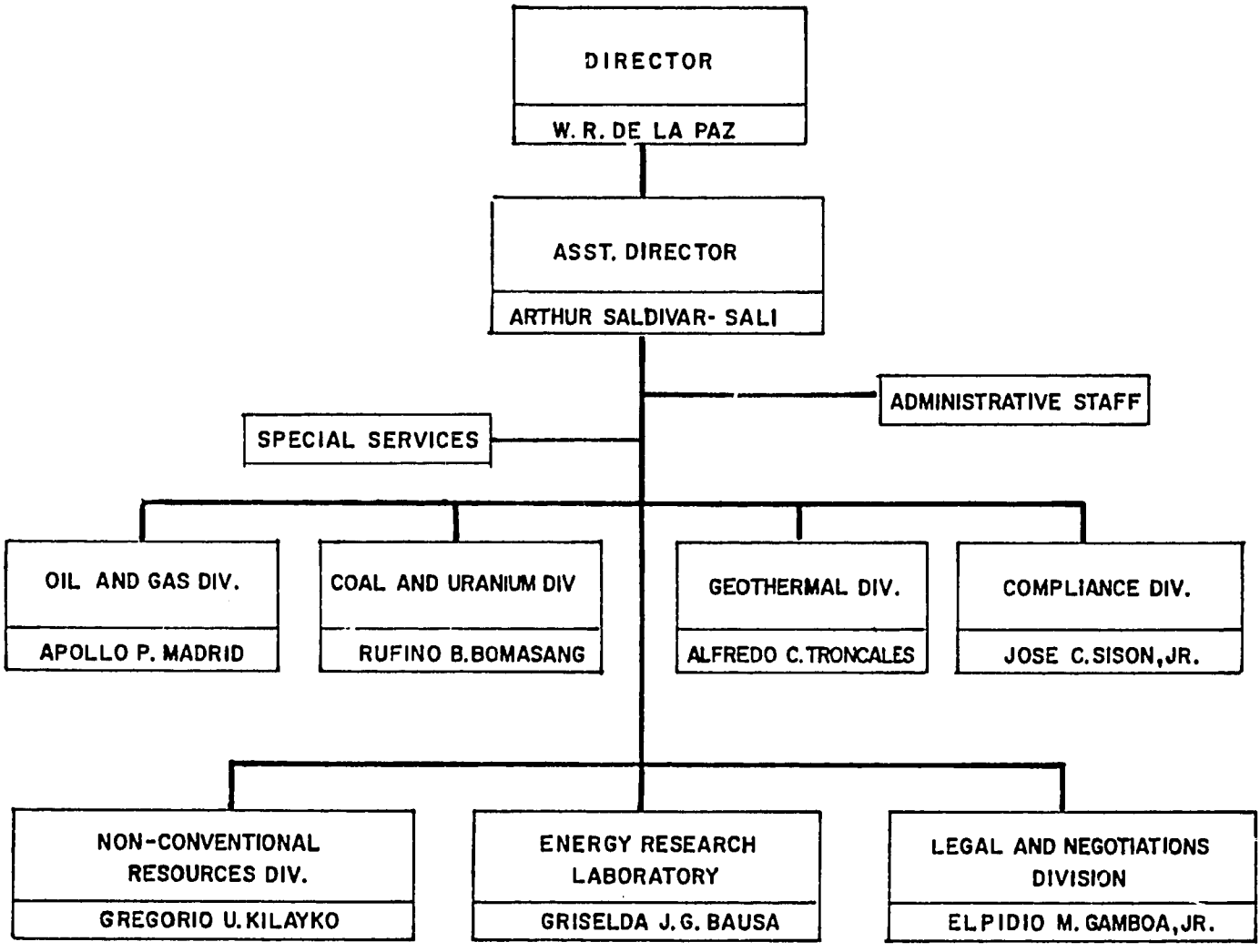

FIGURE 2-1

ORGANIZATIONAL CHART
BUREAU OF ENERGY DEVELOPMENT

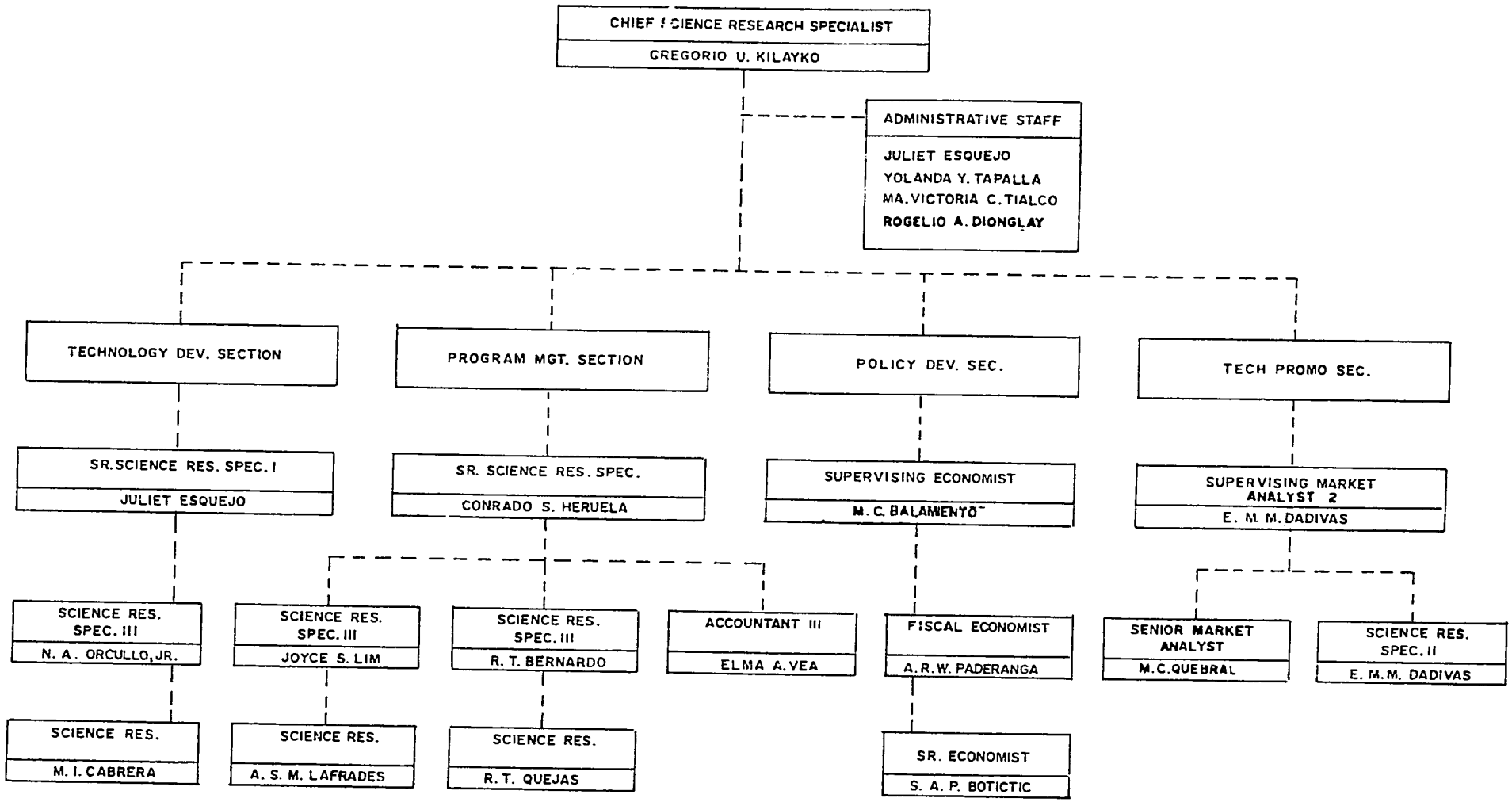

FIGURE 2-2

ORGANIZATIONAL CHART
NONCONVENTIONAL RESOURCES DIVISION
BUREAU OF ENERGY DEVELOPMENT

the Program. The ERDC's R&D activities consist of those funded by Program funds, and are thus subject to the review and approval of the NCRD, and those funded by its own funds, from PNOC or from other fund donors.

The NCRD implements the Program through what it calls a multiphased program approach for nonconventional energy technology (see Figure 2-3 for summary and Appendix A-2 for details). The intent is for the NCRD to take the initiative in proposing R&D projects. The NCRD would bid out nonconventional energy projects for implementation by both government and private agencies. The strategy is to create an environment where both buyers and sellers of nonconventional energy technologies would emerge and thus achieve commercialization.

The Program is implemented though subprojects, each one run by a government or private project implementor. The ERDC is only one of the implementors, but it is the principal implementor of R&D projects.

The responsibilities of implementors in the conduct of subprojects are incorporated in memoranda of agreement. A memorandum of agreement is approved and signed by both the subproject implementor and the BED. It specifies the operational and financial obligations of each party, and the responsibilities of the implementor regarding reporting of project activities, financial status, technical findings, and implementation problems.

The funding and logistical support to a subproject is shared by the GOP through the BED (GOP/BED), the foreign donor of funds (e.g., the USAID), and the project implementor. The implementor's support serves as its counterpart; this is usually in the form of payments for personnel services, provision of facilities, and purchase of supplies.

Program funds are disbursed to project implementors based on agreed upon work plans, and following existing government accounting and auditing procedures. Requests for realignment or adjustment of budgets require the approval of both the BED and the foreign donor; in some cases they may also require the approval of the Office of Budget and Management (OBM).

The key institutions involved in the Program are presented in Figure 2-4. The National Economic and Development Authority (NEDA) serves as the official representative of the government in loan and grant agreements with a foreign donor. It may also be involved in the approval of subprojects requiring foreign funding. In practice, however, the executing agency, in this case, the MOE, deals directly with the foreign source of funds,

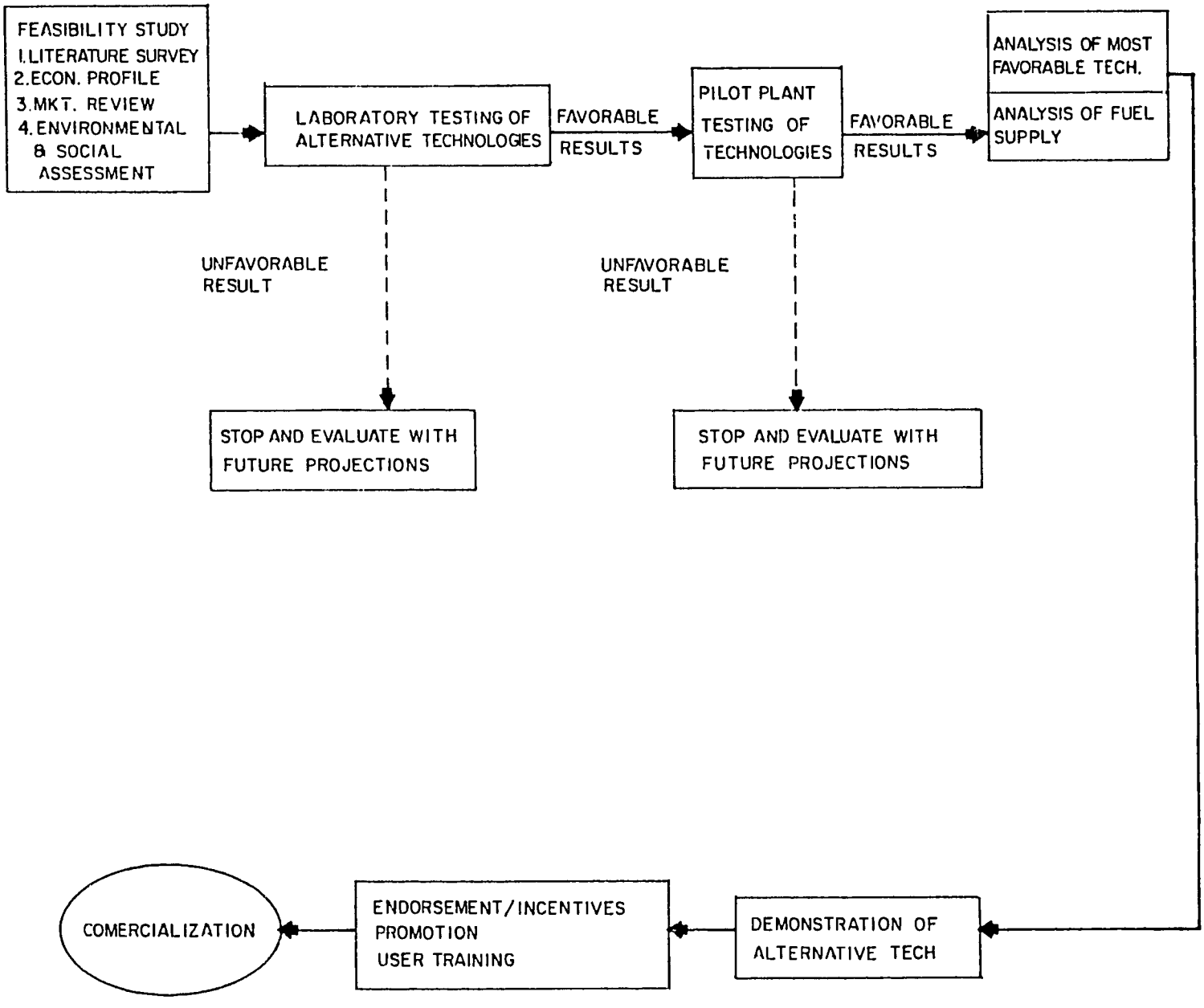

FIGURE 2-3

NCRD'S MULTIPHASED PROGRAM APPROACH FOR
NONCONVENTIONAL ENERGY TECHNOLOGY DEVELOPMENT
SUMMARY FLOW CHART

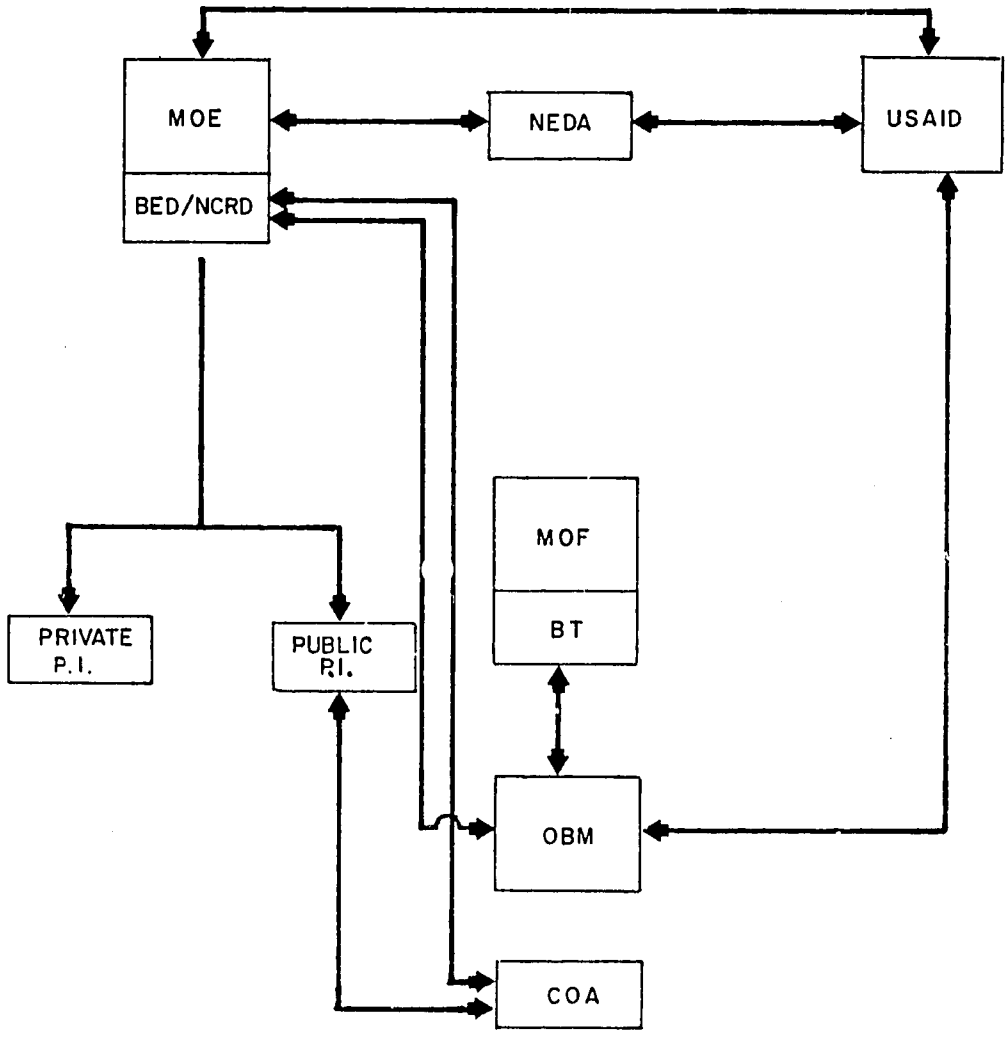

FIGURE 2-4

INSTITUTIONAL LINKAGES
USAID-GOP NONCONVENTIONAL ENERGY DEVELOPMENT PROJECT

LEGEND

MOE : MINISTRY OF ENERGY

BED/NCRD : BUREAU OF ENERGY DEVELOPMENT
NONCONVENTIONAL RESOURCES DIVISION

PNOC : PHILIPPINE NATIONAL OIL COMPANY

ERDC : ENERGY RESEARCH & DEVELOPMENT CENTER

NEDA : NATIONAL ECONOMIC & DEVELOPMENT AUTHORITY

MOF : MINISTRY OF FINANCE

BT : BUREAU OF TREASURY

OBM : OFFICE OF BUDGET AND MANAGEMENT

COA : COMMISSION ON AUDIT

USAID : UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

P. I. : PROJECT IMPLEMENTOR

for example, the USAID. Since GOP counterpart is involved, the Office of Budget Management (OBM), Ministry of Finance/Bureau of Treasury (MOF/BT), and Commission on Audit (COA) participate actively in the process. The OBM reviews the GOP-funded budget and recommends it for approval to the Office of the President and the legislative body. The MOF/BT is responsible for releasing GOP funds; the COA conducts audit of the funds. Expenditures of all public project implementors are subject to the COA's audit at the project level; expenditures of private implementors are audited at the BED level.

In addition to funding, the BED/NCRD provides technical assistance for the conduct of subprojects by using its personnel. In some cases, the agency hires foreign consultants for special types of technical assistance. It also provides access to its library facilities and assists project implementors in coordinating with other government agencies.

The project implementor is expected to keep a complete record of the operation and progress of the project, including the progress of data collection. It is required to submit a quarterly project report to the BED/NCRD, indicating work accomplished together with an accounting of disbursements made from the USAID and BED funds, as well as the disbursements made from the project implementor's counterpart funds. The implementor is also required to submit an inventory of all materials and properties purchased out of project funds.

Subproject personnel are generally hired by the project implementor on a contractual basis for the duration of a subproject. Conditions for hiring such personnel may be embodied in the memorandum of agreement.

Upon completion of a subproject, the project implementor is required to submit a final report indicating the technical findings, subproject accomplishments, and problems encountered. A financial report of all disbursements made out from the USAID and the BED financial assistance is also required. If there are unexpended balances from the financial package, the project implementor is required to remit or return them to the BED. The BED owns all non-expendable materials and properties purchased out of the USAID and BED funds but it may donate them to the subproject implementor after the successful turnover of a subproject.

To hasten the commercialization process, the BED is authorized to recommend grant of incentives to suppliers and users of nonconventional energy technologies. There are two kinds of incentives: One allows a user to fully depreciate the full cost of his investment in the first year. Another is a waiver of all importation duties for equipment imported for a nonconventional energy installation.

2.4 PROGRAM STATUS, ACCOMPLISHMENTS, AND FUTURE DIRECTIONS

The Program started with R&D, economic assessment, and promotion activities covering various resources and technologies: biomass (pyrolysis, gasification, fermentation, methanogenesis, dendrothermal), solar (solar heater, photovoltaic, solar pond), wind (windmills, wind turbines), minihydro, geothermal, and wave energy. From experience gained through these activities, the NCRD identified the technologies that have the best potential for application and eventual commercialization in the Philippines. The NCRD further screened such technologies using the technology prioritization scheme presented in Section 2.2.

A few technologies, for example, solar water heaters and biomass-fired boiler systems have been found to have reached the commercialization stage in the Philippines as evidenced by existing private users of such technologies. The NCRD is now devising incentive policies to further enhance the competitiveness of these technologies. The promotions program is aimed at increasing public awareness of the technologies. Other technologies have been considered to be at the R&D phase still. Included here are: direct combustion systems for producing power heat, gasification, large-scale production and utilization of biogas, alcohol fermentation, and solar water heater for industries. For each of these technologies, the NCRD has developed a technology development program.

The NCRD has also identified four primary technologies, at various stages of development, as having the best potential for commercialization. These are (a) use of biomass for boilers and furnaces, (b) large-scale solar water heating, and (c) large-scale biogas systems.

To date, the NCRD has implemented numerous projects. Table 3-2 in Chapter 3 presents a summary of those funded by the USAID; Appendix A-3 presents a list of those funded by others. This evaluation gives a detailed report on the subprojects funded by the USAID (see Chapters 4 and 5). Appendix A-4 gives a summary of the status of ongoing projects outside of the USAID-GOP Project.

Overall, the Philippines has been successful in reducing the share of imported oil in the country's total energy supply. That share was reduced to 50.68% in 1985 (Table 2-1), from 79.59% in 1976, the year that the Program was introduced. The reduction could be attributed both to the development of nonconventional energy resources and the rapid growth in the utilization of conventional, but locally available, energy resources such as local coal and oil, hydropower, and geothermal energy. Nonconventional energy resources accounted for about 18.17% of

TABLE 2-1

HISTORICAL ENERGY MIX

	1976		1979		1982		1983		1984		1985	
	VOLUME	PERCENT	VOLUME	PERCENT	VOLUME	PERCENT	VOLUME	PERCENT	VOLUME	PERCENT	VOLUME	PERCENT
INDIGENOUS ENERGY	17.12	20.41	26.92	27.64	30.20	31.60	34.02	34.55	39.42	42.07	41.67	45.10
CONVENTIONAL	4.98	5.94	15.86	14.23	16.96	17.75	19.43	19.73	24.42	3.78	24.88	26.93
Oil	---	---	7.18	7.37	2.95	3.09	4.65	4.72	3.54	26.06	2.70	2.92
Coal	0.43	0.51	0.82	0.84	1.11	1.16	2.63	2.67	4.06	4.33	4.38	4.74
Hydro	4.55	5.42	4.80	4.93	6.65	6.96	5.12	5.20	9.01	9.62	9.39	10.16
Geothermal	---	---	1.06	1.09	6.25	6.54	7.03	7.14	7.81	8.33	8.41	9.10
NONCONVENTIONAL	12.14	14.47	13.06	13.41	13.24	13.86	14.59	14.82	15.00	16.01	16.79	16.17
Baggasse	7.54	8.99	6.35	6.52	7.35	7.69	5.47	5.55	6.57	7.01	4.60	4.98
Agriwaste	4.60	5.48	6.71	6.89	5.82	6.09	9.05	9.19	8.23	8.78	12.00	12.99
Alcohol	---	---	---	---	0.03	0.03	0.02	0.02	0.02	0.02	---	---
Coconut oil	---	---	---	---	0.03	0.01	‡	---	‡	---	‡	---
Biogas	‡	---	‡	---	0.01315	0.01	0.02	0.02	0.03	0.03	0.03	0.03
Producer Gas	---	---	---	---	‡	---	0.03	0.03	0.15	0.16	0.16	0.17
Solar Water Heater	---	---	‡	---	‡	---	‡	---	‡	---	‡	---
Windmill	---	---	‡	---	‡	---	‡	---	‡	---	‡	---
NUCLEAR	---	---	---	---	---	---	---	---	---	---	---	---
IMPORTED ENERGY	66.76	79.59	70.50	72.36	65.37	68.40	64.45	65.45	54.28	57.93	50.72	54.90
Oil	66.76	79.59	70.50	72.36	65.37	68.40	63.54	64.53	52.67	56.21	46.82	50.68
Coal	---	---	---	---	---	---	0.91	0.92	1.61	1.72	3.90	4.22
TOTAL ENERGY	83.88	100.00	97.42	100.00	95.57	100.00	98.47	100.00	93.70	100.00	92.39	100.00
GROWTH RATE, % P.A. vs. Previous yr. shown	---	---	---	16.14	---	(1.90)	---	3.03	---	(4.84)	---	(1.40)

‡ Minimal

the total energy supply in 1985 (equivalent to some 16.79 million barrels of fuel oil); more than 99% of that portion came from biomass energy (bagasse and agriwaste). Figure 2-5 presents the energy mix for 1985.

Both the government and private sectors could be credited for the gains achieved to date in the use of nonconventional energy resources. The government, through the BED/NCRD, has taken many initiatives, but the private sector has also taken its own strides. Appendix A-5 presents a list of private companies engaged in nonconventional energy in the Philippines. It includes manufacturers and distributors of equipment and major users of nonconventional energy technologies. Appendix A-6 presents some insights gathered from interviews of a small, random sample of these companies. Some of the private individuals involved in the activities related to nonconventional and other renewable energy technologies have formed an association called Renewable Energy Association of the Philippines (REAP). This association serves as the principal point of contact in the private sector. Appendix A-7 presents a list of contacts that includes REAP members.

The NCRD has outlined its plan for the near future as follows:

a) Biomass for Boilers and Furnaces

* continue the development of biomass resource maps to cover more provinces

* investigate other biomass resources

* conduct additional demonstration projects on heat gasifiers with techno-economic assessment

* assist local manufacturing of biomass-fired boilers and furnaces

b) Solar Water Heating

* conduct technoeconomic assessments of existing installations

* conduct feasibility studies on the use of solar water heaters for each type of industrial or commercial application

* refine insolation mapping

* assist local manufacturing of solar water heaters

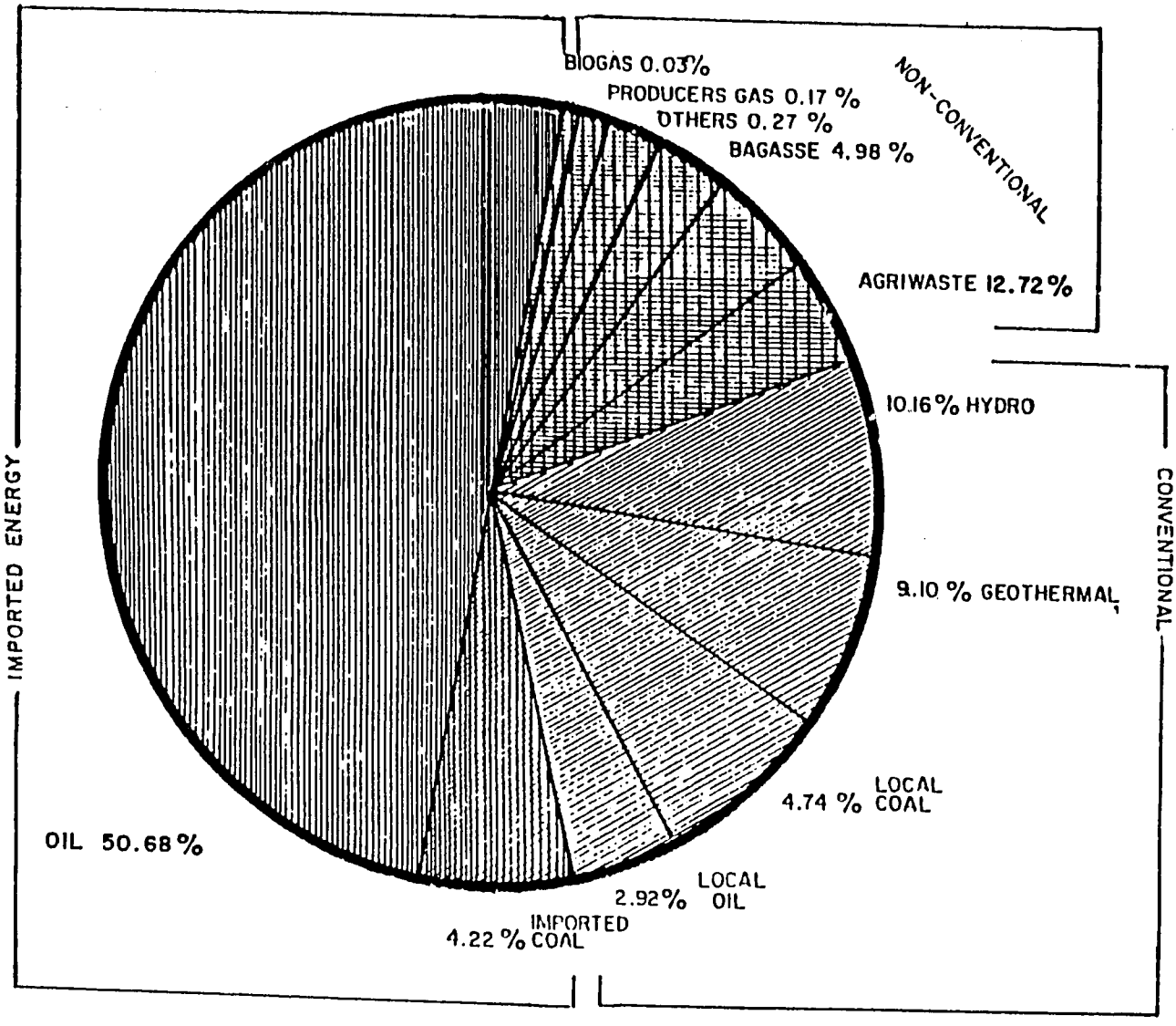

FIGURE 2-5

1985 ENERGY MIX OF THE PHILIPPINES
(IN MILLION BARRELS OF FUEL OIL EQUIVALENT, MMBFOE)
NONCONVENTIONAL ENERGY DEVELOPMENT PROJECT

c) Large-Scale Biogas Systems

* investigate other feedstocks for anaerobic digestion

* conduct demonstration projects on biogasification of distillery

d) Producer Gas Systems

* continue the development of rice hull-fueled producer gas systems

* continue the development of more efficient systems

e) Biomass Derived Liquid Fuels

* continue the development of add-on devices to allow use of hydrous alcohol

* investigate new methods of alcohol production

In order to implement its plan, the NCRD is reorganizing the Program. The current reorganization strategy is to divide the Program into three main components. The first is a technology development program which is essentially an R&D program. It will address the technical impediments towards commercialization, provide technical and economic assessments, and identify priority technologies. The second component is a promotions program which, as the name implies, will involve promotional activities for encouraging the adoption of appropriate nonconventional energy technologies. The third component is a monitoring program. This will involve data-gathering, to satisfy the information needs of the Program, and evaluation of subprojects.

The Program classifies nonconventional energy technology users into large-scale users (who are in accessible urban areas such as Manila and Cebu) and small-scale users (who are in the less accessible, diverse rural areas). As far as the promotions program is concerned, the former group will be serviced by the NCRD's staff, whereas the latter will be covered by Affiliated Nonconventional Centers (ANCs) in selected regions where the potential utilization of nonconventional energy resources is high. Under the ANC system, institutional links will be established with strategically located provincial colleges and universities within which the ANCs will be set up. The ANCs will serve as the principal mechanisms by which the NCRD will promote its rural-based, nonconventional energy technologies.

CHAPTER 3

THE USAID-GOP NONCONVENTIONAL ENERGY DEVELOPMENT PROJECT

3.1 A HISTORICAL BACKGROUND

The USAID assistance to the Philippine Nonconventional Energy Development Program (the Program) began at the time when it was most needed--immediately after the Program was launched, when the Philippine government had to mobilize all the resources that it could to match its aggressive effort to reduce dependence on imported energy. The project-assistance package was signed by both the Government of the Philippines (GOP) and the USAID in May 1978. It established the USAID-GOP Nonconventional Energy Development Project (the USAID-GOP Project or the Project). The USAID funding commitment consisted of a grant component of $1.55 million and a loan component of $7.1 million. The GOP counterpart funding was set at $3.6 million.

The USAID-GOP Project aimed to assist the GOP in organizing and implementing a pilot renewable energy development project including the acquisition of available technologies for exploiting renewable energy resources. The project package covered four major categories: (a) individual applied research and demonstration projects designed to utilize renewable energy resources (wind, water, solar, and biomass); (b) training of the MOE/BED personnel; (c) provision of technical assistance and support; and (d) promotion and dissemination of renewable energy information. The USAID loan was to be used to finance the R&D and training components, while the grant portion was to be used for technical assistance and information dissemination activities.

During the formulation stage of the USAID-GOP Project, a three-man U.S. consulting team provided assistance in assessing the appropriateness of the technologies proposed for investigation, as well as in evaluating the capabilities of the BED to effectively carry out the Program. The team recommended the inclusion of both long-term technical assistance for project coordination and data collection, and short-term technical assistance for designing and evaluating specific subprojects.

The USAID-GOP Project, which was virtually the Program itself during the early years of the Program, encompassed most renewable energy concepts, including solar drying, solar refrigeration, photovoltaics, small-scale hydropower, wind machines, anaerobic digestors, pyrolysis, gasification, and direct combustion of biomass.

The original project package consisted of 10 subprojects covering four major areas: direct solar conversion, small-scale hydropower, wind energy, and biomass conversion. The solar energy package focused on the solar-drying unit, a solar refrigeration system, and a solar-powered irrigation pump. The small-scale hydropower development subproject involved setting up a mini-hydro and a micro-hydro systems. Wind energy applications included a wind-driven water pump and a wind-driven electric turbine. Under biomass conversion were a dendrothermal plant, a solid waste-fired thermal system for electric generation, and a pyrolitic converter for producing charcoal and gas fuel.

An amendment to the original project agreement in 1982 cancelled a portion of the loan component, bringing it down from $7.1 million to $5.5 million. The project completion date was also changed from April 30, 1983 to December 31, 1986. The cancellation of part of the USAID loan component was prompted by the observed under-utilization of funds originally allotted to the Program, the "spin-off" of two major subprojects (hydropower and dendrothermal) to another agency, and the repackaging of subprojects. It is for these reasons and for organizational and administrative delays in project implementation that the completion date was extended to December 1986.

3.2 PROJECT OBJECTIVES, GOAL, AND STRATEGY

Since it was established to support the overall Program, the USAID-GOP Project had the same original objectives mentioned in Section 2.2, namely, (a) to accelerate use of nonconventional energy resources so as to make a significant impact on the mix of energy sources, particularly in displacing imported oil, and (b) to develop technologies appropriate for rural areas. Its goal was also primarily displacement of imported oil.

The original strategy was to include a wide variety of renewable energy resources and technologies and to emphasize village-level technologies. The first set of technologies tried required relatively expensive equipment which, as the Bureau of Energy Development (BED) itself noted later on, could not be propagated commercially in the target rural market without substantial government subsidies. As the Project evolved, the strategy changed: some projects were dropped and others were added or redesigned. The strategy has been flexible to allow adjustment for changes in the environment and corrections of discovered project faults. Both the Program and Project are now implementing a strategy that puts emphasis on commercialization of nonconventional energy technologies.

3.3 INSTITUTIONAL ARRANGEMENTS AND PROJECT MANAGEMENT

The BED, through its Nonconventional Energy Resources Division (NCRD), is the overall coordinator of the USAID-GOP Project. A full-time Project Coordinator has been hired with project funds. The role of the Project Coordinator is to provide assistance in the effective planning and management of the USAID-GOP subprojects. However, primary responsibility for the management of the various subprojects remains with the NCRD. The NCRD is also responsible for monitoring the progress of the various subprojects; this includes on-site inspection, assessment of periodic progress reports, and review of financial statements.

The implementors of subprojects, have, so far, included nine government agencies and four private organizations. The government agencies include the BED itself, the Energy Research and Development Center (ERDC) of the Philippine National Oil Company (PNOC), the National Food Authority (NFA), the Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA), the National Resource Management Center (NRMC), the Forest Products Research and Development Institute (FPRDI), the Farm Systems Development Corporation (FSDC), the University of the Philippines College of Engineering, and the University of the Philippines at Los Banos. The private implementors have included two U.S. consulting groups (Development Sciences, Incorporated (DSI) and Trans Energy Systems (TES), and local companies/institutions (Proctor and Gamble-Philippine Manufacturing Corporation (P&G-PMC), and University of San Carlos-Water Resources Center (USC-WRC)). Ten out of the 26 or 38.5% USAID-assisted projects have been implemented by the PNOC/ERDC, representing approximately 27.20% of total committed funds.

3.4 THE SUBPROJECTS: INTRODUCTION AND FUNDING SUMMARY

The USAID-GOP Project has implemented a total of 26 separate subprojects, some of which were related projects (e.g., Phase I and Phase II of the IVES project). Of these, 19 have been funded by loans only, six by grants only, and one by both grants and loans. Table 3-1 presents a profile of subprojects by technology or purpose. One of these subprojects provided funds for the Project Coordinator and another funded participants' training abroad. The others were subprojects on the research, development, and demonstration of nonconventional energy technologies (16 subprojects) and on support activities such as resource and demand assessments, technical consultancy, energy education and training, and public information and promotional activities (eight subprojects). Of the first category (on

TABLE 3-1

PROFILE OF SUBPROJECTS BY TECHNOLOGY OR PURPOSE
USAID-GOP NONCONVENTIONAL ENERGY DEVELOPMENT PROJECT

	NUMBER OF SUBPROJECTS	FUNDING COMMITMENTS (₱)		
		USAID	GOP/BED	TOTAL
TECHNOLOGY SUBPROJECTS				
Rice Hull-Fed Thermal	1	6,721,673	271,280	6,992,953
Windmill	2	10,383,579	631,370	11,014,949
Solar	4	5,104,328	653,925	5,758,253
Integrated Village Energy System	2	2,908,605	930,480	3,839,085
Gasification	3	10,347,169	1,287,041	11,634,210
Cogeneration	1	7,447,594	65,000	7,512,594
Biomass-Derived Liquid Fuels	1	18,623,000	462,034	19,085,034
Engines	2	4,886,448	2,210,940	7,097,388
PROJECT-SUPPORT SUBPROJECTS				
Education and Training	1	13,313,713	1,960,150	15,273,863
Technical Consultancy	2	4,686,723	250,000	4,936,723
Financial Planning	1	1,112,892	904,222	2,017,114
Energy Resource/Demand Survey	3	1,254,870	1,877,100	3,131,970

	NUMBER OF SUBPROJECTS	TOTAL FUNDING COMMITMENTS (₱)		
		USAID	GOP/BED	TOTAL
Public Information/Promotion	1	916,108	-	916,108
OTHERS*				
Project Coordinator	1	-	200,000	200,000
Participants' Training	1	-	200,000	200,000
	26	87,706,702	11,903,542	99,610,244

* In this report, these items are classified differently from the other project-support activities. Although these items also support the Project, they are not implemented by public and private agencies like the others.

technologies) six have been completed and one terminated; of the second category (on support subprojects), four have been completed. Table 3-2 presents a summary of basic information on the technology and project-support subprojects. These subprojects include the project coordinator and participants' training which are not implemented by public and private agencies like the other subprojects.

As of June 30, 1986 total funding commitments for these projects amounted to ₱99,610,244 with ₱87,461,982 committed to by the USAID (87.80%) and ₱11,903,543 committed to by the GOP/BED (11.95%). Total actual allotments were ₱75,379,577. Total local peso expenditures equalled to ₱22,542,978 and total foreign exchange obligations amounted to ₱44,404,039. The total unobligated balance of the local peso allotments was ₱2,406,166; of the foreign exchange allotments, ₱6,026,394. The unobligated balance of the USAID loan component (local peso cost) was ₱1,862,781; of the grant component, none. So far, the facility at BIOTECH has received the biggest allocation of funds from the USAID, followed by the academic program at the University of the Philippines College of Engineering. Table 3-3 presents a summary of these figures. Tables 3-4 to 3-8 provide the detailed funding status of the subprojects.

Figure 3-1 shows the locations of the ongoing technology subprojects.

3.5 RESULTS OF PREVIOUS EVALUATION

The first comprehensive evaluation of the USAID-GOP Project was conducted by the DSI in late 1981, at a time when the Project was still experiencing developmental and organizational pains. The DSI reported that project performance was below target and actual commitment of funds amounted to only 11.4% of the total funds available, with still nearly $5 million in USAID assistance remaining uncommitted. (Development Sciences, Inc. 1981)

As mentioned earlier, one major reason for the reported low project performance was the transfer of the dendrothermal and small-scale hydro projects to the National Electrification Administration (NEA). Together, these subprojects had accounted for about 68% of the original USAID loan funds. The transfer was done for two main reasons: (a) the NEA was already doing work on these two technologies, and (b) the activities of NEA were more closely aligned to commercialization of these technologies.

The DSI report cited five reasons for the delay in project implementation. First, the original project schedule was based on the existence of an established entity that would implement the Project. In fact, such an entity (the original Center for

TABLE 3-2

SUMMARY OF BASIC INFORMATION ON TECHNOLOGY AND PROJECT-SUPPORT SUBPROJECTS
USAID-GOP NONCONVENTIONAL ENERGY DEVELOPMENT PROJECT
)F JUNE 30, 1986

Project Code	Title	Project Implementor	TOTAL FUNDING COMMITMENTS (₱)			Project Location/Coverage
			USAID	GOP/BED	PROPONENT	
1. TECHNOLOGY SUBPROJECTS						
1.1 Ongoing						
AID 7803-L	Rice Hull Fed Thermal Power Plant	NFA	6,721,673	271,280	367,872	Cabanatuan City, Nueva Ecija
AID 7805.1-L	Medium Scale Wind-Powered System for Rural Electricity and Fertilizer Production	PNOC/ERDC	8,400,610	592,170	635,447	Burgos, Ilocos Norte; Alfonso, Cavite
AID 7806-L	Solar-Powered Pumping System for Village Water Supply I	USC/WRC	799,910	511,975	84,800	Santa Rosa, Olango Island, Cebu City
AID 7807-L	Integrated Village Energy Systems (Phase II: Overall Package)	PNOC/ERDC	2,908,605	657,000	698,793	Pinamuk-an New Washington, Aklan
AID 8203-L	Gasification of Densified Rice Hull	PNOC/ERDC	3,046,664	248,770	523,900	San Carlos City, Negros Occidental
AID 8204-L	Biomass Assisted/Powered Rural Refrigeration	PNOC/ERDC	5,055,910	869,407	298,360	Diliman, Quezon City and Roxas City
AID 8301-L	Direct-Heat Gasifier	PNOC/ERDC	2,244,595	168,864	354,360	Diliman, Quezon City

Project Code	Title	Project Implementor	TOTAL FUNDING COMMITMENTS (₱)			Project Location/Coverage
			USAID	GOP/BED	PROPONENT	
AID 8402-L	Cogeneration System and Interconnection of Independent Power Producer to National Grid	PMC/NPC	7,447,594	65,000	77,134,211	PMC-Vasquez St. Tondo, Manila
AID 8403-L	Establishment of a Pilot Scale Fermentation/ Distillation Facility at BIOTECH	BICTECH	18,623,000	462,034	3,883,890	University of the Philippines at Los Baños (UPLB), Los Baños, Laguna
1.2 Completed						
AID 7801.1-L	Solar Crop Dryer Research and Development	UPLB	1,283,116	77,400	374,180	UPLB, Los Banos, Laguna
AID 7801.2-L	Design, Construction, and Evaluation of a Solar Lumber Dryer with Auxiliary Heating System	FPRDI	220,652	64,550	103,477	UPLB, Los Banos, Laguna
AID 7802-L	Solar Power-Assisted Ice Plant	NRMC	2,800,650	-	922,500	Malabon, Metro Manila
AID 7804-L	Adaptation of Engines for Fuel Interchangeability	PNOC/ERDC	3,138,400	1,997,780	785,800	ERDC Laboratory, Diliman, Quezon City
AID 7804.1-L	Evaluation and Utilization of Stirling Engines	PNOC/ERDC	1,748,048	213,160	287,337	ERDC Laboratory, Diliman, Quezon City; Agno, Pangasinan
AID 7805-L	Windmill Dispersal Program	FSDC/PSB	1,982,969	10,400	870,200	Nationwide
AID 7807.1-L	Integrated Village Energy Systems (Phase I: Community Development Component)	PNOC/ERDC	-	273,480	55,140	Pinamuk-an New Washington, Aklan

Project Code	Title	Project Implementor	TOTAL FUNDING COMMITMENT (₱)			Project Location/Coverage
			USAID	GOP/BED	PROPONENT	
2. PROJECT-SUPPORT SUBPROJECTS						
2.1 Ongoing						
AID 8201-L	Establishment of an Interdisciplinary Graduate Program in Energy Engineering and Management	UP, Diliman	13,313,713	1,960,150	1,763,000	UPCE, Diliman Quezon City
AID 8205.1-L	Biomass Consultancy	TES	1,747,260	-	-	ERDC, Diliman Quezon City
AID 8205.2-L	Solar/Wind Consultancy	DSI	1,462,200	-	-	PAGASA, Quezon City
AID 8401-G/L	Development of Alternative Financial Planning Strategies for Renewable Energy Utilization	BED/NCRD	1,112,892	904,222	-	BED, Fort Bonifacio, Makati, Metro Manila
2.2 Completed						
AID 7814-G	Assessment of the Potential of Biomass Fuels in the Philippines	PNOC/ERDC	989,900	628,000	178,850	6 Provinces
AID 7815-G	Solar Radiation/Wind Mapping of the Philippines Phase I	PAGASA	-	1,226,000	1,171,200	Basco, Dumaguete, Cuyo, Masbate, Mactan, Guiuan, Burgos, Virac, Cagayan de Oro, Daet, Guimaras Island (Iloilo)
AID 8202-L	Solar Radiation/Wind Mapping of the Philippines Phase II	PAGASA	264,880	23,100	110,000	
AID 7816-G	Nonconventional Energy Resources Public Information and Promotions Program	PNOC/ERDC	916,1[illegible]8	-	175,000	ERDC, Diliman Quezon City

TABLE 3-3

FUNDING SUMMARY
USAID-GOP NONCONVENTIONAL ENERGY DEVELOPMENT PROJECT
As of June 30, 1986
(In Pesos)

	LOAN COMPONENT					GRANT COMPONENT					
	USAID			GOP/BED	TOTAL	USAID			GOP/BED	TOTAL	GRAND TOTAL
	LOCAL COST	FOREIGN EXCHANGE COST	SUBTOTAL			LOCAL COST	FOREIGN EXCHANGE COST	SUBTOTAL			
TOTAL COMMITMENTS	16,920,693	68,714,911	85,635,604	9,312,542	94,948,146	1,438,372	632,726	2,071,098	2,591,000	4,662,098	99,610,244
TOTAL ALLOTMENTS	13,828,343	49,843,433	63,671,776	8,754,719	72,426,495	1,327,650	587,000	1,914,650	1,038,432	2,953,082	75,379,577
TOTAL LOCAL PESO EXPENDITURES	11,965,562	---	11,965,562	8,341,924	20,307,486	1,327,650	---	1,327,650	907,842	2,235,492	22,542,978
TOTAL FOREIGN EXCHANGE OBLIGATIONS	---	43,817,039	43,817,039	---	43,817,039	---	587,000	587,000	---	587,000	44,404,039
TOTAL UNOBLIGATED BALANCE (LOCAL PESO ALLOTMENTS)	1,862,781	---	1,862,781	412,795	2,275,576	0	---	0	130,590	130,590	2,406,166
TOTAL UNOBLIGATED BALANCE (FOREIGN EXCHANGE ALLOTMENTS)	---	6,026,394	6,026,394	---	6,026,394	---	0	0	---	0	6,026,394

TABLE 3-4

LOAN COMPONENT: USAID LOCAL COST
USAID-GOP NONCONVENTIONAL ENERGY DEVELOPMENT PROJECT
FINANCIAL STATUS
As of the Quarter Ending June 30, 1986
(In Pesos)

	Proj. Code	Commitment	Allotment*	EXPENDITURES Advance	Actual	Accruals	Total	Unobligated Balance
SOLAR CROP DRYER	AID-7801.1-L	1,283,116	923,270	8,415	914,855	0	923,270	0
SOLAR LUMBER DRYER	AID-7801.2-L	220,652	220,652	16,847	203,505	0	220,652	0
SOLAR REFRIGERATION	AID-7802-L	2,800,650	796,650	0	88,160	0	88,160	708,490
RICE HULL FED THERMAL	AID 7803-L	855,093	855,093	1,150	148,850	352,547	502,547	352,547
FUEL INTERCHANGEABILITY	AID-7804-L	785,800	785,800	116,438	487,462	181,900	785,800	0
STIRLING ENGINES	AID-7804.1-L	137,440	137,440	22,727	114,713	0	137,440	0
PSB WIND ENERGY	AID-7805-L	1,380,700	775,150	0	775,150	0	775,150	0
FSDC WIND ENERGY	AID-7805-L	602,269	514,459	43,429	471,030	0	514,459	0
MEDIUM SCALE WIND POWER	AID-7805.1-L	163,106	132,562	73,590	7,170	25,901	106,661	25,901
PHOTOVOLTAICS	AID-7806-L	0	0	0	0	0	0	0
IVES PHASE II	AID-7807-L	2,908,605	2,904,005	518,709	2,353,796	31,500	2,904,005	0
UPCE ACADEMIC PROGRAM	AID-8201-L	924,000	924,000	421,355	346,145	156,500	924,000	0
SOLAR RADIATION/WIND	AID-8202-L	0	0	0	0	0	0	0
DENSIFIED RICE HULL	AID-8203-L	1,361,476	1,361,476	(183,906)	1,078,550	466,831	1,361,476	0
BIOMASS REFRIGERATION	AID-8204-L	1,108,108	1,108,108	491,551	348,601	267,956	1,108,108	0
CONSULTANCY	AID-8205-L	0	0	0	0	0	0	0
DIRECT HEAT GASIFIER	AID-8301-L	1,613,835	1,613,835	217,280	1,222,005	174,550	1,613,835	0
ALT. FIN. PLANNING	AID-8401-L	775,843	775,843	0	0	0	0	775,843
COGENERATION SYSTEM	AID-8402-L	0	0	0	0	0	0	0
PILOT SCALE FERM./DIST.	AID-8403-L	0	0	0	0	0	0	0
		16,920,693	13,828,343	1,747,585	9,560,292	1,657,685	11,965,562	1,862,781

* Allotted based on the availability of funds

TABLE 3-5

LOAN COMPONENT: USAID FOREIGN EXCHANGE COST
USAID-GOP NONCONVENTIONAL ENERGY DEVELOPMENT PROJECT
FINANCIAL STATUS
As of the Quarter Ending June 30, 1986
(In Pesos)

	Proj. Code	Commitment	Allotment*	O B L I G A T I O N S* Past Year Actual	'86 Cumulative as of last qtr.	This qtr. Obligation	Total
SOLAR DRYER	AID-7801.1-L	0	0	0	0	0	0
SOLAR LUMBER DRYER	AID-7801.2-L	0	0	0	0	0	0
SOLAR REFRIGERATION	AID-7802-L	0	0	0	0	0	0
RICE HULL FED THERMAL	AID 7803-L	5,866,580	5,866,580	5,866,580	0	0	5,866,580
FUEL INTERCHANGEABILITY	AID-7804-L	2,352,600	2,352,600	2,352,600	0	0	2,352,600
STIRLING ENGINES	AID-7804.1-L	1,610,608	1,610,608	1,610,608	0	0	1,610,608
PSB WIND ENERGY	AID-7805-L	0	0	0	0	0	0
FSDC WIND ENERGY	AID-7805-L	0	0	0	0	0	0
MEDIUM SCALE WIND POWER	AID-7805.1-L	8,237,504	8,237,504	2,283,656	0	0	2,283,656
PHOTOVOLTAICS	AID-7806-L	799,910	799,910	279,810	0	520,100	799,910
IVES PHASE II	AID-7807-L	0	0	0	0	0	0
UPCE ACADEMIC PROGRAM	AID-8201-L	12,389,713	12,389,714	12,389,714	0	0	12,389,714
SOLAR RADIATION/WIND	AID-8202-L	264,880	264,880	264,880	0	0	264,880
DENSIFIED RICE HULL	AID-8203-L	1,685,188	1,685,188	1,685,188	0	0	1,685,188
BIOMASS REFRIGERATION	AID-8204-L	3,947,802	3,947,802	3,947,802	0	0	3,947,802
CONSULTANCY	AID-8205-L	4,686,723	4,438,245	4,438,245	0	0	4,438,245
DIRECT HEAT GASIFIER	AID-8301-L	630,760	630,760	630,760	0	0	630,760
ALT. FIN. PLANNING	AID-8401-L	172,049	172,049	99,502	0	0	99,502
COGENERATION SYSTEM	AID-8402-L	7,447,594	7,447,594	7,447,594	0	0	7,447,594
PILOT SCALE FERM./DIST.	AID-8403-L	18,623,000	0	0	0	0	0
		68,714,911	49,843,433	43,296,939	0	520,100	43,817,039

* Dollar rate used: 1983 and 1984 P10 : $1
1985 P10 : $1
1986 P10 : $1

TABLE 3-6

LOAN COMPONENT: GOP/BED COST
USAID-GOP NONCONVENTIONAL ENERGY DEVELOPMENT PROJECT
FINANCIAL STATUS
As of the Quarter Ending June 30, 1986
(In Pesos)

				E X P E N D I T U R E S				
	Proj. Code	Commitment	Allotment*	Advance	Actual	Accruals	Total	Unobligated Balance
SOLAR DRYER	AID-7801.1-L	77,400	69,420	0	69,420	0	69,420	0
SOLAR LUMBER DRYER	AID-7801.2-L	64,550	64,550	15,198	49,352	0	64,550	0
SOLAR REFRIGERATION	AID-7802-L	0	0	0	0	0	0	0
RICE HULL FED THERMAL	AID 7803-L	271,280	271,280	37,362	210,538	23,380	271,280	0
FUEL INTERCHANGEABILITY	AID-7804-L	1,997,780	1,987,779	1,433,488	462,327	91,964	1,987,779	0
STIRLING ENGINES	AID-7804.1-L	213,160	213,160	45,070	200,808	0	245,878	(32,718)
PSB WIND ENERGY	AID-7805-L	28,800	28,800	20,092	8,708	0	28,800	0
FSDC WIND ENERGY	AID-7805-L	10,400	10,400	2,164	8,236	0	10,400	0
MEDIUM SCALE WIND POWER	AID-7805.1-L	592,170	522,170	154,170	294,151	73,848	522,170	0
PHOTOVOLTAICS	AID-7806-L	511,975	511,975	40,893	271,082	200,000	511,975	0
IVES PHASE II	AID-7807-L	657,000	657,005	236,215	409,353	11,437	657,005	0
IVES PHASE I	AID-7807.1-L	273,480	273,480	(8,881)	282,361	0	273,480	0
UPCE ACADEMIC PROGRAM	AID-8201-L	1,960,150	1,699,100	394,834	642,166	331,050	1,368,050	331,050
SOLAR RADIATION/WIND	AID-8202-L	23,100	23,100	23,100	0	0	23,100	0
DENSIFIED RICE HULL	AID-8203-L	248,770	248,770	584	175,730	72,456	248,770	0
BIOMASS REFRIGERATION	AID-8204-L	869,407	869,407	183,949	329,500	303,901	817,350	52,057
CONSULTANCY	AID-8205-L	0	0	0	0	0	0	0
DIRECT HEAT GASIFIER	AID-8301-L	168,864	168,864	34,793	117,079	16,992	168,864	0
ALT. FIN. PLANNING	AID-8401-L	817,222	673,425	0	6,690	666,735	673,425	0
COGENERATION SYSTEM	AID-8402-L	65,000	0	0	0	0	0	0
PILOT SCALE FERM./DIST.	AID-8403-L	462,034	462,034	234,211	43,010	122,407	399,628	62,406
		9,312,542	8,754,719	2,847,242	3,580,512	1,914,171	8,341,924	412,795

* Alloted based on the availability of funds

TABLE 3-7

GRANT COMPONENT: USAID LOCAL COST
USAID-GOP NONCONVENTIONAL ENERGY DEVELOPMENT PROJECT
FINANCIAL STATUS
As of the Quarter Ending June 30, 1986
(In Pesos)

		E X P E N D I T U R E S						
	Project Code	Commitment	Allotment	Advance	Actual	Accruals	Total	Unobligated Balance
Project Coordinator	AID-7811-G	0	0	0	0	0	0	0
S T Consultants	AID-7812-G	0	0	0	0	0	0	0
Participants' Training	AID-7813-G	0	0	0	0	0	0	0
Biomass Assessment	AID-7814-G	989,990	909,990	117,741	792,249	0	909,990	0
Solar Rad. Phase I	AID-7815-G	0	0	0	0	0	0	0
Noncon Promo II	AID-7816-G	338,382	307,660	86,412	221,248	0	307,660	0
Fin. & Planning	AID-8401-L/G	110,000	110,000	57,112	52,888	0	110,000	0
		1,438,372	1,327,650	261,265	1,066,384	0	1,327,650	0

TABLE 3-8

GRANT COMPONENT: USAID FOREIGN EXCHANGE COST
USAID-GOP NONCONVENTIONAL ENERGY DEVELOPMENT PROJECT
FINANCIAL STATUS
As of the Quarter Ending June 30, 1986
(In Pesos)

	Project Code	Commitment	Allotment*	O B L I G A T I O N S* Past Year Actual	'86 Cumulative as of last qtr.	This qtr. Obligation	Total
Noncon Promo II	AID-7816-G	577,726	532,000	532,000	0	0	532,000
Fin. & Planning	AID-8401-L/G	55,000	55,000	55,000	0	0	55,000
		632,726	587,000	587,000	0	0	587,000

*Dollar rate used: 1983 and 1984 P10 : $1
1985 P14 : $1
1986 P20 : $1

TABLE 3-9

GRANT COMPONENT: GOP/BED COST
USAID-GOP NONCONVENTIONAL ENERGY DEVELOPMENT PROJECT
FINANCIAL STATUS
As of the Quarter Ending June 30, 1986
(In Pesos)

				E X P E N D I T U R E S			
	Project Code	Commitment	Allotment	Advance	Actual	Accruals	Total
Project Coordinator	AID-7811-G	200,000	107,361	0	51,232	12,539	63,771
S T Consultants	AID-7812-G	250,000	515	0	500	15	515
Participants' Training	AID-7813-G	200,000	132,606	0	112,762	19,844	132,606
Biomass Assessment	AID-7814-G	628,000	628,000	302,498	325,502	0	628,000
Solar Rad. Phase I	AID-7815-G	1,226,000	82,950	54,975	0	27,975	82,950
Noncon Promo II	AID-7816-G	0	0	0	0	0	0
Fin. and Planning	AID-8401-L/G	87,000	87,000	0	0	0	0
		2,591,000	1,038,432	357,473	489,996	60,373	907,842

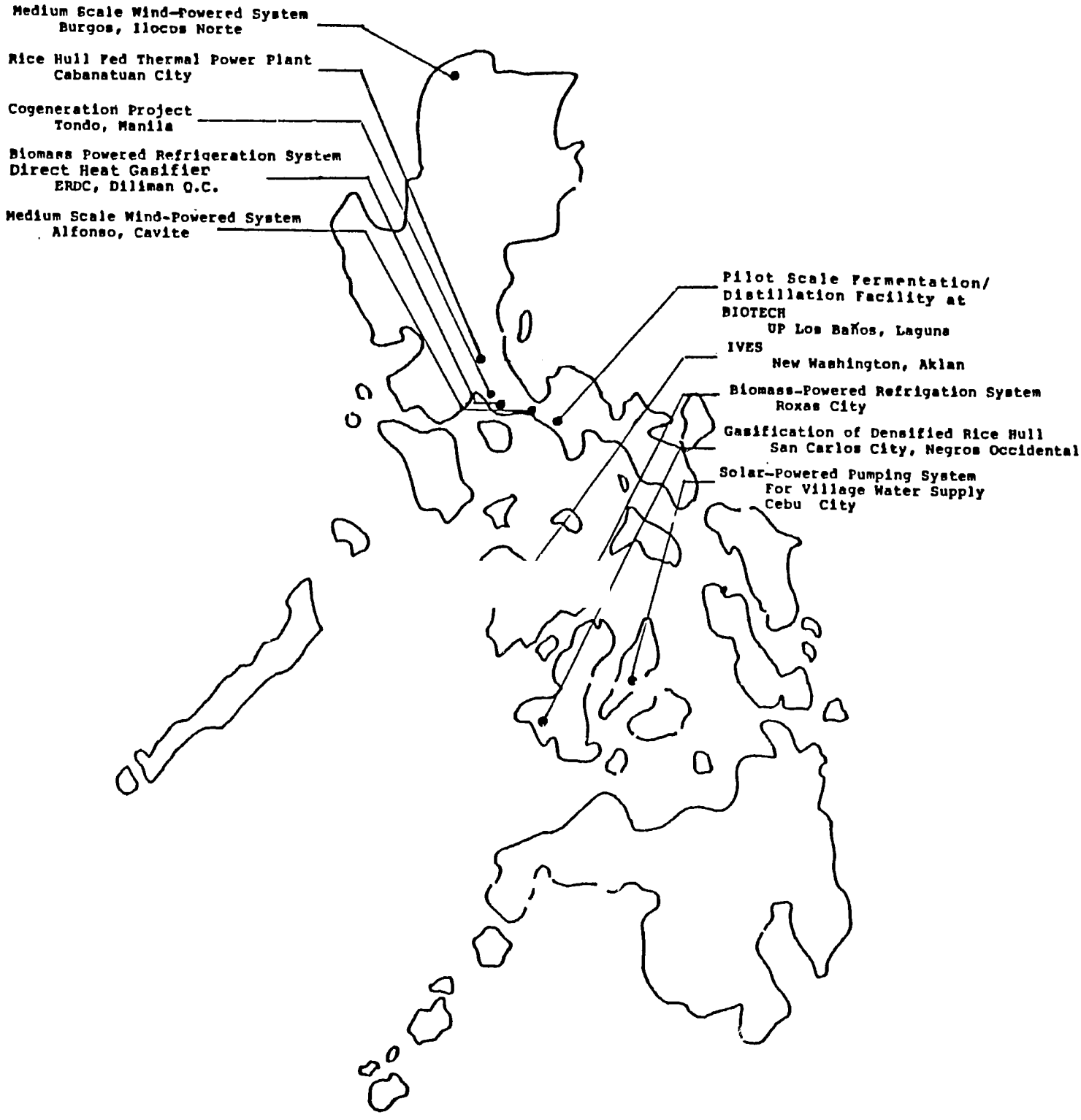

FIGURE 3-1

LOCATIONS OF ONGOING TECHNOLOGY SUBPROJECTS
USAID-GOP NONCONVENTIONAL ENERGY DEVELOPMENT PROJECT

Nonconventional Energy Division) was only established at about the same time that the Project was launched. Thus, much time was spent in institution-building. Second, the two subprojects mentioned above were transferred. The development and subsequent transfer of the subprojects took valuable time and resources out of the BED. Third, there were difficulties experienced in fiscal management which the DSI report attributed to the lack of experience of the newly-established BED. Fourth, there was adversial relationship between the former Project Coordinator and the BED/CNED staff. Fifth, there was still lack of proven "institutional maturity".

For future USAID-funded renewable projects, the DSI report provided recommendations that emphasized the need to allow for institution-building and training of project staff, better planning, and frequent project evaluation. Specific to the USAID-GOP Project, the DSI report proposed the hiring of a team of U.S. consultants to assist the CNED, other project implementors, and the Project Coordinator. The DSI also recommended the assignment of a senior technical staff for each subproject for the purpose of monitoring its implementation. Lastly, the DSI report proposed better preparation of subproject proposals and tighter controls on subproject implementation.

The current evaluation effort starts from the Project inception although it focuses on ongoing subprojects. Among others, we assessed the progress of the implementation of the DSI recommendations.

CHAPTER 4

THE USAID-GOP SUBPROJECTS ON NONCONVENTIONAL ENERGY TECHNOLOGIES

Chapters 4 and 5 present the results of our evaluation of each USAID-GOP subproject. This chapter discusses the subprojects dealing with research, development, and demonstration of nonconventional energy technologies, whereas, Chapter 5 discusses the subprojects on supporting activities such as training, technical consultancy, planning, public information, and conduct of surveys. The items "project coordinator" and "participants' training", which are treated also as subprojects for funding purposes, are not included in these two chapters since they are not implemented in the same way as the other subprojects. These items are discussed in Sections 6.3 and 6.6.

Our evaluation is based on review of available documents, personal interviews, and, where feasible, observations of actual project operations. As per Mission directive, we gave emphasis to the evaluation of ongoing subprojects. Individual subproject reports were prepared by separate team members following a standard format. However, since the subprojects vary in terms of status, accomplishments, and data availability, some reports ended being longer than others.

We have tried to probe into each subproject in detail so as to bring out any remaining problems that must be corrected in order to ensure successful project completion. In doing this exercise, we interacted with project staff, thus, some of the recommendations may reflect not only our thoughts but theirs as well.

ONGOING SUBPROJECTS

4.1 RICE HULL-FED THERMAL POWER PLANT (AID 7803-L)

Duration	:	56 months (April, 1982 - December, 1986)
Implementor	:	National Food Authority (NFA)
Location	:	Cabanatuan City, Nueva Ecija
Project Leader	:	Mr. Mauricio Valdez
Funding Commitment (₱):		USAID - 6,721,673
		GOP/BED - 271,280
		GOP/NFA - 367,872

4.1.1 Objectives and Goals

The objective of this subproject is to demonstrate the technology and economics of a rice-hull fed thermal power plant. Specifically, the subproject aims to:

a) assist in the disposal of rice hulls, the accumulation of which is increasingly becoming an environmental problem in the Philippines;

b) provide the electrical and heat energy requirements of the NFA rice mill complex, thus, saving an equivalent of 23,230 liters of diesel fuel oil, 10,787 liters of kerosene, and more than 354,800 kw-hrs of purchased electricity, and;

c) serve as a demonstration of the technology necessary to eventually convert the more than 14,000 rice mills in the Philippines from petroleum-fueled systems to biomass-fueled systems using rice hulls.

The subproject goal is not only to provide power but also to help in solving an environmental problem.

4.1.2 Description and Funding Commitment

Figure 4-1 presents the system flowchart. The boiler has a rating of 10.5-12.5 million BTU/hour. It was originally designed for sawdust fuel. The original feed mechanism was a rotary valve but this was modified into a positive suction fan to accommodate the low-density rice-hull fuel. The fuel feed rate is 1.0 M.T./hour for peak operation. Hull residue is withdrawn from the furnace by a suction fan.

The boiler runs a steam turbine at 1240 RPM. The steam turbine in turn runs a sentinel brushless AC genset, (315 KW

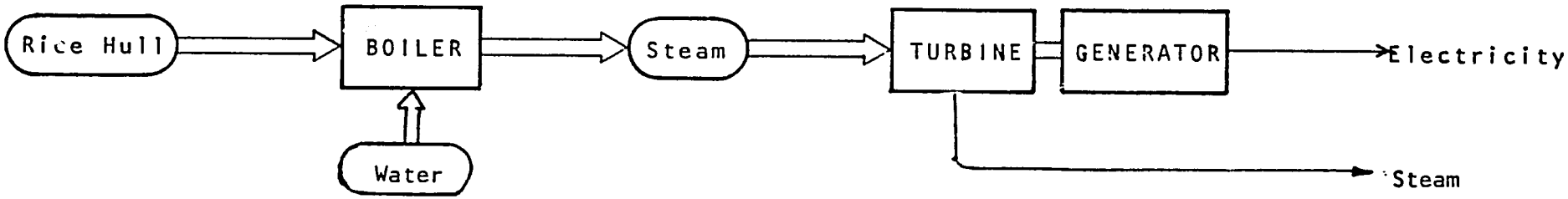

FIGURE 4-1

SYSTEM FLOWCHART OF THE RICE HULL-FED THERMAL POWER PLANT
(AID 7803-L)

capacity). The generator set is a medium-speed unit running at 1820 RPM.

The system was intended to run a rice mill which has a milling capacity of 10 tons/hour and a power consumption of 200 KW-hours daily.

The 300-HP boiler is also intended to supply partial power to a number of drive motors of small HP ratings which run a high brilliancy polisher for milled rice. The total power consumption of the polishing system is approximately 50 KW. It was estimated that the subproject payback period would be between five to seven years, with the plant life estimated to last 15 years.

As of June 30, 1986 the USAID's total funding commitment to the subproject was ₱6,721,673 all in loan form; ₱150,000 of this was in local cost. The total GOP/BED's commitment was ₱271,280. The NFA provided the project site and the milling facilities for experimental use of the system.

4.1.3. Institutional Arrangements and Subproject Management

The project implementor is the National Food Authority (NFA). The local equipment supplier is SAE Products, Inc. whose equipment source is Ray Burner Company in San Francisco, California. Some equipment designed by Ray Burner Co. were fabricated in Taiwan. Trans Energy Systems, a U.S. consultancy firm, was contracted by the Bureau of Energy Development (BED) to provide technical assistance to this and other biomass-energy subprojects.

4.1.4. Accomplishments and Current Status

The subproject was originally envisioned to be completed in two years from 1982. It was designed to cover the following phases: (a) technical information-gathering for design purposes and economic analysis, (b) specification and procurement of equipment, (c) construction and installation, and (d) operation and evaluation of the system.

Information gathering and screening of prospective equipment suppliers began in 1982. However, delays were met in equipment procurement. At present, the plant is not yet operational because modifications had to be introduced, for example, changes in the condensate recovery system. It has been tested for brief periods since 1985; the maximum continuous test-operating time has been six hours.

The total actual allotments made by the USAID to this subproject, as of June 30, 1986 amounted to P6,721,673. Total local peso expenditures amounted to ₱502,546.50, leaving an unobligated local cost balance of ₱352,546.50. Total foreign exchange obligations summed up to ₱5,866,580. The GOP/BED's share of ₱271,280 has been fully allotted to and spent by the subproject.

4.1.5. Findings and Recommendations

This subproject provides some useful information and experience on the technical, economic, and organizational feasibilities of a technology for which there is no off-the-shelf equipment available for experimental use.

The subproject, which is now entering its fifth year, continues to be beset with technical problems and delays. Part of the problems, such as the need to recover condensate, could have been anticipated and avoided. Some problems were caused by fabrication flows when the equipment was modified for rice hull fuel. Other problems were met during trial runs: the abrasive quality of the high-silica hull has been found to affect the hull feeding rate, the blower propeller blade has shown a high erosion rate, and the governor of the steam turbine has suffered a breakdown. The NFA is hopeful that minor spare parts can be locally fabricated. However, parts for major repairs might have to be imported.

As it now stands, the system will be used only for power generation with the steam from the turbine dumped to a condenser, rather than used as well to dry rice. It is not clear whether the initial payback period and fuel savings estimates included the use of steam for drying. If so, the economics of the subproject will be affected by the modified application of the system. The primary economic concern, however, appears to be the rather low load factor.

The history of the project indicates that it suffered from some early organizational difficulties, for example, poor coordination among parties concerned and repeated changes in work schedule.

Some of the foregoing problems result from the experimental nature of the project; a few could be remedied. In particular, the contractors for equipment and civil, mechanical, and electrical works could be held responsible for the design and fabrication flows. Fortunately, the U.S. supplier, Ray Burner, Co., seems to be committed to make the system work; it continues to check on the equipment performance.

We recommend that this subproject, which is now nearing completion, be monitored until there is at least a crop-season's length of operating data. We further recommend documentation of the results of the NFA's experience with the system. The documentation should include the following information:

a) Performance parameters: rice hull fuel consumption, steam and power outputs;

b) Design parameters for the rice hull feeding and combustion system, as well as the ash-handling system.

Future projects should await such documentation.

The challenge to develop an appropriate system that can use a large potential resource--rice hull--remains. The USAID-GOP Project took the first difficult step to address this challenge. We recommend that the Program continue its interest in this technology. However, as shown by the USAID-GOP Project, much work still has to be done to develop a fully adaptable system. In view of this, we recommend that additional experimental projects focus on small steam power systems.

There are special conditions under which small systems may have merit. These are: (a) a high annual load factor for the system, and (b) an application for the steam exhausted from the prime mover, as in a cogeneration system. These conditions could lead to a more favorable return than now indicated by the NFA project.

4.2 MEDIUM SCALE WIND-POWERED SYSTEM FOR RURAL ELECTRICITY AND FERTILIZER PRODUCTION (AID-7805.1-L)

Duration	:	44 months (April, 1983 - December, 1986)
Implementor	:	Energy Research and Development Center (ERDC)
Location	:	Alfonso, Cavite and Burgos, Ilocos Norte
Cooperating Agencies	:	Office of the Governor, Ilocos Norte; San Miguel Corporation
Project Leader	:	Dr. Venancio Alcantara
Funding Commitment (₱)	:	USAID - 8,400,610 GOP/BED - 592,170 GOP/ERDC - 635,447

4.2.1 Objectives and Goals

This subproject has several objectives, namely:

a) to evaluate the technical feasibility of harnessing windpower for electricity generation and fertilizer production;

b) to undertake a socioeconomic study of the community affected by the project;

c) to gather technical information towards large scale use of wind power, and

d) to conduct training related to the subproject.

The original goal was to use windpower as a nonconventional energy resource for rural electrification and fertilizer production.

4.2.2 Description and Funding Commitments

The subproject entailed the installation of two wind electric generators in selected rural areas. These were originally intended to be stand-alone units but were, subsequently, intertied to a local grid and used for providing electricity for local consumption. The two project sites chosen were Alfonso, Cavite and Burgos, Ilocos Norte. Figure 4.2 presents a simple flowchart of the system. The heart of the system is a windmill, rated at 60 KW in this case.

As of June 30, 1986, funding commitment from the USAID for this subproject amounted to ₱163,106 in the form of local peso loans and ₱8,237,504 in the form of foreign exchange loans. The GOP/BED committed a total of ₱592,170.

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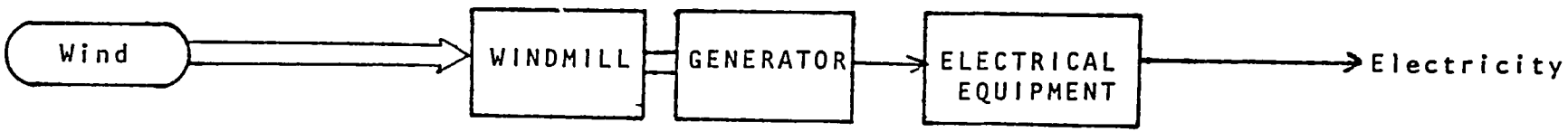

FIGURE 4-2

SYSTEM FLOWCHART OF THE MEDIUM-SCALE WIND-POWERED SYSTEM FOR RURAL ELECTRICITY (AID 7805.1-L)

4.2.3 Institutional Relationships and Subproject Management

The Energy Research and Development Center (ERDC) of the Philippine National Oil Company is the proponent and primary implementor. The subproject is managed directly by its Wind and Wave Section. The Development Sciences, Inc. (DSI), an American-based consulting firm, acted as technical consultant to the project. The Office of the Governor, Ilocos Norte facilitated the use of the site at Burgos, Ilocos Norte. The Magnolia Division of the San Miguel Corporation provided the site at Alfonso, Cavite and the wind-turbine generator system for rural electrification; it also agreed to assist in monitoring its part of the subproject. ENERTECH Corporation, a U.S. company, was awarded the contract to install the plant (FORTE Management Corporation is the local representative of ENERTECH Corporation)

At the ERDC, the Project Monitoring and Evaluation Section monitors the project and expedites the execution of project activities.

4.2.4 Accomplishments and Current Status

Tentative plant sites were first identified for the installation of stand-alone wind-powered systems. Thereafter, additional wind data were gathered for the alternative sites chosen. After the data-gathering and further consideration of costs, the fertilizer manufacturing aspect of the subproject was dropped. It was decided then to install a 50-KW wind turbine generator (WTG) for electricity generation, intertied at each location. The necessary agreements with Burgos and Alfonso were then drafted and subsequently signed (for Burgos, between MOE and the Governor's Office; and for Alfonso, between ERDC and Magnolia). Additional wind monitoring equipment and instruments were also procured. During the latter part of 1984, the specifications of the WTG and the tower foundation design were completed. Bill of materials for outside installation (poles, electric wires, switch gear, etc) were prepared. Early in 1985, the Enertech Corporation was awarded the contract to install the plant. There were no other significant activities during the latter part of 1985.

At present, the towers for both sites have been installed, and the machines (two wind generators of 50 KW each) have been delivered. At the time of our evaluation, the subproject was waiting for the manufacturer to send someone to supervise the installation and commissioning of the units.

As of June 30, 1986, total local peso allotments made by the USAID to this subproject amounted to ₱132,562 leaving an

unobligated balance of ₱25,901. The foreign-exchange commitment has been fully allotted and total obligations amounted to ₱2,283,656. The GOP/BED portion has been fully allotted and spent.

4.2.5 Findings and Recommendations

The subproject has met problems in hiring personnel with appropriate qualifications or in obtaining right of way at the sites, and in installing the power plant.

ENERTECH, the contractor for the plants, met difficulties in providing the engineer needed to supervise the installation. It was reported that this resulted from the company's financial difficulties. At the time ENERTECH was selected, the company and its products were reported to be highly regarded. (We understand that this problem was solved recently, immediately after our evaluation, when ENERTECH sent someone to commission the plants). Both the BED/NCRD and the ERDC are now exerting efforts to have the plants operated.

Other funds could perhaps be sought to completely finance the socioeconomic study, the technical evaluation of large-scale use of windpower , and the training for the transfer of necessary technology, since these activities require more time than is provided by the USAID assistance.

We recommend that the operation of the subproject be monitored for at least a year. The information that should be gathered include wind-duration data and needed design improvements. This activity should not require further significant infusion of USAID funds. Future efforts to use wind systems can benefit from the experience with these two units.

4.3 SOLAR-POWERED PUMPING SYSTEM FOR VILLAGE WATER SUPPLY (AID-7806-L)

Duration	:	49 months (November, 1982 - December, 1986)
Implementor	:	University of San Carlos, Water Resources Center (USC-WRC)
Location	:	Santa Rosa, Olango Island, Cebu
Project Leader	:	Fr. Herman Van Engelan
Funding Commitment (₱)	:	GOP/USAID - 799,910 BED - 511,975 USC - 84,800

4.3.1 Objectives and Goals

The aim of the subproject is to investigate the use of solar energy through a photovoltaics (PV) system. The primary objective, in the context of research and experimentation, is to determine how much usable power could be derived from solar energy. This includes investigating the characteristics of the energy supply, for example, the intensity of solar radiation, its distribution over time and nature of fluctuation. The secondary objective is to demonstrate the application of photovoltaic technology for pumping and delivering water for domestic consumption. The goal is to install and operate a solar-powered pumping system for village water supply.

4.3.2 Description and Funding Commitment

The basic system consists of a pumping station, a 1600-meter pipeline, and a 20-cubic meter water storage (concrete) reservoir. Photovoltaic cells (i.e., 12-solavolt modules) convert solar energy into electricity providing a peak power output of 500 watts, with a voltage capacity of 64 volts. A controller mechanism automatically regulates the delivery of current to the motor that drives the pump. The pump has a maximum capacity of 1.0 liter per second (15 gpm). On a sunny day, the pumping station can produce up to 17-cubic meters of water. The water is conveyed by a 51-mm diameter polybutelene pipe across 1600 meters of tidal area to a 20-cubic meter concrete reservoir which is located at the center of the 400-m radius service area.

Unlike conventional photovoltaic installations, this system (Figure 4-3) does not use batteries to store electricity produced by the solar panels. This is because, for water pumping purposes, there is less need to provide a steady flow of power.

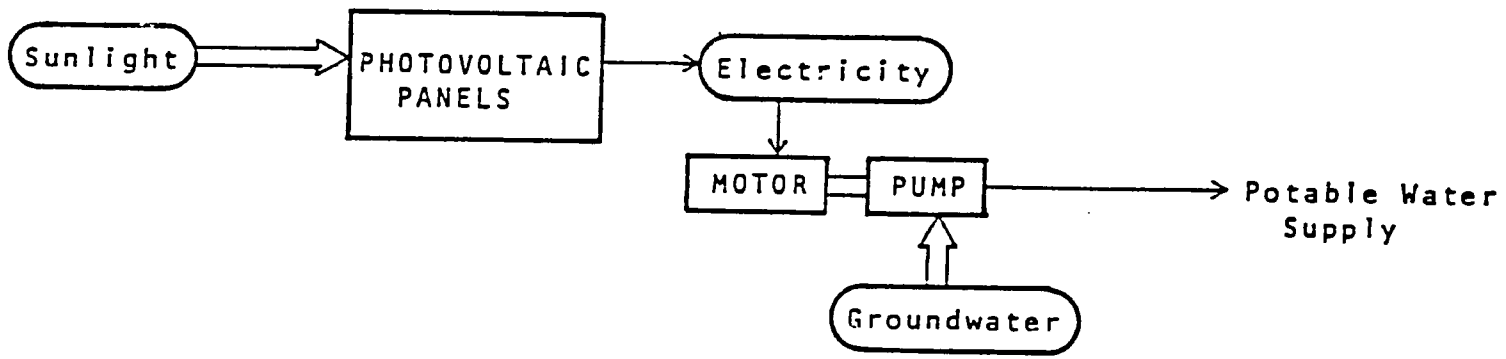

FIGURE 4-3

SYSTEM FLOWCHART OF THE SOLAR (PHOTOVOLTAIC)-POWERED PUMPING SYSTEM FOR VILLAGE WATER SUPPLY (AID 7806-L)

The pump may be operated intermittently depending upon the availability of power. The water storage reservoir stores the excess water produced at peak production hours (or days) thereby regulating the water delivery at a relatively even rate. The 20-cubic meter reservoir is capable of providing for a two-day supply of water during times when available solar energy is low and the pump is unable to operate.

Before the system was installed, the villagers paid ₱1.50 per 20-liter can delivered by motorcyle. Water is now being sold at the reservoir in the same 20-liter cans at ₱0.50 per can. The proceeds are more than sufficient to cover operating costs. A caretaker for the system receives ₱500.00 per month. The average daily water consumption is about 8 cubic meters, but the system is capable of producing up to 17 cubic meters of water per day. The average for 1985 was slightly over 5 cubic meters per day. Thus the system has excess capacity.

Currently, there are about 2000 beneficiaries of the project (400 households). The acceptance of the project by the local people has reportedly been good (after some initial skepticism during the project's inception). This acceptance is attributable mainly to the fact that the system has been successful in delivering water at less cost to the community. Local participation in the maintenance of the system has also been encouraging (e.g., the local people provided free labor for securing the pipeline by covering it with rocks to prevent pipes from moving during high tides). A local association has been formed to take care of the system's maintenance.

4.3.3 Institutional Arrangements and Subproject Management

The subproject was designed and implemented by the University of San Carlos. No outside technical assistance was involved, nor was such assistance found necessary by the implementing organization. The channels and procedures for securing subproject funds were found to be adequate; no problems were encountered in the disbursement and administration of funds. The subproject is reportedly the only one among the various USAID-GOP subprojects that did not apply for a budget realignment.

No major slippages in schedule were encountered. The subproject's one-year extension period from December 1985 was reportedly initiated by the BED/NCRD for the purpose of collecting additional data from the subproject.

4.3.4 Accomplishments and Current Status

Site visits, preliminary site survey, and drillings were accomplished during the first six months of the project (up to

March 1983). Design was finalized and specifications for the system were prepared also in 1983. The latter part of 1983 was spent on screening prospective equipment suppliers and contractors for laying the piping system, well drilling, and construction of the water reservoir. In the first nine months of 1984, the implementor had all wells dug, the piping system completed, the reservoir almost finished, and the PV system completely tested in the laboratory on-campus. The system started operating in the latter part of 1984. The socioeconomic assessment showed that the system was highly acceptable to the user-community. The control and recording procedures were found to be weak initially. But the organization of a user's association led to the organized monitoring of water consumption and the setting up of water rates.

The subproject has produced useful data for sharing with others. These include data on the efficiency of conversion of solar energy to electric power, the efficiency of conversion of electric energy to mechanical energy for driving the pump, the overall efficiency of the PV water supply system, water production rates in relation to solar energy availability, water storage requirements to even out fluctuations in pumping, financial data on installation costs, maintenance costs, and revenue-generating potential. Equally important, the experience and data obtained in making the project acceptable to the local beneficiaries, and in involving them in the maintenance and operation of the system, are useful for future replication and validation of the project, and for investment decisions. For applications of PV systems to rural water supply and other rural development systems, institutional considerations such as those brought to light by this subproject are important.

At present, one year of continuous and detailed data are available. A two-year record, based on monthly agregated data, is also available. It is expected that the final report on the subproject, which will be submitted after the end of the current extension period (December 1986), will include a detailed analysis of technical and financial data.

As of June 30, 1986, actual foreign exchange allotment from the USAID loan component was ₱799,910 in peso equivalent. (There was no local peso-cost provision from the USAID). Actual obligations amounted to ₱1,320,010. The GOP/BED commitment of ₱511,975 was fully allotted and spent.

4.3.5 Findings and Recommendations

On the basis of its objectives, we find that the project has been successful in testing and demonstrating the technical feasibility of using "off-the-shelf", commercial photovoltaic

technology for providing power for a village water supply system. The experience and insights gained in setting up institutional mechanisms for local participation in the project are useful for devising future strategies for propagating similar technologies in other rural areas.

We attribute the successful implementation of the project to several factors: technical competence and experience of the project implementor, good planning, adequacy of funds, the relatively manageable size of the project, and the acceptance of the technology by the people.

This is a case where an expensive energy technology has found a suitable localized application, given a lack, or absence, of other readily available sources of energy. The project location is a small island, with limited local energy resources and with no connection to an electric grid. It is probably quite isolated to justify the regular transport of conventional fuels. The power requirements are too small for conventional piston engines and the lack of potable ground water at the village site precludes the use of handpumps in the village.

The cost of the system itself, excluding special project instrumentation, was about ₱175,000. If half of the annual capacity of the system could be sold at the current price, the payback period would be about three to four years.

The implementation of the project appears to have been successful both in terms of showing that the technology works and of making the beneficiaries accept and participate in the process. No major obstacles were encountered in the administration and execution of the project, except for initial problems in instrumentation. However, for the purpose of data validation, the extent and effect of instrument malfunctions must be accounted for fully in the project's final report. We recommend that data on the technical aspects of the project be compared for validation with results obtained from other research projects on photovoltaic systems (e.g., the Shell project in Cebu and the German-funded project in Bulacan). We further recommend continued monitoring and data collection to maximize use of existing instrumentation.

Notable aspects of this project are its smooth implementation and the positive response from the local people. Other projects could benefit from the management experience of this subproject. We recommend that the implementor, as part of his final report, document the subproject experience into a case study. The study report should discuss experience in project planning, management, and local institution-building. This case study may be carried out also by an objective third party.

The acceptance of the subproject by the local people has been an important factor in the success of this subproject. Sustaining this success seems to depend on the institutional arrangement for collective ownership and management of the subproject. This factor must be considered in judging the financial viability of the project. It is possible that, where such arrangement is lacking, a project may not succeed in charging water costs to users.

Replication of the subproject is not needed if the intent is to ascertain or demonstrate the technical feasibility of photovoltaic systems. However, investigating other applications of the technology for supplying power requirements to meet essential needs in isolated, rural areas appears warranted. Such applications must also test various institutional approaches and mechanisms for hastening acceptance of the technology by the local people and obtaining their active cooperation.

Photovoltaics is a mature and commercial technology. However, the economics remains unfavorable for the widespread application of this technology. The cost of this system, for instance, is about ₱120,000 per kilowatt or around ₱80,000 per horsepower. Unless the cost of solar cells is reduced by a significant order, the suitability of photovoltaics technology [illegible] ed to localized applications, dictated primarily [illegible] the lack or absence of readily available alternative energy sources.

This subproject is essentially complete except for the submission of the final report. It can already operate on its own. It will be worthwhile for the BED/NCRD to identify other areas with conditions similar to that of this subproject for the purpose of introducing additional demonstration subprojects with funding from other sources. The USAID assistance has already paved the way for such future efforts.

4.4 INTEGRATED VILLAGE ENERGY SYSTEMS (IVES)

Phase I (AID 7807.1-L)

Duration	:	12 months (February 1982 - February 1983)
Implementor	:	Energy Research and Development Division (ERDD), PNOC
Location	:	Pinamuk-an, New Washington, Aklan
Cooperating Agencies	:	Pinamuk-an Samahang Nayon
Project Leader	:	Ms. Zenaida Mondejar
Funding Commitment (₱)	:	USAID/GOP - 273,140 PNOC/ERDC - 55,140

Phase II (AID 7807-L)

Duration	:	44 months (April 4, 1983 to December 31, 1986)
Implementor	:	Energy Research and Development Center (ERDC), PNOC
Location	:	New Washington, Aklan
Cooperating Agencies	:	Pinamuk-an Samahang Nayon; Office of the Mayor, Washington, Aklan; Municipal Development Staff, New Washington, Aklan; Bureau of Animal Industry, Ministry of Agriculture.
Project Leader	:	Mr. Teodoro Reyes
Funding Commitment (₱)	:	USAID - 2,908,605 GOP/BED - 657,000 PNOC/ERDC - 698,793

4.4.1 Objectives and Goals

The objectives of this subproject are:

a) to develop and apply a generalized methodology for demonstrating potential applications of integrated renewable energy technologies in rural Philippine villages;

b) to develop and apply a generalized methodology for village participation in technology development process. This includes the design, construction, operation, maintenance, and evaluation of the system;

c) to develop a methodology for monitoring and evaluating the technical performance of the system as well as the changes in the economic, sociocultural, and ecological spheres;

d) to provide both technical and non-technical inputs for possible replication of the integrated renewable technologies in other rural areas in the Philippines and where applicable, elsewhere.

The primary goal of the subproject is to integrate renewable energy systems into rural development.

4.4.2 Description and Funding Commitment

The IVES project is the first of its kind in the Philippines and, perhaps, one of the very few being undertaken worldwide. It is expected to demonstrate the feasibility of an integrated nonconventional energy system within the context of a typical rural setting. The project also aims to study the socioeconomic, political, institutional, technical, and environmental parameters that influence the success or failure of an integrated project. Self reliance and community participation are important elements of the subproject.

The IVES project is located in Barangay Pinamuk-an, New Washington, Aklan. It is an island village with a total land area of 319 hectares, excluding fish ponds, and a population of 360 families.

Figure 4-4 contains a schematic diagram of the IVES subproject. It shows the major technology components and their relationships. The main nonconventional energy technology is the charcoal-fed gasifier for diesel engines. The two applications demonstrated are:

a) a gasifier-diesel engine system driving a 30-KW generator with transmission lines and providing electricity for lighting 100 houses in the island, from 6:00 p.m. to 10:00 p.m. daily.

b) a gasifier-diesel engine system driving a 2-tonner ice plant. (The ice produced is sold to generate income for the villagers.)

The minor nonconventional energy installations at the site are:

a) a household-size digester with a pig pen, a sludge pond (on which azolla for fertilizer is to be cultured), a

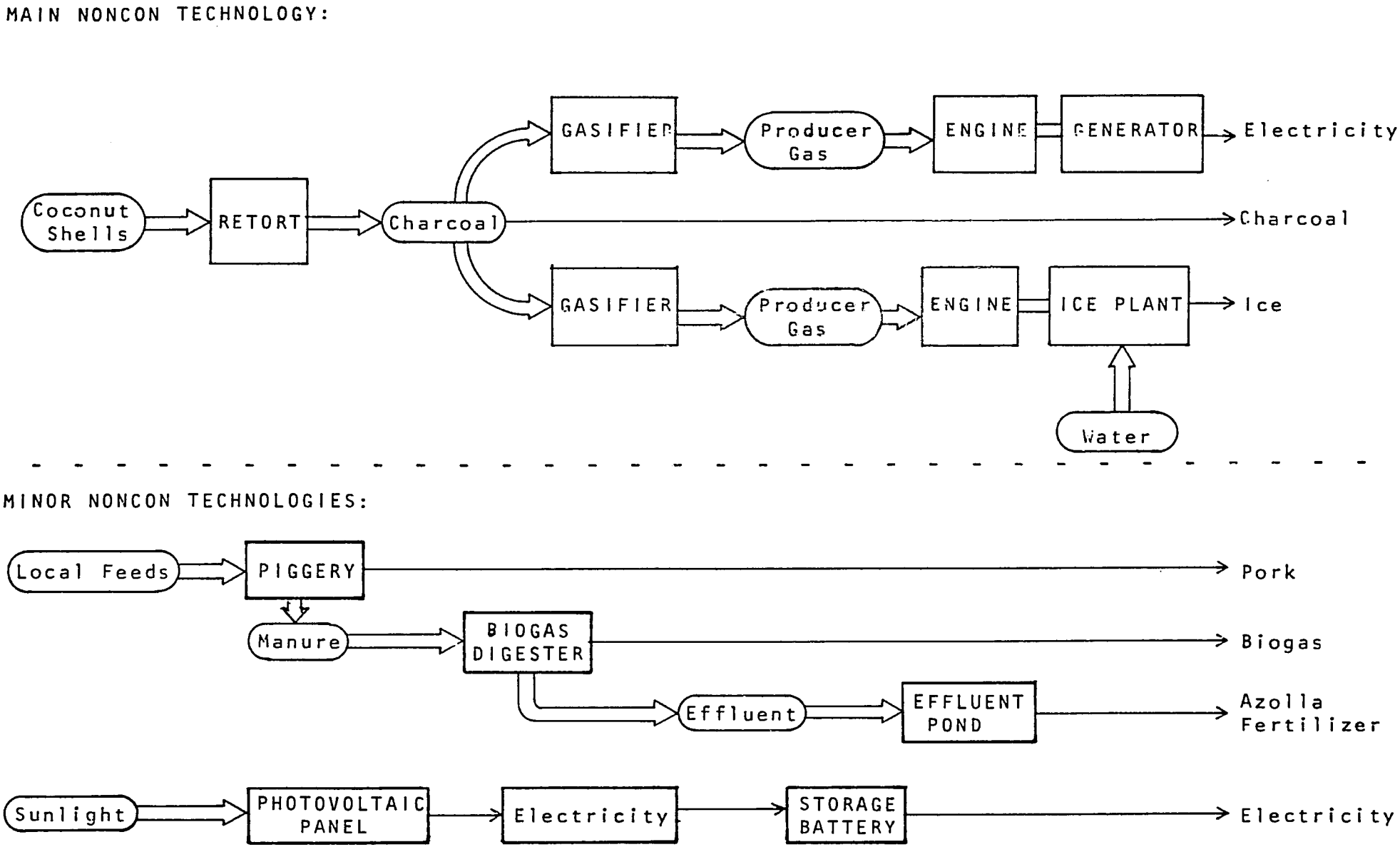

FIGURE 4-4

SYSTEM FLOWCHART OF THE INTEGRATED VILLAGE ENERGY SYSTEMS
(AID 7807-L)

two-burner biogas stove, a biogas-fired lamp, and a biogas-heated flat iron.

b) a retort for producing charcoal from coconut shells or wood. The charcoal is used as fuel for the gasifier.

c) a 1.5-m by 1.5-m photovoltaic panel which generates solar electricity, stores it in an automotive battery, and powers a radio transceiver which is capable of communicating with Manila.

The IVES project is broken down further into four major subprojects:

Subproject A - Community Development

Subproject B - Rural Electrification from Producer Gas Systems

Subproject C - Biomass-Powered Ice Plant

Subproject D - Village Interaction and Monitoring and Evaluation System

The total funding commitment of the USAID for the subproject, as of June 30, 1986, was ₱2,908,605 in local peso-funded loan; that of BED/GOP was ₱657,00.

4.4.3 Institutional Arrangements and Subproject Management

Figure 4-5 presents the organization and institutional arrangement for the IVES project. The bottom boxes in the figure show the principal agencies responsible for the following corresponding sets of activities:

a) Water well system, communal toilet system, demonstration house construction, cottage industries, self-help projects (bayanihan road, ipil-ipil tree planting, and others);

b) Gas producer set, coconut oil expeller, irrigation pump, residential battery lighting system;

c) Alcohol production from nipa sap, alcohol marketing, nipa resources management; and

d) Evaluation and status reporting, monitoring system, nonconventional-powered radio station, nonconventional motorized-powered banca, piggery and biogas digesters, solar stills, dryers (copra dryer, fruit and vegetable dryer) and charcoal kilns.

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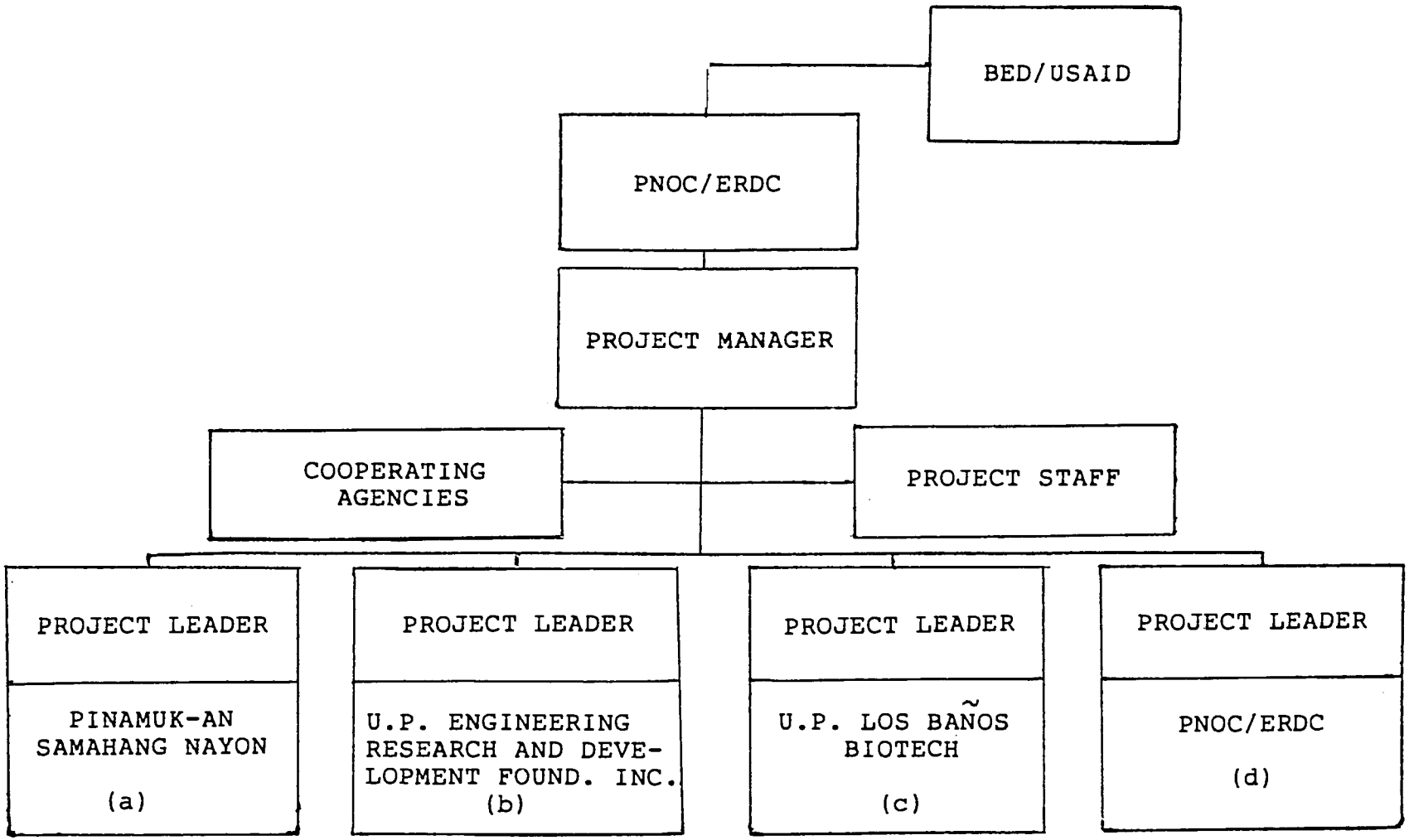

FIGURE 4-5

ORGANIZATIONAL AND INSTITUTIONAL RELATIONSHIPS
THE IVES PROJECT

4.4.4 Accomplishments and Current Status

Phase I of the subproject was implemented involving community development work which laid the ground work for Phase II. Community self-help type activities were initiated; these inluded charcoal-making, fish processing and drying, construction of training facilities, and others. An assessment of potential energy resources identified cocoshell, nipa for alcohol, and livestock for biogas as some of the leading possibilities. Since the village derives most of its income from fishing and coconut production, one of the technologies selected was a gasifier-driven 2-ton ice plant fueled wih coconut shell charcoal. A gasifier-driven 50-KVA generator was also planned to be installed to supply electricity to the village.

During the initial months of the project, the layouts for the biomass-powered electric plant, ice plant, and biogas were prepared. The rest of 1983 saw the installation of electric power lines, negotiation with the local cooperative on electricity generation, and finalization of design specifications for the electric and ice plants. The design of the biogas generator from piggery waste was also finalized during this same period.

Early in 1984, it was determined that an additional gasifier reactor was needed. This, together with the procurement of a used diesel engine, suffered some delays. In the meantime, the electric distribution system was expanded and components of the ice plant were procured. The initial operation of the ice plant and the installation of the biogas digester and a second gasifier happened before the end of 1984.

At present, Phase I of the subproject has been completed. It included site selection; an assessment of the villagers' main concerns, needs, and arrangements for distributing the benefits of the program; assessment of resources, and preliminary screening of technologies. Also during this phase, communal toilets and wells were installed, a community demonstration center was constructed, seminars were held for the villagers, and a small ipil-ipil tree farm was started.

Phase II of the IVES project, which is now nearing completion, includes the installation of the gasifier at the ice plant, of the gasifier and generator equipment for the elecricity generation, and of the electrical distribution system. It also provides for the training of operating personnel and includes an evaluation of the subproject.

The IVES project is scheduled to be completed by October 1986 after which it would then be turned over to the municipal

government of New Washington, Aklan. In summary, the status of the subproject is as follows:

Subproject A - Community Development	-	100% completed
Subproject B - Rural Electrification from Producer Gas System	-	95% completed
Subproject C - Biomass-Powered Ice Plant	-	95% completed
Subproject D - Village Interaction and Monitoring and Evaluation System	-	80% completed

As of June 30, 1986, the IVES project had received a total allotment of ₱2,908,605 from the USAID loan fund. This has been almost entirely spent. It also received and fully spent the GOP/BED funding counterpart of ₱657,000.

4.4.5 Findings and Recommendations

The IVES project is a social development project with an energy aspect, rather than a purely energy project. It is a needs-driven project rather than a technology-driven project.

A few problems have been encountered in the implementation of the IVES subproject. These included (a) hiring of personnel, (b) sudden price escalation which caught the implementor unprepared, and (c) delays in fund releases. The latter contributed to the delays in the conduct of the subproject activities.

This subproject fits the USAID's focus on rural development. The lessons to be learned from it can only be determined completely after several years. Since it involves social changes, the IVES project requires a long period of monitoring and evaluation. Continuing modest maintenance assistance to the subproject may be necessary.

The remaining time of the subproject could be used by the PNOC/ERDC to effect the smooth transition of the subproject management to the Pinamuk-an Consumer Service Cooperative, Inc. To prepare the local cooperative for assuming responsibility over the system, a training on cooperative management can be of help. This can be done in cooperation with the Ministry of Agriculture and Food and other concerned parties. The subproject will benefit from the PNOC/ERDC's continuing technical assistance in the operation and maintenance of the energy technologies after the turnover.

Part of the remaining project funds could perhaps be used to support an evaluation to determine the socioeconomic impact of the project. The current monitoring and evaluation efforts should be able to specify the different parameters that will influence the success or failure of similar integrated village projects.

A minimum of one year is desirable for monitoring the subproject. After the duration of the current subproject period, it is hoped that the BED/NCRD shall have gathered valuable experience that can be used for the improved design of an integrated energy system. Important dimensions to consider before replication of the IVES concept are: economic, psychological, institutional, social, technical and technological, legal, and environmental.

Appendix A-8 presents details of our technical assessment of various technologies in the IVES project. Appendix A-9 presents a brief report on the training activities pursued by the subproject.

4.5 GASIFICATION OF DENSIFIED RICE HULLS (AID 8203-L)

Duration	:	38 months (November, 1983 - December, 1986)
Implementor	:	Energy Research Development Center (ERDC), Philippine National Oil Company (PNOC)
Location	:	San Carlos City, Negros Occidental
Coordinating Agency	:	Gamboa Hermanos, Inc. (GHI)
Project Leader	:	Mr. Francisco Sta. Ana
Funding Commitment (P):		USAID - 3,046,664 GOP/BED - 248,770 PNOC/ERDC - 523,900

4.5.1 Objectives and Goals

The principal objective of the subproject is to evaluate the technical feasibility of converting rice hulls into a fuel with high energy density. It also aims to assess the suitability of using densified rice hull as gasifier fuel, and to compare its performance as such with loose rice hulls. The goal is to come up with an optimum design of a suitable gasifier (by analyzing variances in monitored parameters such as temperature, pressure drops, and air-gas flows) and then to install and operate a pilot plant based on results obtained from the laboratory set-up.

This subproject is significant since the potential of rice hull for displacing fuel oil is big (approximately 3.7 million barrels of oil equivalent per crop season). It is also an important source of information on densified rice hull as gasifier feed. Aside from their potential use for internal combustion engines, densified rice hull can serve as fuel for cooking stoves and industrial boilers.

4.5.2 Description and Funding Commitment

The technology involved in this subproject is the gasification of rice hull for running diesel engines. The design of the gasifier is different from those which use other feedstock (like charcoal or woodchip) because of the particular characteristics of rice hulls. Rice hull comes in loose, small particles containing about 20% ash. Its ash fusion (or clinker formation) temperature is low. Densified rice hull is in the form of charred briquettes or pallets.

Ordinarily, gasification temperatures are high and the gasifiers require fuel sizes no finer than about 10mm x 10mm. The higher percentage of ash requires a specially designed ash

removal mechanism in the gasifier reactor as well as a highly efficient gas cleaning train to ensure that clean gas enters the engine.

Very few rice hull gasifier systems have been reported in the technical literature, probably due to the difficulty of gasifying this fuel.

The subproject consists of two major activities: laboratory testing and debugging, and pilot plant installation and operation. Figure 4-6 presents the system flowchart.

As of June 30, 1986, total USAID commitment to the subproject was ₱1,361,476 in local peso loans and ₱1,685,188 in equivalent foreign exchange loans. The GOP/BED commitment was ₱248,770 and that of PNOC/ERDC, ₱523,900.

4.5.3 Institutional Relationships and Subproject Management

Four institutions are involved in the subproject. The Energy Research and Development Center (ERDC) of the Philippine National Oil Corporation (PNOC) is the proponent and project implementor. The U.P Engineering Research and Development Foundation, Inc. acted as subcontractor for the design of the gasifier system. Revan's Engineering constructed the test facility building at the PNOC/ ERDC compound. Gamboa Hermanos, Inc. (GHI) of San Carlos City, Negros Occidental provided the pilot plant site and supplied the rice hull feedstock.

The primary target beneficiaries of the subproject are rice millers. Household users and industrial plants using boilers are included as potential users of the technology. Researchers on gasifier technology using rice hull as feedstock are expected to benefit also from the results of the subproject.

The subproject implementing unit within the ERDC is the Biofuels Section. This section has two subunits: a technical group and an administrative group. The technical group handles the energy aspects of the subproject while the administrative group takes care of financial and reporting requirements to the BED/NCRD. The Project Monitoring and Evaluation Section of the ERDC is responsible for internal monitoring of the subproject. This section regularly updates the status of the subproject and expedites the execution of subproject activities.

4.5.4 Accomplishments and Current Status

Work was started near the end of 1983 with the conceptualization of the system. Hiring of personnel and

FIGURE 4-6

SYSTEM FLOWCHART OF THE GASIFICATION OF DENSIFIED RICE HULLS PROJECT
(AID 8203-L)

detailed design of the system were done during the first quarter of 1984. During the same period, test procedures were finalized and a procurement list for required equipment was submitted.

From April to June 1984, selection of the pilot plant site took place, along with procurement of auxiliary facilities. Construction of the pilot system started toward the end of 1984, accompanied with the hiring of additional project personnel. In the meantime, fabrication of the gasifier took place and a commercial briquetting machine was purchased. By early 1985, equipment installation had been completed. The rest of 1985 was spent on testing and debugging of the pilot plant.

As of June 30, 1986, the total USAID commitment of ₱3,046,664 to the subproject was fully allotted and spent. The GOP/BED committed budget of ₱248,770 was likewise fully allotted and spent.

4.5.5 Findings and Recommendations

Price escalation of needed equipment and lack of qualified personnel caused major delays in the subproject. The subproject is now about eight months behind schedule. Technical problems were encountered, such as defects in the reactor refractory wall of the gasifier. Because of problems with the gasifier and its perceived unreliability, there has been hesitancy on the part of GHI to use the system to provide power for its rice mill. At the time of our evaluation, the gasifier was coupled to a generator set (which the PNOC/ERDC had temporarily installed in order to test the gasifier) not to the rice mill's engine.

Table 4-1 shows a trial data sheet covering a system test run for an aggregate period of 16 hours. The data show:

a) total running time using the gasifier with the diesel engine;

b) fuel consumption (diesel and rice hull) and percentage displacement of diesel by producer gas;

c) indication of performance of the gas cleaning train; and

d) problems encountered.

As can be expected, the problem lies mostly in the gas cleaning train. The data sheet shows that the filter elements are cleaned or replaced every hour. This problem is also clearly indicated in the last column. It is no suprise that the gasifier is not connected to the rice mill engine at the site. Densification would not remove any ashes and, therefore, appears unlikely to solve the problem.

TABLE 4-1

TRIAL DATA SHEET FOR GASIFICATION OF RICE-HULLS

DATE	TEST NO.	TOTAL RUNNING TIME (HR.)	DIESEL CONSUMED (KGS)	DIESEL CONSUMED (LTRS)	RICE HUSK CONSUMED (SACKS)	RICE ASH RECOVERED (CANS)	TIMES THAT SCREEN AT DRY FILTER CLEANED	CONDENSED WATER RECOVERED AT CONDENSER (LTRS)	LOAD USED (HP)	CLOTH FILTER USED (QTY) PCS.	CLOTH FILTER USED (HRS.)	PROBLEMS ENCOUNTERED
12-6-85	1	2	1.28	1.5	10	12	1	5	3	1 1	1st hr. 2nd hr.	Easily clogged cone screen at dry filter
12-10-85	2	1	0.425	0.5	5	3	1	3	3	1	1st hr.	-do-
12-17-85	3	3.5	1.193	2.25	20	21	4	14	3	1 1 1 1	1st hr. 2nd hr. 3/4 hr. 3/4 hr.	 -do-
12-18-85	4	2.75	1.275	1.5	17	16.5	2	9	3	1 1	1st hr. 1 3/4 hr	-do-
12-19-85	5	1.75	0.638	0.75	5	4.5	1	3	3	1 1	1st hr. 3/4 hr.	-do-
12-20-85	6	4.25	1.9125	2.25	27	22.5	4	15	3	1 1 1	1st hr. 2 1/4 hr 1st hr.	Cone screen at dry filter clogged w/ fine ashes between 1-1/2 & 2 hours of operation
12-20-85	7	0.75	2.125	2.50	NONE	NONE	NONE	NONE	NONE	---	---	NONE

Source: PNOC/ERDC

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The critical component in the system is the gasifier which is fuel-specific. More research and development are needed to improve its performance, both in terms of material of construction and thermodynamics.

The gas cleaning mechanism requires good engineering studies. Perhaps, GHI could be requested to assist in undertaking design improvements. GHI has already fabricated twelve units of gasifiers which have been reported to be working better than other commercially produced gasifiers. Thus, GHI's experience could be of use to the subproject.

Considering the perception of the subproject staff that no major delays in the remaining activities of the subproject are expected, no extension or additional funding is recommended. It would be worthwhile, though, to conduct performance monitoring of this subproject.

It can be seen from this subproject, and from existing technical literature, that rice hull gasification does not present immediate hope for practical use in running engines. Although the use of rice hull as fuel should remain a priority, it may be advisable to give greater emphasis to the use of rice hull as fuel for direct combustion in dryers, boilers, and kilns.

4.6 BIOMASS ASSISTED/POWERED RURAL REFRIGERATION SYSTEMS (AID 8204-L)

Duration	:	37 months (November, 1983 - December, 1986)
Implementor	:	Energy Research and Development Center (ERDC), PNOC
Location	:	ERDC, Diliman, Quezon City and Roxas City
Cooperating Agencies	:	Sycip, Gorres & Velayo, Inc,; Alicia Ice Plant, Roxas City; Philippine Fisheries Development Authority
Project Leader	:	Mr. Francisco B. Sta. Ana
Funding Commitment (₱):		USAID - 5,055,910 GOP/BED - 869,407 GOP/PNOC/ERDC - 298,587

4.6.1 Objectives and Goals

This subproject aims to carry out a comprehensive assessment of the feasibility of using biomass as a source of energy in rural refrigeration systems. The specific objectives are:

a) to ascertain the potential for reducing the consumption of fossil fuels by conventional refrigeration systems through the use of biomass and nonconventional energy conversion technology;

b) to design, fabricate, assemble, and field test vapor compression and absorption refrigeration units using gasification or direct combustion of biomass, or both;

c) to determine the technical, economic, financial, social, and environmental factors relevant to refrigeration systems powered by biomass; and

d) to conduct an independent resource mapping of possible sites for biomass refrigeration technology dispersal.

4.6.2 Description and Funding Commitment

The refrigeration system used in the project is the vapor-compression type. The site selected is an existing ice plant in Roxas City (Alicia Ice Plant). An independent resource mapping of possible sites was also to be conducted. A local consulting firm was engaged to provide resource mapping services covering biomass supply, demand for refrigeration, consumption pattern, and livelihood profile. Figure 4-7 presents the system flowchart.

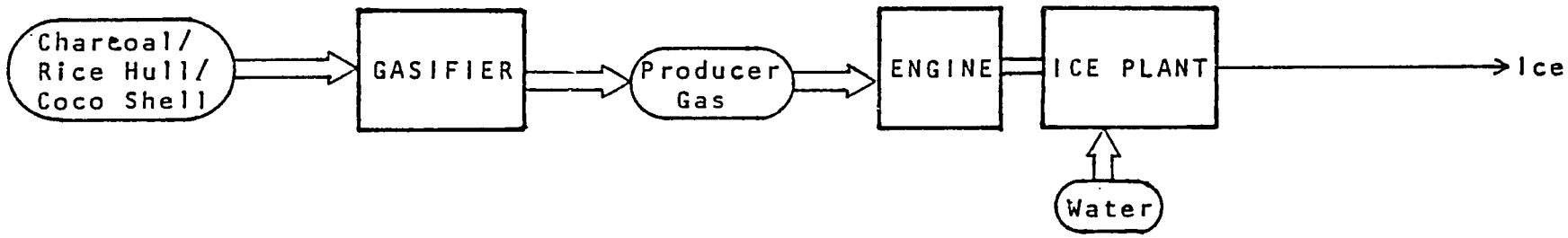


FIGURE 4-7

SYSTEM FLOWCHART OF THE BIOMASS ASSISTED/POWERED RURAL REFRIGERATION SYSTEM
(AID 8204-L)

As of June 30, 1986 funding commitments to this subproject amounted to ₱1,108,108 (local peso) and ₱3,947,802 (foreign exchange) from the USAID loan-assistance package. The GOP/BED counterpart was ₱869,407 and that of the GOP/PNOC/ERDC, ₱298,584.

4.6.3 Institutional Arrangements and Subproject Management

Four institutions have been involved in this subproject. The Energy Research and Development Center (ERDC) of the Philippine National Oil Company (PNOC) is the proponent and the project implementor. Sycip, Gorres, Velayo and Co. (SGV), a local consulting firm, conducted the biomass resource mapping of possible sites. The Philippine Fisheries Development Authority was involved in the identification of refrigeration and cold storage sites. The Alicia Ice Plant in Roxas City provided the final site.

The Alicia Ice Plant is the primary target beneficiary of the subproject. But all ice plants with accessible and economical biomass resources stand to benefit from it.

The project implementing unit within ERDC is the Biofuels Section. This section has two subunits: a technical group, and an administrative group. The technical group handles the engineering aspects of the subproject while the administrative group takes care of financial and reporting requirements to the BED/ NCRD. The Project Monitoring and Evaluation Section of the ERDC is responsible for internal monitoring of the subproject. This section regularly reports the status of the subproject and expedites the execution of project activities.

4.6.4 Accomplishments and Current Status

The first three months of implementation were devoted to subproject organization, site survey, and general familiarization with the subproject. The rest of 1984 were devoted to finalizing the design of the system and to negotiating with the Roxas City ice plant owner for the cooperative venture.

During 1985, testing of the diesel engine using different fuels, such as coco-oil, alco-gas, alco-diesel, ester-diesel-alcohol, and others took place in a related project of the ERDC. The most feasible fuel was found to be producer gas and this was the one used for this subproject.

For 1986, the project's timetable calls for the construction of a gasifier shed to install the gasifier at the ice plant. Also included is the training of personnel to operate the system and the 95-KVA diesel generator set.

A locally fabricated gasifier that has been tested for performance at the Integrated Village Energy Systems Project in New Washington, Aklan will be shipped to Roxas City and installed at the Alicia Ice Plant. At present, the site where the system will be installed is ready. The gasifier is undergoing further tests to ensure smooth operation. Installations will require about three weeks, during which time the operators will also be trained on the handling of the equipment.

Total funding allotments to the subproject as of June 30, 1986 amounted to ₱5,055,910 from the USAID. Actual local peso expenditures were ₱1,108,108 leaving no unobligated balance for the local peso portion of the loan. Total obligations of the foreign exchange component amounted to ₱3,947,802. Of the funding commitment made by the GOP/BED, ₱817,350 has been spent, leaving an unobligated balance of only P52,057.

4.6.5 Findings and Recommendations

This and other gasifier projects could benefit from sharing of information. There appears to be inadequate information transfer among related projects (such as the IVES project, and the densified rice hull project) on the use of producer gas for diesel engines.

The part of this subproject on utilization of producer gas for diesel engines is similar to a component of the IVES project. However, there may be some benefits obtainable from demonstrating the same technology in different social environments.

We recommend that this subproject be completed soon. Once completed, the findings should be compared with the results of the IVES project (i.e., the refrigeration component), and other related projects on gasifier technology.

This subproject has shown that more detailed study is needed on gasifier systems. Rigorous assessment of the state-of-the art of gasifier technology should be undertaken to generate useful inputs for design purposes, and to provide direction for future research and development work. Experience derived from current applications of gasifier systems should be publicized to avoid duplication of efforts.

Both the BED/NCRD and the PNOC/ERDC staff could benefit from added training and technical assistance on gasifier technology, especially since this technology offers great promise for widespread application in the country.

4.7 DIRECT-HEAT GASIFIER (AID 8301-L)

Duration	:	30 months (March, 1984 - December, 1986)
Implementor	:	Energy Research and Development Center (ERDC), Philippine National Oil Company (PNOC)
Location	:	ERDC, Diliman, Quezon City
Project Leader	:	Mr. Francisco B. Sta. Ana
Funding Commitment (₱)	:	USAID - 2,127,140 GOP/BED - 168,864 GOP/ERDC - 354,360

4.7.1 Objectives and Goals

The project aims to evaluate the feasibility of utilizing low-BTU gas from gasifiers for existing oil-fired boilers. The specific objectives are:

a) to design and set up an experimental facility that would be used to evaluate the technical feasibility and requirements of direct-heat gasifier systems;

b) to design and fabricate experimental fixed-fed and fluidized fed gasifiers;

c) to determine suitable fuels for the gasifiers;

d) to determine the technical requirements of utilizing low-BTU gas from gas producers in an oil-fired boiler.

e) to optimize the design of direct-heat gasifiers, and

f) to evaluate the reliability, acceptability, and economics of direct-heat gasifier systems by designing and testing a pilot plant.

4.7.2 Description and Funding Commitment

This subproject began in March, 1984 and was initially scheduled to be completed in January, 1986. The first phase would involve the design, installation, and operation of an experimental direct-heat gasifier facility at the PNOC/ERDC compound at Diliman, Quezon City. (The system is termed "direct-heat" because the gas fuel from the gasifier does not undergo a stage of cleaning or filtering prior to entering the boiler). During this period, the technical requirements of a direct-heat gasifier system would be evaluated. During the second phase, a demonstration direct-heat gasifier system would be designed based on the experience obtained from the experimental unit. The

performance of this system would be monitored under actual operating conditions to evaluate its reliability, acceptability, and economics. Figure 4-8 presents the simple system flowchart.

Direct heat utilization of producer gas requires less gas cleaning than if the gas were used as fuel for an internal combustion engine. The elimination of the often problematic gas cleaning system immediately offers significant advantages for the project (e.g., savings in construction materials cost and in the maintenance and operating costs).

As of June 30, 1986 this subproject received funding commitments totalling ₱2,244,595 from the USAID. Of this amount, ₱1,613,835 was in local peso cost and ₱630,760 in foreign exchange. The GOP/BED's commitment was ₱168,864.

4.7.3 Institutional Arrangements and Subproject Management

The subproject implementor is the PNOC/ERDC. As of this date, no site for field testing has been identified. The implementor has its own boiler which may be used for testing the gasifier.

4.7.4 Accomplishments and Current Status

Initial work involved the hiring and training of project personnel and the installation of the boiler. The design of the gasifier was completed in December 1984. However, delays in the hiring of personnel and in the construction of the boiler house were encountered.

The whole of 1985 was devoted to testing the boiler and fabricating the gasifier system. Delays were reported in the procurement of the boiler's dual fuel burner.

Installation of the gasifier system and setting up of instrumentation are scheduled for 1986. Tests are expected to begin before the end of the year. There has been a delay in the completion of the final reactor component; this part was expected to be completed by the second week of April 1986. The rest of the system components have reportedly been completed. Final blueprints of the machine and instrument layout were finished as early as the end of February 1986. No further delays are foreseen since all major imported instruments are on site and ready for installation. There is also a pile of wood fuel for preliminary firing tests. The locally fabricated dual fuel burner which the ERDC designed will be tested after flaws in the initial design are corrected. The dual fuel burner is

FIGURE 4-8

SYSTEM FLOWCHART OF THE DIRECT-HEAT GASIFIER PROJECT
(AID 8301-L)

designed to burn a variety of biomass fuels. In this case, a mixture of bunker oil and producer gas will be fired. The burner will be fitted to a small boiler which produces process steam for electric power.

As of June 30, 1986, total fund allotments from the USAID amounted to ₱2,244,595. The total USAID-funded local peso expenditures amounted to P1,613,835; the total obligations of foreign exchange, ₱630,760. The GOP/BED counterpart share (P168,864) has been fully allotted and spent.

4.7.5 Findings and Recommendations

Lack of manpower and delays in the construction of the building and installation of the equipment have been the major problems of the project to date.

No information is deemed suitable for dissemination as of now since the project is not yet completed and no performance data have been generated.

We recommend that the project be given enough support to accomplish its main objective of determining whether low-BTU gas can be used in firing a boiler effectively.

4.8 COGENERATION SYSTEM AND INTERCONNECTION OF INDEPENDENT POWER PRODUCER TO THE NATIONAL GRID (AID 8402-L)

Duration	:	Almost 24 months (September 10, 1984 - July 31, 1986)
Implementor	:	Proctor & Gamble, Philippine Manufacturing Company (P&G-PMC)
Location	:	P&G-PMC, Vasquez St., Tondo, Manila
Cooperating Agencies	:	National Power Corporation (NPC) and Manila Electric Company (MERALCO)
Project Leader	:	Mr. Rene Santiago
Funding Commitment (₱)	:	USAID - 7,447,594 GOP/BED - 65,000 P&G-PMC - 77,134,211

4.8.1 Objectives and Goals

The primary objective of this subproject is to investigate the technical and economic viability of intertying independent power producers to the national grid. Other purposes are to encourage the use of solid biomass resources as fuel and to generate policy recommendations for industrial cogeneration systems.

The subproject also aims to collect data on the operation of a grid-connected cogeneration plant and gather experience on related institutional issues. The goals of the project are to produce the following results:

a) technical and economic feasibility evaluation of the grid interconnection,

b) policy recommendations for industrial cogeneration systems, and

c) promotion of the utilization of solid biomass resources as industrial fuel.

4.8.2 Description and Funding Commitment

Cogeneration is the simultaneous production of electric and thermal energy using the same fuel. The reject heat from the engine or generator set is captured and used to meet steam and hot water requirements. Current application of cogeneration in the Philippines is limited to a few industries that have access to low-cost or free fuels (e.g., biomass waste). These industries comprise sugar, wood, and petroleum processing, with

an estimated total power generation of about 152 MW. Predominant fuels for existing cogeneration appear to be bagasse and wood waste. Existing cogenerators consume on site all the energy produced (electric and thermal) without providing excess capacity to the utility grid.

This subproject is the first major utility-grid connected cogeneration system in the Philippines. It involves a cogeneration system being installed by Proctor and Gamble-Philippine Manufacturing Corporation (P&G-PMC) that is intended to be a full-scale demonstration system.

The P&G-PMC is installing a turbogenerator to produce electricity for internal plant consumption and sale to MERALCO. Steam is produced in a boiler fired by coconut shells and wood. The boiler was installed in 1983 and began operation in February 1984. The turbogenerator was installed recently and will be operating by the end of the year as soon as remaining electrical equipment is in place. Figure 4-9 presents a schematic diagram of the system without and with the subproject.

The manufacturing processes of the plant require 40,000 pounds per hour of steam at 200 pounds per square inch. The boiler produces steam at 600 pounds per square inch pressure. Boiler efficiency is 79%. The generator produces 4 megawatts (MW) of electricity.

This project is significant because cogeneration appears to have the greatest conservation and fuel-switching potential from among the subprojects under the USAID-GOP Project. A recent study (Stanley Consultants, January, 1986) showed that there is good potential for industrial cogeneration in the Philippines: about 80 to 145 cogeneration plants totalling 350 to 450 MW; half would be biomass waste-fired, half coal-fired. Potential fuel savings could be 1,000 million liters of oil equivalent per year. The firing of cogeneration by biomass shows great economic potential, subject only to the availability of fuel on location.

As of June 30, 1986, the USAID funding commitment to this subproject was in the form of foreign exchange-funded loan equivalent to ₱7,447,594. The GOP/BED commitment was ₱65,000; the P&G-PMC's, ₱77,134,211.

4.8.3 Institutional Arrangements and Subproject Management

Agencies cooperating in the project are the National Power Corporation (NPC) and the Manila Electric Company (MERALCO). The BED/NCRD is the coordinating agency for all project activities.

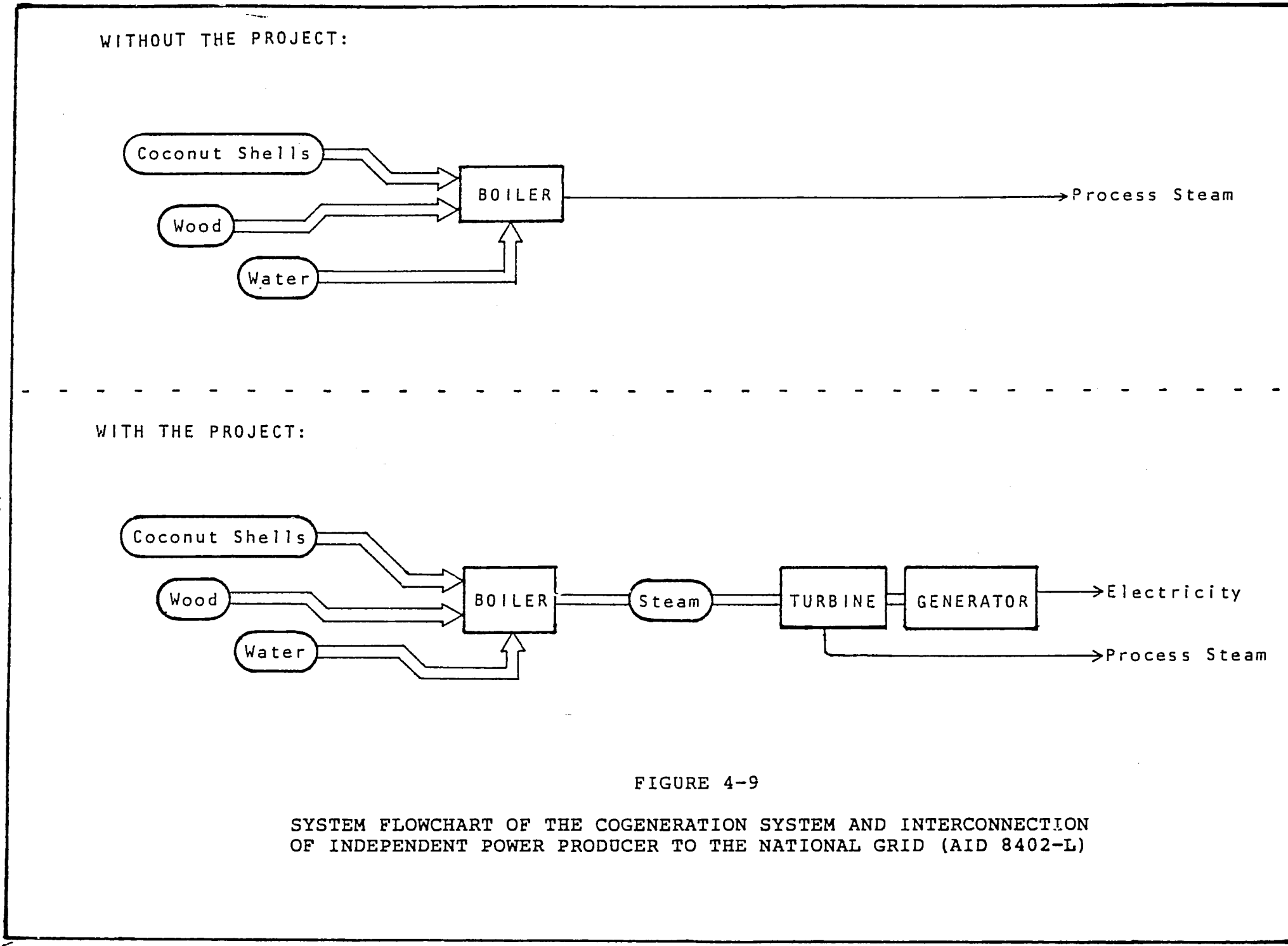


FIGURE 4-9

SYSTEM FLOWCHART OF THE COGENERATION SYSTEM AND INTERCONNECTION OF INDEPENDENT POWER PRODUCER TO THE NATIONAL GRID (AID 8402-L)

The P&G-PMC is providing the cogeneration facilities with funding for certain intertie and generator equipment by the USAID. The P&G-PMC will monitor the cogenerator's performance and collect pertinent data. MERALCO will monitor the power input to their distribution system.

This subproject has profited from its connection with the worldwide corporate energy management of the P&G-PMC which requires all plants to monitor their energy consumption per unit of output and to consider options for reducing energy costs. This plant had previously the highest reported energy consumption; now it will be near the average. (Most of other P&G plants outside the Philippines already cogenerate.)

Originally, a local contractor had handled plant design and construction. Now P&G-PMC depends only on the help of the P&G corporate staff for further technical assistance. The plant engineers and management seem well-qualified to plan and operate the subproject.

4.8.4 Accomplishments and Current Status

The memorandum of agreement between the BED, P&G-PMC, NPC, and MERALCO was signed on September 10, 1984, with minor amendments regarding fund sourcing and handling done on November 23, 1984 and on April 25, 1985. The subproject funding covered equipment ordered through the USAID and fees for a U.S. consultant.

Stanley Consultants, Incorporated, a U.S. firm, was contracted to provide consultancy services in training two local personnel (one from NPC and one from MERALCO) in the United States and to conduct a study to determine the potential for cogeneration in the Philippines.

The Stanley study involved an analysis of the potential for cogeneration with recommendations for appropriate government policies and guidelines to encourage an expanded role for cogeneration in meeting future energy requirements. The study report was completed early this year; it strongly encourages the use of biomass fuel for cogeneration and suggests the passing of a legislation that will provide financial incentives to independent power producers and will allow them to intertie with the utility grid.

All equipment for power generation have been purchased as of June 1985. Installation was completed in December 1985. All interconnection equipment, except for one, have been purchased and delivered. Delays encountered in the purchasing process

prompted MERALCO to install their equipment in order to meet the subproject schedule, with the understanding that they would be replaced by those purchased through the subproject.

The new boiler system (fired by coconut shell and wood) is now in operation; the generating equipment is not yet operational because of contractor problems. The P&G-PMC has taken over from the contractor and will finish the work with their own personnel. The cogeneration plant will be ready to operate as soon as electrical installation is completed, possibly later in 1986 or early 1987.

A project-funded consultant from the Development Science, Incorporated has submitted to the BED the draft legislation report entitled "The Independent Power Production Act of 1986".

The USAID funding commitment was fully obligated by June 30, 1986, whereas, that of the GOP/BED had not been allotted.

4.8.5 Findings and Recommendations

The subproject is now proceeding well despite earlier difficulties in going on line. The USAID and BED should stay involved long enough to get some useful data. There remains the problem of negotiating with MERALCO a price for the electricity that will be produced from the plant.

This subproject should be extended, if necessary, to complete the demonstration (including the documentation of the results) and to encourage adoption of the Stanley Consultants' recommendations.

It will be worthwhile for the USAID and the BED/NCRD to monitor the operation of the system for a year, learn from its technical performance, and assist in resolving institutional issues, notably the contractual arrangement with MERALCO.

Training on cogeneration technology should be continued. With the U.P. Graduate Program in Energy Engineering as the focal point, the widespread consideration and use of cogeneration in energy conservation could be accelerated. The experience of the P&G-PMC and other industries which have used cogeneration could likewise be shared in appropriate symposia and fora.

4.9 ESTABLISHMENT OF A PILOT-SCALE FERMENTATION/DISTILLATION FACILITY AT BIOTECH (AID 8403-L)

Duration	:	(November 1984 - December 1986)
Implementor	:	BIOTECH
Location	:	University of the Philippines, Los Baños, Laguna
Project Leader	:	Dr. Ernesto del Rosario
Funding Commitment (₱)	:	USAID - 18,623,000 GOP/BED - 462,034 GOP/BIOTECH - 3,883,890

4.9.1 Objectives and Goals

The aim of this subproject is to enhance the capability of the National Institute of Bio-Technology and Applied Microbiology (BIOTECH) at the University of the Philippines, Los Baños (UPLB) to perform research and development work on alcohol fuels. The goal is to establish a pilot-scale alcohol fermentation and distillation facility.

4.9.2 Project Description and Funding Commitment

The three main components of the subproject are:

a) Procurement of a pilot-scale fermentation and distillation facility and laboratory equipment;

b) Installation and start-up of the equipment;

c) Training and information exchange with key international alcohol R&D institutions.

As of June 30, 1986, this subproject has received a funding commitment of ₱18,623,000 from the USAID, ₱462,034 from the GOP/BED, and ₱3,883,990 from the GOP/BIOTECH.

4.9.3 Institutional Arrangements and Subproject Management

The subproject is managed by BIOTECH's regular staff members who also perform work outside of the subproject. The BED/NCRD facilitates the purchase of imported equipment.

4.9.4 Accomplishments and Current Status

The project leader went to Brazil and the United States for seven weeks (April-June 1985) in order to visit some alcohol distilleries and fermentation research centers.

According to the plan, all equipment would be purchased within 16 months from the initial release of project funds. Of the 14 equipment listed, three have been purchased and installed and nine are due for delivery in September 1986. The local equipment supplier contracted by the BED for the three equipment was Dakila Trading Corporation.

Both the USAID and the GOP/BED commitments have been allotted as of June 30, 1986. Total expenditures charged against the GOP/BED fund amounted to ₱399,628 leaving an unobligated balance of ₱62,406. After the receipt and installation of all equipment, the remaining activities will be to test the system and train the staff. The intended information exchange with international alcohol R&D institutions will be a continuing activity. The value of the facility can only be realized when research activities actually start.

4.9.5 Findings and Recommendations

Equipment purchase was delayed by three months due to the usual, program-wide snags in the purchasing process that seem to be beyond the control of Project Managers for the most part.

The USAID/GOP Project does not provide funding for operation of the facility and it is not clear yet whether BIOTECH will have adequate funds for the purpose. Both the USAID and the BED are concerned about how the facility will be run.

The use of regular staff members can reduce operating costs. However, it may pose problems in ensuring the continuity and progress of the project. At present, there already appears a fast turnover of personnel assigned to the project.

BIOTECH should be encouraged to develop an appropriate research program and obtain outside funding. If funds will permit, it might be worthwhile to consider the funding of a small well-defined research project that can start the operation of the facility. Such an effort will be beneficial to the subproject in attracting other donors.

The BED/NCRD should continue to monitor the activities of this subproject and facilitate the dissemination of useful information to interested parties.

4.10 SOLAR CROP DRYER RESEARCH AND DEVELOPMENT (AID 7801.1-L)

Duration	:	37 months (November, 1979 - December, 1982)
Implementor	:	College of Engineering and Agro-Industrial Technology, University of the Philippines at Los Baños (UPLB)
Location	:	Los Baños, Laguna
Cooperating Agency	:	Isabela State University
Project Leader	:	Dr. Emerico Mendoza
Funding Commitment (₱)	:	USAID - 1,283,116 GOP/BED - 77,400 UPLB - 374,180

4.10.1 Objectives and Goals

The main objective of this subproject was to test the field performance of existing solar crop dryers designed by the UPLB. The subproject also involved an evaluation of the suitability of thermal conversion processes for the temporary and long-term storage of crops, as well as optimization and variational studies to arrive at an efficient solar crop dryer design.

Several crop dryer designs were to be field-tested using operational and experimental set-ups at various locations. The evaluation of the operational, as well as economic performance of the dryers, was intended to generate important baseline information for possible mass manufacturing and promotion of solar crop dryers. The target application was batch-type operation, with capacities ranging from one to two tons. In addition, a high-volume continuous-flow drying system was to be designed and fabricated to provide information on the technical and economic feasibilities of high capacity solar-drying units.

4.10.2 Description and Funding Commitment

The UPLB batch-type solar dryers utilize solar flat plate collectors which transmit absorbed solar energy into a heating medium, usually air (although it is also possible to use water as the heating medium). The heated air is circulated into a blower assembly which transmits the heat to a drying bin containing the material to be dried. Figure 4-10 presents the system flowchart.

Various designs of solar flatplate collectors were fabricated and tested. The parameters considered in designing the solar collectors were operating temperature, physical properties and dimensions, cost of materials, and efficiency of

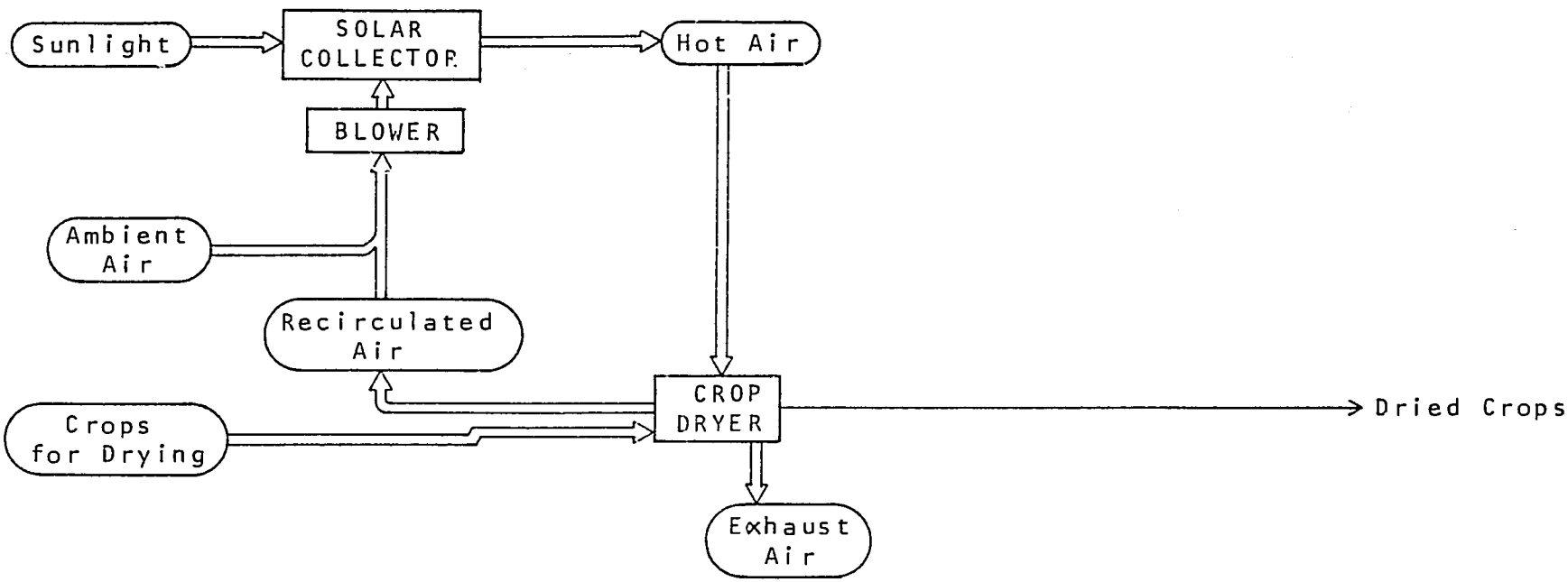


FIGURE 4-10

SYSTEM FLOWCHART OF THE SOLAR CROP DRYER
AND RESEARCH DEVELOPMENT PROJECT (AID 7801.1-L)

the system. Several types of construction materials were selected for testing. For the solar flat plate collector cover, silicon transparent glass and polyethylene plastic were tested. Results showed that the latter type of material was preferable. For the heat absorber, two types of materials were tested and compared: (a) plain GI sheet with a 1/2-inch thick plywood as insulator, and (b) concrete pavement. Although much cheaper than the use of GI sheet, the use of concrete pavement as heat collector resulted in lower heat absorption efficiency.

The experimental flatplate solar collector measured 3 feet by 3 feet, and was partitioned into five sections (each with an effective width of seven inches). Air flow through the collector was maintained at about 25 cubic feet per minute. Results showed that the optimum length of air path was 9 feet, beyond which heat collected was dissipated to the sorroundings. Air temperatures observed ranged from 85 to 130 degrees farenheit.

Initial drying tests were conducted at the UPLB. Results showed that, for an 8-hour sunny period, palay was dried from an initial moisture content of 20-22% to 14% final moisture content. Actual drying operations in the field were then conducted. The (40-cavan capacity) batch-type solar dryers tested were located in Muñoz (Nueva Ecija), Pulilan (Bulacan), and Urdaneta (Pangasinan). The dryers were backed up by rice-hull fired furnaces used for rainy periods and for night-drying operations.

Funding commitment to this subproject amounted to a total of ₱1,360,516, of which, ₱1,283,116 was charged against the loan component of the USAID fund. The balance of ₱77,400 was charged against the GOP/BED fund.

4.10.3 Institutional Arrangements and Subproject Management

The subproject was implemented by the College of Engineering and Agro-Industrial Technology (formerly called the Institute of Agricultural Engineering and Technology) of the University of the Philippines at Los Baños. Minimal assistance in the form of technical personnel and facilities was required from the BED.

Seminars and demonstrations were conducted at the various sites where operational and experimental UPLB-designed solar drying units were installed. These seminar-demonstrations were attended by farmer-leaders and members of local farmers' associations.

4.10.4 Accomplishments and Current Status

The project was completed in 1982. The notable accomplishments of the project lie mainly in the design, fabrication, and testing of solar dryer components (e.g., solar collector) using various types of construction materials to characterize differences in heat absorption efficiencies. These investigations also involved varying the dimensions of the solar collector components, and determining the best orientation of the solar collector (with respect to the sun) to maximize solar energy utilization.

The data generated by the project are of three types: (a) designs and specifications of various types of solar crop-drying systems (i.e., solar batch-type dryer using either air or water as heating medium) and continuous flow dryers; (b) comparative cost analysis between kerosene-fired dryer and solar batch-type dryer (with back-up rice hull furnace); and (c) methodology for analyzing solar radiation data.

The principal factor recognized as crucial for predicting the performance of solar crop dryers is the availability of solar radiation. Statistical information on solar radiation data was recognized as important for predicting the average output of the solar collectors, as well as for determining the probability of success of solar grain-drying operations at specific locations on a long-term basis. For this purpose, the project developed a methodology for analyzing hourly and daily observations of solar radiation (recorded by mechanical pyranometers), and conducted measurements for two project sites (Pangasinan and Isabela).

The proposed socioeconomic impact study was not done, however, even though an approach for conducting such a study had been formulated. This approach involved cross-sectional statistical method to evaluate differences in impact indicators (e.g., income) among users and non-users of solar crop grain dryers. This component of the subproject could not be done because it was found that the actual number of users of solar dryers was too small to be able to test for significant differences in the impact indicators. For instance, a survey disclosed that, since the dryer was installed on February 20, 1981, only two farmers had used the units.

As of the June 30, 1986 statement, the reported expenditures for this subproject amounted to ₱923,270 charged against the USAID fund and ₱69,420, against the GOP/BED fund.

4.10.5 Findings and Recommendations

As implied above, there is a very limited number of users of solar-drying systems, despite the fact that, technically, solar-drying units have been shown to serve their purpose adequately. The UPLB solar dryers performed successfully in the field in terms of demonstrating their crop-drying capability and of producing products with the desired quality. Furthermore, a commercialization study for solar dryers conducted by the Economic Development Foundation (EDF) in 1983 reported that, based on the UPLB tests, the quality of grains produced from solar drying units were superior than those dried using traditional direct sun-driving methods; for rice grains, the quality was comparable to those dried using conventional fuel-based mechanical dryers. (The last point, however, seems to be inconclusive and still subject to contention.) The study also indicated that drying times were similar between solar and mechanical dryers (i.e., around seven hours, compared to 16-20 hours for the traditional open sun-drying method).

The above findings show that solar crop drying is technically feasible. In addition, the utilization of solar dryers is favored by the fact that the bulk of the rice harvest coincides with the peak insolation months of November to June.

Nevertheless, from the user's economic standpoint, solar grain dryers are perceived to have no competitive advantage over natural sun-drying methods. The 1983 EDF study conducted a cost-comparison among three types of rice drying: (a) using solar dryer, (b) using conventional mechanical grain dryer, and (c) using traditional sun drying. The EDF study showed that solar drying--in terms of initial investment alone--is 1.4 times more expensive than conventional mechanical drying (using gasoline as fuel) and is about 50 times more expensive than traditional sun-drying.

Thus, with conventional mechanical dryers, solar dryers are not cost-competitive, much less so in comparison with traditional sun-drying. The disadvantage of solar grain dryers is that, while their initial cost is high, they do not offer significant advantages in operating cost. For instance, solar grain dryers still need auxiliary heating systems to provide necessary back-up.

Based on the study, it appears that, unless investment costs are brought down, solar grain dryers are not likely to be commercially attractive within the near term. Thus, future development activities on solar grain dryers should focus primarily on reducing investment costs.

A major advantage of solar dryers over traditional direct sun drying is in the improved quality (e.g., hygienic quality) of the product. For grain products, however, the advantage of improved quality is not readily translated into significantly higher selling price for the products. But, while such may be the case for grain products, other products like fruits and vegetables are much more sensitive to quality standards in determining selling price. For fruit and vegetable drying, therefore, the economic advantage of improved quality by solar drying may be sufficient to justify the cost of investing in it. Thus, more emphasis should probably be placed on research and development of solar dryers for drying fruits and vegetables.

It appears that the potential market for solar dryers are those relatively large-scale users whose volume of demand for drying are favorable for attaining economies of scale with the use of solar dryers. The initial investment in solar dryers is invariably more expensive compared to that of conventional fuel-fired dryers because, while the construction materials are the same for both types of dryers, the solar dryer has to have two heating systems: the solar heating system and the back-up (auxiliary) heating system. By contrast, the conventional dryer only needs one heating system. As such, the economic advantage of solar dryers is realized only by way of reduced fuel cost, and this is more readily attained with higher volumes of drying requirement.

Finally, performance data currently available on solar dryers are primarily indicative of the latter's operational characteristics. More data are needed regarding their long-term performance under field conditions, particularly on the durability and service life of the dryer's solar collector (i.e., glazing and heat absorber) and other solar-heating components.

4.11 DESIGN, CONSTRUCTION, AND EVALUATION OF A SOLAR LUMBER DRYER WITH AUXILLARY HEATING SYSTEM (AID 7801.2-L)

Duration	:	49 months September 1979 - October 1983
Implementor	:	Forest Products Research and Development Institute, (FPRDI) University of the Philippines
Location	:	Los Baños, Laguna
Cooperating Agency	:	POLYMART, Inc., Santa Rosa Laguna
Project Leader	:	Mr. Ricardo Casin
Funding Commitment (₱)	:	USAID - 220,656 GOP/BED - 64,550 FPRDI - 103,477

4.11.1 Objectives and Goals

In the Philippines, the current methods of drying lumber are by air-drying and kiln-drying. Open air-drying is the cheapest method, and is the one most extensively used. Air-drying, however, requires a long-time which could range from four to eight months. As a result, considerable capital is tied up in stock inventory. Furthermore, this method is prone to result in uneven drying of lumber and consequent poor quality of product which may not meet export standards.

Conventional, steam-heated kiln-dryers, by comparison, can dry lumber in a much shorter span of time. It also produces good quality lumber. However, the capital and operating costs (for fuel) of these dryers are high, thus limiting their actual and potential widespread use by the wood industry.

Alternative methods for drying lumber are still in the research and development stage. Currently, there appears to be two potentially applicable methods. One method is through the use of biomass as fuel for furnace-type kiln-dryers. The other method is through the use of solar energy.

The overall aim of this subproject was to investigate and demonstrate the use of solar lumber dryers as an alternative to the traditional methods of air-drying, and kiln-drying using conventional fuels. The subproject would also integrate a biomass-fueled (woodwaste) auxiliary heating system integrated with the solar dryer.

The specific subproject objectives were: (a) to design and construct a solar lumber dry kiln (with an auxiliary biomass-fired back-up heater), (b) to conduct performance tests at three different periods of the year in order to determine variations in total drying times, (c) to compare the performance of the solar

lumber dryer with the traditional air-drying and (steam-heated) kiln-drying methods, (d) to demonstrate the adaptability of the solar lumber dryer to small and medium-scale wood industries, and (e) to prepare an operations manual to guide prospective users.

4.11.2 Description and Funding Commitment

There are two types of heat-collecting solar lumber dryers. One type is the "greenhouse" or direct solar lumber kiln; the other is the "external collector" or indirect solar lumber kiln.

In the "greenhouse" type, the building itself acts both as the solar heat collector and kiln. This type is inexpensive and easy to construct. However, it is subject to radical changes in temperature and does not efficiently utilize solar energy (i.e., cannot store excess heat).

During the late sixties, the FPRDI conducted experiments on the use of greenhouse-type solar dryers. Tests showed that the greenhouse dryer was capable of drying lumber in about 30 to 40% less time than it took to air dry a comparable sample. Despite those favorable results, the wood industry showed little interest in adopting the technology. Many of the reasons for the prospective users' resistance in using the method centered on: (a) lack of an auxiliary heating system for use during night time drying, and as back-up during periods of inadequate sunshine, (b) lack of a device for storing excess heat, (c) difficulties in controlling relative humidity inside the greenhouse dryers which effects the quality of the product, and (d) problem with durability of the solar dryer components (e.g., glazing of cover material).

This subproject, in effect, was formulated to address the above deficiencies in the previous solar dryer systems. The method proposed under the project was the "external collector" type of solar lumber kiln. This type features a seperate solar heat collector system connected by a duct to the main kiln. The proposed system also included an auxiliary heating unit, and a humidification unit (to prevent checking and case-hardening of solar-dried lumber). Figure 4-11 presents the system flowchart.

Funding commitment to this subproject consisted of ₱220,656 from the loan component of the USAID assistance, ₱64,550 the GOP/BED counterpart fund, and ₱103,477 from the FPRDI.

4.11.3 Institutional Arrangements and Subproject Management

The subproject was implemented by the Forest Products Research and Development Institute (FPRDI) under the National

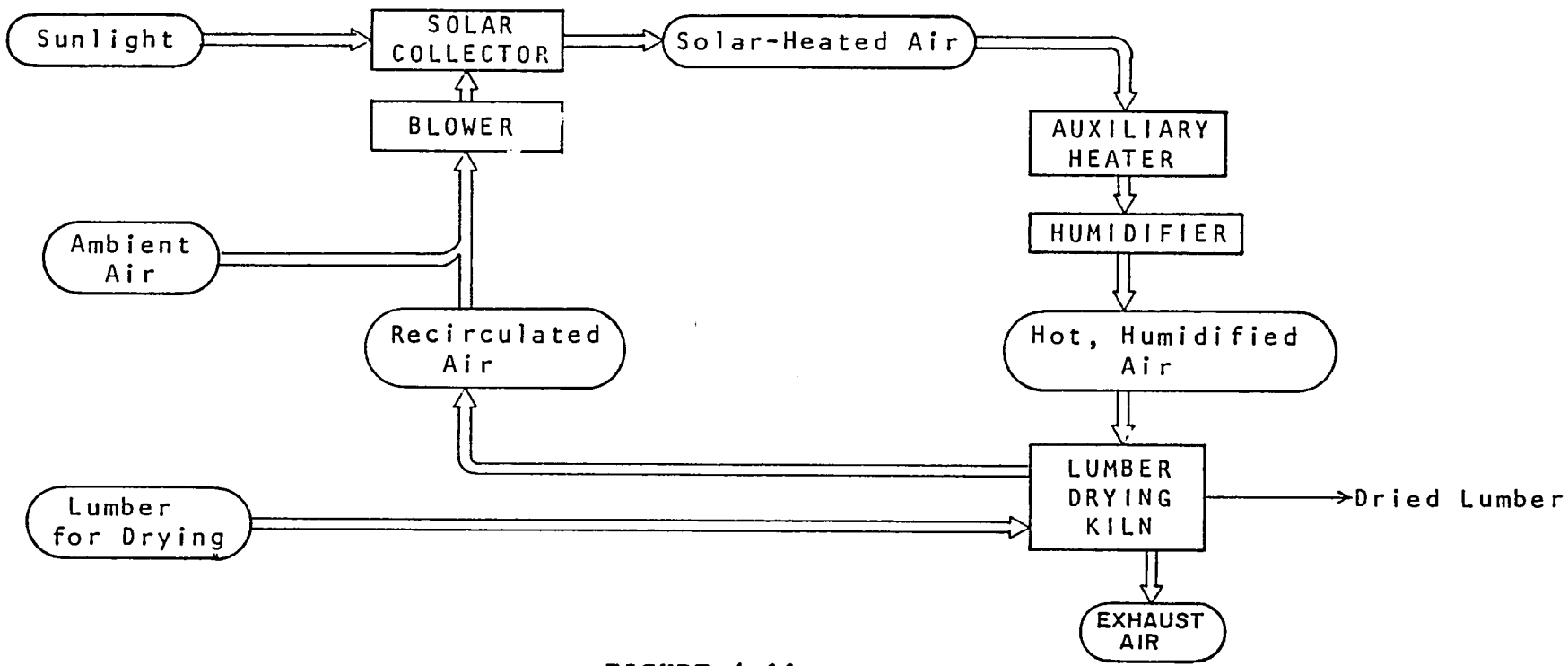


FIGURE 4-11

SYSTEM FLOWCHART OF THE SOLAR LUMBER DRYER PROJECT
(AID 7801.2-L)

Science and Technology Authority. The project was based at the University of the Philippines at Los Baños, College of Forestry campus. The BED/NCRD monitored the execution of the subproject.

Fabrication of the solar lumber prototype was done with the cooperation of POLYMART, Inc., located at Santa Rosa, Laguna. POLYMART provided the construction site and utilities (electricity and water) for the operation of the system.

4.11.4 Accomplishments and Current Status

The experimental solar lumber dryer (with an auxiliary heater) was constructed during March 1982. Drying tests using various lumber species and thicknesses were conducted from the last quarter of 1982 through the third quarter of 1983. These tests covered the overall operational performance of the system and the efficiencies of the system's components (i.e., glazing and heat absorber). Originally, the project was planned to be completed by December 1982. This terminal date was moved to October 1983 to enable the conduct of the above tests. No additional funding was required for the extension, however.

The solar dryer prototype had a capacity of 4.7 m^3 (2000 bd. ft.). It consisted of an external, flat-bed solar heat collector, a biomass-fired furnace-type auxillary heater, and a centrifugal-type humidifier (powered by a 1/4 HP motor).

Three sets of drying tests were conducted corresponding to periods or seasons of high, moderate, and low-solar insolations. These tests were done to evaluate the performance capacity and operating economics of the system. Table 4.2 summarizes the findings on the total drying contributions from solar heat and the auxiliary heater for the three test periods. During these tests, the auxiliary heater collector was used for overnight drying as well as during rainy days.

Table 4-3 summarizes the comparison of drying times (solar dried vs. air dried lumber) using various wood species. The data indicate that, on the average, the solar dryer (with auxiliary heater) was able to achieve 1.6 to 3.1 times greater reduction in moisture content compared with that of air drying.

In comparison with the conventional-type kiln dryer, the solar dryer showed a roughly equal rate of drying, indicating that the two methods are comparable in their efficiencies. In terms of costs, however, the solar lumber dryer (with auxiliary heater) was found to be 10 to 15% cheaper than the conventional-type kiln-dryers.

The funding commitments to the subproject were fully allotted and spent.

TABLE 4-2

COMPARISON OF PERCENTAGE
UTILIZATION OF SOLAR HEAT AND AUXILIARY HEAT
FOR THE SOLAR LUMBER DRYER
(including amounts of woodwaste used for auxiliary heating)

	PERIOD		
	High Insolation	Moderate Insolation	Low Insolation
% of total drying time attributed to solar heat	45%	30%	38%
% of total drying time involving the use of auxiliary heater	55%	70%	61.65%
Amount of woodwaste consumed by auxiliary heater	3 0.24 m /day	3 0.30 m /day	3 0.6 m /day

Source: Casin, R.F. and A.A. Salita, Jr. "A Solar Lumber Dryer with Auxiliary Heater." FPRDI, Los Baños, Laguna, Undated.

TABLE 4-3

DRYING RATES[a/]
ACHIEVED WITH SOLAR LUMBER DRYER
FOR SPECIFIED DRYING PERIODS/DURATIONS

Test Duration / Type of Wood Tested	March 2-8, 1983 (High Insolation)	October 14-19,1982 (Moderate Insolation)	September 14-20, 1983 (Low Insolation)
Mahogany (Swietenia Macrophylla)	47.3% - 10.42% (46.2% - 23.7%)		
Lanate (Wrigthia Laniti)		21.1% - 11.4% (21.1% - 18%)	
Narra (Pterocarpus Inducus)			62.0% - 10.5% (62% - 33%)

[a/] Figures in parentheses are for comparable air-dried samples.

Source: Casin, R.F. and A.A Salita, Jr. "A Solar Lumber Dryer with Auxiliary Heater." FPRDI, Los Baños, Laguna, Undated.

4.11.5 Findings and Recommendations

This subproject provides a good example of the complementary utilization of solar energy and biomass (woodwaste) energy. From a technical standpoint, the project succeeded in designing and demonstrating the prototype solar dryer. Furthermore, the evaluation of the prototype's performance in comparison with the traditional lumber drying methods (air-drying and kiln-drying using conventional fuel) indicates that the solar lumber dryer is competitive in both operational and cost aspects.

As mentioned earlier, experiments with solar drying of lumber began as early as the sixties. The solar drying system developed then was the "greenhouse" type. But although these early prototypes showed favorable drying rates, their acceptance by the wood industry was low, and the reasons were attributed mainly to the lack of a back-up heating system and technical problems involving excess heat storage and humidity control.

This subproject appears to have successfully overcome those problems. Yet it is evident that the adoption of the technology by the wood industry still has not taken place. One major reason is that there are still few commercial kilns in operation and they have inadequate control systems.

There is a potentially vast market for efficient and economical lumber dryers, considering the size of the wood industry. For solar-based technology to become established in this market, it is important to overcome inertia to change traditional methods in favor of new technology. This inertia appears to be brought about mainly by lack of familiarity with the technology, and herein lies the importance of an effective marketing and promotions strategy.

As with any technology whose initial investment is high and whose economic advantage lies in its low operating cost (by replacing conventional fuels), the profitability of its use depends on attaining economies of scale. It follows that this system is appropriate to both medium-scale and large-scale users whose operations require a relatively steady demand for drying.

There is no need to replicate this project inasmuch as the additional benefits of further research and development appear nil. However, it is important to follow up on its potential introduction to the market--in line with the BED/NCRD's emphasis on promoting renewable energy technologies for potentially large-scale users--so as not to lose whatever favorable results have been obtained from the development and testing of the technology.

4.12 SOLAR POWER-ASSISTED ICE PLANT (AID 7802-L)

Duration	:	January 10, 1979 - (discontinued)
Implementor	:	Natural Resources Management Center (NRMC), Ministry of Natural Resources
Location	:	Bacolod
Cooperating Agency	:	Center for Development Studies (under a Service Contract with MNR)
Project Leader	:	Dr. Celso Roque
Funding Commitment (₱)	:	USAID - 2,800,650 GOP/NRMC - 922,500

4.12.1 Objective

This subproject essentially involved the design, construction, and testing of a 2.3-ton capacity ice plant deriving power from solar energy.

4.12.2 Description and Funding Commitment

The subproject involved the design and layout of the solar refrigeration system, including the fabrication of its various components (solar collector, ammonia storage tank, atmospheric tank, hydro-pneumatic tank, energy storage tank, and condenser). It also included the structural design of the ice-plant building and the solar collector assembly.

The funding commitment for the subproject amounted to ₱2,800,650. As per the January 10, 1979 memorandum of agreement between the BED and the MNR, all of this amount was to be charged against the loan component of the USAID/GOP Project. An initial allotment of ₱769,650 was advanced by the BED to the subproject in order to cover personnel expenses and the cost of fabricating various refrigeration equipment.

4.12.3 Institutional Arrangements and Subproject Management

The principal implementor of this subproject was the Natural Resources Management Center (NRMC) of the Ministry of Natural Resources. The BED, as overall coordinator of the USAID-GOP Project, was mainly responsible for monitoring the implementation of the subproject; this required minimal participation in the form of technical personnel and the provision of facilities.

The design of the proposed system was to be undertaken, through a service contract with the Center for Development

Studies. The fabrication of the refrigeration components was contracted out to Western Steel, Inc. The control loops of the refrigeration system was to have been purchased through one of the following suppliers: United Engineering Corporation, Warner Barnes & Co., Inc., and PID Controllers and Contractors Corporation.

4.12.4 Accomplishments and Current Status

By the end of 1981, the subproject was discontinued as a result of an internal evaluation of the project's progress, costs, and relevance to rural needs. It was planned that the unexpended balance of its original budget would be used for a replacement project that would also be on rural refrigeration systems but which would entail investigating other sources of energy besides solar power. The biomass-assisted rural refrigeration project, which was started in November 1983, was the system which replaced or supplemente the original solar-based refrigeration project.

The progress report submitted in March 1981--more than two years after the memorandum of agreement was executed--showed that the work accomplished had been limited to finalizing the structural and electrical designs and layout of the ice-plant's major components. Actual fabrication of the refrigeration components was behind schedule and would not have allowed adequate time for actual testing and operation before the project's termination date.

Of the ₱769,650.00 advanced by the BED, only ₱444,439.71 (58%) was reported to have actually been obligated by the subproject as of December 31, 1981. Of the obligated amount, however, only ₱88,159.71 (20%) was actually paid out, primarily for the services of the contractor, the Center for Development Studies. The balance of the obligated amount (₱356,280) was to have been paid for equipment ordered from Western Steel, Inc. However, since the equipment was not actually delivered, the amount was returned to the BED in February 1983. Thus, in terms of the original targetted funding of ₱2.8 million, the actual amount obligated by the tine of the subproject termination was only about 3%.

Of the initial BED allotment of ₱796,650.00, ₱352,210.29 remained unobligated as of December 31, 1981, when the suproject was discontinued. This unused allotment was remitted to the BED as per financial status report of the subproject, dated March 31, 1982.

4.12.5 Findings and Recommendations

The slow implementation of the subproject was caused mainly by the fact that the technology was found to be more complex than originally thought. Components for the technology were not readily available in the market to enable one to assemble the system easily. The design and fabrication of the components necessarily entailed a major effort, resulting in delays.

But beyond the question of scale and complexity of the project lie the more important issues on adaptability and economic feasibility of solar-based rural refrigeration systems in the Philippines. The subproject appears to have been conceived primarily from a technical standpoint--that of designing and fabricating a solar-powered ice plant. Yet, even if the subproject had actually succeeded in constructing such a system, the practical applications would still have remained doubtful. The scale of the demonstration project could have been reduced since there was no adequate data available on the feasibility of the system.

The decision to terminate the subproject appears to have been a sound one, considering the factors and shortcomings mentioned above. The funds sunk into the subproject represented only 3% of the original targetted funding. Its termination avoided significant dissipation of resources.

4.13 ADAPTATION OF ENGINES FOR FUEL INTERCHANGEABILITY (AID 7804-L)

Duration	:	36 months (November, 1982 - December, 1985)
Implementor	:	Energy Research & Development Center (ERDC), PNOC
Location	:	ERDC, Diliman, Quezon City
Project Leader	:	Mr. Jesus Tanchuco
Funding Commitment (₱)	:	USAID - 3,138,400 GOP/BED - 1,997,780 GOP/ERDC - 785,800

4.13.1 Objectives and Goals

The main purpose of this subproject was to develop and test alternative means of operating internal combustion engines on a variety of fuels derived from renewable energy sources. The secondary objective was to design and field test small-scale renewable fuel-processing stations in rural areas.

4.13.2 Description and Funding Commitment

The subproject involved the testing of fuels in both compression ignition and spark ignition engines. The range of fuels would include gaseous (producer gas, pyrolytic gas and biogas), liquid alcohol, coconut oil and esters, plant hydrocarbons, and pyrolytic oil, and solid fuel (pyrolytic charcoal). Engine add-on devices would be designed, fabricated, tested, and standardized to enable a single engine to run on a variety of nonconventional fuels. Figure 4-12 presents the simple system flowchart for this subproject.

If pilot tests would be favorable, the rural stations would enable entrepreneurs or village organizations to process their own alternative fuel supply for use in conjunction with the engine add-on devices. As a support activity, analysis would be conducted on various biomass-based fuels to determine their chemical properties, effects on engine performance, and economic viability.

As June 30, 1986, funding commitments to the subproject totalled ₱5,136,180, with ₱3,138,400 coming from the USAID, ₱1,997,780 from the GOP/BED, and ₱785,800 from the project implementor, ERDC.

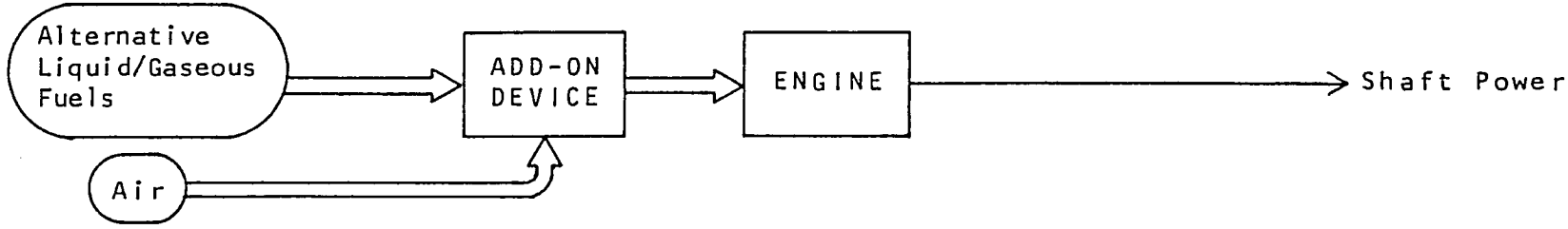


FIGURE 4-12

SYSTEM FLOWCHART OF THE ADAPTATION
OF ENGINES FOR FUEL INTERCHANGEABILITY PROJECT
(AID 7804-L)

4.13.3 Institutional Arrangements and Subproject Management

The subproject was implemented by the Energy Research and Development Center (ERDC) of the PNOC, in cooperation with the University of the Philippines at Los Baños (UPLB), and the U.P. College of Engineering in Diliman.

4.13.4 Accomplishments and Current Status

The memorandum of agreement was signed on August 25, 1982. An amendatory memorandum for increased funding by ₱1.5 million was signed on December 24, 1984. The subproject ended as scheduled on December 31, 1985.

The fuels that were finally selected for testing were as follows:

Compression-Ignition (Diesel) Engine:

a) crude coconut oil-diesel oil blend
b) ester-ethanol-diesel blend
c) hydrated ethanol-diesel blend

Spark-Ignition (Gasoline) Engine:

a) hydrated ethanol-gasoline blend
b) producer gas from rice hull
c) acetylene gas

The add-on devices designed, fabricated, and used were:

a) Carburetting system for the fumigation of hydrated ethanol into the intake manifold of a compression-ignition (diesel) engine.

b) Metering and mixing system of acetylene gas/air generated from calcium carbide for a spark-ignition (gasoline) engine.

The following tests were conducted:

a) Miscibility test
b) Fuel physico-chemical properties determination
c) Stationery engine performance/endurance test
d) Vehicle/fleet tests
e) Fuel system material compatibility test
f) Blended fuel storage stability tests

All these tests were completed. Under another but related ERDC Project, buses of the Metro Manila Transit Corporation were

used in the fleet tests of fuels for diesel engines for a period of two years using cochin oil (from coconut) in a blend with diesel. The results showed no significant change in fuel consumption from using straight diesel oil. Change-oil, however, had to be more frequent and the abrasion rate of the engine was observed to be higher. Three vehicles using different fuels were test-driven over a distance of 1500 kilometers from Manila to Matnog, Sorsogon. Ethanol-diesel blend was used in an Isuzu KC-20 utility vehicle, gasoline/methanol 80/20 blend in a Volvo motor vehicle, and gasoline with an add-on device for acetylene gas in a Toyota Tamaraw.

The add-on devices were further improved up to a third generation prototype. The last design, however, was not fully tested as of the end of the subproject.

As of June 30, 1986, total local peso expenditures charged to the USAID fund amounted to ₱785,800. Total obligations in foreign exchange were ₱2,352,600. The GOP/BED fund expenditures totalled P1,987,779.

4.13.5 Findings and Recommendations

This subproject produced engine performance test results in using the various fuels mentioned earlier. These results provide useful information on blending and storage. The design of the aded-on devices was certainly a significant factor in the attainment of the test results. However, the subproject fell short of accomplishing the objective of designing and field testing small-scale renewable fuel-processing stations in rural areas.

Any follow-up on activities of this subprojet should include endurance testing using on-the-road vehicles. The test should cover periodic engine inspections. Further work requires qualified personnel to conduct the tests and tie-up with prospective beneficiaries of the test results.

Since the costs of the various fuels tested are highly variable and influenced by fluctuations in world petroleum and vegetable oil prices, only those combinations requiring a minimum of engine modification should be considered for fuel interchangeability. The objective should be to enable consumers to switch fuels readily.

4.14 EVALUATION AND UTILIZATION OF STIRLING ENGINES (AID 7804.1-L)

Duration	:	30 months (June 1983 - December 1985)
Implementor	:	Energy Research and Development Center (ERDC), PNOC
Location	:	ERDC, Quezon City and Agno, Pangasinan
Project Leader	:	Mr. Jesus Q. Tanchuco
Cooperating Agency	:	A rice mill owner in Agno
Funding Commitment (₱)	:	USAID - 1,748,048 GOP/BED - 213,160 GOP/PNOC/ERDC - 287,337

4.14.1 Objectives and Goals

The objective of this subproject was to study the potential use of Stirling engines in the Philippines. (Stirling engine is an external-combustion type which may use various fuels, such as agriwaste, woodwaste, or even sunlight.) The specific objective was to assess the applicability of a new rice hull-fired Stirling engine to service small rural power needs. The engine design and development work was earlier supported by a USAID-funded project in another country.

4.14.2 Description and Funding Commitment

Two Stirling engines, rated at 5 KW each, were purchased--one for testing in the ERDC laboratory and another for testing in a small rice mill. Figure 4-13 presents the simple system flowchart for this subproject.

A rice hull hopper and burner for the combustion system was designed by a U.S. firm and locally fabricated at the machine shop.

As of the latest available financial statement (June 30, 1986), funding commitments to this subproject totalled ₱2,248,545 with ₱1,748,048 coming from the USAID, ₱213,160 from the GOP/BED, and ₱287,337 from the PNOC/ERDC.

4.14.3 Institutional Arrangements and Subproject Management

The Energy Research and Development Center (ERDC) implemented this subproject. The supplier of the Stirling engines was Sunpower Corporation, a U.S. firm based in Athens, Ohio; it also designed the hopper and burner. Pilot

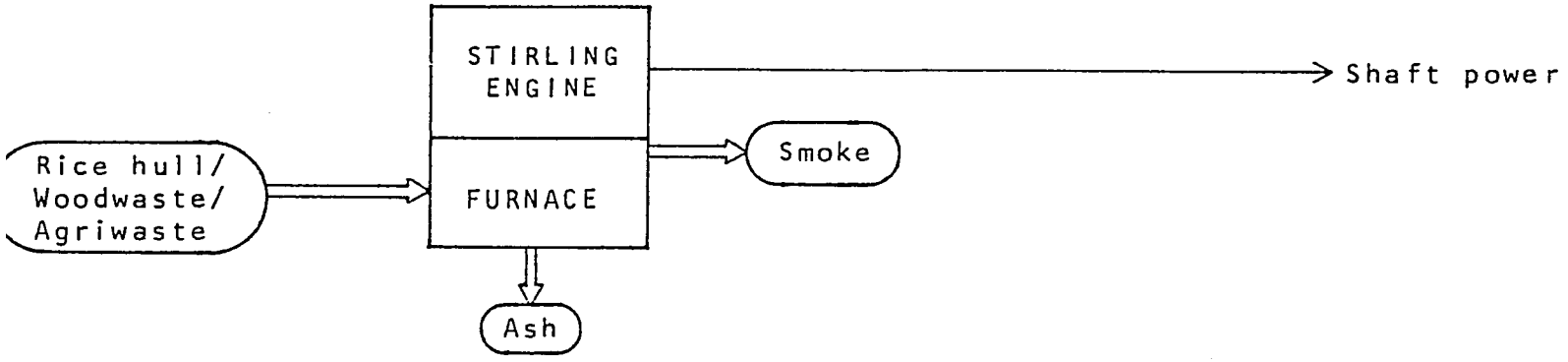


FIGURE 4-13

SYSTEM FLOWCHART OF THE STIRLING ENGINE PROJECT
(AID 7804.1-L)

implementation in the field was conducted with the cooperation of a rice mill in Agno, Pangasinan.

4.14.4 Accomplishments and Current Status

Both Stirling engines were test run for an aggregate period of about 100 hours each. Although the units were rated at 5 KW each, they produced only 3 to 3.5 KW each. Their efficiency was only about 3%.

The laboratory unit suffered a broken crank arm after about 80 hours of operation. (There are reports that other units of this design experience similar failures). This failure could be due either to weak material or misalignment of the crank arm. The component was welded together and tests were continued.

The unit powering the rice mill had operated for about 30 hours until project funds were exhausted.

Problems encountered were: ash build-up in the burner's combustion engine; technical difficulties with the burner which did not seem to suit local rice hull, a coarse material; and frequent breakdowns of the rice mill which were not attributable to the engine.

The following comparative data were generated from the test:

Engine	18-HP Diesel Engine	Stirling Engine
Milling Output	3-4 cavans/hr	2.5 cavans/hr
Percentage Recovery	65-70%	68.55%

The Stirling engine was able to drive the rice mill satisfactorily for the short period that it was tested. The implementor's report, however, expressed doubts about whether the engine would last for prolonged operation. There is also a concern that very few rice mills of the size that could be driven by a Stirling engine exist in the Philippines. Although data were generated, these could not provide conclusive results on the appropriateness of the Stirling engine in the Philippines.

The subproject expenditures amounted to ₱137,440 in local pesos funded by the USAID and ₱245,878 funded by the GOP/BED. The total obligations in foreign exchange reached ₱1,610,608 in peso equivalent.

4.14.5 Findings and Recommendations

More operating experience is still needed before any attempt to design a local Stirling engine should be made. Any further experiments could be conducted using the units acquired through the subproject without necessarily requiring financial assistance from the USAID. Equipment failures and poor economics, however, make this a low priority for further work.

This subproject has produced some information on the capacity of the Stirling engine, its performance when fueled with rice hull, and on the design of the rice hull feeding and combustion system.

4.15 WINDMILL DISPERSAL PROGRAM (AID 7805-L)

Duration	:	36 months (January, 1980 - December, 1983)
Implementors	:	Project Sta. Barbara (PSB) Farms Systems Development Corporation (FSDC)
Coverage	:	Nationwide
Project Leader	:	Ms. Gwendolyn Asistores
Funding Commitment (₱):		USAID - 1,982,969 GOP/BED - 39,200 GOP/FSDC - 870,200

4.15.1 Objectives and Goals

The objectives of this subproject were to: (a) survey potential sites for windmill installation, (b) assess latest developments on windmill design and fabrication, (c) assess possible users of windpower, (d) procure or fabricate best suited systems, (e) promote a local windmill industry, (f) gain experience in installing windmills, (g) provide technology transfer and training, (h) monitor performance of installed windmills, and (i) assess the socioeconomic impacts of the subproject.

The goal was to use windpower on a large scale in the Philippines.

4.15.2 Description and Funding Commitment

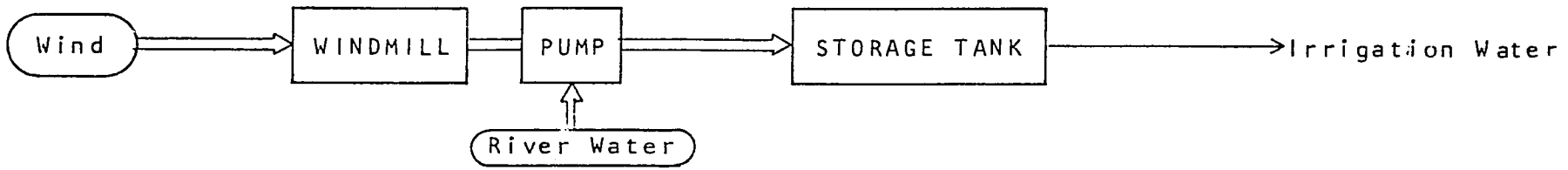
The original subproject plan called for 26 windmills to be installed: 14 windmills for irrigation, six pumping potable water, and six electricity generation. Figure 4.14 shows the system flowchart covering these three types of installation.

Doubts on the dispersal of windmills for electric generation surfaced early enough because the cost estimates of the systems far exceeded the budgets. The workplan was, thus, modified to limit windmill installations for purposes of irrigation and pumping potable water.

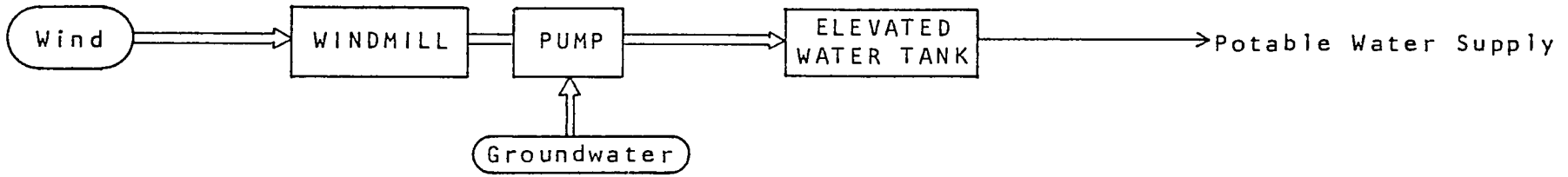
Criteria were set for selecting sites for the installations. These criteria included: (a) need for community irrigation system, (b) lack of community potable water system, and (c) adequate wind velocities (minimum of 7 KPH).

As of June 30, 1986, total funding commitments received by this subproject were: ₱1,982,969 from the USAID (local peso) and ₱39,200 from the GOP/BED. The FSDC committed a counterpart of ₱870,200.

TYPE 1: WIND-POWERED IRRIGATION SYSTEM



TYPE 2: WIND-POWERED POTABLE WATER SUPPLY SYSTEM



TYPE 3: WIND-POWERED ELECTRICITY GENERATION SYSTEM

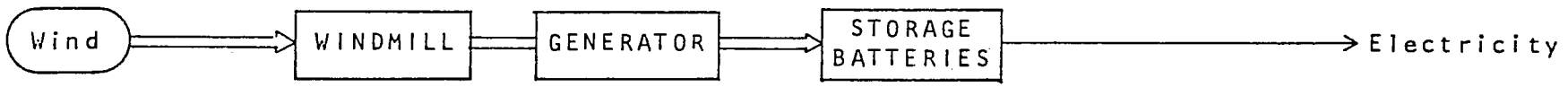


FIGURE 4-14

SYSTEM FLOWCHART OF THE WINDMILL DISPERSAL PROGRAM
(AID 7805-L)

4.15.3 Institutional Arrangements and Subproject Management

The subproject was originally jointly implemented by Project Sta. Barbara (PSB) and Farm Systems Development Corporation (FSDC). The PSB was responsible for fabrication or procurement of the windmills and the preparation of installation, operating, and maintenance procedures. The FSDC was responsible for the selection of sites, installation of the equipment, and monitoring of performance. In early 1982, however, the PSB found difficulty in supplying windmills. An amendment to the original memorandum of agreement made the FSDC the sole project implementor; it also provided an additional time extension of six months and an additional budget of ₱651,842 from the USAID.

The owners of sites surveyed were either private individuals, farmers' associations (Irrigators' Service Associations) or government officials.

4.15.4 Accomplishments and Current Status

One hundred sixty-four potential sites were listed from which 80 sites were actually visited and surveyed. Of these, 22 sites were found to satisfy the criteria. By the subproject's end, 17 windmills had been installed. These comprised installations in Negros, Cebu, Laguna, the Ilocos Region, Batangas, Cavite, Misamis, the Bicol Region, Mindoro, Tarlac, and Pangasinan.

The total subproject expenditures as of the June 30, 1986 statement amounted to ₱1,368,009 with ₱1,289,609 charged against the USAID fund and ₱39,200, against the GOP/BED fund.

4.15.5 Findings and Recommendations

As mentioned earlier, the windmill fabricator (the PSB) fell short in providing the windmills needed by the subproject. This could be due to several factors--financial being one of them. Technical difficulties started when the water pump system did not perform well. Operating and maintenance manuals were not adequate and replacement parts were not easy to find. It was also found, that for irrigating large farms, windpower was inadequate and might thus be good only for vegetable gardens and small areas.

We recommend that the windmills be reevaluated, now that they can already provide performance data for the past few years. This is to verify the feasibility of further dispensing small-scale windmills for water pumping, mechanical power, and, possibly, small-scale electric power generation. The assessment of wind resource in different localities, which is another funded subproject, should be of help for any future windmill dispersal programs.

CHAPTER 5

THE USAID-GOP SUBPROJECTS ON PROJECT-SUPPORT ACTIVITIES

ONGOING SUBPROJECTS

5.1 ESTABLISHMENT OF AN INTERDISCIPLINARY GRADUATE PROGRAM IN ENERGY ENGINEERING AND MANAGEMENT (AID 8201-L)

Duration	:	36 months (April 1983 - April 1986)
Implementor	:	University of the Philippines College of Engineering (UPCE)
Location	:	UP, Diliman, Quezon City
Cooperating Agencies	:	University of Wisconsin-Madison, (UW-Madison), UP National Engineering Center (NEC), UP Research and Development Foundation, Inc.(UPRDFI), Philippine Council for Industry and Energy Research and Development (PCIERD)
Project Director:		Dean Ruben Garcia
Project Leader	:	Prof. Francisco L. Viray
Funding Commitment (P):		USAID - 13,313,713 GOP/BED - 1,960,150 GOP/UP - 1,763,000

5.1.1 Objectives and Goals

The Development Plan of the Ministry of Energy (MOE) projected additional manpower requirements of 102,337 man-years to support the energy program from 1982 to 1987. Of this projection, 17% (16,941 man-years) required professional management and technical skills on research and development; energy development, management and conservation; design and operation of generation, transmission, and utilization systems; policy studies; and energy program formulation.

This USAID-GOP subproject was conceived and launched against the foregoing background. Its main goal is to provide post-baccalaureate training that will address the management and technical manpower requirements. Its specific objectives are:

a To establish a formal academic program leading to the Master's and Ph.D. degrees in Energy Engineering;

b) To provide opportunities for post-baccalaureate studies in current energy technology and in science and management

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techniques, through continuing education activities, such as short courses, seminars, workshops, and publications;

c) To establish linkages with government agencies, private entities, and foreign or international organizations for purposes of research, extension, and teaching through the identification of areas of need, provision of support, and the exchange of personnel; and

d) To conduct research activities in appropriate topics involving energy and related or affected fields.

5.1.2 Description and Funding Commitment

The subproject was designed to have various components that would address the foregoing specific objectives directly. Additional supporting activities that would facilitate the attainment of the subproject goal were also developed.

The main component of the subproject is the offering of full-time interdisciplinary M.S. and Ph.D. programs focused on energy engineering. The plan was to have a curricula that integrate existing courses on mathematics, physical sciences and energy, and elective courses on energy engineering management, resource economics, policy development, project design and planning, and social and organizational structures. Qualified graduate students, selected through a strict screening process, would be encouraged to enroll full-time by providing them with stipends. Promising senior undergraduate students interested in energy engineering would be allowed to take some graduate courses. The programs would require students with no significant work experience to undergo a one-semester full-time internship in an institution involved in energy. Subproject funds would be used to supplement any other allowances of interns. Ph.D. students would be required to do a 3-unit countryside-oriented project on energy alternatives, conservation, or development, with funding support from the project for basic supplies and materials and travel to rural areas. Table 5-1 presents the projected student stream.

To further ensure the continuity and success of the program, the subproject would also provide for faculty development, specifically the full support to the Ph.D. program of one UPCE faculty member now studying abroad.

The second component of the subproject would involve the conduct of non-degree courses, seminars, and workshops at the National Engineering Center. The faculty would include visiting local and foreign experts. This component would also include

TABLE 5-1

PROJECTED STUDENT STREAM
UPCE GRADUATE PROGRAM IN ENERGY ENGINEERING AND MANAGEMENT

School Year:	1983-84		1984-85		1985-86		1986-87		1987-88	
Semester :	1	2	1	2	1	2	1	2	1	2
1. Expected Number of Students:										
Ph.D. a) New	12	0	12	0	12	0	12	0	12	0
b) Old	0	12	10	22	20	32	30	42	30	42
M.S. a) New	15	5	15	5	15	5	15	5	15	5
b) Old	0	15	15	30	15	30	15	30	15	30
2. Expected Number of Graduates										
Ph.D.	0	0	0	0	0	0	0	10	0	10
M.S.	0	0	0	15	0	15	0	15	0	15

Assumption:
Ten new Ph.D. students will be fully supported by fellowship per year for a period of four years each.

Source: Viray (1986)

short observations or training for faculty members abroad to keep them up-to-date on energy topics.

Both the degree and non-degree programs were planned to be designed with the assistance of a curriculum and program design expert. They were aimed at responding to the manpower requirements of the national energy program, both directly (through the training of students) and indirectly (through assistance in upgrading the energy teaching capabilities of other colleges and universities).

The third component of the subproject is the establishment of linkages with local and foreign institutions involved in energy training, research, development, and operations. This aspect would also support the internship training of students outside the university, and the exchange of expertise and sharing of facilities with local and foreign research and educational institutions.

Some of the local institutions targetted for the internship and exchange program were the National Science and Technology Authority (NSTA), Energy Research and Development Center (ERDC), National Electrification Administration (NEA), National Power Corporation (NPC), Farm Systems Development Corporation (FSDC), and Manila Electric Company (MERALCO). The Philippine Council for Industry and Energy Research and Development (PCIERD) also committed to support the energy engineering program (together with five other interdisciplinary graduate programs with a budget of about 10 million pesos).

The subproject would develop a continuing relationship with an educational institution that could assist UPCE in implementing the subproject, particularly in identifying foreign faculty and experts, arranging overseas dissertation work of Ph.D. students, placing UPCE faculty members in short courses abroad, and developing the library.

The fourth and last component of the subproject was planned to address research needs on energy and related topics. This aspect would include upgrading of library facilities and research capabilities, and conduct of research activities. The latter included funding of M.S. and Ph.D. thesis projects locally or abroad (if local facilities would not be adequate).

Through the foregoing components, the subproject was expected to benefit students and faculty members who are interested in energy studies, public and private companies that need well-trained manpower, other schools, and eventually, the nation, through a well-managed energy program.

The subproject commenced on April 22, 1983. Funding for three years, originally totalling more than nine million pesos was committed by the USAID, the GOP/BED, and the University of the Philippines (UP). As of June 30, 1986, funding commitments for the subproject were ₱13,313,713 from the USAID, ₱1,960,150 from the GOP/BED, and ₱1,763,000 from the GOP/UP--a total of more than 17 million pesos. Of the USAID commitment, ₱12,389,773 was in the form of equivalent foreign exchange.

5.1.3 Institutional Arrangements and Subproject Management

Figure 5-1 presents the principal parties involved in the subproject. The sources of assistance are the USAID, GOP/BED, PCIERD, and GOP/Office of Budget and Management (OBM). The latter provides the direct GOP support to the UP; this support forms part of the GOP counterpart of the subproject. All forms of assistance are officially received by the UP. The UPCE implements the subproject with both the National Engineering Center (NEC) and the UP Engineering Research and Development Foundation, Incorporated (UPERDFI). The NEC is the project extension arm of the UPCE, whereas, the UPERDFI serves as the R&D contracting organization. The University of Wisconsin at Madison (UW-Madison) contracted by the USAID and the BED provides advisory assistance in implementing the subproject.

Prof. Francisco L. Viray of UPCE, a doctor in electrical engineering, serves as the project leader. He is also the Chairman of the College Energy Committee, a committee consisting of four other members covering various energy specializations, as follows:

Prof. Nestor Rañeses (IE)	-	Energy Economics
Prof. Regano Benito (ME)	-	Solar Energy
Prof. Leonardo Liongson (E.Sc)	-	Hydropower
Prof. Teodorico Festin (Ch.E.)	-	Biomass and Coal

The project leader reports directly to Prof. Ruben Garcia, UPCE Dean and Project Director.

The short courses designed and conducted by the NEC (through the UPERDFI) are directed by Dr. Leopoldo Abis, the NEC Executive Director.

The UP graduate program on energy engineering involves a pool of faculty members whose full-time appointments are with other engineering departments since there is no department exclusively for energy engineering. Of these faculty members, seven are with Ph.D.s in various engineering fields and three have Masters degrees. In addition to these faculty members, lecturers and consultants are drawn from local agencies such as

SOURCES OF PROJECT ASSISTANCE:

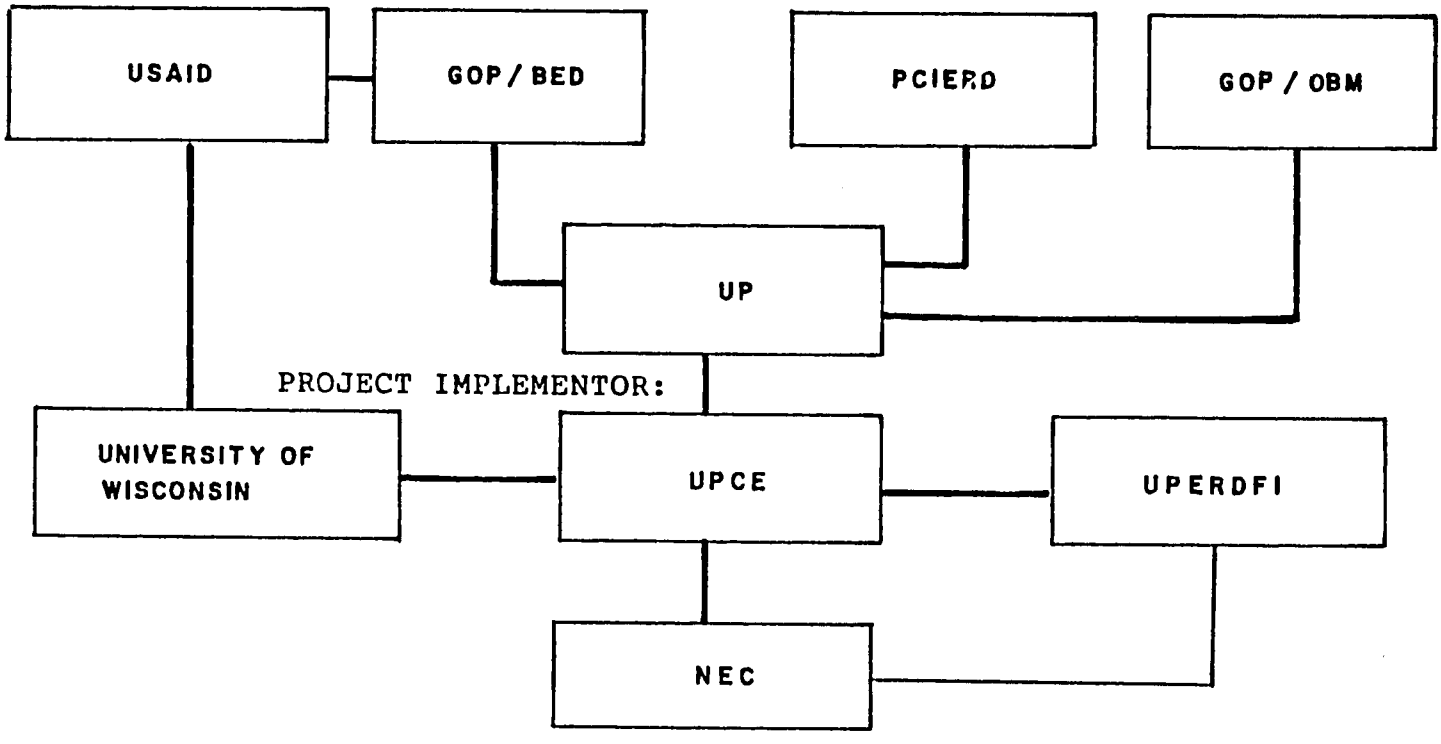

FIGURE 5-1

INSTITUTIONAL LINKAGES
THE UPCE GRADUATE PROGRAM IN ENERGY ENGINEERING AND MANAGEMENT

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the ERDC, Bureau of Energy Utilization (BEU) and NPC, and from the UW-Madison.

5.1.4 Accomplishments and Current Status

a. Academic Programs (M.S. and Ph.D. Programs)

The programs started with the first set of course offerings held in June 1983. Appendix A-10 presents the program designs. Regular mathematics and engineering courses have been supplemented with ten newly developed graduate courses on energy. In addition, two courses have been developed and introduced in the undergraduate program. Table 5-2 presents the energy courses developed since project inception. Four local consultants helped in developing three of the courses. Of the originally planned courses for development, only three (Wind and Hydro Systems, Geothermal Energy, and Nuclear Energy) still have to be developed. The UW-Madison faculty members and the local consultants assisted the UPCE faculty in developing course materials.

The number of students that enrolled in each course reflects interest in the courses. The students' preferences for some electives and disinterest in others have led to the deviation of actual programs from the original design.

Table 5-3 shows the actual student statistics. As of the second semester of school year 1985-86 the actual number of enrolled M.S. students (old and new) is seven less than the projected number (Table 5-1). On the other hand, the actual number of enrolled Ph.D. students is twenty-one less than the projected number. Two MS students have finished their course work and are now fulfilling their internship requirements. Four Ph.D. students are now preparing for their comprehensive examination and thesis research. So far, the target number of M.S. graduates (15) has not been attained.

Fellowship assistance to graduate students was made available starting November 1985. Fellowship grants have been awarded to two M.S. students. No internship grants have been awarded, although about five students have finished their internships.

Faculty development activities have been undertaken. These include the Ph.D. studies of one faculty member at UW-Madison and the short-term training of seven others in various places in the United States. Some junior faculty members of UPCE have enrolled in the Energy Engineering Program.

TABLE 5-2

DEVELOPED ACADEMIC COURSES ON
ENERGY ENGINEERING AND MANAGEMENT

Subject	Total Number of Students Enrolled (Number of Energy Engineering Students) 1983-84 1	1983-84 2	1984-85 1	1984-85 2	1985-86 1	1985-86 2
EGY 201 - Energy Resources and Uses	24(12)	-	20(17)	-	13(11)	-
EGY 211 - Energy Conservation	22(12)	-	16(15)	-	8(8)	-
EGY 221 - Solar Energy	-	18(10)	-	19(13)	-	9(6)
EGY 222 - Biomass Energy	-	29(17)	-	15(14)	-	8(4)
EGY 223 - Wind & Hydro Systems	-	8(6)	-	-	-	-
EGY 224 - Geothermal Energy	-	-	-	-	3(3)	-
EGY 225 - Nuclear Energy	-	-	-	-	8(6)	-
EGY 231 - Energy Economics	-	-	30(21)	13(5)	-	14(11)
EGY 232 - Energy Systems Modelling and Design	-	-	19(14)	-	10(7)	-
EGY 101 - Introduction to Energy Engineering	-	-	19	-	22	-
EGY 197 - Special Problems	-	-	-	-	3	-

Source: Viray (1986)

TABLE 5-3

ACTUAL STUDENT STATISTICS
UPCE GRADUATE PROGRAM IN ENERGY ENGINEERING AND MANAGEMENT

School Year:	1983-84		1984-85		1985-86	
Semester :	1	2	1	2	1	2
1. No. of applicants:						
a) M.S.	22	11	19	5	8	12
b) Ph.D.	8	4	12	3	6	3
2. No. of applicants qualified for admission:						
a) M.S.	16	9	16	4	7	10
b) Ph.D.	6	2	11	2	6	2
3. Total number of students eligible for enrollment:						
a) M.S.	16	25	41	45	52	62
b) Ph.D.	6	8	19	21	27	29
4. No. of students actually enrolled:						
a) M.S.	10	18	24	18	23	28
b) Ph.D.	5	7	15	14	13	11

Source: Viray (1986)

Continuing technical support to the program has been provided by UW-Madison under a contract with USAID/BED.

b. On the Continuing Education Program

The NEC has developed and implemented 12 short courses on energy. One course each was offered on biomass energy, solar energy, and cogeneration. Three courses were on energy systems analysis, planning, and environmental impacts on energy. The rest covered other energy topics, such as energy conservation, transportation applications, and other conventional energy technologies.

As earlier mentioned, the planned short-term training abroad of the UPCE faculty members has been implemented. As part of the relationship established with the UW-Madison, short-term visits to the UPCE have been made by UW-Madison faculty members. They participated in the conduct of both degree and non-degree courses.

c. Linkages with Other Institutions

The subproject has established linkages with all local agencies involved in energy and with the UW-Madison. The UPCE is a member institution of the Asian and Pacific Energy Planning Network (APENPLAN). It has also access to INNERTAP, a regional network for facilitating information exchange on new and renewable sources of energy which has its secretariat at the ERDC.

Internship of students have been at local agencies with whom the UPCE maintains linkages. These include the BEU, the PNOC, and some private firms.

d. Research

The project has contributed more than 200 volumes of energy and energy-related books to the engineering library.

Research activities have been in the form of thesis projects and special project studies of M.S. and Ph.D. students, and undergraduates' projects. Table 5-4 presents the research projects that have been supported by the subproject. Of these research projects, about eight deal directly with nonconventional energy technologies. Part of the funds allocated for dissertation research have been applied to support the studies abroad of two students from the International Rice Research Institute (IRRI) and one student from the BED.

TABLE 5-4

RESEARCH PROJECTS FUNDED BY THE USAID-GOP/BED-UPCE SUBPROJECT

Title	Researcher	Funding Supp (In Pesos
M.S./Ph.D. Thesis Projects		
a. Drying Characteristics of Ipil-Ipil Firewood	Arturo I. Figueroa	14,300
b. Studies of the Performance Characteristics of a Compartmentalized Chilled Water Storage Tank	Arturo B. Santos	16,230
c. An Investigation of the Performance of a Solar Dryer for Agricultural Products Using Packed Bed Storage and Supplementary Fuels	J. Amado A. San Mateo	18,150
d. Predicting the Performance of Solar Dryers with Packed Bed Storage (Passive Systems)	Alfredo F. Diaz, Jr.	9,500
Ph.D. Special Projects		
a. Comparative Evaluation of Centralized and Decentralized Rural Energy Systems	Rolando P. Dayco	9,800
b. A Comparative Study of Air vs. Air-Steam Gasification	Ferdinand A. Pecson	3,259
c. Instrumentation for Field Monitoring of Gasifier Systems	Edwin N. Quiros	9,550
d. Small-Scale Windmill for Rural Electrification	Gino T. Bautista	10,000

Title	Researcher	Funding Support (In Pesos)
e. Producer Gas as Substitute for Diesel Oil in Drying Natural Rubber: A Technical and Economic Feasibility	Felipe D. Vinluan	10,000
f. An Improved Biomass Stove: Improved Efficiency Through Waste Heat Recovery	Jose Ali F. Bedano	10,000
e. Development of an Energy Conservation Manuals for Rural Areas	Rene M. David	10,000
Undergraduate Student Projects *		
a. Gathering Base Line Data for Energy Systems Analysis and Planning in the Philippines		22,000
b. A Survey of Existing Small-Scale Hydroelectric Power Plants in the Philippines		7,000
c. Basket Burner		10,500
d. Grover Carbonizer		4,920
e. Fluidized Bed Burner		6,270

* These projects involved various groups of students

e. Funding

As of June 30, 1986 total local peso expenditures funded by the USAID/GOP Project amounted to ₱2,292,050, ₱924,000 of which was funded by the USAID and the balance by the GOP/BED. The total foreign exchange obligations incurred and funded by the USAID totalled ₱19,145,862.

5.1.5 Findings and Recommendations

a. General

The development and introduction of a new academic program requires both innovativeness and experience. Both qualities have been shown by the project implementor. The subproject has been staffed by a combination of junior and senior faculty members who are among the leading educators and trainors on energy engineering in the Philippines. The subproject has achieved most of its goals on time.

b. Information Capability

This subproject has developed and gathered many valuable data and information that could be shared with other interested parties. Some of these are as follows:

(i) Student research studies. Some of the studies could be shared with potential investors and other researchers on energy.

(ii) Course design and materials. The materials could be shared with trainors of other schools at a reasonable cost.

(iii) Library collection. Up-to-date literature on energy, and for that matter on many other topics, is very limited in the Philippines. The UPCE collection, although still inadequate, is probably one of the few collections of published material on energy. Others could benefit from having easy access to the collection at a reasonable fee that could help maintain the library. Such a system is in place and we expect that an increasing number of researchers will be interested to have access to the UPCE collection.

We recommend that the faculty and students be encouraged to develop case studies and papers on nonconventional energy technologies that could be shared with a wider audience, for example, private investors and the general public.

c. Academic Programs

Of the seven suggested tracks (research, management-public, technical-public, management-private, technical-private, extension, and others-teaching) mentioned in the Development Sciences, Incorporated (1982) report, about two or three tracks have evolved: management-public, technical-public, and technical-private. Student choices and availability of faculty members have influenced the development of these tracks.

The College Energy Committee itself has noted that, in all the tracks, the specialty courses have not adequately provided students with a strong foundation for dissertation work. The committee has, thus, developed Ph.D. program designs with specialization in biomass and solar energy, the subjects which seem to be most preferred by students.

Due to shortage of faculty members, course offerings are not often synchronized with other courses that potential students have to take. The latter could be one reason for the significant dropouts of students. (Note lines 3a and 4a in Table 5-3). Other noted causes of student dropouts are the economic and time constraints of part-time students who hold full-time jobs.

The UPCE is now taking steps to correct both the student drop-out and synchronization problems. The UPCE plans to solve the former with a plan to extend competitive fellowships and research or teaching assistanships, both from project funds and from solicited support of industry employers of some of the students. The UPCE hopes that the step will also help solve the subject synchronization problem.

The UPCE plans to develop further the courses on wind and hydro, geothermal, and wind energy, and to develop new courses on power-plant technology and enzyme engineering. It has identified the following areas where the current faculty have expertise in:

Biomass
Wind and mini-hydro
Solar
Coal benefication and utilization
Technology assessment
Energy conservation and management

Thus, the UPCE plans to direct the future development of its faculty along these six areas. The UPCE hopes that the program can generate its faculty members through its own M.S. and Ph.D. programs, with further short-term training abroad to keep them up-to-date on developments in energy engineering and management.

We strongly support the UPCE's plans to develop its energy degree programs further, through the measures mentioned above. It is not clear, however, whether these measures would be adequate to sustain the programs as they are now designed--independent from other engineering programs--in terms of eliciting continuing student interest and tapping a broader base of financial support to it. (One possible cause of student dropouts is the limited focus of the degree programs on energy--a matter that needs to be confirmed through a survey of students who have been qualified but did not enroll and of students who dropped out from the program).

Funding support for the academic programs will be reduced after the expiration of the USAID-GOP Project. It is not clear that the small student population and limited support from other sources can sustain independent programs. One fall-back position is to continue the offering and further development of selected energy courses at the UPCE, but to offer them as elective courses for other M.S. and Ph.D. programs--principally programs in engineering, economics, business, and management. Some students of these programs could be encouraged to develop specialization in a particular energy system rather than in a particular energy technology.

The focus on energy system will consider both the supply and technology development and the demand side, including the adaptability of a certain technology on specific markets and locations in the Philippines. Since other engineering programs (e.g., mechanical engineering program) are well established and current faculty members of the energy programs come from the engineering programs anyway, the suggested fall-back position could help in ensuring the continuity of the courses. However, it is hoped that donors of funds will continue to support the development of energy courses, faculty, and materials, even if the degrees granted by the UPCE are not on energy engineering. What is important is to ensure that more students benefit from an education that offers in-depth energy courses.

We recommend that the Project continue funding the studies of the Ph.D. fellow at UW-Madison until his completion which is expected to be before the end of 1987, provided the funding requirement is within the original subproject cost allocation for the purpose.

d. Continuing Education Program

We support the UPCE's plan to conduct an evaluation of the short courses that were offered through the subproject.

We recommend that additional special short courses be developed and implemented. In addition to the two courses that have been identified by the UPCE (Instrumentation and Controls in Energy Systems, and Wind and Mini-hydro Technology), we recommend the offering of the following courses:

(i) Energy Project Design, Evaluation, and Technology Assessment. The NCRD and ERDC staffs who are tasked to design, monitor and evaluate projects could benefit from this course.

(ii) Technical Communications. This course could address the need to develop communication packages that are suitable for various audiences. The packages include written cases, visual displays, and audio packages. Both the NCRD and private firms engaged in commercial distribution of nonconventional technologies could benefit from such a course.

(iii) Energy Systems for Countryside Development. This could be offered as a seminar-workshop that focuses on various energy system models and the adaptability of these systems to specific rural locations. The target audience for this short course could be the NCRD staff and the staff of local governors and mayors.

(iv) Energy Research and Development Management. This course could cover basic and specialized skills, tools, and techniques for R&D management in the field of energy. The staffs of NCRD, ERDC, and private firms engaged in R&D could benefit from this course.

e. Institutional Linkages

At present, the UPCE has formal relationships with both the ERDC and the UW-Madison and only informal relationships with other institutions. However, despite the memorandum of agreement with the ERDC, there has not been significant sharing of expertise between the UPCE and the ERDC. So far, only one lecturer from the ERDC has participated in the UPCE program. One possible sharing is in information packaging and dissemination. The ERDC researchers and the UPCE energy faculty and students could, together, develop information materials based on local experiences with nonconventional technologies that may be gathered from the ERDC projects.

The planned linkages with other foreign institutions with the help of UW-Madison has not been fully realized. We recommend that the UPCE initiate linkages with additional foreign institutions. One such institution is Stanford University which has a diverse and active energy program. The Energy Modeling Forum which attracts energy modelers from all parts of the world is based at Stanford University. Linkage with the Forum will

give the UPCE access to up-to-date developments on energy planning and modeling methodologies.

The continuity and success of the linkages, however, will depend on what the UPCE can share with other institutions. To be effective, any linkage between two parties must be beneficial both ways.

f. Research Capability

The effectiveness of an academic program depends largely on the research facilities and research capabilities of the faculty. At present, the research component is hampered by the shortage of faculty who conduct research on energy. Funds are also lacking to finance needed laboratories.

The UPCE has identified the needs for five research laboratories, one each on coal analysis, solar, wind power, biomass, and instrumentation and control. These plans require further analysis and justification as to priority.

The library collection on energy has to be continuously improved and updated with new materials. We recommend that the UPCE tap other potential donors of library materials, such as foundations and private companies.

Feedbacks from student surveys indicate the need to further develop course handouts and materials. The UPCE has planned to attend to this matter on a continuing basis.

Four Ph.D. candidates have been identified for the cooperative thesis project with UW-Madison. However, a student who will be working on a topic that deals specifically or significantly with nonconventional energy has yet to be identified.

One recent initiative taken by the UPCE is to launch an energy and environmental research program. Scheduled to start in the second semester of School Year 1986-1987, the program aims to reinforce teaching, research, and extension services on the fields of Energy and Environmental Engineering. The program will seek financial support from various sources to carry out its planned mission (Appendix A-11). The program could attract renewed and sustained faculty interest in energy research.

g. Project Extension Recommendation

We recommend that this project be extended from its current termination date of December 31, 1986 for at least six months or preferrably 12 months. This extension will allow the UPCE to conduct a deeper evaluation of the program design, to conduct the

additional recommended short courses, to develop additional institutional linkages, to develop a stronger research program, and to formulate plans to ensure program continuity. In particular, we recommend the offering of courses for the NCRD and ERDC staffs that could help strengthen further the program and research management capabilities of these institutions that are at the forefront of the nonconventional energy program of the Philippines. The anticipated organizational changes at NCRD will make it particularly important to provide training for the staff, many of whom eventually will assume greater responsibilities.

5.2 BIOMASS CONSULTANCY (AID 8205.1-L)

Duration	:	40 months (August 1983 - December 1986)
Implementor	:	Trans Energy Systems (TES)
Location	:	ERDC, Diliman, Quezon City
Cooperating Agency	:	Energy Research and Development Center (ERDC), PNOC
Project Leader	:	Mr. Gregorio Kilayco
Funding Commitment (₱)	:	USAID - 1,747,260

5.2.2 Objectives and Goals

The objective of this subproject is to provide technical assistance for the implementation and evaluation of biomass energy projects. The goal is to enable assisted agencies to develop their own technical capabilities by interacting with technical experts.

5.2.2 Description and Funding Commitment

The subproject was awarded to the Trans Energy Systems (TES), a U.S. consultancy firm. The TES was asked to provide technical assistance for the following USAID-GOP subprojects:

a) Adaptation of Engines for Fuel Interchangeability (AID 7804-L)

b) Gasification of Densified Rice Hull (AID 8203-L)

c) Rice Hull-Fed Thermal Power Plant (AID 7803-L)

d) Biomass Assisted/Powered Rural Refrigeration System (AID 8204-L)

The following activities for the consultants were defined in the Request for Technical Proposal.

Adaptation of Engines. A consultant will assist in the design of add-on devices, prepare schematic devices to specific field and industrial uses, establish procedures for testing the add-on devices, prepare schematic diagrams and practical plans for applying fuel production equipment to specific field applications, and establish appropriate testing procedures for fuel technologies.

Rice Hull-Fed Thermal Power Plant. A consultant will assist in the review of change orders recommended by the suppliers; provide advice, as requested, to resolve technical problems that may arise during project implementation; and assist in preparing the project evaluation plan.

Biomass Refrigeration System. A consultant will provide technical assistance in the areas of cold storage and ice production using gasification and direct combustion of biomass to power absorption and vapor-compression refrigeration systems. Assistance will be needed to prepare equipment designs, implementation plans and strategies, to formulate participating agency plans for adopting nonconventional resource-powered refrigeration systems, and to prepare a project evaluation plan and conduct the evaluation.

As of June 30, 1986, this subproject received a funding commitment of ₱1,747,260 from the USAID.

5.2.3 Institutional Arrangements and Subproject Management

Trans Energy Systems (TES) subcontracted the technical assistance of some projects to Battelle-Columbus and Battelle-Northwest. The implementor of all the subprojects which were provided this consultancy or technical assistance was the Energy Research and Development Center, PNOC.

5.2.4 Accomplishments and Current Status

After the award of the project to the TES, consultants were identified and recommended to the Project Coordinator for approval. There was difficulty in identifying an appropriate consultant for the project on rice-hull gasification. Finally, the following consultants were accepted:

a) Adaptation of Engines for Fuel Interchangeability -
David A. Trayser (Battelle-Columbus)

b) Gasification of Densified Rice Hull -
D. E. Eakin (Battelle-Northwest)

c) Biomass-Assisted Refrigeration -
Donald W. Pingrey (TES)

The consultants worked in the Philippines for approximately one week each in October and November 1983. Their work resulted in suggested improvements of the equipment for the biomass-assisted refrigeration project and design revisions for the gas-cleaning devices of the gasification system.

Because of the need for further expertise on the gasification of densified rice hull, a project official (Mr. Francisco Sta. Ana) was sent to the United States for a two-week specialization study on gasification research at the University of California.

The funding commitment to the subproject was fully allotted and spent.

5.2.5 Findings and Recommendations

Records show that the USAID Project Coordinator conducted an active search for appropriate experts who could provide the necessary technical assistance, made arrangements for the arrival of the consultants, and informed appropriate parties accordingly.

The ERDC reported that the contractual service, possibly due to its short-term nature, fell short of providing the needed technical assistance, particularly with respect to gasification, which is the technology used in two of the subprojects listed for assistance (Rice-Hull Gasification and Biomass-Powered Refrigeration). Sending a project official for the brief study and inspection trip abroad proved helpful in gaining more technical expertise for the subproject.

In the future, the move to sponsor a researcher's study visit to research institutions abroad could be an alternative to hiring short-term consultants, especially in cases where difficulties in identifying available, qualified consultants arise. Another option could be to hire a number of local consultants.

By its nature, not much information could be disseminated from this consultancy project. However, the bibliography of biomass gasification literature on microfiche that was provided by the TES to the BED may be useful to researchers on nonconventional energy.

5.3 SOLAR/WIND CONSULTANCY (AID 8205.2-L)

Duration	:	36 Months (August, 1983 - August, 1986)
Implementor	:	Development Sciences, Inc. (DSI)
Cooperating Agency	:	Philippine Atmospheric, Geophysical, Astronomical Services Administration (PAGASA)
Project Leader	:	Mr. Daniel Waddle
Funding Commitment (₱)	:	USAID - 1,462,200

5.3.1 Objectives and Goals

The objectives of the subproject are: (a) to assist in making the PAGASA monitoring stations operational (see AID 7815-G and 8202-L), (b) to establish a reliable maintenance and calibration program for the PAGASA stations, and (c) to establish a data management program for obtaining and processing solar and wind data.

5.3.2 Description and Funding Commitment

The subproject called for three to four short-term visits of the consultants to the Philippines. Their main task would be to assist the PAGASA in completing the instrumentation of the twelve solar and wind monitoring stations and to see to it that all those stations are brought to operation.

As of June 30, 1986, total funding commitments to this subproject amounted to ₱1,462,200 in equivalent foreign exchange from the USAID.

5.3.3 Institutional Arrangements and Subproject Management

This subproject principally involved the Development Sciences, Incorporated, (DSI), a consulting firm, and the PAGASA. The DSI consultants interacted directly with the PAGASA staff. The NCRD coordinated and monitored project activities.

5.3.4 Accomplishments and Current Status

The consultants evaluated first some of the available wind data relative to resource assessments of some localities and potential sites. They also assisted in reviewing the proposal for the medium-scale wind project for electricity and fertilizer

production (AID 7805.1-L) and the proposal on the photovoltaics for pumping water (AID 7806-L).

The consultants assisted also in the procurement of the remaining equipment to complete the wind installations, and recommended Phase II of the Solar/Wind Mapping Project. They evaluated the initial performance of the monitoring stations, helped in the organization of maintenance groups, and assisted in debugging some installations.

The consultants conducted training on such topics as: equipment installation, operations and maintenance, data-rescue techniques, data-processing techniques, calibration of instruments, calculation techniques, and techniques in safeguarding data.

The total funding commitment from the USAID was fully allotted. Actual obligation figures were not yet available as of the June 30, 1986 report.

5.3.5 Findings and Recommendations

One need that has to be addressed immediately in the subproject at the PAGASA is the maintenance of instruments and equipment. Some of the facilities, for example, the integrators, require attention. The subproject could profit from a good preventive maintenance program. Its management and technical personnel could benefit from further training on instrumentation and control.

Before they leave, the DSI consultants could perhaps be asked to assist in the following:

a) preparation of a complete listing of installed equipment and instruments, indicating their physical condition, calibration needed, repair work if necessary, and estimates of cost to put the facilities in working order;

b) procurement of the necessary operations and maintenance manuals;

c) preparation of training modules and course outlines for the training of needed personnel; and

d) setting up of a program for technology transfer on solar and wind mapping.

5.4 DEVELOPMENT OF ALTERNATIVE FINANCIAL PLANNING STRATEGIES FOR RENEWABLE ENERGY UTILIZATION (AID 8401-G/L)

Duration	:	32 months (April, 1984 - December, 1986)
Implementor	:	Nonconventional Resources Division (NCRD), Bureau of Energy Development
Location	:	Ministry of Energy, Fort Bonifacio, Makati, Metro Manila
Project Leader	:	Mr. Gregorio U. Kilayco
Funding Commitment (P)	:	USAID - 1,112,892 GOP/BED - 904,222

5.4.1 Objectives and Goals

The specific objectives of this subproject are as follows:

a) to conduct a survey aimed at gathering data on (i) energy planning and policies of different energy research institutions, (ii) funding schemes and financial administration for renewable energy projects and programs, (iii) monitoring and control practices of renewable energy projects, and (iv) arrangements allowing government-funded programs to assist energy development in the private sector;

b) to evaluate the efficiency and effectiveness of the NCRD's current administration of the Nonconventional Energy Development Program; and

c) to establish linkages with other renewable energy research institutions outside the Philippines.

The goal is to develop the capabilities of the NCRD to coordinate the Program.

5.4.2 Description and Funding Commitment

Covering a nine-month period (April 1984-December 1984), a survey of renewable energy institutions in the United States was conducted to gather information regarding project planning, financial management, and monitoring for possible adoption by the NCRD, and to establish linkages with such institutions.

Funding for the survey, which began in April 1984 and ended in December 1984, amounted to P309,408. The results of the survey indicated the importance of increasing the Program's information efforts. An expansion in the activities of the subproject was, thus, made to include the following:

a) holding of a national symposium on renewable energy;

b) publication of a newsletter on alternative energy technologies;

c) conduct of a survey on gasifiers in the Philippines; and

d) gathering of current information on renewable energy resources and technologies through (i) subscription to energy journals, (ii) use of on-line search facilities at the Energy Research and Development Center (ERDC), and (iii) establishment of cooperative relationship between the BED and a U.S. institution engaged in energy-related R&D. The BED/NCRD will also establish its own on-line access to network data bases, publish the proceedings of the national symposium on renewable energy, and purchase office equipment to facilitate project information and research.

The expansion extended the subproject period to December 1986. As of June 30, 1986, total funding commitments to the subproject amounted to ₱2,017,114, 88% of which (₱1,765,114) came from the USAID (₱947,892 in the form of loans and ₱165,000 in the form of grants). The balance (₱904,222) was committed to by the GOP/BED (₱817,222 as counterpart to the loan and ₱87,000 as counterpart to the grant). Of the total amount, the total foreign exchange-funded budget from the USAID was equivalent to ₱227,098, of which 76% was in the form of loan and the balance, of grant.

5.4.3 Institutional Arrangements and Subproject Management

This is an in-house project of the NCRD. The project leader is also concurrently the head of the NCRD. The USAID-GOP Project Coordinator attended to day-to-day operations of the project.

5.4.4 Accomplishments and Current Status

Work on the survey of energy research institutions began in April 1986. Visits and interviews were conducted by the USAID-GOP Project Coordinator in 25 public and private institutions in the United States. The survey showed that, while program direction is set by government and funding agencies, research and development projects in the United States are developed and proposed by interested public and private institutions. Thus, the initiative for undertaking projects lies with the proponent who must compete with other proponents for project funding in terms of capability to do the project and project cost. Total project cost is provided by the funding agency. All equipment purchased for the project becomes the property of the project implementor.

Another significant finding in the survey is the assignment of patent rights to the institution or researcher undertaking the project (i.e., the project implementor). The royalties that a project implementor could earn from the patents provide him incentives to develop an energy technology.

As a result of the survey, the following activities aimed at increasing the capability of the NCRD to process and distribute information were undertaken:

National Symposium on Renewable Energy

The symposium was held on November 5-7, 1986 during which 38 technical presentations were made. One hundred eighty-six companies and agencies participated in the symposium, with 205 observers from various private and government institutions. This gathering of researchers, project implementors, and renewable technology users provided a forum for assessing the state-of-the-art of renewable energy technologies at the local and international levels. It also identified future directions in the field of renewable energy development. The symposium proceedings are presently being prepared for publication.

Publication of a Newsletter

A newsletter on energy alternatives is being published quarterly by the NCRD. The publication contains articles on developments in nonconventional energy technologies in the Philippines which are aimed at generating public interest and awareness and at increasing the number of users at the firm level. Seven hundred copies of the newsletter are printed and distributed to local companies, energy research institutions in the Philippines and abroad, and suppliers of commercialized technologies.

To date, two issues of the newsletters have been printed. Available subproject funds will provide for the publication of three more issues until the end of the subproject period in December 1986.

Survey of Gasifiers in the Philippines

The conduct of the survey was aimed at analyzing the level of use and effectiveness of stationery gasifiers in the country. The survey, which covered 64 independently financed gasifiers, resulted in the findings and recommendations presented in Appendix A-12.

Enhancement of Information Facilities

The facilities of the BED Data Bank and Library were enhanced with the acquisition of computerized literature and subscriptions to energy journals in microfiche and printed copies. On-line accessing to network data bases in the United States will soon be established with the purchase of two micro-computers.

The total reported expenditures of the subproject, as of June 30, 1986, amounted to P783,425 with the GOP/BED loan peso counterpart equal to P673,425 and the USAID grant peso-cost equal to P110,000.

5.4.5 Findings and Recommendations

General

Administrative problems that caused delays in subproject implementation are mainly inherent in the bureaucratic system. For most of these problems, for example, delayed releases of advice of allotment and cash disbursement ceiling by the Office of Budget and Management, the solutions are beyond the control of the NCRD program managers. In the management of government-funded programs, therefore, such factors must be taken into consideration and provided for with time allowances so that planning and financial schedules could be met. Admittedly, estimating how much time allowance to give is not easy.

As already noted by the project staff, an efficient information system is essential for effective project management. Continued efforts are warranted to strengthen the Program's information system.

The finding from the survey of energy research institutions regarding the full funding of subcontracted projects (in this case it would be by BED) and assignment of patent rights to project implementors or researchers is worth further study for possible applicability in the Philippines. This is discussed further in Section 6.3.

Information Capability

The NCRD has significantly improved its information capabilities as a result of this subproject. With the increased availability of computerized information and published materials on renewable energy, the project staff has strengthened its project management function, particularly in the review of technical proposals and monitoring of research and development projects.

The NCRD's efforts to update its information materials in order to be well-informed on current developments in renewable energy technologies are, indeed, necessary. An important source of information that could be developed are case studies on the USAID-GOP and other subprojects. These could include an in-depth analysis of the management, technology development, and research experience of subproject implementors which could be of benefit to many parties, for example, potential investors and future project proponents.

Information Dissemination

Efforts of the NCRD to disseminate information on nonconventional energy technologies, particularly through the publication of a quarterly newsletter, have been successful. The newsletter provides users with valuable information on renewable energy technologies developed in the Philippines.

It will be worthwhile to develop other forms of information packages aimed at specialized audiences, for example, briefing kits for potential investors, and technical guidebooks on the technologies. This effort which the USAID could support, may utilize the data that the NCRD gathers through computer on-line access to network data bases, published materials, and case studies of project implementors.

The conduct of the National Symposium on Renewable Energy provided an excellent forum for exchange of views on the subject and an effective means to inform concerned publics of developments in the field. Similar activities could be planned in the future to continuously assess the state-of-the-art of nonconventional energy technologies and to develop a bigger market for the technologies. The Renewable Energy Association of the Philippines and the BED seem to have the working relationship necessary to make these activities possible.

Institutional Linkages

The planned cooperative linkage between the BED and a U.S.-based institution engaged in energy R&D has not been attained, despite efforts to contact 25 of them. No suitable arrangement could be made without substantial cost to the BED/NCRD. Thus, the BED/NCRD will need the continuing cooperation of agencies such as the USAID that may have better access to up-to-date technical developments outside the Philippines.

The USAID-GOP Project could also benefit from institutional linkages with the ERDC/INNERTAP information project. This project could potentially provide information on nonconventional energy technologies that may be of use to prospective and current project implementors.

Technology Surveys

The conduct of surveys on renewable energy technologies and resources provide another important source of information for research and development efforts. Studies similar to the gasifier survey should be undertaken on the other technologies to effectively assess field performance and to determine needed improvements for local applications. Findings of such survey should be made available to the public.

COMPLETED SUBPROJECTS

5.5 AN ASSESSMENT OF THE POTENTIAL FOR THE UTILIZATION OF BIOMASS FUELS IN THE PHILIPPINES (AID 7814-G)

Duration	:	41 months (July, 1982 - December, 1985)
Implementor	:	Energy Research and Development Center (ERI PNOC
Coverage	:	5 Provinces (Quezon, Batangas, Laguna, Ilo: and Cavite)
Project Leader	:	Dr. Germelino F. Abito
Funding Commitment (P):		USAID - 989,990 GOP/BED - 628,000 GOP/ERDC - 178,850

5.5.1 Objectives and Goals

The subproject was undertaken to generate a data base on renewable energy that is sufficient to provide a basis for articulating policy directions for a) the applied research and technical dissemination efforts on biomass fuels of the ERDC and the Ministry of Energy; b) the resource management activities of the Ministry of Natural Resources; and c) the development of projects by the National Economic and Development Authority (NEDA), private voluntary organizations, and international assistance entities. Feasible intervention strategies for programs and policy recommendations for the specific technology-resource combinations studied were also to be developed through the subproject.

The specific objectives of the subproject are as follows:

a) To provide baseline data on biomass resource availability and utilization in the agricultural, household, transport, cottage industry, light and heavy industry sectors in selected geographical areas of the country;

b) To identify appropriate biomass-based technologies deserving greater or lesser institutional support, giving emphasis to resource availability, technology adaptability, dissemination potential, cost, complexity, and other pertinent criteria;

c) To develop a relatively site-specific environmental, socioeconomic, and institutional impact analysis of identified technologies in the selected geographical locations of the survey;

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d) To determine the different characteristics of selected biomass resource at both source and end consumers;

e) To determine problems, obstacles, issues, and other barriers involved in the procurement, processing, and utilization of such resources;

f) To assess government policies that affect the use of renewable energy resources and technologies and to recommend policy modifications necessary to expand the use of these resources; and

g) To identify specific areas in the country which can serve as pilot areas for agro-forestry energy development and utilization programs.

5.5.2 Description and Funding Commitment

The project began in July 1982. Baseline data on biomass resource availability and utilization were gathered initially in three provinces: Quezon, Batangas, and Laguna. The project was extended to December 1985 for the purpose of covering the provinces of Iloilo, Cavite and Rizal in the survey.

The methodology adopted in the conduct of the study consisted of eight phases, as follows:

a) Phase I--Preparatory Phase

Available data, including efforts taken by government and private institutions, along the area of concern of the study were examined. For this purpose, secondary data on the technical, economical, social, and political aspects of the utilization of biomass resources in the country were gathered and analyzed. At the same time, all available literature on the nature and characteristics of the selected resources and different technologies considered were reviewed. To strengthen the methodology, international consultants were invited for a five-day workshop.

b) Phase II--Design of Survey and Control Forms

Questionaires and survey forms for the different geogpraphical areas and specific sectors were designed and prepared.

c) Phase III--Pre-testing and Revision of Survey Forms

Prior to the actual conduct of the survey, the questionaire and survey forms were pre-tested in selected areas

with characteristics similar to those of identified survey sites. The pre-tested results led to revisions of the survey tools.

d) Phase IV--Training of Personnel to Implement the Survey

Local interviewers were hired and trained for the survey. In addition, professionals, e.g., economists, foresters, and engineers, were also tapped to take charge of technical measurements and observations.

e) Phase V--Conduct of Actual Survey and Field Editing

The different sets of surveys were conducted sequentially rather than simultaneously. Six geographical areas for each resource were selected according to the predominance of the biomass resource and the presence of the characteristics that most closely reflected the primary resource region as a whole, in terms of such parameters as income distribution, land ownership, economic base, population density, distribution of industry, and employment.

Energy-consuming activities in the selected areas, as well as the existing and potential of the technologies, and resource flows were identified and analyzed. This was done through random sampling, stratified by resources, technologies, and geographical areas.

Interviews were conducted to identify seasonal and other cyclical variations of resource availability. Field editing of the surveys were done by the senior project staff.

Senior project staff and local resource persons were made available to assist interviewers. On-site inspections were done by the Senior Project Staff to monitor the survey.

f) Phase VI--Final Editing of the Survey Results

To ensure proper coding and to correct surveyor errors and respondent inconsistencies, final editing of survey results was done.

g) Phase VII--Analysis of Data/Survey Results

After the completion of each survey set, computer analysis and report preparation were done by the senior project staff. Computer processing, however, was contracted to a private firm using the specifications provided by the project team.

h) Phase VIII--Write-Up and Project Development

This Phase involved the integration and comparison of the analysis of the separate surveys. Emphasis was placed on the development of feasible intervention strategies for specific programs and appropriate technologies deserving institutional support.

Fund commitments to this subproject totalled ₱1,796,840. Of the total commitment, ₱989,990 was charged against the grant component of the USAID/GOP Project, while ₱628,000 was charged against the GOP/BED fund. The balance of ₱178,850 came from the GOP/ERDC fund.

5.5.3 Institutional Arrangements and Subproject Management

This subproject was implemented by the ERDC with participation from local interviewers and professionals. A private firm participated in computer processing of survey results. The subproject management was similar to those of other ERDC subprojects presented earlier.

5.5.4 Accomplishments and Current Status

The original timetable for the project of two years was extended to three-and-a-half years to allow the ERDC more time to do the analysis of the survey results and to conduct a survey for two more provinces, Cavite and Iloilo (Rizal Province was not covered as planned).

The subproject officially ended in December, 1985. Reports on the biomass survey in five provinces--Iloilo, Batangas, Quezon, Laguna and Cavite--were submitted by the ERDC to the BED-NCRD. Data gathered included annual generation or production, net annual availability, utilization, selling price, and heating values of nine types of biomass resources, namely: coconut husk, coconut shell, coconut shell charcoal, rice hull, rice straw, firewood, wood charcoal, bagasse, and biogas.

The survey covered the practices or methods of generation, processing, procurement and utilization of the biomass products, and the existing laws and policies regarding their handling. The subproject team submitted new policy recommendations or modifications. They did not,however, identify specific areas that can serve as pilot sites for the agro-forestry energy development and utilization programs of the Ministry of Natural Resources as targetted in the subproject objectives.

The determination of the physical and chemical characteristics of the biomass resources was completed by the

project team. The study also identified some biomass-based technologies deserving institutional support.

Appendix A-13 provides a summary of the results of the survey.

As of the June 30, 1986 statement, the reported expenditures for this subproject amounted to P1,537,990. Of this amount, P909,990 was charged against the USAID/GOP Project fund, while the balance was charged against the GOP/BED fund.

5.5.5 Findings and Recommendations

The study was an important initial attempt to explore and document the potential of biomass resources in selected provinces.

The NCRD's evaluation of the result (Lim, Quebral, and Botictic, 1986) presents a good critique to which we concur. The main recommendations for the future conduct of similar studies were to include data on (a) the economics of producing and extracting required products from biomass resources and (b) demand projections, including alternative uses of the biomass resource.

To these recommendation we wish to add the following suggestions for future biomass assessments. First, it will be helpful to include a location-specific analysis of the uncertain factors that influence the production of biomass resources. This analysis is important to potential users or investors who must depend on the reliability of a fuel supply in terms of quantity and affordability. Identification of these uncertain factors could also help in projecting future generation capabilities which, to resource users, may be more important than the current generation levels. Second, we noted that the data were targetted for use mainly by industrial firms in Metro Manila. Before any further assessment is undertaken, we recommend that the results of the available reports be shared with a few of such firms to find out if the data are indeed useful enough or are presented in a way that the firms can use.

Following these recommendations, similar studies on renewable energy resources in other parts of the country could be undertaken to generate increased utilization and development of biomass-based technologies. Considering the number of provinces that have yet to be covered, a prioritization scheme has to be devised. The scheme should include consideration of such factors as proximity to target users of the resources and the cost of conducting the assessments, in addition to the factors identified by the ERDC (See [e], Phase V).

5.6 SOLAR RADIATION/WIND MAPPING OF THE PHILIPPINES

Phase I (AID 7815-G)

Duration	:	34 months (February, 1983 - December, 1985)
Implementor	:	Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)
Coverage	:	6 stations
Project Leader	:	Mr. Manuel Bontoc
Funding Commitment (P)	:	USAID - 1,152,336 GOP/BED - 1,126,000 GOP/PAGASA- 1,171,200

Phase II (AID 8202-L)

Duration	:	January, 1983 - August, 1986
Implementor	:	PAGASA
Coverage	:	12 stations (including the first 6 stations)
Funding Commitment (P)	:	USAID - 264,880 GOP/BED - 23,100 GOP/PAGASA- 110,000

5.6.1 Objectives and Goals

Phase I of the subproject was awarded to PAGASA through a memorandum of agreement effected in June 1979. This subproject had the following objectives: (a) to provide researchers and research institutions involved in the utilization of solar and wind energy resources data and information on solar insolation and wind velocity patterns at various locations in the Philippines, (b) to determine seasonal and monthly variations in the distribution of solar radiation and wind velocity, and (c) to expand and upgrade the present solar/wind station network in the Philippines by providing equipment to existing PAGASA stations at strategic sites.

5.6.2 Description and Funding Commitment

The plan was, first, to conduct a survey of potential sites for the monitoring equipment, then to procure and install the equipment at such sites. Once installed, the equipment would be used to gather solar radiation and wind data.

As of June 30, 1986, funding commitment to Phase I of the subproject totalled P1,226,000. This amount was charged against the GOP-BED fund. The total funding commitment for the Phase II

amounted to ₱287,980, with ₱264,280 coming from the USAID fund and ₱23,100 from the GOP/BED fund.

5.6.3 Institutional Arrangements and Subproject Management

The subproject was implemented by PAGASA, a government agency, and monitored by the NCRD. The Development Sciences, Incorporated (DSI), a U.S. consulting firm, provided technical assistance to the subproject.

5.6.4 Accomplishments and Current Status

Based on surveys of possible strategic sites, it was decided to upgrade the monitoring capability of 12 stations throughout the Philippines. These stations were located at Basco, Dumaguete, Cuyo, Masbate, Guiuian, Sijoton, Mactan, Burgos, Tagaytay, Virac, Cagayan de Oro, and Daet.

Financial and administrative constraints led to the upgrading of only six stations initially. The subproject experienced delays in fund releases and equipment delivery which changed its timetable. The subproject also encountered some technical difficulties, such as problems with the electronic control systems, inadequate installation, and inadequate wiring diagrams. Nevertheless, by October 1982, wind monitoring equipment and instruments had been installed in Basco, Dumaguete, Cuyo, Masbate, Mactan, and Guiuian, while work on site confirmation of other installations continued.

A second phase of the subproject was subsequently developed in order to allow time for the subproject to realize its objectives. This move was based on the recommendation of the DSI. The second phase was, thus, simply an extension of the first phase and was within the original subproject plan.

Phase II was to cover the period January 1983 to January 1984. The remaining sites chosen were located at Maasim, Burgos, Virac, Iloilo, and Cagayan de Oro. Wind monitoring facilities were also installed in Tagaytay, while the set-up in Puerto Princesa was transferred to Virac.

Additional equipment (integrators) were procured at the start of Phase II to complete the necessary instrumentation of the 12 stations, including the equipment for laboratory work. Additional equipment for calibration and standardization were likewise procured, while maintenance groups were organized.

By the end of 1983, 10 stations had been fully equipped and were operational. These stations comprised those in Basco,

Guiuian, Mactan, Cuyo, Dumaguete, Virac, Daet, Masbate, Cagayan de Oro, and Guimaras (Iloilo). During March 1984, additional equipment were installed in Basco, Guiuian, Cuyo, and Guimaras bringing the total of covered stations to 12.

Initial data have now been gathered on solar radiation and wind velocities. A reported weakness in data-gathering that has been checked is the technicians' practice of stopping operations in the evening to save on supplies. The practice required reprogramming the integrator and printer every time the machine was turned on again--this sometimes caused reprogramming errors.

As of June 30, 1986, the total expenditures of Phase I of the subproject amounted to P82,950 charged against the GOP/BED fund. Phase II reportedly incurred total expenditures amounting to P23,100 also charged against the GOP/BED fund. The total obligated foreign exchange funds as of the same date totalled P24,880.

5.6.5 Findings and Recommendations

An earlier evaluation of the project by the DSI consultants found some equipment defective and out of calibration. Problems were traced to faulty wiring in the electrical or electronic circuitry. These could have been corrected early had adequate manuals and wiring diagrams been made available. Likewise, lack of spare parts and difficulties in stock piling expendable supplies (ink, pens, charts, etc.) affected subproject operations. Technicians appeared poorly motivated, and there seemed to be a communication gap between them and the subproject management.

As of June 1986, the anticipated data from stations have not been reported, indicating that, perhaps, the stations have not been diligently gathering data. Although all integrators have been in operation for the past year or two, the only data available were old ones. This, again, indicates lack of maintenance program and weak monitoring control procedures on the part of the subproject implementor.

It will be important for PAGASA to institute, as quickly as possible, a program for checking the calibration of the subproject instruments and equipment. An effective maintenance program should also be carried out.

The subproject should be able to collect and disseminate good data to various interested parties, particularly entrepreneurs who plan to market (or are already doing so) equipment using solar or wind energy.

Further work on this subproject should go hand-in-hand with the other windmill and solar projects. It might be worthwhile to increase the number of monitoring stations if only to establish a good data base. But such work, which may be within or outside the USAID-GOP Project, will depend on PAGASA's demonstrated capability to institute a good maintenance program and to improve monitoring control procedures.

5.7 NONCONVENTIONAL ENERGY RESOURCES PUBLIC INFORMATION AND PROMOTIONS PROGRAM--Phase II (AID 7816-G)

Duration	:	36 months (January, 1983 - December, 1985)
Implementor	:	Energy Research and Development Center (ERDC), PNOC
Location	:	ERDC, Diliman, Quezon City
Project Leader	:	Ms. Laurie B. Navarro
Funding Commitment (P):		USAID - 916,108 GOP/ERDC - 175,000

5.7.1 Objectives and Goals

This subproject began with Phase I, which was implemented by the PNOC Public Affairs Department for one year, with financial assistance from the BED. The project aimed to generate public awareness and acceptance of nonconventional energy technologies.

This subproject covers Phase II, which was implemented by the ERDC for three years. In line with the objectives of Phase I, the initial activities of Phase II for the first semester of 1983 were aimed at (a) undertaking an active public information campaign on the availability and utilization of alternative energy sources; (b) developing public awareness and acceptance of existing nonconventional energy technologies; (c) making people accept the technologies as a way of life and motivating them to invent, adopt, and innovate with alternative sources from within their immediate environment.

A redirection in subproject thrust was made in the second half of 1983, giving more emphasis to the compilation and repackaging of information material, and establishing and maintaining information exchange linkages with local and foreign energy institutions. This was aimed at providing the BED/NCRD project staff and project implementors with the information they needed.

5.7.2 Description and Funding Commitment

Phase II of the Nonconventional Energy Public Information Program, as originally designed, involved activities that included rural extension seminars, workshops, and assistance to schools and institutions.

With the change in subproject thrust in the middle of its first year (1983), promotions and public information activities were discontinued and emphasis was placed on enhancing the ERDC's

Information Center in order to provide project implementors and the BED/NCRD staff with the data they needed. In line with this objective, technical books and journals were acquired, a computer system for on-line accessing of international data bases was established, a library users' profile was prepared, and collated information were repackaged.

An extension of one year, from an original project period of two years, was given to the subproject as a result of the change in subproject thrust. Thus, the subproject which began in January 1983, ended in December 1985. As of June 30, 1986 total funding for the subproject amounted to ₱1,109,108 with P916,108, coming from the USAID Project fund and ₱175,000 from the GOP/ERDC fund.

5.7.3. Institutional Arrangement and Subproject Management

This project was an in-house project of the ERDC. It was managed similar to the other ERDC subprojects presented earlier. It was monitored by the NCRD.

5.7.4. Accomplishments and Current Status

Rural Extension Seminar On Solar Dryer

A two-day extension seminar was conducted in June 1983 in Pinamuk-an Island, New Washington, Aklan. The seminar was aimed at encouraging the people to use local materials for the construction of a solar dryer for home use. Participants included barangay leaders, school teachers, housewives, out-of-school youth, and other members of the community who could promote transfer of the technology to the rest of the populace. Lectures on food preservation using the solar dryer were also conducted in coordination with the Philippine Women's University.

Assistance to Schools and Institutions

The ERDC provided technical and financial assistance to the Science Promotions Institute for the conduct of a youth summer training program on energy research for science-inclined students. The training was aimed at enhancing the capabilities and skills of students in undertaking research on energy-related subjects. The one-month training course, which was held at the ERDC Complex, taught the students methodologies for conducting energy research projects.

Workshop on Biogas Generation

A workshop on biogas generation from coconut water was conducted towards the end of 1984. Local and foreign experts in the field exchanged their experiences on the technology.

Acquisition and Retrieval of Information Materials/Data

To enhance the collection of information materials in the ERDC Information Center, technical books and periodicals which were relevant to the needs of end-users were acquired; subscriptions to journals were also placed.

On-line accessing of international data bases was established with the installation of a computer system in the premises of the ERDC Information Center and Library. This now enables the ERDC to link up with other international information centers around the world. At present, this is done through the use of the computer brokerage facilities of DIALOG. The computer facilities have provided the ERDC with an information retrieval system using a published bibliographic data base.

Users' Profile

A periodic survey of information material requirements of end-users is being conducted to enable the ERDC to respond more effectively to their needs.

Repackaging of Information

The information materials gathered and collated at the ERDC are repackaged through abstracts and literature reviews.

The total expenditures of this project, as reported in the June 30, 1986 statement, amounted to ₱307,360, charged against the USAID-GOP Project fund. The total foreign exchange obligations amounted to ₱532,000.

5.7.5 Findings and Recommendations

Outside of the ERDC, only a few project implementors have availed of the information at the ERDC Information Center and Library. Utilization of on-line data has been limited by the cost of accessing the data base and the still inadequate users' familiarity with the system.

The ERDC has recognized that added effort must be undertaken to reach many more possible users of the available information. The availability of such information must be made known to the public in order to draw their interest in the field and, at the

same time, ensure that those who need the information will know where to go. There is a continuing need to train users on the system of accessing on-line data.

Substantial data and information on renewable energy technologies have been collated by the ERDC Information Center. It is important, however, to package these into more usable forms, other than catalogues and abstracts. Information packages could be developed for specific potential users, such as policymakers, suppliers, and household and commercial users of nonconventional energy technologies in both rural and urban areas. A few of these packages could be self-financed. Others could perhaps, be funded by solicited sponsors. The packages could be a valuable input to the current promotions program of the NCRD.

CHAPTER 6

MAJOR AREAS OF CONCERN AND ISSUES

This chapter presents the results of the evaluation on the areas of concerns and issues spelled out in SITECH's scope of work (Appendix A-1) which are not yet covered by the detailed discussion of USAID-GOP subprojects in the preceeding chapters. We grouped the concerns and issues into related topics, as follows.

6.1 PROGRAM AND PROJECT OBJECTIVES, GOAL, AND STRATEGY

This section addresses Items 1 and 8 in the scope of work.

6.1.1 Objectives and Goal: Realistic and Relevant

As already discussed in Sections 2.2 and 3.2, the Philippine Nonconventional Energy Development Program, as well as the USAID-GOP Project component that supports it, had originally two development objectives: to accelerate the use of nonconventional energy resources with the goal of significantly displacing imported oil and to develop technologies appropriate for the rural sector. Considering the country's former dependence on imported oil, despite the availability of indigeneous nonconventional energy resources, and the large rural sector that cannot progress much without adequate energy supply, one can clearly conclude that the Program and Project objectives and goal are realistic and relevant to the Philippine energy needs.

The first strategy adopted was to introduce selected technologies, for example, windmills and biogas systems, to the rural sector. But the program and project management subsequently realized that, given the limited resources and the goal of displacing imported oil, pursuing the second objective by going directly to the rural sector with the technologies did not seem to be realistic and practical. To be appropriate to the rural sector, a technology must not only be technically adaptable to rural needs; it must also be affordable. Affordability of a technology, however, depends greatly on the presence of an adequate market that can make its cost of production low enough. In most instances, the rural sector cannot immediately generate a demand that is sufficient to nurture a technology's commercial development.

6.1.2 The New Strategy: Viable and Practical

The program and project strategy was, modified sometime in 1982 to give emphasis first on the commercialization of nonconventional energy technologies. The shift in emphasis, however, does not mean ignoring rural needs, as program officials explained. It only recognizes that the long-term viability of providing for the needs of the rural sector (e.g., water supply and electricity) depends on the ability of the manufacturing sector to make the technology available and affordable on a sustainable basis. Only when there is a viable industry serving both rural and urban sectors will the impact of nonconventional energy technologies become truly significant. As part of the commercialization strategy, therefore, there is also increased emphasis to make nonconventional energy technologies attractive for large-scale, urban-based users in order to hasten the commercialization process.

The program and project management should be credited for the shift in the strategy which is now more viable and practical than before. Its demonstrated creativity and flexibility to do so are some of the most positive signs that it can now effectively steer the Program to the right direction.

In the future, the rural sector can more readily become the area for immediate commercialization of nonconventional energy technologies. The rural development policy of the Philippine government, anchored at agricultural modernization and agro-industrial expansion, can hasten the creation of viable rural markets. The challenge to program managers and entrepreneurs is to watch for that switch point when opportunities in rural areas (resulting from their income-generation capabilities or the presence of external assistance) can already offer immediate commercialization possibilities for nonconventional energy technologies. In the meantime, efforts to introduce nonconventional energy technologies in rural areas should continue to focus on systems, such as in the Integrated Village Energy System (IVES) subproject, where the technology is but one essential component of the rural development process. In such cases, there must be explicit understanding that the efforts have long-term purposes that may not immediately achieve the program goal.

Research and development were not emphasized in the original program strategy since the technologies were assumed to be known and well-established. However, as the program and project implementors soon realized, the technologies were not as immediately adaptable to local conditions as originally thought. In certain cases, where the technology was relatively proven (for example, gasification of charcoal), the conversion of the technology using an abundant, indigeneous fuel, such as rice-

hull, met various technical problems. Given these problems, continued applied research and development appears to be an appropriate strategy. In fact, demonstration projects should not be undertaken until all technical problems have been resolved in the research laboratory.

At the time that the Program and Project were established, very little data existed on resource availability, market potential, and possible socioeconomic impacts of nonconventional energy technologies. Thus, the initially diffused "shotgun approach" to technology development was probably inevitable. Experience now provides a reasonably adequate basis for judging which technologies and resources offer the best potential for development, and for formulating a strategy focused on those technologies and resources.

6.1.3 Toward an Improved Implementation Strategy

The BED/NCRD has a well-defined direction for implementing its program strategy, that is, commercialization of certain technologies with potentially large-scale applications. The next step now is to identify the specific fuels and technology systems that need to be given the most attention. For instance, the type of biomass that offers the best possibilities needs to be further identified. Research on gasifiers must focus on a particular type of biomass fuel that is found to be most suitable. The gasification of rice hull, for example, appears to be more technically difficult compared to that of charcoal; rice hull fuel is probably better used for direct combustion in dryers and boilers.

Further development of the technologies to overcome remaining problems, which the BED/NCRD is now doing, should continue in parallel with existing efforts to develop increased institutional capability and to implement other project-support activities. One such activity that has an important impact on the program strategy is the promotion of nonconventional energy technologies.

The criteria used for project selection as a means of attaining the program and project strategy could be expanded to include resource availability and other factors, as follows:

(a) availability of the required nonconventional energy resource in terms of volume, location and accessibility, and quality;

(b) maturity of the technology, determined based on its technical feasibility, operational viability, and commercial feasibility; and

(c) social and economic benefits taking into account target users, employment and income-generation potentials, and contribution to the goal of displacing imported conventional fuels.

Since there are many anticipated changes in the management of the Program and Project, in addition to the changes that have already occurred in the Philippine government, it might be worthwhile for the BED/NCRD to host soon a planning and policy workshop involving different institutions and individuals involved in nonconventional energy development. The objective of such a workshop would be to review the program and, if necessary, to come up with a revised nonconventional energy development program that will take into account the current national energy policies and that will be consistent with the current national development strategies of the new government.

6.2 RELEVANCE OF USAID-GOP SUBPROJECTS TO LOCAL CONDITIONS AND NEEDS

This section addresses Items 4 and 13, and partly Item 15 in the scope of work.

6.2.1 The Relevance Issue

In addressing this issue, one presupposes that there is adequate knowledge of local energy requirements, resource bases, and economic conditions. This knowledge can be obtained from existing data and up-to-date observations. At the time that the USAID-GOP Project started, however, available data were not adequate to give localized information on those factors. Surveys were undertaken, therefore, as part of some of the subprojects. Partly due to the unavailability of baseline data, the design and implementation of some subprojects have not been the most effective in terms of addressing local needs. The BED/NCRD has recognized this issue, such as in the case of windmills.

One subproject that directly addresses local conditions and needs is the Integrated Village Energy System (IVES). This subproject was designed to integrate the nonconventional energy development efforts in the rural development process of a community. One reason given for the failure of many renewable energy projects aound the world is that they were more technology-driven rather than needs-driven, and that they were not sensitive to the needs of the people they were supposed to serve. The IVES subproject is an excellent application of a needs-driven approach: it determines the villagers' wants and needs and the available local resources for meeting those wants and needs.

Earlier, we mentioned the shift in emphasis from small-scale village-level technologies to relatively large-scale commercially viable technologies. The shift has been accompanied by a change in the continuing introduction of a few appropriate technologies in rural areas. The new approach involves making rural beneficiaries more capable, not only of acquiring the technologies, but also of properly maintaining them. For instance, the IVES subproject is built around a strategy of implanting renewable energy technologies that can generate income for their own maintenance, and in such a way that responsibility for the system is assigned to a group (or association) rather than to an individual. As such, the objective of raising rural standards of living is addressed along with that of ensuring both the viability and sustainability of the technologies introduced.

The solar-powered (photovoltaic) pumping system project has addressed a local need for power where there was lack of needed sources of energy. The area is not connected to an electric grid; it badly required energy to pump and deliver water for domestic consumption. The subproject introduced a system that the local people accepted.

The rice hull-fed thermal power plant subproject has addressed, not only power needs, but also an environmental problem resulting from the accumulation of rice hulls. Rice hull is an abundant resource that can potentially be put to good use.

The pilot scale fermentation/distillation facility at BIOTECH is an important investment in a long-term development program for generating alcohol fuels from indigeneous biomass resources.

The subprojects on project-support activities have been similarly relevant to local conditions and needs. In fact, some of them (such as the resource surveys and technical consultancies) are essential for establishing proper project directions.

6.2.2 Integration of USAID-GOP Subprojects

Based on fund support for subprojects, the USAID-GOP Project now represents approximately 60% of the total Non-conventional Energy Development Program of the Philippines. The number of USAID-assisted subprojects accounts for 43% of the total. There appears to be adequate integration of USAID-GOP subprojects with other projects. Furthermore, the objectives and goals set for the subprojects are consistent with those of the overall Program.

6.2.3 Subprojects with the Greatest Potential Local Impact

The subprojects with the greatest potential impact on local energy production and use appear to be the cogeneration subproject and the three subprojects oriented towards research, development, and demonstration of gasifiers.

The 1986 report by Stanley Consultants on cogeneration potential in the Philippines (Stanley Consultants, January 1986) indicated a potential of 350 to 450 MW of cogeneration capacity based on assessment of industries existing in 1983. Such cogeneration output could save 550,000 KLOE (1000 liters of oil equivalent heat content) of fuel oil due to conversion of coal-fired boilers and 530,000 KLOE due to additional waste-fired boilers. Thus the cogeneration subproject is an important step towards attaining the goal to displace imported oil. Its ultimate success, however, will depend on enactment of legislation similar to the Public Utility Regulatory Policy Act (PURPA) in the United States--an act that permits independent power producers to connect with, and sell power to, utility grids. This matter is now under consideration by the BED.

The gasifier research, development, and demonstration work is significant to the Philippines because of the large biomass resource base and the potential of gasifiers to serve a power range now supplied almost entirely by diesel fuel. Gasifiers are already currently being used by the private sector (see Sycip, Gorres, Velayo & Co. and DCCD Engineering 1985 for a survey of users). They have four primary applications: drying or direct heating, irrigation, electricity generation, and rice milling. The most commonly preferred feedstock is charcoal (wood and coconut shell) because of its abundant supply and higher BTU content per volume. The economics of gasifiers, however, remain to be poor, mainly due to the low efficiency of existing designs. The subprojects on gasifiers are expected to produce cost-effective designs that can use indigeneous resources. It is, however, important that the gasifiers under development be thoroughly tested in the laboratory, and that field operators be trained in their operation and maintenance before the units are deployed. It is also important to establish what type of biomass fuels are most suitable for gasification.

6.3 INSTITUTIONAL ARRANGEMENTS AND PROJECT MANAGEMENT

This section addresses institutional issues, as well as Items 3, 6, 7, and 11 in the scope of work. Details on the first three items are discussed in Chapters 4 and 5.

6.3.1 Institution Building: An Important Project Accomplishment

A notable accomplishment of the USAID-GOP Project is likely to be overlooked because the stated goal does not include it and the original funding allocation did not explicitly provide for it. This is the development of institutional capabilities for the formulation and implementation of the Program. Its contribution to institution-building seems to be the single, most important accomplishment of the Project. This was achieved with the help of the participants' training program, the technical consultancies, and the opportunity and flexibility granted the program implementors to carry out a pioneering project. There are, however, some remaining issues to be resolved and needs that have yet to be addressed.

6.3.2 Institutional Issues

One important issue to address with regard to institutional arrangements is the contracting procedure adopted at present. The subprojects are funded jointly by the USAID and the GOP/BED, therefore, they are contracted out following both the GOP and USAID requirements.

Funding support from the GOP/BED comes from its grants-in-aid (GIA) budget item which is part of the national government budget that is approved by both the executive and legislative branches of the Philippine government. The GIA budget is further allotted to project implementors in accordance with GOP regulations. Funds released by the Office of Budget and Management (OBM) based on a GIA budget are treated as government funds, regardless of whether the end user is a private company or a public agency. In practice, however, private fund beneficiaries are granted some flexibility in using GIA funds, for example, their personnel budget is not evaluated by the Office of Compensation and Position Classification, the Office that enforces the government salary scale.

One GOP requirement is the use of memoranda of agreement (MOA) approved by the BED and the project implementor (Apendix A-14 is a sample MOA). Another GOP regulation assigns rights to discoveries and inventions to the government if the project implementor is a government agency; it assigns rights to the project implementor if the implementor is a private agency, provided that the implementor pays a royalty of not more than 50% of the benefits accruing from such discoveries and inventions (see Annex D to the sample MOA in Appendix A-14).

One USAID requirement is the GOP counterpart funding for its assistance. The GIA money from the GOP/BED and whatever counterpart the project implementors can raise (an optional feature of an MOA) are used to satisfy this requirement.

The MOA, thus, specifies both the rights to discoveries and inventions and the counterpart requirement. The first issue is on the rights to discoveries and inventions. There is a question on whether a project implementor could be motivated more if the rights are fully assigned to him, whether he is from a government or a private agency. The issue, which does not seem to be a pressing one at present, requires further representation with legal authorities in government. We believe that the BED/NCRD could be granted the flexibility to adopt innovative arrangements that will enable it to reach program goals. Cases for study, for comparative purposes, are the Philippine Population Program and the University of the Philippines, both of which have received government funds under flexible conditions.

The second issue refers to whether project implementors should be required to raise counterpart funds. On one hand, the BED/NCRD considers the provision of counterpart funds as an indication of a project implementor's interest in a project. On the other hand, some program managers have expressed the concern that, when an implementor provides some funds, it weakens the BED/NCRD's control over the progress of a subproject. Some officials of the BED/NCRD believe that a contract which is fully funded by the BED/NCRD can require more strict adherance to work schedules on the part of project implementors. As it appears, there are advantages and disadvantages in withdrawing the counterpart fund requirement. It might be fruitful to experiment with each procedure, with or without counterpart funds (or without significant counterpart funds, if such a requirement is unavoidable). The underlying issue, however, is the fact that the BED/NCRD has identified only a few potential project implementors to choose from. This is especially true in the area of R&D where the ERDC seems to be the only choice for many subprojects. Continuing efforts, in both information and institution-building, will be needed to increase the pool of potential project implementors. Unless there is a larger pool, the BED/NCRD cannot effectively require strict adherance to its standards--it cannot effectively impose penalty to the only available project implementor.

6.3.3 Planning of Subprojects

It has been pointed out that early efforts in planning subprojects were rushed. Project managers have made up for the early planning deficiencies by being flexible and sensitive to needed project adjustments. This flexibility has greatly helped in saving the Project from early ruin. The BED/NCRD's planning capabilities have improved greatly over time, although there is still some room for project management development at the middle level of the organization.

At the subproject level, both the photovoltaics and the IVES subprojects show some of the needed elements for planning and implementing rural-based projects, namely: (a) clear understanding of goals by all parties concerned, (b) sensitivity of project implementors to the needs of the locality, and (c) participation of the local people in the plannning and execution of the project.

6.3.4 Implementation of Subprojects and Performance of Project Implementors

Except for the photovoltaics subproject, all subprojects have undergone adjustments in their financial and work schedules. Implementation of most subprojects has been considerably delayed due to the various factors discussed in Chapters 4 and 5. Demonstration units have not been used continuously for the following reasons: (a) lack of working capital, (b) absence of spare parts of broken equipment, and (c) inadequate familiarity with the technology. Despite these difficulties, the BED/NCRD staff and many of the project implementors have expressed continuing enthusiasm to see the Project reach its terminal date successfully.

The top management of the BED/NCRD has both the capabilities and motivation to make the USAID-GOP Project succeed. The staff members seem diligent and motivated as well. In addition to middle-level project management development, one area that requires further strengthening is in the technical aspect. The BED/NCRD staff can benefit from additional technical training and interactions with technical experts. These should include matters related to the design and evaluation of R&D projects, since the NCRD wants to take the initiative in designing them.

The PNOC/ERDC, being the primary research agency involved in the implementation of the Program, requires further R&D management enhancement support. Its middle-level staff can profit from additional R&D training, both at the technical skills development level and at the research management level (including planning and evaluation). The ERDC needs a comprehensive long-term plan on how to implement its R&D objectives. An in-house research and development consultant who can work closely with the staff in designing, managing, and evaluating research projects could be of help to the ERDC.

6.3.5 The Project Coordinator's Role

The Project Coordinator (resident coordinator) function has been served by an individual rather than by a firm who hires the individual and provides technical support. This arrangement has both advantages and disadvantages. An advantage is that an individual can adjust more easily to the needs of the project--

this has been demonstrated in this case. A disadvantage is that an individual does not have supporting technical and manpower resources that a firm has and can mobilize. An issue has been raised regarding the possibility that a firm could have provided both the short-term technical support (now given by two separate U.S. consulting firms) and the individual for the Project Coordinator position. Following this point of view, with the consultants and project coordinator coming from one firm, a continuing relationship with the firm could have been achieved; it could have overcome the problem of short-term consultants to come up with a long-term program perspective. The issue is whether all the technical assistance requirements of the Project could have been provided by one firm. If not, the present arrangement, as far as the Project Coordinator's role alone is concerned appears adequate, provided the hired individual is capable and competent.

The first evaluation of the Project (Development Science, Inc. 1981) reported, as one of its major findings, the adversarial relationship between the former Project Coordinator and the executing agency (at that time, the BED/CNED). In contrast, the incumbent Project Coordinator, an agricultural engineer, seems to have served the needs of the Project well and is very well regarded by the BED/NCRD program management. A source of concern is the gap that he might leave behind when he leaves the Project, since he has been attending to much of its administrative requirements, including follow-ups on the releases of funds and equipment from the USAID. The challenge to the BED/NCRD is to ensure that smooth transition will be achieved. Although the USAID assistance is expected to be phased out eventually, there will remain a continuing need to coordinate and monitor the USAID-GOP subprojects beyond their terminal dates.

6.4 FINANCIAL REQUIREMENTS AND MANAGEMENT

This section addresses Items 2 and 9 in the scope of work.

6.4.1 Adequacy of Budgeted Funding

By the end of the current project period (December 31, 1986), the estimated balance of the USAID assistance will be about $500,000 to $900,000 depending on how remaining activities will progress. This amount could be adequately applied to the recommended extension of some subprojects (see Section 6.8).

6.4.2 Financial Channels and Management

Many of the delays in the implementation of subprojects could be traced to the difficulties met in the financial management of the USAID-GOP Project, particularly in the release of funds. Figure 6-1 presents the flow of funds to subprojects. The diagram presents the key steps that are generally followed.

Assuming that the subproject objectives and goals are consistent with those of the approved project agreement, then the detailed project proposal, together with the request for first fund release, are submitted by the proponent to the BED/NCRD. If they are acceptable, they are approved and submitted for the approval of the Office of Budget and Management (OBM), if the proposal requires GOP counterpart, and of the USAID. If they are not acceptable, by either the NCRD, the OBM, or the USAID, the proponent, together with the NCRD, makes necessary adjustments. In some cases, the proposals are initiated by the NCRD. Documents for a number of subprojects and for the NCRD's own fund requirements are usually processed at the same time for the OBM's purposes.

Based on the approved project document, the USAID notifies the OBM and the Bureau of Treasury (BT) so that the latter can raise the corresponding counterpart and cash advance to the Project. In some instances, there may not be adequate counterpart funds available; in this case the request has to wait. If counterpart funds are available, the OBM issues an advice of allotment (AA) and a cash disbursement ceiling (CDC) to cover the total requirements of subprojects and of the NCRD itself for a certain period (usually a quarter). Based on the AA and CDC, the NCRD issues separate AAs and CDCs to the project implementors, each one based on the approved project document (i.e., memorandum of agreement) and fund requests. After a certain period, for example, a quarter, each project implementor submits a financial statement supported by expense receipts. Some of the expenses may be disallowed if they are found by the NCRD to be inconsistent with the MOA. The BED/NCRD-approved statements and expense receipts become the basis of a request for the USAID's reimbursement of the cash advance in the previous release of funds. If the expenses are acceptable to the USAID, then it informs the OBM and the BT and effects the transfer of funds to the BT to cover the reimbursement. In a few rare cases, some items may be disallowed by the USAID. Thereafter, the OBM issues another set of AA and CDC based on another request from the BED/NCRD. Again, this includes the cash advance for the USAID portion. At the end of the process, if all things go right, all cash advances by the government are reimbursed by the USAID and all expenses are paid by both the GOP and USAID funds according to their respective budgets.

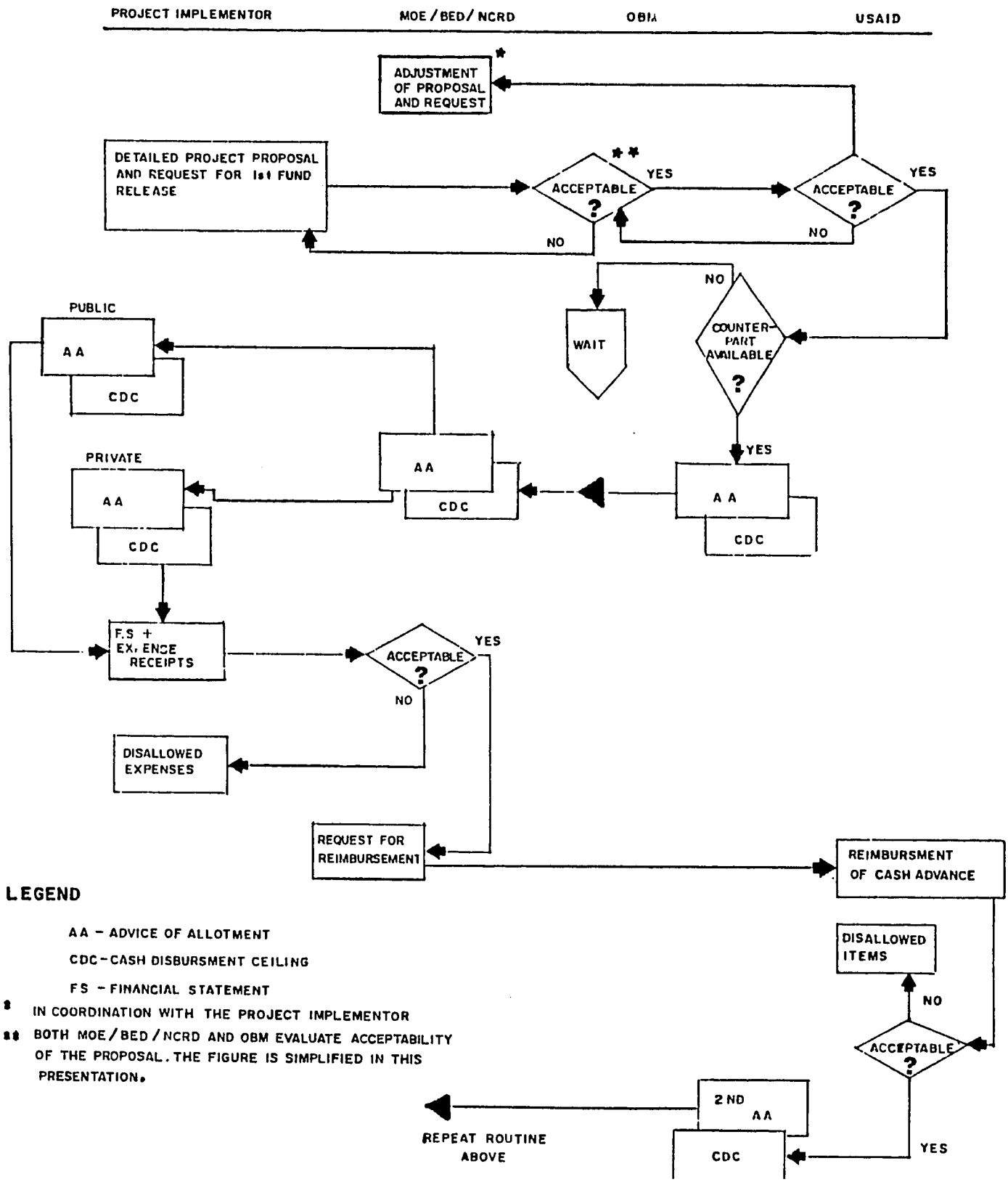

FIGURE 6-1

FLOW OF FUND RELEASES
USAID/GOP NONCONVENTIONAL ENERGY DEVELOPMENT PROJECT

The entire process for one release can take months. Significant delays can occur in the following areas: (a) initial approval of the project agreement (which takes about 30 to 45 days), (b) submission of financial statements and expense receipts by the project implementor and their subsequent approval (about 30 to 60 days), and (c) release of AA and CDC by the OBM (60 to 210 days). Delays attributable to project implementors arise from their inability to submit viable technical proposals and to fully satisfy documentation requirements. Another delay has been reported to be caused by redundant auditing (for example, expenses of the ERDC are subjected to the review of both the PNOC auditor and the MOE auditor).

Some of these delays require solutions beyond the scope of the Project; others could be remedied within the Project. For example, the inability of the OBM to raise counterpart funds is not within the scope of the Project. It is a constraint that must be recognized and provided for with adequate time allowance in the work schedule. Admittedly, the magnitude of such time allowance is highly uncertain. The other problems could be solved or at least avoided by: (a) maintaining close communications with the agencies involved in fund releases, (b) being familiar with all requirements and satisfying them on time, and (c) providing for adequate time allowance for the processing of papers.

The funding difficulties experienced by the Project could be one motivation for the government to revert to the old procedure of allowing USAID-funded projects to maintain checking accounts in government depository banks. This matter obviously requires further study at the OBM level.

6.5 PROGRAM AND PROJECT SUPPORT

This section addresses Items 5 and 12 in the scope of work.

6.5.1 Adequacy of the Program and Project Support

The main issues under this topic seem to be the timing of availability of support, the adequacy of budgetary allocations for personnel salaries, and the quality of logistical support.

The Project and, thus, the Program have suffered significantly from delayed releases of funds, equipment, and parts leading to the de-obligation of some funds during the earlier phase of the Program. The main causes of delays, some of which have been pointed out earlier are: (a) delayed release of the GOP counterpart, (b) inability of some project implementors to satisfy documentation requirements, (c) lack of familiarity with the GOP and the USAID procurement procedures, (d) inability of project implementors to submit accurate technical

specifications, (e) discontinued production of equipment and parts, and (f) clearing procedures for imported equipment in the port area.

The budgetary allocations for personnel do not provide for competitive salaries, especially for the BED/NCRD staff. The participants' training program abroad and local training opportunities attract good personnel despite the low salaries. However, if an excellent level of technical expertise is to be maintained, salaries will have to be upgraded otherwise the Program will continuously suffer from a high turnover of personnel.

The logistical support to the Project has been weakened by failures of some equipment. For example, the Sunpower Stirling engine performed far below the stated efficiency and one even failed completely. The photovoltaic water pumping equipment arrived from the United States with the controller improperly wired, with no documentation, and with a faulty data recorder. The IBM personal computer arrived with a defective power supply that neither the U.S. supplier nor the manufacturer would replace under warranty. The windmill installation has been delayed due to the financial failure of ENERTECH. The Ray Burner rice-hull combustor has had many problems, although in this case, the company continuously attempts to repair it. In all of these cases, there is no evidence of improper procurement procedures on the part of of the USAID-GOP Project management. Procurement decisions were based on the manufacturers' specifications and reputations--which, unfortunately, turned out to be below expectation.

6.5.2 Short-term Consultancy Support

On the technical area of concern, the ERDC, which implements most of the subprojects, requires consultancy assistance in installation, testing, and general maintenance of special laboratory equipment. The ERDC management should be asked to participate in the selection of such consultants.

The difficulties encountered in the timing of consultants' availability in the past should be avoided so as not to waste costly consultants' time. At least one consultant on R&D management who will work closely with the ERDC staff for an extended period of time is desirable.

6.5.3 Some Concerns and Project Support

The future administrative support to the Program and the USAID-GOP Project raises some concern. The Project Coordinator and the NCRD head have both expressed their plans to leave the Program soon. The future of the Program will be highly dependent

on the BED's capability to provide for smooth transition, and to appoint new personnel who can assume, and execute effectively, the responsibilities of the incumbents. Evidence of such capability should help in obtaining further support to the Program.

One major concern regarding support to the Program arises from the government's policy on energy development: the government has expressed that it "will not give funding priority to energy development projects in the next few years because of expectations that oil prices will stay at a low $18 per barrel in the next two years" (Business Day, July 3 , 1986). The government expects that the private sector will take the lead in energy development--privatization is the aim of the government in the energy industry. However, even the Deputy Executive Secretary for Energy has hinted that there is not enough Filipino capital.

The problem with this stand is not only financial--energy research and development is a long process as has been shown already in the Program. Current development efforts will have their impact years from now--when, probably, oil prices are high again. The lull due to the momentarily low price of oil at present is not enough reason to de-emphasize energy development. It just provides, perhaps, a fleeting opportunity to concentrate on energy development before the country's attention and resources are again claimed for solving an energy crisis.

Another concern which is related to the first is about the imminent phasing out of USAID assistance to the Program. The issue is: Who will share in underwriting the risk in the development of nonconventional energy technologies. The Program requires continuing financial, as well as political and public support.

Still another concern, which is less pressing than the foregoing, is the increasing tendency of the agriculture sector to plant new crops, such as fruits, nuts, and spices, that are geared for export. If this tendency leads to lesser production of traditional crops, such as rice, it could mean less rice hulls to use as fuel for nonconventional technologies. What will happen then to all of the R&D efforts that are currently being spent to use rice hull as fuel?

6.6 TRAINING PROGRAM

This section addresses Item 10 in the scope of work.

6.6.1 Training Categories

Training carried out under the USAID-GOP Project falls under three categories. The first category is the training program on energy engineering and management at the University of the Philippines. This covers both degree (Ph.D. and M.S.) and non-degree courses and training of faculty abroad. Section 5.1 in Chapter 5 gives a detailed review of this subproject. The second category refers to the participants' training program that sponsored degree and non-degree training and observation visits of project personnel abroad. Appendix A-15 presents a list of the beneficiaries of this training component and their respective training programs. The third category consists of local training--seminars, workshops, and conferences--that subprojects have undertaken. These are generally focused on specific technologies. The first two categories comprise the relatively more formal and costlier training activities and are, thus, the principal subject of this discussion.

6.6.2 Funding

The total funding commitment for the first two training components above was ₱15,473,863 as of June 30, 1986. Of this amount, ₱13,313,713 was commited to by the USAID, and ₱2,160,150 by the GOP/BED. The total expenditures as of the same date amounted to ₱13,313,713 for the USAID component and ₱1,500,656 for the GOP/BED component. In terms of actual allotments made as of June 30, 1986, the training program has received approximately 20% of the total Project allotments.

6.6.3 Cost-Effectiveness and Relevance of the Training Program

The training of project personnel abroad under both program components have achieved many objectives. It provided much needed development of the staff. The USAID-GOP Project assisted in opening a new field of study--energy--in the Philippines. Although, some Project personnel may transfer to other projects, their training will always be of benefit to them individually and, hopefully, to the Philippine economy as a whole. The training has served as incentive for qualified individuals to work for the Nonconventional Energy Development Program even if government salary scales are much lower than those in the private sector. (This is not to say, however, that the training program alone is adequate to retain a highly qualified staff; in fact, it is not.) The training program has benefited many individuals, some of whom will remain to be the leading figures in the field of nonconventional energy in the Philippines.

A rigorous cost-effectiveness assessment of the training program would have required more time than was provided for in this engagement. The program has had many beneficiaries.

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However, a good indication of cost-effectiveness could be ascertained through a critical mass, for example, a selected and, possibly, representative group and the effects that the training of such a group have made on the Program.

We can, therefore, focus on the NCRD staffers (because they are responsible for the management of the Program) and the UPCE faculty (because they are responsible for the management of the academic program) trained by the Project. Ten NCRD staff members have trained abroad and most have undergone local training; six faculty members from the UPCE have trained abroad, including one who is still pursuing a doctoral program.

The effectiveness of the training of the NCRD personnel could be assessed based on their management of the Program. We have noted earlier the appreciable improvement of program management. This is a substantial and, perhaps, adequate indication of the effectiveness of their training. The effectiveness of the training of the UPCE faculty could likewise be assessed based on how the UPCE subproject has progressed and on the feedbacks from students who have been trained. On the former, there is enough evidence that the UPCE faculty's training have benefited the program. There is still need to obtain student feedbacks which the subproject management is now currently undertaking.

6.7 INFORMATION CAPABILITY AND TRANSFER

This section addresses Items 14 and 16 in the scope of work.

6.7.1 Information Capability

All subprojects, whether they have been successful or not, have produced some information that could be used for investment decisions. Even data on failures, such as in the discontinued solar refrigeration subproject, may be useful--they show the path that should not be taken further.

Chapters 4 and 5 present the nature and quality of available information and data from the subprojects (see under Findings and Recommendations). In summary, the information that may be valuable for private sector investment decisions and possible project replication includes the following: (a) identified crucial elements that influence project success (see Sections 6.3 and 6.8), (b) adaptability of technologies to specific rural situations, (c) some data on the performance of the technologies, (d) technical problems that, henceforth, should be avoided or corrected, (e) organizational problems and constraints, most of which can be avoided in the future, and (f) experience with contractors.

There is need to completely document the technical performance of most subprojects. At least one subproject is expected to produce data that could encourage positive investment decision--the cogeneration subproject. It will be worthwhile to develop separate in-depth case studies of the subprojects.

6.7.2 Processes, Mechanisms, and Institutional Relationships for Information Transfer

The established processes, mechanisms, and institutional relationships that could help in achieving project objectives through increased transfer of information, are as follows. First, there is the academic program at the University of the Philippines/College of Engineering (UPCE). Both degree and non-degree (continuing education) courses could be effective vehicles for transfer of information from abroad and from other projects. The non-degree program has a wider reach that includes potential private users of the technologies. The information transfer capability of this subproject can be enhanced further if it is provided with some assistance in linking up with appropriate foreign academic and research institutions that can share up-to-date information on nonconventional energy. Transfer of information through this subproject is achieved through the conduct of formal classes, seminars, and conferences (some conducted with the cooperation of the Renewable Energy Association of the Philippines (REAP)), materials made available to the public through its library, and the National Engineering Center's publications.

Second, there is an in-house data bank at the NCRD that can be strengthened further so that it can access similar data banks on nonconventional energy elsewhere. The data bank will soon acquire capability for full access to related network data bases in the United States. In addition, the NCRD has a library which is accessible to those interested in nonconventional energy. Third, the ERDC has its own library which may also be accessed by interested parties. Fourth, there are the proposed Affiliated Nonconventional Centers (ANCs). Through the Centers, the NCRD could transfer information and promote nonconventional energy technologies outside of Metro Manila.

An important institutional relationship that can facilitate the transfer of information to private manufacturers and suppliers of technologies is that between the NCRD and the REAP. The REAP includes many of the private individuals currently involved in nonconventional energy technology production or marketing.

6.8 PROJECT EXTENSION AND FUTURE DIRECTION

This section addresses Item 15 in the scope of work and discusses the future of the USAID-GOP Nonconventional Energy Development Project and, to some extent, that of the Philippine Program.

6.8.1 Subproject Extension

In formulating recommendations for subproject extension, we used the following criteria:

(a) the subproject can potentially have significant contribution to the commercialization goal of the Program,

(b) the subproject is, or can become, technically and economically viable,

(c) the subproject will benefit from extension, through further experimentation or data collection, and

(d) the required funding can be accommodated by the expected balance of the USAID-GOP Project.

Chapters 4 and 5 discuss separately the recommendations for all ongoing and completed subprojects. The following is a summary.

Rice Hull-Fed Thermal Power Plant (AID 7803-L)

This subproject should be completed soon. Even after the termination of funding assistance, however, it should be monitored until there is properly documented operating data for at least a season. Future projects of this type should take into account the project implementor's (National Food Authority's) experience from this subproject. Such projects should focus on small steam power systems in environments where there is a high annual load factor for the system and an application for the steam generated, as in a cogeneration system.

Wind-Powered System (AID 7805.1-L)

The equipment that are already on hand should be installed soon. The subproject should be allowed to operate for at least one year in order to collect information (e.g., wind data and needed design improvements) which private distributors of windmills have been waiting for. The extension, however, should not require substantial funding assistance.

Solar-Powered Pumping System (AID 7806-L)

This subproject is almost complete and does not require additional funding. It has succeeded in finding a niche for photovoltaic systems: where power requirement is too small for conventional piston engines and the lack of potable ground water at the site precludes the use of handpumps.

It will be worthwhile to investigate other similar applications--small power requirements that are far from the power grid. The long-run sustainability of this subproject will depend on the continuing motivation of the community to assume responsibility for the maintenance of the system.

Integrated Village Energy Systems (AID 7807-L)

Subproject D (village interaction and monitoring and evaluation system), the last major activity of the IVES Project (Phase II), is about 80% completed. It should be fully completed and required to produce adequate documentation of the lessons learned from the overall subproject. A modest level of funding assistance and continuing technical guidance will be needed for about a year. The ERDC has proposed to conduct a third phase of the subproject--testing of the systems approach in a new village. This is worthwhile to pursue after the ERDC has prepared a plan and approach based on experience gained from the subproject. Since such a proposal will go far beyond the remaining time and money of the subprojects, it could be funded through another project, either by the USAID or by another donor. This subproject should be monitored for several years.

Gasification Subprojects (AID 8203-L, AID 8204-L and AID 8301-L)

There are three separate gasification subprojects: gasification of densified rice hulls (AID 8203-L), biomass-assisted/powered refrigeration system (AID 8204-L), and direct heat gasifier (AID 8301-L). They have a common theme: research, development, and demonstration of gasifiers.

Gasifiers can make significant contributions to meeting rural energy needs using indigeneous fuel materials. They have the potential to service power requirements in the range of ten to hundreds of kilowatts--a range too small for steam engines and one that is now almost entirely served by diesel fuel. However, much laboratory work has yet to be done to develop a design that is well suited to indigeneous resources.

The subproject on densified rice hulls, which involves field testing of the gasifier, does not require further extension or funding in its present form--field demonstration. Good engineering studies are needed to improve the design

further. The biomass-assisted/powered refrigeration system subproject should be completed soon and its findings documented. The third subproject, direct heat gasifier, has to be given enough support to completely accomplish its objective of determining whether low-BTU gas can be used in firing a boiler effectively.

The gasification component of the USAID-GOP Project, as a whole, merits long-term R&D support. There is an attractive potential market for the technology in the Philippines that is already developing. However, as already proven by the subprojects, one cannot rush the demonstration of the technology: a gasifier that can live up to expectations in actual field operations has yet to be designed and tested in the laboratory. The survey on gasifiers conducted in 1985 (Sycip, Gorres, Velayo and Co. and DCCD Engineering 1985) recommended further studies on the gasifier reactor, filtration system, and gas-cooling mechanisms.

The cost of gasifiers needs to be reduced or their efficiency increased to make the technology cost-effective and attractive to private users. The 1985 survey showed that existing units do not generate cost savings when compared with alternative systems that could deliver the same required energy (See Appendix A-12 for cost comparisons conducted during field tests and for other findings in the survey.)

Charcoal-fired gasifiers seem to be most promising because of their satisfactory technical performance, minimal clogging problem, and good commercial value.

The USAID's extended assistance to the gasification program component should probably include technical assistance to the PNOC/ERDC in the areas of instrumentation, data acquisition, and testing. Beyond or within the USAID-GOP Project, the BED/NCRD could further enhance the commercialization of gasifiers, by providing technical support to gasifier manufacturers and users. This could be done through various means, for example, transfer-of-information support and training of technical personnel. These activities could be funded jointly by the Program and the private beneficiaries of the assistance.

Cogeneration (AID 8402-L)

The P&G-PMC installation should be completed and the results publicized. It may be extended, if necessary, to complete the demonstration results. Probably, the proposed legislation on cogeneration (that will provide financial incentives to independent power producers and will permit them to intertie with the grid with sell-back arrangements) could be more easily pursued with some documented experience that can prove the viability of the idea.

Because of its potential for significantly contributing to the attainment of Program goals, the cogeneration program must be given adequate support not only by the USAID-GOP Project but also by the government. Such support is needed especially in the area of information dissemination, where other agencies of the government can help out.

The use of biomass fuel for cogeneration offers great promise.

Fermentation/Distillation Facility at BIOTECH (AID 8403-1)

This subproject, which falls under institution-building, is almost completed. Equipment is expected to be fully delivered and installed soon. It is not clear yet, however, whether BIOTECH will have adequate funds to operate the facility. The future of this subproject will depend greatly on the ability of the staff to develop a research program that can attract fund donors. It might be worthwhile, if funds will permit, to provide a modest amount to finance a small well-defined research project and to provide technical assistance to this subproject. The NCRD should continue to monitor the activities of this subproject and include the information that it will produce in the NCRD's data bank.

Solar Crop/Lumber Dryer (AID 7802-L and AID 7801.2-L)

These subprojects were technically successful but did not attract enough interest for widespread adoption. No further demonstration work or assistance is warranted at this time. However, information dissemination on the technologies could be done so as not to lose the favorable results gained from the subprojects.

Solar Refrigeration (AID 7802-L)

This subproject was terminated and no further work is recommended at this time.

Engines for Fuel Interchangeability (AID 7804-L)

This project is essentially completed. Follow-up activities, if desired, should include endurance testing using on-the-road vehicles. These activities could be more effectively pursued if appropriate sectors of the Philippine industry--those who can potentialy benefit from the results--are involved. Further work requires qualified personnel to do the laboratory tests.

Stirling Engines (AID 7804.1-L)

More operating experience is required as basis for the design of a local Stirling engine. The existing units could be used for further experiments even without additional funding assistance. Equipment failures and poor economics make this project a low priority for further work.

Windmill Dispersal (AID 7805-L)

This subproject, which had originally aimed to promote a local windmill industry had installed 17 windmills. Windmill dispersal is not considered a priority area for further work due to the technical and logistical problems met by the subproject. It might be worthwhile, however, to give it a second look. An in-depth evaluation could provide some suggestions for design improvements that could benefit existing local private suppliers of windmills.

Graduate Program in Energy Engineering and Management (AID 8201-L)

Most of the goals of this subproject have been achieved. However, an extension of about six to 12 months beyond December 31, 1986 is recommended to allow (a) the evaluation of the program design, (b) the conduct of additional recommended short-term courses that are mostly aimed at supporting the completion or smooth transition of the other subprojects and of providing additional training for both the BED/NCRD and PNOC/ERDC staffers, (c) the development of additional institutional linkages for continuing information transfer from abroad, (d) the development of a strong research program which has been initiated already, and (e) the formulation of plans to ensure program continuity. The extension will also allow adequate time for the UPCE Ph.D. fellow at the University of Wisconsin-Madison to complete his program.

Technical Consultancy Services (AID 8205.1-L, AID 8205.2-L)

Technical consultancy services were provided under subprojects AID 8205.1-L and AID 8205.2-L. Both were for short-term purposes. Under Section 5.3.5, we presented some tasks requiring assistance of the DSI consultant that still need to be done.

As we have indicated in various parts of this report, the NCRD, ERDC, and BIOTECH could benefit from some forms of technical assistance. For the NCRD, the purpose will be to provide assistance in project design and evaluation. The subprojects under the Program, especially the R & D ones, have characteristics that differentiate them from other projects. We have mentioned the most important characteristics in Section

1.4.2: uncertainty, long time horizons, and many potential alternatives competing for limited resources. These characteristics require special analytical and evaluation methods that are not yet currently being used in the Program.

For the ERDC, the technical assistance should cover research management and specific requirements related to the gasification and, perhaps, solar research. For BIOTECH, the technical assistance will be for research alcohol fuels and for developing a long-term viable research program.

Alternative Financial Planning Strategies (AID 8401-L)

One important aspect of this subproject is information gathering and dissemination. The NCRD can enhance the commercialization of nonconventional energy technologies through an effective information program. The NCRD should be assisted further in developing information networks outside the Philippines and in developing communication packages that will disseminate information gathered to specific target audiences. The appropriate packages include case studies on subprojects and technical guidebooks and kits on the technologies. This subproject should be extended until the results of the technology subprojects are analyzed, a task that could take about a year.

Assessment of Biomass Fuels (AID 7814-G)

Biomass is and will continue to be a very important nonconventional resource in the Philippines because of its abundance. Thus the complete development of biomass resource maps is essential and should be pursued.

The USAID-GOP Project, through AID 7814-G, has produced five maps, one each for the provinces of Iloilo, Batangas, Quezon, Laguna, and Cavite. Since there are many more provinces to be covered, the assessment must follow a prioritization scheme. Section 5.5.5 presents some factors for consideration in prioritization and recommendations regarding the conduct of the assessment. Additional work on this subproject may involve other project implementors. It might be desirable to distribute the potentially heavy load of work to a number of qualified agencies--competitiveness might promote even better outputs.

Solar/Radiation Wind Mapping

This subproject is essentailly completed. It is important, however, to institute a maintenance program for the instruments installed at the PAGASA stations. The BED/NCRD will soon require the reporting of collected data. If the quality of the data is good, they could be made available to private suppliers of solar- and wind-powered technologies. Further work on this subproject

should go hand-in-hand with the windmill and solar subprojects. It might be worthwhile to increase the number of monitoring stations if only to establish a larger data base on solar and wind for the Program. But such an effort, which may be pursued outside the USAID-GOP Project, should depend on demonstration of improved monitoring control procedures and maintenance practices on the part of PAGASA.

Information and Promotions Program (AID 7816-G)

The subproject was completed in 1985. It has set up an information center and library which are now available to the public. These facilities provide a means for transferring information from abroad to potential private investors. There will be continuing need to upgrade the collection of materials and to make the public know of their availability. Further assistance to this subproject may be in the form of facilitating its linkages with other research institutions outside the Philippines.

In summary, therefore, our recommendations for extension allow for further experimentation with the most promising technologies (cogeneration and gasification) and some reasonable time for completion of data-gathering and documentation efforts, and smooth transition for others.

6.8.2 Future Project Direction

Projects Proposed by the ERDC

In addition to the sought extension of some ongoing subprojects, the ERDC has submitted three additional proposals, one each on (a) fuel-saving devices and alternative fuels, (b) direct-heat gas producer system, and (c) small gas-producer system. Appendix A-16 presents a summary of these subprojects. At the time of our evaluation, the methodology for each proposal was not yet available.

The first proposal (Item [a] above) requires discussion with various sectors--the industry and the public--that will be affected by what seems to be a major policy direction. In such discussions, the ERDC must be prepared to demonstrate its capability for conducting the tests. This project could take several years to develop, unless there is strong clamor for it. The second proposal (Item [b]) is related in scope to the ongoing subproject on direct-heat gasifier. This and the third proposal (Item [c]) are better viewed in the context of an overall plan for gasifiers--one that has yet to be developed or articulated clearly by the ERDC. These proposals merit the serious attention that we have proposed for the gasification program in general.

The NCRD's Plan

The NCRD has outlined its plan for the immediate future (See Section 2.4) Two of the proposed areas for future work, solar water heater and large-scale biogas, are beyond the current scope of the USAID-GOP Project, but they are worth investigating. These and other projects could benefit from the application, at the planning stage, of an analytical approach which explicitly considers uncertain factors that influence the goal of the projects--an exercise that is not yet done in the Program and, for that matter, one that is not done in other government programs. (See further discussion in this section.)

The other three proposed projects for further work by the NCRD are within the scope of the USAID-GOP Project. One proposed subject is biomass for boilers and furnaces. The first proposed activity--development of biomass resource maps for additional provinces--is a continuation of the effort initiated by the USAID-GOP Project. Our comments on this are presented in Section 5.5.5. The investigation of other biomass resource is clearly warranted considering their great potential for contributing to program goals. This effort requires a plan that spells out priorities and specific approaches. Also, in this and similar efforts, a thorough literature review on work done elsewhere and sharing of information will avoid duplication and wastage of resources. The proposed gasifier demonstration projects under this subject, should, again, be viewed as part of the total gasification program. The concern that we have expressed regarding the conduct of demonstration projects, when laboratory results are not yet well established, holds true for this case. The proposed assistance to local manufacturers of biomass-fired boilers and furnaces could be done in various ways. The R&D and demonstration activities that can lead to better equipment design and cost reduction could already be a significant form of assistance to manufacturers. In addition, the NCRD can facilitate the transfer of information from other countries and among projects. The USAID-GOP Project is already providing assistance for these activities.

The second proposed subject is now covered by the USAID-GOP Project--the producer gas systems. Much of the work on this subject is now being funded by the Project. There is, indeed a need to develop more efficient systems, especially those that can use abundant rice hulls. This is one area which merits further extension of USAID assistance, possibly for about a year. Such assistance should include the provision of a technical expert to work with the ERDC on a long-term basis or for, at least, a year.

The third proposed subject is biomass-derived liquid fuels. One proposed activity under this project--development of add-on devices to allow use of hydrous alcohol--seems to be a

continuation of the work done under AID 7804-L (adoption of engines for fuel interchangeability) and is related to the ERDC proposal mentioned earlier. The commercialization potential of this activity might be better realized if affected sectors, e.g., the industry, are brought into the picture early enough. They could even potentially assist in undertaking the project. This proposal, within the context of the USAID-GOP Project, requires a clearly-defined methodology that relates its objectives to the commercialization thrust of the Program. The other activity--to investigate new methods of alcohol production--can be accomplished within the subproject at BIOTECH (AID 8403-L), which we have discussed earlier.

Approach to Project Evaluation

For most of the foregoing proposals, there is a need to evaluate how each proposed subproject will contribute to the Project's and the overall Program's commercialization goal. The NCRD's multiphased program approach for technology development (see Figure 2-1 and Appendix A-2) serves as an important tool in terms of providing a clear guide to the development process towards that goal. Applying this approach, one gets to reach the goal in an experential way--by taking the logical sequence of events. This is a good approach. However, it will be beneficial to support it with an analytical approach or tool that forces one to assess the probable attainment of the commercialization goal. The approach should be applied during the first stage of the development process, even before resources are committed. Such an approach can be developed for the Program but is beyond the scope of this evaluation. We can, however, define the features and general steps that the approach should possess. These are as follows:

a) The analytical approach, applied to a particular technology, must clearly specify or identify the following:

(i) general and specific goals and objectives of the development process for the technology,

(ii) outcome and time preferences defined in as specific terms as possible, for example: "10% of private companies, that can potentially have co-generation systems, will install the systems five years from now". This is a clear specification of the expected outcome.

(iii) key decisions that have to be made along the way towards commercialization and their potential alternatives,

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(iv) information available and needed for each decision point, and

(v) variables that can influence the outcome of each decision (this is further discussed subsequently)

b) It must allow for a screening of the most crucial variables that influence the commercialization of the technology. At this point, accumulated experience from the subprojects had already brought to light such variables.

c) It must explicitly consider the uncertainty of each critical variable and must provide for a way of estimating such uncertainty.

d) It must provide recommendations for action for all the decision points.

e) It must be applied at the first stage of the development process and reapplied along the way as uncertainties are resolved or their estimates updated.

f) It must also recognize that the development of a technology and its eventual commercialization involve many stakeholders, the seller and buyer of technology are but two of them. It is important to understand early enough what each stakeholder's concerns and motivations are related to the commercialization of a technology.

g) It must provide for a rationale for the NCRD's actions, in terms of how such actions support the commercialization goal.

Such an approach, if developed and applied well, should enable the NCRD and project implementors to choose which development path to take prior to the commitment of significant resources. Even R&D projects which are experimental in nature can benefit from such a disciplined approach. The development of the approach under the USAID-GOP Project, possibly under subproject AID 8401-L/G (Alternative Financial Planning Strategies), will be a good contribution of the Project towards the future of the Program--for it can potentially help in optimizing the use of resources.

Past experience can help in identifying the crucial decision and uncertain variables that influence the desired outcome, that is, displacement of imported oil. Based on our evaluation, including discussions with key Project officials, we have identified the variables as those presented in Figure 6-2.

Viewing the development process from the perspective of the BED/NCRD, we have identified the three major decisions or decision points (represented by rectangles in the Figure 6-2) as

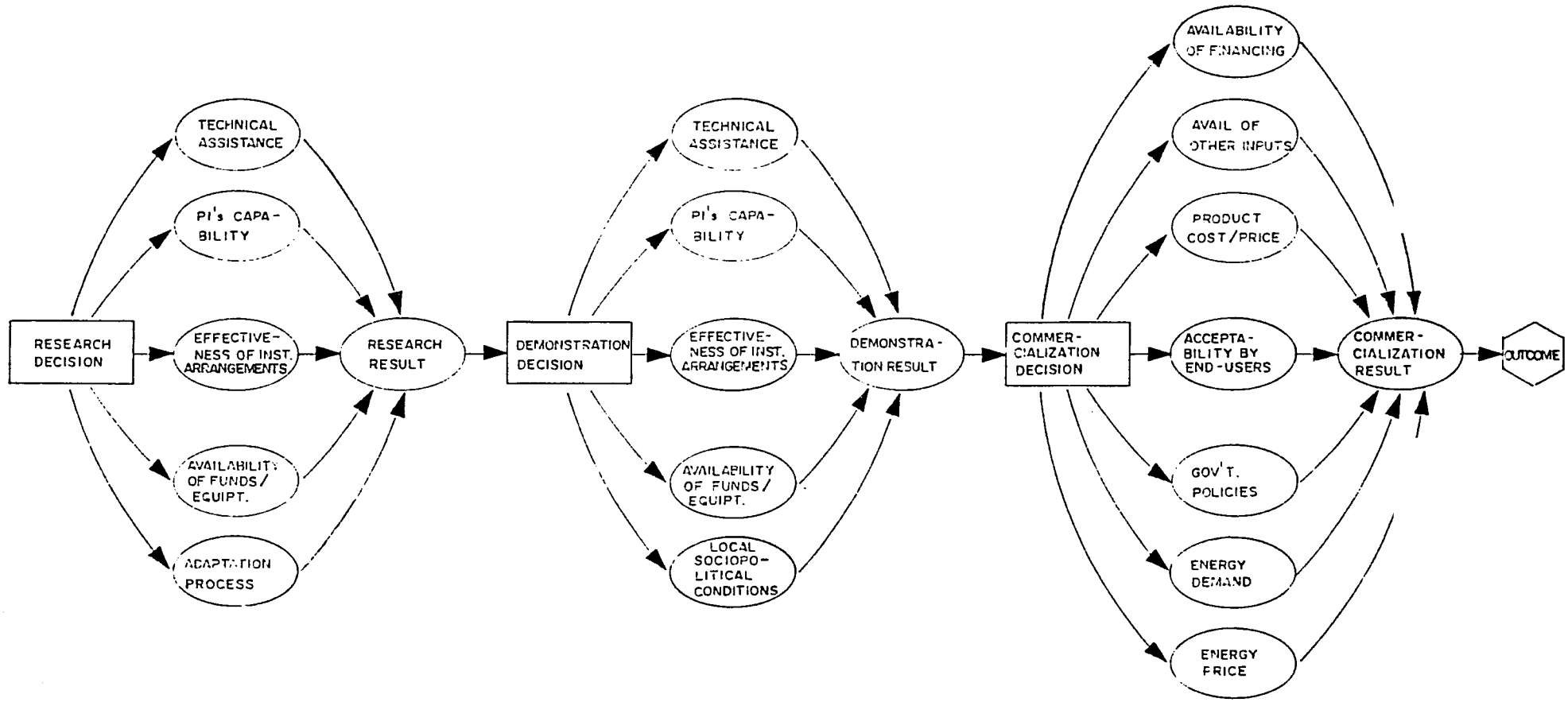

FIGURE 6-2

NONCONVENTIONAL ENERGY DEVELOPMENT PROCESS
KEY DECISIONS AND VARIABLES

follows: (a) research decision (this includes laboratory work and pilot testing which may be treated separetely in a more detailed analysis), (b) demonstration decision, and (d) commercialization decision. For the BED/NCRD, the commercialization decision is that point when it considers to stop the demonstration process because the technology can already be used commercially. The uncertain outcomes of a decision, which also serve as information for a subsequent decision, are shown as oblongs--these are the uncertain variables that must be identified and assessed at the planning stage. These variables which have significant effects on the outcome of the development process are as follows:

Key Variables Affecting the Research Result

a) Technical assistance. Concerns refer to the quality and timing of the technical assistance.

b) Project implementor's capability. The actual capability is not known at the time that the research decision is taken; it is only demonstrated during the conduct of the research. Part of the concern here is the commitment of the implementor--an uncertain factor that has significant effect on the research result.

c) Effectiveness of institutional arrangement. This variable covers government policies and contractual methods.

d) Flow of funds and equipment. This variable has been found to have significant influence on the research results: delayed releases of funds, for instance, have caused delayed implementation of research plans, and consequently, affected the results of many research subprojects.

e) Adaptation process. At the time that the research decision is taken, the process of adapting a technology to local resources (e.g., rice hull) and conditions (e.g., as in the windmill project) is not known. Modification requirements to adapt a technology has been found to influence the research result greatly.

Key Variables Affecting the Demonstration Result

The variables affecting the demonstration result are similar, except in one case, to those affecting the research result. The variables are:

a) Technical assistance,

b) Project implementor's capability,

c) Effectiveness of institutional arrangements,

d) Flow of funds and equipment, and

e) Local sociopolitical conditions. These conditions are important since demonstrations of technologies are done in local communities. In the IVES subproject, this variable had significant impact on the demonstration result.

Key Variables Affecting the Commercialization Result

The outcome of the commercialization process, and of the overall development process, depends on the following variables:

a) Availability of financing. In most instances, financing is required by both the sellers and users of the technology.

b) Availability of other inputs. These inputs include fuel source, technical expertise in the market, and spare parts. A more detailed analysis should treat these variables separately.

c) Product cost. The importance of this variable has been shown in the subprojects on solar dryers; our interviews of private distributors of technologies confirm it (See Appendix A-6).

d) Acceptability by end-users. The commercial outcome of the technology will greatly depend on whether end-users will accept it or not, which is a major source of uncertainty. This variable can be expanded further to consider the effects of promotion.

e) Government policies. These policies include tax exemptions, incentives, and top-level support. For example, the future of the cogeneration project will depend greatly on the proposed government legislation similar to PURPA.

f) Energy demand. The energy demand at the time that the commercialization decision is taken is uncertain.

g) Energy price. This variable is a major source of uncertainty.

Some of the variables influence the outcome of other variables; for example, "product cost" affects "acceptability by end-users". We have tried to simplify the diagram by reducing the arcs, however, such dependencies among variables must be considered in a more rigorous analysis.

The objectives in applying the foregoing tool are to identify the key decisions and variables, to determine their probable relationships, and asssess their probable values for the purpose of determining the best path towards the commercialization goal--before resources are committed.

We are, for example, interested in the variable "energy price" even before the research decision is actually taken but the value of that price that is important to us--that has significant influence on the outcome--is that value after the commercialization decision shall have been taken, not the current value which is relatively low. Before the research decision is made (i.e., during the planning stage), such value is unknown. We must, therefore, have a way of assessing its future value. The approach, thus, forces one to think about the commercialization objective even before an R&D effort is started.

Figure 6-2 requires further refinement before it can be used with the analytical approach that we have proposed to be developed. A well-done analysis of this sort can apply the lessons learned in the past in formulating the future direction of the Project and Program. The tasks ahead are to develop the approach and apply it.

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APPENDIX A-1

SITECH'S SCOPE OF WORK

The USAID mission to the Philippines contracted SITECH Resources Group, Incorporated for the purpose of evaluating the USAID-GOP Nonconventional Energy Development Project. The mission asked SITECH to review the work carried out since the previous evaluation in 1981 and to address specifically the following questions:

1. Are project and program goals realistic and relevant to the Philippine energy needs? Why or why not?

2. Is presently budgeted funding adequate?

3. Are specific subprojects well planned?

4. Are specific subprojects being implemented and planned relevant to the energy requirements, resource base, and economic conditions of the Philippines?

5. Are the USAID-GOP Project and the Philippine Program as a whole receiving adequate administrative, clerical, logistical, and technical support?

6. Is USAID-GOP subproject implementation proceeding according to written plans?

7. Are present or planned USAID-GOP subproject implementors capable of adequately carrying out their projects and how effective is their performance to date?

8. Is the project implementation strategy pursued by the Ministry of Energy viable and practical?

9. Are the channels for getting project funds from the USAID to project implementors adequate?

10. Is training carried out so far under the USAID-GOP Project cost effective and relevant?

11. Is the role of the USAID-GOP Project Coordinator adequately defined and are present Project Coordinator contractual arrangements adequate to enable the Project Coordinator to carry out responsibilities as now defined?

12. Are short-term consultants provided to the Project in a manner and of a quality such as to enhance the results of the Project?

13. Is the USAID-GOP Project adequately integrated with locally funded and other foreign-funded projects?

14. Which subprojects are producing data which can be effectively utilized by the GOP or the private sector for positive investments decisions in the use of nonconventional energy technologies?

15. Which subprojects would cost-effectively benefit from an extension of time for experimentation and data collection in order to produce more useful data?

16. What processes, mechanisms, and institutional relationships have been established and could be established under the Project in order to achieve project objectives through increased transfer of information, acquired both from abroad and from the Project, and from the MOE program R&D, to potential private sector users?

APPENDIX A-2

NCRD'S MULTIPHASED PROGRAM APPROACH FOR NONCONVENTIONAL ENERGY TECHNOLOGY DEVELOPMENT

STRATEGY

To create an environment whereby both buyers and sellers of nonconventional technology will emerge and thus achieve commercialization. This is done by introducing projects that will lead to positive answers to the questions in Figures A-2.1 and A-2.2. If after considerable effort on the part of the government, such answers cannot be attained, the technology program shall be terminated or held in abeyance until the market favors its adoption.

METHODOLOGY

Each technology program has the same general pattern presented in Figure A-2.3.

Pre-program activities include doing a social cost-benefit analysis for each technology that takes into consideration its economics, market potential, and environmental and social impacts. In some cases, political issues are also addressed. The purpose of the analysis is to justify the investment of the government in developing the technology and to have an initial feel of its status.

Usually, the starting phase of a technology program involves the development of laboratory scale models of several concepts and the conduct of a nationwide survey of fuel supply. After this phase, the government should be able to determine if at least one concept is technically feasible. If it is so, the program proceeds, otherwise, a decision shall be made by the NCRD (through a committee composed of a number of invited experts) whether to fund another laboratory scale testing project or to rescind the development of the technology.

In the second phase, the feasible concepts in the initial phase are tested in a larger scale. This is done by setting up a pilot plant for each concept. Technical and socioeconomic assessments of each of the plants shall be done to determine the best concept. Only the best concept shall be developed unless another concept(s) may be just as good, such that prioritization should be made. The other major activities in this phase are the market survey to determine if there is sufficient market

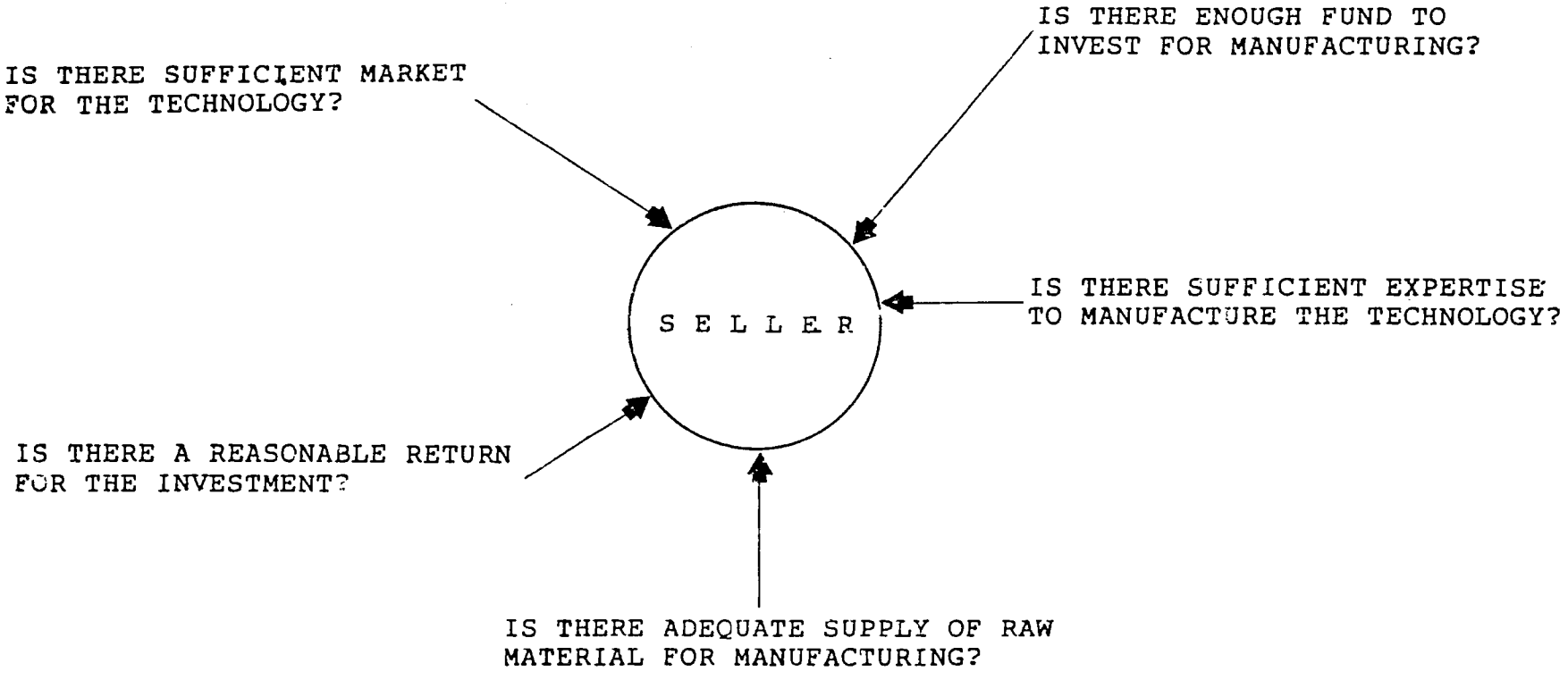


FIGURE A-2.1

SELLER'S QUESTIONS ON RENEWABLE ENERGY TECHNOLOGY

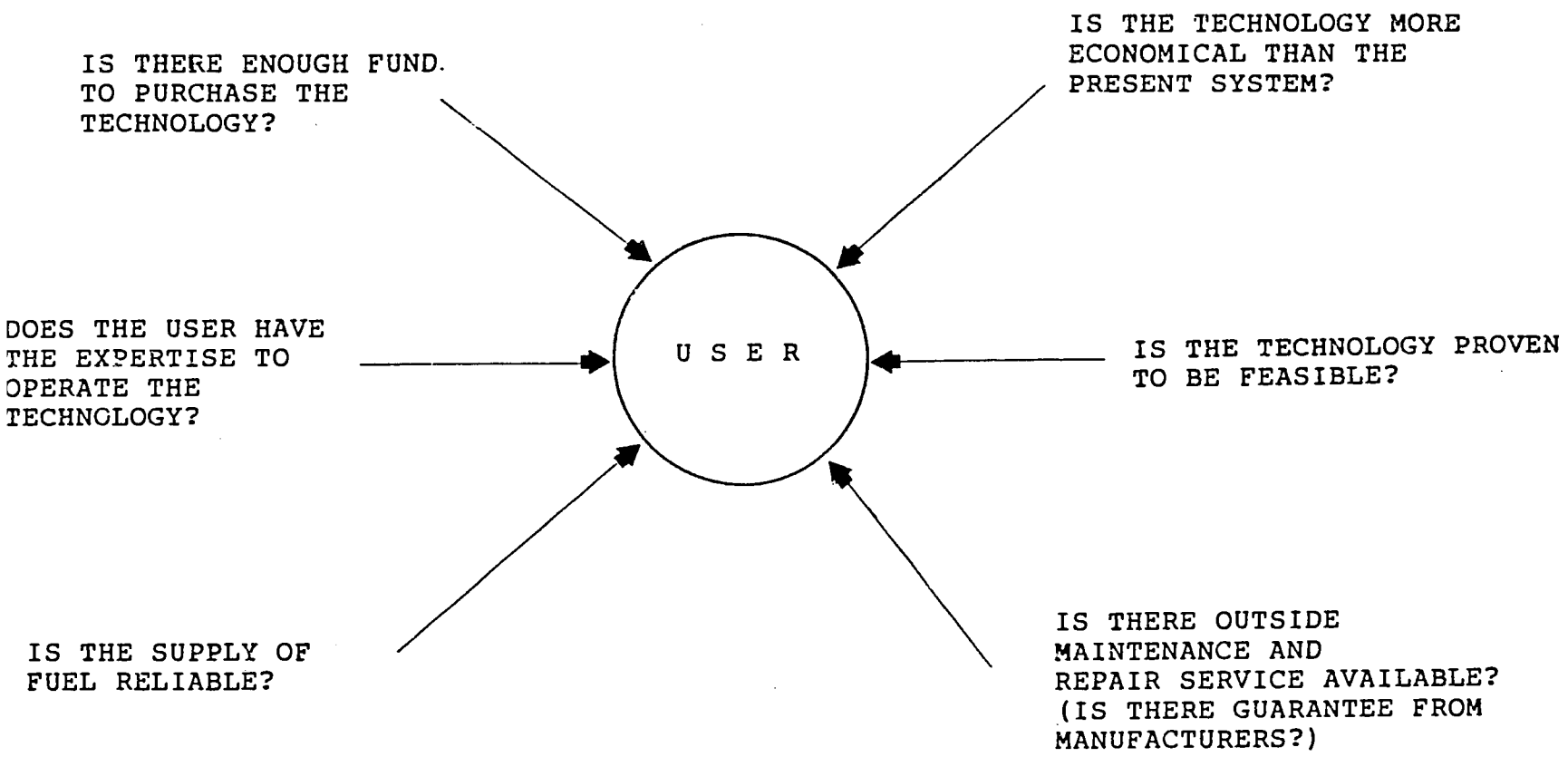


FIGURE A-2.2

USER'S QUESTIONS ON RENEWABLE ENERGY TECHNOLOGY

Pre-Program

Do Social Benefit-Cost Ratio Analysis of Technology include the following preliminary studies?

1. Economics
2. Market Potential
3. Environmental
4. Social

- "State of the Art" Literature survey

- Identify concepts to investigate

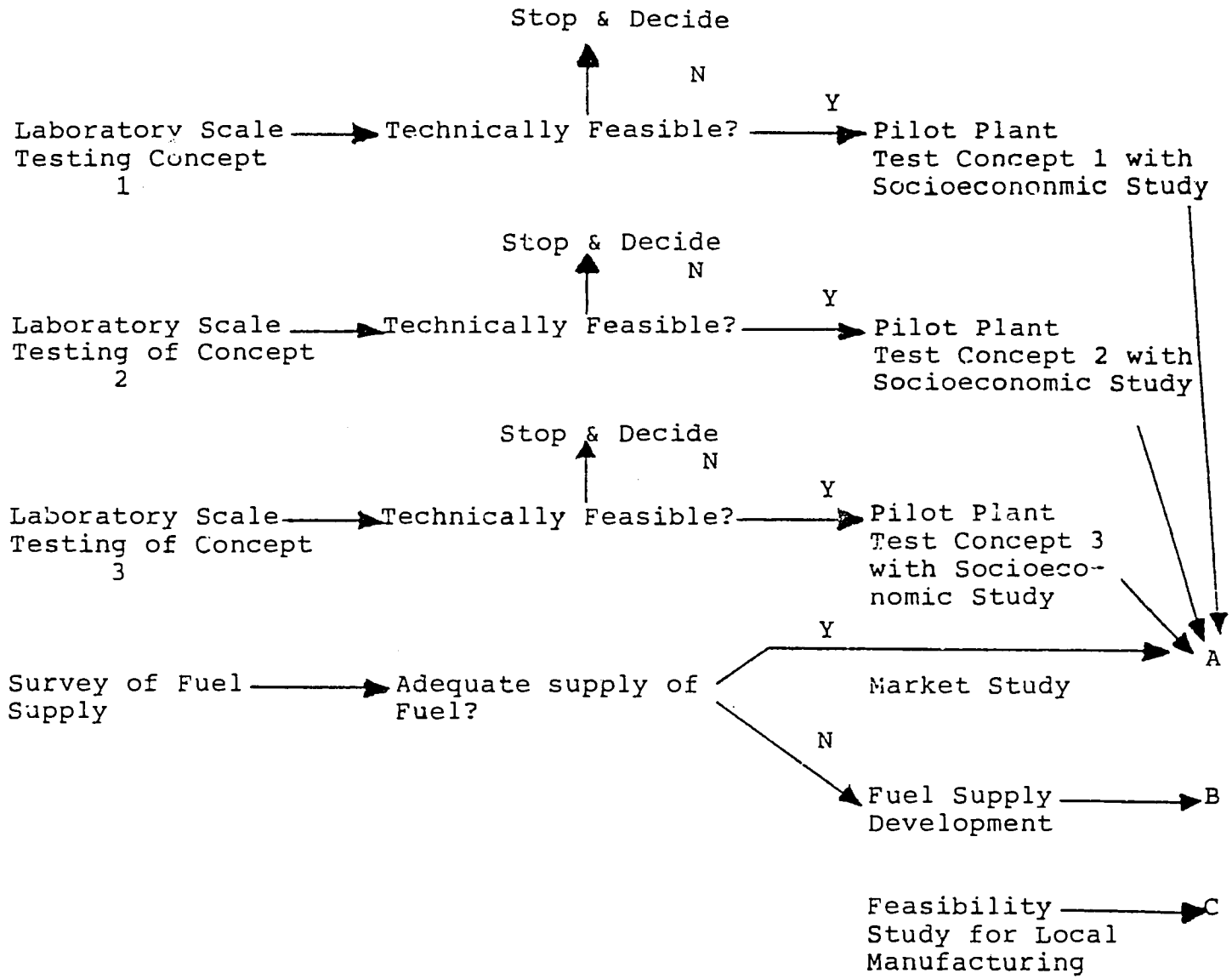
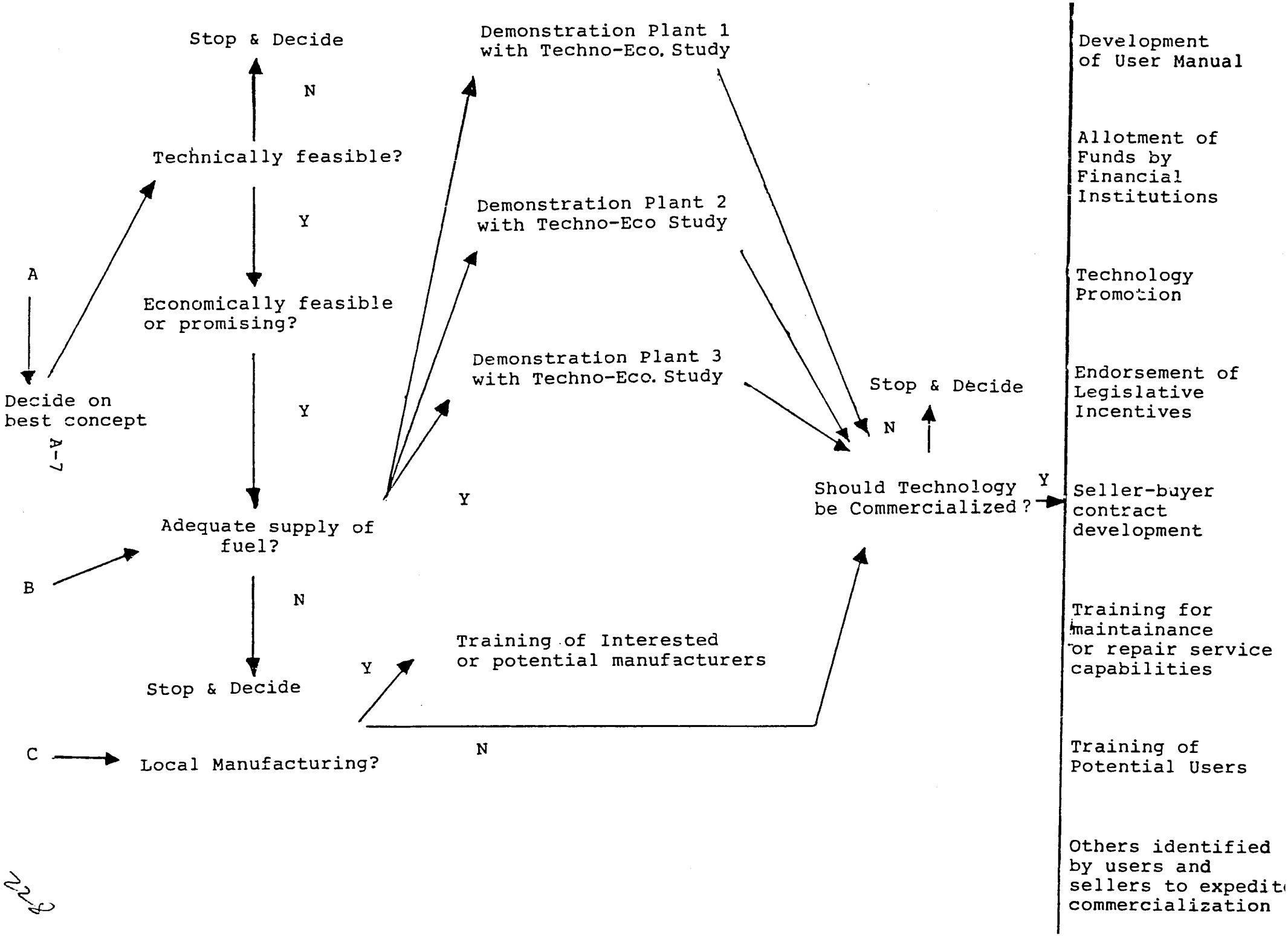


FIGURE A-2.3

NCRD'S MULTIPHASED PROGRAM APPROACH FOR NONCONVENTIONAL ENERGY TECHNOLOGY DEVELOPMENT


Stop & Decide
N
Technically feasible?
Y
Economically feasible or promising?
Y
Adequate supply of fuel?
Y
Stop & Decide
N
Local Manufacturing?
A
Decide on best concept
A-7
B
C
Demonstration Plant 1 with Techno-Eco. Study
Demonstration Plant 2 with Techno-Eco Study
Demonstration Plant 3 with Techno-Eco. Study
Stop & Decide
N
Should Technology be Commercialized?
Y
Training of Interested or potential manufacturers
Y
N
Development of User Manual
Allotment of Funds by Financial Institutions
Technology Promotion
Endorsement of Legislative Incentives
Seller-buyer contract development
Training for maintainance or repair service capabilities
Training of Potential Users
Others identified by users and sellers to expedit commercialization

(existing and potential) for the technology and a feasibility study to find out if it is rational to manufacture the technology locally. Furthermore, in the event that the fuel supply survey reveals that the supply is neither adequate nor reliable, then there shall also be a fuel supply development project in the second phase.

The next phase can start only if the following conditions are satisfied:

a. That the technology is technically feasible,

b. That its application is economically feasible or promising, and

c. That there is reliable supply of fuel.

If at least one of the conditions is not met, then the NCRD shall decide whether to terminate the technology's development or to have another project on it. Such a project may incorporate some improvements (e.g., in design) or may simply verify the initial findings.

Using the results of the project "Feasibility Study for Local Manufacturing", the NCRD shall at this stage also make recommendations as to whether or not it is prudent for local entrepreneurs to manufacture the technology. Oftentimes, if economy of scale is not present (i.e., the market size is not large enough), importing the technology may be more economical. However, care must be taken before endorsing such approach by assessing its long-run effects on the economy, such as unfavorable trade balance and effects on the security of energy supply--factors that are not easily captured in the price mechanism.

A recommendation by the NCRD to locally manufacture the technology should result to a third phase of the project, (i.e., training of potential manufacturers). This is another step towards creating the proper environment that would induce manufacturers to join the commercialization effort. The most critical project in this phase is the setting up of three demonstration plants. An intensive technoeconomic study of each plant shall be undertaken, the results of which shall be given to the public. Three <u>successful</u> demonstration plants should convince the potential users that the renewable energy technology being demonstrated is both technically and economically feasible. The program can then proceed to the pre-commercialization phase, otherwise, the NCRD may have to install more demonstration plants or simply give up the program.

The pre-commercialization phase has the objective of clearing out the remaining obstacles to commercialization. A project shall develop a manual that would enable users to repair or service the nonconventional energy device. Similarly, a training program shall be instituted for local technicians on how to repair and service the devices with the long-run objective that the technicians can provide expert services for a fee. Models of seller-buyer contracts shall be developed so that agreements between sellers and buyers of either the technology itself or the output can easily be reached.

Promoting the technology to the public by media, seminars and exhibits is a must in order to create awareness. The suppliers may be able to advertise their product. However, such may be limited due to financial constraints. Thus, a vigorous industry promotion shall be funded by the government.

Another important activity in the pre-commercialization phase is the development of financing schemes by financial institutions which the users and the sellers can avail of. Renewable energy technologies are generally capital intensive; they are, therefore, sensitive to changes in interest rates. Unless some innovative financing schemes are made available, the commercialization of the renewable technologies would remain a problem.

In instances that the technology requires some type of legislative incentives, such as import duties and accelerated depreciation, such incentives shall be endorsed by the NCRD to the legislative body or to the President. To properly defend such endorsement, the NCRD should show that the social benefit that can be derived from using the technology outweighs the social cost by having legislative incentives.

Other projects in the pre-commercialization phase may be instituted upon request by the sellers or users, or both, to expedite commercialization.

If all the undertaking in the pre-commercialization phase are successful, commercialization can easily be achieved. This means that all the questions given in Figures A-2.1 and A-2.2 are answered affirmatively. In effect, the risk exposures for the market participants are significantly reduced using the results of the series of projects. If commercialization is not achieved in spite of the fact that all the queries are answered affirmatively, then the government itself may have to step in and manufacture the technology, and possibly become its main user.

APPENDIX A-3

LIST OF NONCONVENTIONAL ENERGY DEVELOPMENT PROJECTS
OUTSIDE OF THE USAID-GOP PROJECT
1977-1986

CODE	TITLE	PROJECT IMPLEMENTOR*
AW-003-77	PRACTICAL APPLICATION OF PRODUCER GAS FROM AGRICULTURAL WASTE RESIDUES AS ALTERNATIVE FUEL FOR DIESEL ENGINES	UPERDFI
IS-006-77	APPLICATION OF ALTERNATIVE SOURCES OF ENERGY IN INTEGRATED VILLAGE FOOD PROCESSING SYSTEM	PSB
AW-007-78	PILOT ELECTRIFICATION OF A BARRIO USING AGRICULTURAL WASTE	EDF
AP-008-78	MODIFICATION OF AN EXISTING DISTILLATION PLANT AS AN ANHYDROUS ALCOHOL PILOT PLANT	PSB
WE-009-78	WIND TURBINE SYSTEM FOR PAGASA RADAR STATION AT BASCO, BATANES	PAGASA
AP-012-78	TECHNICAL AND ECONOMIC FEASIBILITY STUDY OF PRODUCING, MARKETING, AND UTILIZING ETHYL ALCOHOL AS GASOLINE COMPONENT	PNOC
WE-014-78	DESIGN AND DEVELOPMENT OF A HYBRID WINDMILL	PSB
AW-014-78	PYROLYSIS OF WASTES	UP
HS-017-78	NATURAL HOT WATER HEATED DRYING PILOT PLANT	UPLB
DS-019-78	SOLAR DISTILLED WATER FOR LIVESTOCK VACCINE PRODUCTION	BAI
HS-020-78	HOT SPRING WATER FOR POWER GENERATION	BED

* See Appendix A-17 for the meaning of each acronym

CODE	TITLE	PROJECT IMPLEMENTOR
BG-021-78	COW MANURE BIOGAS PRODUCTION AND UTILIZATION IN AN INTEGRATED FARM SYSTEM AT THE ALABANG DIARY PROJECT	BAI
AW-002-78	LOW-COST CONTINUOUS FLOW DRYING SYSTEM USING RICE HULL AS FUEL, PHASE I	UPLB
HS-023-78	DESIGN AND DEVELOPMENT OF A 10-KW HOT SPRING POWER	DLSU
IS-024-78	DEVELOPMENT MODEL FOR A SMALL ISLAND: ALTERNATIVE ENERGY COMPONENT	HSC
BG-029-78	ECONOMIC AND NET-ENERGY ANALYSIS OF BIOGAS SYSTEMS	NIST
DT-030-78	PILOT DENDRO THERMAL PLANT FOR RURAL POWER	NPC
DT-031-78	FEASIBILITY REPORT ON THE 500 KW DENDROTHERMAL PROJECT	NPC
MG-036-78	ESTABLISHMENT OF PILOT MODELS FOR UTILIZATION OF LOW PRESSURE NATURAL GAS SEEPAGES IN SEVEN AREAS	COMVOL
BG-041-78	TECHNO-ECONOMIC STUDY ON A COMMUNAL BIOGAS SYSTEM USING HUMAN WASTE	EDF
PS-042-78	PASSIVE COOLING OF MEDIUM SIZED BUILDINGS FOR HOT-HUMID LOCALITITES	UDA
PS-042-78	GLOSSARY FOR PASSIVE COOLING	UDA
PS-042-78	MECHANICAL SYSTEMS FOR AIR DELIVERY	UDA
DS-044-78	SOLAR DRYING TECHNOLOGY DISPERSAL FOR COUNTRYSIDE DEVELOPMENT	PWU
DS-044-78	PROCESSING FOOD PRODUCTS THROUGH OSMOSOL TECHNOLOGY USING "SOLDRY" - A MANUAL	PWU
BG-047-78	COW MANURE BIOGAS UTILIZATION AT ALABANG, PHASE II	BAI

CODE	TITLE	PROJECT IMPLEMENTOR
SA-049-79	NONCON DEVICES BROCHURES FOR ANGAT FAIR	BED
SA-050-79	NONCONVENTIONAL ENERGY PUBLIC INFORMATION AND PROMOTIONS FOR 1979	PNOC/PA
SA-050-79	INVENTORY OF STOVE TECHNOLOGY FROM LITERATURE AND ACTUAL INVENTIONS	PNOC/ERDC
SA-050-79	RENEWABLE ENERGY IN THE PHILIPPINES - A WORKSHOP TO CATALYZE PRIVATE SECTOR INITIATIVES	PNOC/ERDC
SA-050-79	STOVE FIELD-TESTING REPORT	PNOC/ERDC
SA-050-79	BASELINE SURVEY REPORT ON EXISTING STOVE TECHNOLOGY AND COMMUNITY PREFERENCES IN THREE PILOT AREAS	PNOC/ERDC
AW-054-59	LOW-COST CONTINUOUS FLOW-DRYING SYSTEM USING RICE HULL AS FUEL, PHASE II	UPLB
SA-055-79	INTEGRATION OF NONCONVENTIONAL ENERGY TECHNOLOGIES FOR THE CURRICULUM OF SECONDARY SCHOOLS	MEC
SA-056-79	SCREENING AND EVALUATION: DEVELOPMENT STUDIES FOR SELECTED INVENTIONS PERTAINING TO NONCONVENTIONAL SOURCES OF ENERGY	PIC
SP-058-79	SOCIAL INVESTMENT ANALYSIS OF ENERGY R&D UNDER PHILIPPINE CONDITIONS (VOL. 1-3)	REAP
AP-062-80	RESEARCH ON THE PRODUCTION OF GLUCOSE AND ETHYL ALCOHOL FROM CELLULOSE MATERIALS PARTICULARLY FROM WOOD WASTE, PHASE I	PAEC
AW-064-80	MANUFACTURE OF GREEN CHARCOAL	MAPECON
DS-065-80	PORTABLE PHOTOVOLTAIC GENERATORS	AFP
AW-066-80	STUDIES ON THE GENERATION OF ELECTRICITY BY DUAL-FUEL ENGINE OPERATION ON COCONUT OIL PRODUCER GAS	UPERDFI

CODE	TITLE	PROJECT IMPLEMENTOR
SP-067-80	RESEARCH ON THE BARRIERS TO THE POPULAR USE OF SELECTED NONCON ENERGY TECHNOLOGIES	UPISSI
DA-069-80	DESIGN AND IMPLEMENTATION OF A NATIONAL INSOLATION MEASUREMENT PROGRAM USING AVAILABLE CHEMICAL TECHNIQUES AND LABORATORIES	AMU
AP-070-80	OPTIMUM PRODUCTION OF HIGH GRADE ALCOHOL FROM NIPA	UPFI
SA-072-80	ESTABLISHMENT OF AFFILIATED NONCON CENTERS (SILLIMAN UNIVERSITY)	PNOC/EC
SA-072-80	ESTABLISHMENT OF AFFILIATED NONCON CENTERS (DON MARIANO MARCOS STATE UNIVERSITY)	PNOC/PA
EP-077-81	SURVEY, IDENTIFICATION, EVALUATION AND SPECIES-SITE ADAPTABILITY STUDIES OF POTENTIAL OIL-BEARING TREES	UPLB/FORI
EP-078-81	PETROLEUM-LIKE PRODUCTS FROM OLEORESINS OF PHILIPPINE PLANTS	PWU
BG-080-82	EVALUATION STUDIES OF SOLID, LIQUID AND GASEOUS FUELS	PNOC/ERDC
WE-081-82	SITE DEFINITION AND FEASIBILITY STUDIES FOR WIND, WAVE AND TIDAL POTENTIAL OF NEGROS AND OTHER SITES	PNOC/ERDC
DS-084-81	COMMERCIALIZATION OF NONCON DRYING SYSTEMS IN THE FOOD PROCESSING INDUSTRY (Parts 1 and 2)	PWU/UP
DS-084-81	A MANUAL FOR THE USE OF SOLAR PROCESSING AGRO-WASTE DRIER IN THE FOOD PROCESSING INDUSTRY	UPISSI
SP-086-81	PLANS FOR THE COMMERCIALIZATION OF SELECTED NONCON TECHNOLOGIES	PNOC/ERDC
SP-086-81	COMMERCIALIZATION STUDY - ALCOGAS FUEL	EDF

CODE	TITLE	PROJECT IMPLEMENTOR
SP-086-81	COMMERCIALIZATION STUDY - BIOGAS	EDF
SP-086-81	COMMERCIALIZATION STUDY - COCO-DIESEL AND ALCO-DIESEL	EDF
SP-086-81	COMMERCIALIZATION STUDY - HYDROUS ALCOHOL FUEL	EDF
SP-086-81	COMMERCIALIZATION STUDY - PHOTOVOLTAIC CELLS	EDF
SP-086-81	COMMERCIALIZATION STUDY - PRODUCER GAS TECHNOLOGY	EDF
SP-086-81	COMMERCIALIZATION STUDY - SOLAR DRYER	EDF
SP-086-81	COMMERCIALIZATION STUDY - SOLAR REFRIGERATION AND AIR CONDITIONING	EDF
SP-086-81	COMMERCIALIZATION STUDY - SOLAR WATER HEATER	EDF
SP-086-81	COMMERCIALIZATION STUDY - WINDMILL	EDF
SP-086-81	COMMERCIALIZATION STUDY - WOOD-BURNING POWER STATION	EDF
SP-086-81	SITUATIONAL ANALYSIS - DENDROTHERMAL ENERGY	EDF
SP-086-81	SITUATIONAL ANALYSIS - HYDROUS ALCOHOL FUEL	EDF
SP-086-81	SITUATIONAL ANALYSIS - PHOTOVOLTAIC CELL	EDF
SP-086-81	SITUATIONAL ANALYSIS - PRODUCER GAS TECHNOLOGY	EDF
SP-086-81	SITUATIONAL ANALYSIS - SOLAR DRYER	EDF
SP-086-81	SITUATIONAL ANALYSIS - SOLAR REFRIGERATION AND AIR CONDITIONING	EDF
SP-086-81	SITUATIONAL ANALYSIS - WINDMILL	EDF
AP-091-82	RESEARCH ON THE PRODUCTION OF GLUCOSE AND ETHYL ALCOHOL FROM CELLULOSE MATERIALS, PHASE II (SEE AP-062-80)	PAEC
EP-095-83	PRODUCTION OF PETROLEUM FUEL SUBSTITUTES FROM COCONUT OIL	NIST

APPENDIX A-4

SUMMARY OF ONGOING NONCONVENTIONAL ENERGY DEVELOPMENT PROJECTS
OUTSIDE OF THE USAID-GOP PROJECT
AS OF APRIL, 1986

1. RESEARCH AND DEVELOPMENT PROJECTS

1.1 Gasification

1.1.1 Project Title : Rice Hull-Fueled Power Plant for Rice Mill and Other Industries
Project Code : AW-103-84
Duration : January 1985 - December 1986
Implementor : Economic Development Foundation (EDF)
Project Cost : BED Funding - ₱ 220,000
EDF Counterpart - 108,000

Project Description:

The project involves the development of an electric power supply system based on producer gas from rice hulls. The system is intended for the rice milling and other small industries where the process could optimize use of both the electricity to run small machinery and the heat to dry grains and other agricultural crops.

1.1.2 Project Title : Integrated Green Charcoal-Activited Carbon Plant
Project Code : PG-105-84
Duration : January 1985 - December 1986
Implementor : Manila Pest Control (MAPECON)
Project Leader : Mr. Gonzalo O. Catan
Project Cost : BED Funding - ₱ 800,000
MAPECON Counterpart - 1,647,000

Project Description:

The project will demonstrate the concept of an integrated green charcoal activated carbon plant. The green charcoal, dried with waste heat from a gasifier, will then be used to generate heat energy for the activation of cocoshell charcoal. The following objectives are set forth for the study: (a) to show the technical and commercial viability of the combined gasifier and green charcoal technologies for industrial application; (b) to replace or find an alternate for the coconut shell fuel, i.e., the green charcoal; and (c) to make the integrated Green Charcoal Activated Carbon Plant in Alaminos, Laguna a model of biomass energy utilization in industries.

1.2 Biogas System

1.2.1 Project Title : Biogas Generation from Aquatic And Marine Plants
Project Code : BG-102-84
Duration : January 1985 - December 1986
Implementor : Economic Development Foundation (EDF)
Project Leader : Mr. Gil C. Gueverra
Project Cost : BED Funding - ₱ 306,876

Project Description:

The project aims to determine the technical feasibility of biogas systems run on aquatic and marine plants such as water hyacinth and sargassum species. The project shall begin with the determination of the digestion properties of the materials through laboratory studies. The extent and seasonality of water hyacinth and sargassum availability shall be studied. A survey of possible demonstration sites for both units shall be conducted. Pilot demonstration units will be constructed on the site selected. Finally, an evaluation of the results of the operations of pilot demonstration units will follow along with an assessment of the commercialization potentials.

As of the latest progress report, the project has accomplished the monitoring of biogas plants both in San Pablo, Laguna and Calatagan, Batangas.

1.2.2 Project Title : Animal Husbandry Energy Survey
Project Code : BG-108-85
Duration : June 1986 - June 1987
Implementor : Planning Service, Ministry of Energy (MOE/PS)
Project Leader : BED Funding - ₱ 495,300
MOE/PS - 38,500

Project Description:

The study aims to generate energy data on the animal husbandry sector where presently very little specific energy data exist. Expected to provide valuable input for planning and evaluation purposes, this project will generate base time-series data and other relevant information on energy supply and utilization in the sector. Time-series data will be from 1973 to 1974 for commercial farms, and for one-year for backyard farms. It is also expected to identify and quantify the effects of the variables that significantly influence energy demand by the sector.

1.3 Alcohol Fuel

1.3.1 Project Title : Research and Development of Pilot-Level Process for Hydrous Alcohol Production for Agricultural Crops
Project Code : HE-104-84
Duration : January 1985 - December 1986
Implementor : National Institute of Biotechnology and Applied Microbiology, University of the Philippines at Los Baños (UPLB/BIOTECH)
Project Leader : Dr. Ernesto J. del Rosario
Project Funding: BED Funding - ₱2,117,388
BIOTECH Funding - 450,528

Project Description

The project involves the fabrication of fermentation and distillation equipment using locally available materials, as well as other accessories needed for the production of ethyl alcohol. The production of 60 liters of hydrous alcohol (95%) per day is planned using a continuous-flow fermentation process and improved distillation process. Some equipment have been fabricated; negotiations for the fabrication of the rest are ongoing.

1.4 Solar Water Heater

1.4.1 Project Title : Analysis of Solar Water Heating Systems
Project Code : DS-098-84
Duration : April 1984 - June 1986
Implementor : Energy Research and Development Center, Philippine National Oil Company (PNOC/ERDC)
Project Leader : Mr. Edelmiro I. Quibilan
Project Cost : BED Funding - ₱ 141,858
ERDC Funding - 239,300

Project Description:

The project monitors and evaluates the performance of solar water heater systems of selected commercial and industrial users. Monitoring instruments have been installed in the solar water heating units of the ERDC canteen.

1.4.2 Project Title : Commercial and Industrial Scale Solar Water Heating Demonstration Project
Project Code : DS-048-78
Implementor : PNOC/ERDC
Project Cost : ₱1,500,000

Project Description:

The project aims to demonstrate the uses of solar water heaters in commercial and industrial establishments. The project has been completely monitored under DS-098-84. The recipient of the project, Marlim Mansions Hotel, has paid the second amortization as of February, 1986.

1.5 Photovoltaic

1.5.1

Project Title	:	Pilot Photovoltaic Power Plant
Project Code	:	DS-088-82
Duration	:	April 1982 - December 1989
Implementor	:	Energy Research and Development Center, Philippine National Oil Company (PNOC/ERDC)
Project Leader	:	Mr. David M. Mahilum
Project Cost	:	BED Funding - ₱ 1,442,960 GTZ Funding - 2,055,003 ERDC Funding - 350,750

Project Description:

The project aims to enhance the country's solar energy program, develop manpower capability, and prepare the groundwork for eventual production of phovoltaic cells in the country. A 10-KW plant was installed and interfaced with an existing utility grid in Don Remedios Trinidad, Bulacan. The 13.3-KW power plant which services about 62 households in Pulong Sampaloc was inaugurated in April, 1983. Other small power photovoltaics rural remote applications are now being conducted.

1.6 Pyrolysis Waste, Phase II

Project Title	:	Assistance to Energy Production from Waste Materials (Pyrolysis of Waste, Phase II)
Project Code	:	AW-087-82
Duration	:	April, 1982 - June, 1986)
Implementor	:	PNOC/ERDC
Project Cost	:	GOP Funding - ₱ 572,000 UNDP Funding - 3,199,000

Project Description:

The project aims to utilize biomass materials for producing energy by converting it to charcoal or gasifier. Six (6) units of charcoal or gasifier converter have been fabricated. Four (4) of these units were installed in the PNOC/ERDC Laboratory in Diliman, Quezon City and one in New Washington, Aklan.

2. SUPPORT PROJECTS AND ACTIVITIES FOR ALL TECHNOLOGY PROGRAMS

2.1 Project Title : Energy Demand Survey
Project Code : SA-028-78
Duration : January, 1978 - June, 1986
Implementor : Ministry of Energy, Planning Service (MOE/PS)
Project Leader : Mr. Gary S. Makasiar
Project Cost : BED Funding - ₱ 500,000

Project Description:

The project's aim is to generate baseline data on the different types and systems of energy resources used by various economic sectors. The following have been finished:

a) Household Energy Usage Survey. A final report is being prepared by the MOE/PS.

b) Capiz Energy Survey. Results are ready for data processing and statistical analysis.

c) Land Transportation Energy Survey. Data processing and analysis for this survey are being contracted out.

2.2 Project Title : Determining the Feasibility of Manufacturing Selected Noncon Energy Devices for both Local and Foreign Markets
Project Code : SP-096-83
Duration : April, 1984 - June, 1986
Implementor : Asian Institute of Management
Project Leader : Dr. Edilberto L. Roberto
Project Cost : BED Funding - ₱100,000

Project Description:

On the assumption that the nonconventional energy devices are commercially feasible, this project aims to 1) determine production schedule together with the market demand to arrive at a decision; 2) know the financial and organizational structures of the local manufacturers which would include a study on their processes and equipment, optimal plant scale, layout, location as well as manpower to ensure movement of products; 3) determine if support industries would be present to boost local production; and 4) boost local production and determine if there is an export potential for selected noncon energy devices. Two Master of Business Management students have been conducting feasibility studies on biogas technology and on the production of charcoal.

2.3 Project Title : Affiliated Noncon Center I (Utilization and Commercialization of Alternative And Renewable Sources of Energy in the Negros Provinces)
Project Code : SA-101-84
Duration : January 1985, - December, 1986
Implementor : Silliman University
Project Leader : Dr. Sabellon M. Wale
Project Cost : BED Funding - ₱203,100

Project Desription:

The overall program for the ANCs will present a general pattern of energy utilization and supply for meeting or satisfying the energy needs of the rural sector. Each Center will address problems associated with satisfying the energy requirements of rural areas.

2.4 Project Title : Development, Testing and Evaluation of Energy-Related Devices and Fuels
Project Code : SA-106-85
Duration : June, 1984 - December, 1986
Project Cost : BED Funding - ₱ 414,000

Project Description:

This is an in-house project of the NCRD which provides funding assistance to investors, scientists, and enterpreneurs who intend to fabricate, and conduct performance characteristics of noncon energy-related devices and/or fuels within the scope of the NCRD's Priority Program. The project has initially accomplished the design and fabrication of a Rice Hull Briquetting Machine.

2.5 Project Title : Establishment of Program Management/ Monitoring System to Identify Noncon Energy Resources Utilization
Project Code : SA-107-85
Implementor : BED
Project Cost : BED Funding - ₱353,650

Project Description:

The project aims to establish and manage a computerized monitoring system to identify the acceptance of noncon devices, to identify the site and implementor of the affiliated noncon centers, and to provide staff training.

2.6 Project Title : Integrated Testing of Energy Consuming Systems and Devices
Project Code : AP-051-79
Implemento : BEU
Project Cost : Federal Republic of Germany (FRG) Funding - ₱1,215,000

Project Description:

This project aims to evaluate the performance of a pilot-scale boiler and conduct an extensive study on the utilization of electricity and petroleum fuels in households.

APPENDIX A-5

PRIVATE COMPANIES ENGAGED IN NONCONVENTIONAL ENERGY IN THE PHILIPPINES

TECHNOLOGY/COMPANY OR AGENCY	CONTACT/S AND TEL. NO/S.
A. Biogas	
1. Maya Farms Angono, Rizal	Mr. Enrico Obias Mr. Calixto Taganas Mr. Alejandro Judan 86-50-11
2. Little Giant Mill Supply Mandaluyong, Metro Manila	Mr. Vic Lim Mr. Sin del Jamorol 700-193; 794-306; 781-688
3. Bureau of Animal Industry Quezon City	Dr. Felicidad Mangali 952-184; 951-844
4. Sanamatic Mfg. Corp. 2350 Taft Avenue, Manila	Mr. Chit Palisoc 504-774; 508-396 501-388
5. Biogas, Incorporated 11 Galaxy St., GSIS Heights Matina, Davao City	Engr. Agustin Tabin
6. Rokar Metalcraft 18 D. Reynaldo Street Tierra Bella Subdivision Tandang Sora, Q. C.	Engr. Ignacio Felizardo Gen. Manager 704-368; 798-076 794-542
B. Windmills	
1. World Windmills Pte. Ltd. 217 C.R.M. Avenue B.F. Homes, Almanza Las Piñas, Metro Manila	Mr. Roy Watt 801-4426
2. VMM Construction Rd. 8A, United Parañaque Subd. Ph. 5, Dr. Arcadio Santos Ave. Parañaque, Metro Manila	Mr. Venerando Mendoza 827-6621; 827-2365
3. Reymill Metalcraft Sta. Rosa, Nueva Ecija	Mr. Felipe Reyes

4.	Aerodyne Windmill Cubao, Quezon City	Mr. Bernard Sy 708-398
5.	Forte Management 4th Floor, 150 Legaspi Village, Makati	Mr. Victor Abeleda 817-2609; 817-2639 818-4766; 818-2396 818-1563
6.	Philippine National Oil Co. Gen. Mariano Marcos Avenue Diliman, Quezon City	Dr. Germelino F. Abito 977-611 loc. 2190
7.	Teledyne Marketing and Const. Corp., 902 State Financing Center, Ortigas Avenue San Juan, Metro Manila	Ms. Evelyn Villa 721-0454;721-0447
8.	VS Energetics Inc. 4th Floor, Dolmar Bldg. 56 EDSA, Greenhills, Q.C.	Mr. Vic Sianghio, Jr. 780-593; 782-568
9.	Servotrade Int'l, Inc. 607 Ortigas Building Ortigas Avenue, Q. C.	Mr. Oscar Judan 673-2062
0.	Paces Industrial Corp. Sarmiento Building 678 Ayala Avenue, Makati	Mr. Danilo Roldan 818-7438; 892-251 884-102; 892-787

C. Solar Water Heaters

1.	Economic Energy Systems, Inc. 109 Perea Street Legaspi Village Makati, Metro Manila	Mr. Efren Flores 815-2977
2.	Yazaki-Torres Mfg., Inc. 2665 Bautista cor. Z. Roxas Singalong, Manila or Torres Auto Supp., Wash., Espana	Mr. Ven R. Legasto 545-1666 (factory) 500-621 to 25; 521-1621 Connie Galos - 741-6557 741-4024; 741-3933
3.	Cost Savers Corporation Castillo Building 2205 Aurora Blvd. Pasay City	Mr. Juanito Sucgang 833-9368

D. Photovoltaics

1.	Filipinas Shell Shell House 1330 Roxas Blvd., Manila	Mr. Vic Abuyuan Mr. Vic Panlilio 521-1541
2.	Matec-Siemens 3rd Floor, Technology Center (EEI), Bo. Ugong, Pasig	Mr. Oly Serafica 673-1861 to 70
3.	Paces Industrial Corp. Sarmiento Building 678 Ayala Avenue, Makati	884-102: 892-787
4.	Phil. Electronics Industries, Inc. 11 Pioneer Street Pasig, Metro Manila	Mr. Orlando Abellon 673-4321
5.	Milrod Co. Rm 405 G & L Bldg. 251 EDSA, Mandaluyong, MM	Mr. Dennis Osolio 785-571

E. Biomass-Fired Boilers

1.	Enertech Systems Industries, Inc. Susano Rd. cor. Diamante St. Novaliches	Mr. George Tumamao 900-007;901-465;902-938
2.	Chum-Li Machinery 147 Sevilla St., Grace Park Caloocan City	361-1623 362-0282 362-0268
3.	ESTA Trading Corp. 11th Floor, Solid Bank Bldg. 777 Paseo de Roxas, Makati	Mr. Ed Bruce 817-1901 817-4479
4.	Phil. Industrial Engineering Co., Inc., 2242 Pasong Tamo Extension, Makati, MM	Mr. Rofolfo Salvacion 879-916 to 19
5.	AG&P Port Area, Manila	Mr. Danny Napalinga Mr. Roberto Zuniga 471-951
6.	TOA Energy Development 1238 E. Rodriguez St. Quezon City	Mr. Kasuhiro Hamada Mr. Arturo Salazar 792-245; 721-3511;721-3801 Plant: 236-111

7.	Assistco Energy & Industrial 2276 Pasong Tamo, Makati	Mr. F. L. Nacino 899-468; 853-126
8.	SAE Products Mktg. Corp. Room 321 Merchants Bldg. 213 Buendia Avenue Extension Makati, Metro Manila	Mr. Noel Risos 899-855; 884-803
9.	Alpha Machinery & Eng'g Corp. Pasong Tamo, Makati	Ms. Lens T. Datu 865-556

F. Producer Gas

1.	GEMCOR 2nd Floor, Rudgen Bldg. Shaw Blvd., Pasig Plant: Bo. Maduya	Mr. Louie Baja Mr. Tony de Guzman 683-6296 to 98 693-6266 loc 209/206/228
2.	Gamboa Hermanos, Inc. GHI Bldg., 7431 Yakal St. San Antonio Village, Makati	Mr. Victor Manuel Torres 886-691 to 93 888-107

G. Agri-Dryer

1.	Ayala Agricultural Development Corp. (User)	Mr. Teodoro Abilay 864-473; 855-295
2.	PADISCOR 114 Plaza Rizal Pasig, Metro Manila	Mr. Candido Miguel 682-7861
3.	SCANCON Trading 118 Scout Fuentebella Roxas District Quezon City	Mr. Preven Thestrup Mr. David Ambrose Mr. Lazaro Clavell 964-519; 964-514
4.	Mechanical Factors Phil., Inc. (formerly PAN-ASIA)	706-898; 707-294

H. Charcoal

1.	Manila Pest Control 2533 Madre Perla St. Vito Cruz Ext. Makati	Mr. Gonzalo O. Catan 581-627; 509-271 506-946; 500-229 580-364

I. Alcohol

1.	CRD International 91 V. Luna Ext. Quezon City	Ma. Carlita Doran 921-5649

APPENDIX A-6

MAJOR INSIGHTS GAINED FROM INTERVIEWS OF A SMALL, RANDOM SAMPLE OF PRIVATE COMPANIES ENGAGED IN NONCONVENTIONAL ENERGY

1.0 SOLAR WATER HEATER

1.1 Companies Interviewed

1.1.1 Economic Energy Systems, Inc. (EES)
109 Perea Street
Legaspi Village, Makati

1.1.2 Yazaki Torres Manufacturing, Inc.
Espana Blvd., Manila

1.2 Findings and Insights

1.2.1 The solar water heating device sold in the market consists of a flat-plate solar collector panel and an insulated water storage tank. The solar collector panel is made of aluminum, under which is embedded a series of copper coils through which water flows. Heated water, stored in an insulated tank, is used for domestic purposes (washing and bathing).

1.2.2 The solar water heaters are imported from Japan, (for Yazaki, Inc.) and Australia (for the EES). The EES sells 55-gallon tank capacity solar water heaters for ₱55,000 per unit.

1.2.3 The ESS has sold about 500 units of its solar water heaters, mainly to household users. The units have reportedly been operating well; complaints from users are minimal.

1.2.4 One factor affecting the marketing of solar water heaters is their price. At ₱33,000 to ₱55,000 per unit, only relatively high income households and some commercial and service establishments, such as hotels, sports clubs, and hospitals, can afford the system.

1.2.5 Besides price, another factor limiting the market for solar heaters is lack of appreciation for the advantages and energy-saving attributes of the product, resulting in low

levels of demand. A local firm, Pilipinas Sunpower Corporation, attempted local manufacturing, pricing its units at a competitive ₱13,500 per unit. Nonetheless, low sales forced the company to close down.

1.2.6 Apart from reducing cost, promotion appears to be an important element in stimulating demand for solar water heaters for both household use and for commercial and service establishments.

2.0 PHOTOVOLTAICS

2.1 Company Interviewed: Philippine Electronic Industries, Incorporated, 11 Pioneer St., Pasig, Metro Manila

2.2. Findings and Insights

2.2.1 The market for imported photovoltaic cells is presently very limited. Telecommunications companies are currently the only viable source of demand. These companies use PV cells to provide power for remote telecommunications relay stations that are not connected to existing grids and are inaccessible for the transport of conventional fuels.

2.2.2 The Sales Manager of the Company estimates that the market for photovoltaic cells during the past five years in the Philippines has not exceeded $200,000. The main reason for this low demand is the prohibitive price of the product when compared with conventional energy source alternatives.

3.0 WINDMILLS

3.1 Companies Interviewed

3.1.1 Aerodyne Corporation
153 10th St., New Manila
Quezon City

3.1.2 Servotrade International, Inc.
6817 Ortigas Building
Ortigas Avenue, Pasig, Metro Manila

3.2 Findings and Insights

3.2.1 Aerodyne Corporation has been able to sell only five units since 1981. Although the performance of the units have been satisfactory, the level of demand remains low and reportedly not enough to make the enterprise viable. Servotrade abandoned the production of windmills because of the very limited market for the product.

3.2.2 Aerodyne's windmills are assembled using locally available parts. Production is carried out by subcontracting to various fabrication shops. Each unit costs ₱60,000, including installation.

3.2.3 Lack of promotion and high investment cost (coupled with unavailability of financing for users) were identified as the two most important obstacles to the widespread adoption of windmill technology.

3.2.4 The government is expected to help in the form of research assistance and institutional promotion of windmill technology. Financing research into the intensity and variability of windpower at various sites is beyond the capability of individual entrepreneurs.

3.2.5 Existing government incentives, such as exemptions from sales tax and product licensing fees, are viewed as adequate.

4.0 CROP DRYERS USING BIOMASS WASTE AS FUELS

4.1 Companies/Institutions Interviewed

4.1.1 Group Developers Incorporated (GDI)
Batulao Farming Division
Nasugbu, Batangas

4.1.2 Ayala Agricultural Development Corporation
5th Floor, Makati Stock Exchange Building
Ayala Avenue, Makati, Metro Manila

4.1.3 National Food Authority
Directorate for Infrastructure
E. Rodriguez Avenue, Quezon City

4.2 Findings and Insights

4.2.1 The GDI fabricated its biomass waste-fired dryer in 1975 at a cost of ₱45,000. The system was used to dry various field crops (corn, sorghum, castor seeds, cowpea, and mungbeans), the residues of which were used as fuel for the dryer.

4.2.2 The Ayala Agricultural Development Corporation installed a biomass-fueled corn dryer at the company's corn-seed processing plant at General Santos City. The dryer was fabricated for ₱50,000 by PADISCOR, a local firm that manufactures crop processing equipment. The dryer has a variable capacity of 5-10 tons per batch.

4.2.3 The two companies' experience with the operation of the crop dryers indicates that they are technically and economically viable. Except for the initial capital cost and the hauling cost of the fuel during operation, the aggregate cost is low compared with the cost of using conventional fuels for drying purposes. This is essentially due to the fact that the biomass fuel is free.

4.2.4 The germination percentage obtained from using biomass fuel for seed drying has been good. This indicates that the fuel can be applied easily for drying some grains.

4.2.5 The main problem encountered in the operation of the dryer has been the production of too much smoke. It is not yet known whether the pollution created is harmful to workers, but changes have been initiated to minimize the production of combustion residues.

4.2.6 The NFA has 50 operational (mostly flatbed) dryers that use rice hull for fuel. Each flatbed dryer has a capacity of 40 cavans per batch at a rate of about 0.25 tons per hour.

4.2.7 The requirement for rice hull fuel for the NFA dryers is 30-35 sacks per hour for each dryer. sack contains about 10 kg. of rice hull. This translates to a fuel consumption rate of 300

kg. rice hull for each 0.25 tons of grain to be dried, or a rate of about 1.2 tons rice hull per ton of grain.

4.2.8 In addition, the NFA has two units of continuous-flow dryers that use rice hull for fuel. The capacity of each of these units is 2 tons per hour. There is also one 10-ton grain dryer that was converted from diesel to rice hull fuel.

4.2.9 The NFA dryers have been shown to meet drying requirements, at a cost of about 40% less than that of conventional dryers. This is because the rice hull fuel is essentially free (except for the hauling cost).

4.2.10 Rice hull-fueled dryers have been found by the NFA to be an economically viable alternative to the conventional kerosene-fired dryers.

4.2.11 The main problem encountered in the operation of the NFA rice hull-fired dryers is rapid deterioration of the screens and plates of the rice hull bin due to direct heat exposure. This requires replacing these parts about once every year at a cost of about ₱5,000.

The NFA does not have reported pollution problems from the combustion residues.

APPENDIX A-7

LIST OF CONTACTS ON NONCONVENTIONAL ENERGY IN THE PHILIPPINES*

Dr. Leopoldo Abis
Executive Director
National Engineering Center
Tel. No. 922-4714
(Training on Nonconventional Energy)

Dr. Germelino F. Abito
Assistant Manager
Energy Research and Development
Center, (PNOC/ERDC)
Diliman, Quezon City
Tel. No. 977-611
(Biomass/Solar/Others)

Mr. Vicente R. Abuyuan
Manager
Shell Distribution Co.
Shell House, 1330 Roxas Blvd.
Ermita, Manila
Tel. No. 521-1541
(Photovoltaics)

Dr. Venancio Alcantara
Energy Research & Development
Center, Diliman, Quezon City
Tel. No. 977-611
(Windmills)

Mr. Arthur M. Alvendia
President
Woodkoal, Inc.
8th Floor. Adamson Center
Alfaro St., Salcedo Village
Makati, Metro Manila
Tel. No. 816-3923
(Solid Fuels)

Ms. Gwendolyn Asistores
Farm Systems Development
Corporation
Tel. No. 693-6295
(Windmill)

Mr. Manuel Bontoc
Philippine Atmospheric, Geo-
physical and Astronomical
Services Administration
Tel. No. 980-661
(Solar Radiation/Wind Mapping)

Mr. Ricardo Casin
Forest Products Research and
Development Institute (FIRDI)
University of the Philippines
at Los Banos, Los Banos, Laguna
(Solar Lumber Dryer)

Dr. Corazon Pe Benito-Claudio
Chairman & President
SITECH Resources Group, Inc.
P.O. Box 241, Greenhills Post
Office 3113, San Juan, M.M.
Tel. No. 673-2619
(Project Design & Evaluation,
Feasibility Studies, Engineering-
Economic Analysis)

Mr. John L. Coulthard
President
Sanamatic Manufacturing Corporation
2350 Taft Avenue, Malate, Manila
Tel. No. 573-665
(Biogas)

Dr. Ibarra Cruz
Technical Consultant
Energy Research and Development
Center, Diliman, Quezon City
Tel. No. 977-611

Mr. Carlito R. Doran
91 V. Luna Rd. Ext.
Quezon City
Tel. No. 921-5649
(Solid Fuels)

Mr. Arsenio Dungo
President
Kaunlaran Industries, Inc.
Calamba, Laguna
(Husk-fired dryer)

Fr. Herman van Engelan
University of San Carlos
Water Resources Center
Sta. Rosa, Olango Island, Cebu
(Photovoltaics)

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Mr. Ignacio L. Felizardo
General Manager
Rokar Metalcraft
18 D. Reynaldo St.
Tierra Bella Subd.
Tandang Sora Avenue
Quezon City
Tel. No. 704-368
(Biogas)

Ms. Connie T. Galos
Sales Manager
Torres Trading Co.
2011-17 Espana Street
Sampaloc, Manila
Tel. No. 741-4024
(Solar Water Heater)

Dr. Ruben Garcia
Dean, College of Engineering
UP, Diliman, Quezon City
Tel. No. 993-144
(Education & Training)

Mr. Conrado S. Heruela
Sr. Science Research Specialist
Nonconventional Energy Development
Center, Bureau of Energy
Development
Tel. No. 851-021 to 31
(Program Management)

Mr. Froilan L. Hong
Managing Director
FL Hong & Partners
123 Kalayaan Avenue
Diliman, Quezon City
Tel No. 921-8279
(Systems Design)

Mr. Doroteo B. Jacob, J
15-16 Concha Cruz Drive
BF Homes, Paranaque
Metro Manila
Tel. No. 842-5014
(Photovoltaics)

Mr. Gregorio U. Kilayco
Chief, Nonconventional Energy
Resources Division, Bureau of
Energy Development
Ministry of Energy
Tel. No. 851-021 to 31
(Program Management)

Mr. Rafael Laboz, Jr.
President
Kalayaan Engineering Co., Inc.
4225 Emilia Street
P.O. Box 665, Makati
(Manufacture of Husk-fired Dryers)

Mr. Geronimo V. Manahan
Dean, College of Architecture
UP Diliman, Quezon City
Tel. No. 876-061
(Systems Design)

Mr. M. Manfred
Corwen, Inc.
708 Aurora Boulevard
Quezon City
(Husk-fired Power Plants)

Mr. Ernesto Mariñas
President and General Manager
Marinas Machinery Mfg., Co.
Rizal Street, Pila, Laguna
(Rice Husk Dryer)

Dr. Emerico Mendoza
College of Engineering and Agro-
Industrial Technology
University of the Philippines at
Los Baños, Los Baños, Laguna
(Solar Crop Dryer)

Mr. Casimiro Nadala
Kamalig Philippines, Inc.
D & E Building
Quezon City
(Boc-type dryers)

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Mr. Roberto A. Tulio
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powered plant for mill
operation)

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*

See also Appendix A-5 for additional names.

APPENDIX A-8

EVALUATION OF TECHNOLOGIES IN THE IVES PROJECT

For the technical assessment of the technologies demonstrated in the IVES project we interviewed operators and project staff, inspected the equipment used in each subsystem, reviewed logbooks of performance, and analyzed project reports. Following are our findings and recommendations.

1. FINDINGS

1.1 Gasifier Systems

Among all the demonstration units in the IVES project, only the gasifier-genset and the gasifier-ice-plant systems have data recording sheets. These contain the following column headings:

	ICE PLANT SYSTEM DATA		GENSET SYSTEM DATA
(1)	Time	(1)	Time
(2)	Diesel Consumption	(2)	Fuel (Diesel) Consumption
(3)	Charcoal Consumption	(3)	Fuel (Charcoal) Consumption
(4)	Compressor Pressure	(4)	Ampere Reading
(5)	Water Temperature	(5)	HZ Reading
(6)	Alternative Voltage	(6)	Volts Reading
(7)	Remarks	(7)	Remarks

We based our technical assessment on the available logsheets covering nine months (August 24, 1985 to May 24, 1986) for the genset system and 15 months (April 19, 1985 to July 20, 1986) for the ice plant. These logsheets show that, for the nine months of genset operation at four hours daily, the gasifier was used for only one month (actually twenty-five days). The gasifier, thus, shows minimal wear. Of the fifteen months operation of the ice plant, the records show that the gasifier was used for less than a week. The reliable technical results relevant to gasifier operation that can be derived from the data sheets are: (a) percentage displacement of diesel fuel by producer gas and (b) fuel consumption rate of diesel and charcoal for the given loads and constant engine speed.

The engine installed for the genset system was secondhand and defective. Thus, except for fuel consumption data, a techno-economic study of the gasifiers which includes effects on the life and operating and maintenance requirements o costs would not be reliable at this point. A brand-new genset is presently being installed which is expected to provide better data.

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Since the installation of the genset in May 1982, the following major repairs have been done:

(a) one engine valve broken--replaced
(b) 2 piston worn-out--replaced
(c) all piston rings worn-out--replaced
(d) engine over-hauled twice

Without the gasifier the operator can simply start the engine, leave it and do some other work within hearing distance of engine sound, and return occasionally to check. With the gasifier, however, the operator has to stay nearby always because of unpredictable gasifier behaviour which requires immediate attention--mostly to stoke the charcoal in the gasifier reactor.

The gasifier requires daily cleaning of filters, occasional removal and disposal of ash, and replacement of unserviceable filter elements. Some parts of the gasifier, like the air nozzles, may wear out faster than other components and may need replacement.

1.2 Biogas

No technical performance data are available on the biogas system as of this date. However, biogas digesters are known to be technically viable. The biogas system at the site is still in good condition. However, it is not working because there have been no pigs in the pen for a long time. End-use equipment (stove, flat iron, lamp) are still there, in good condition.

1.3 Photovoltaic Solar Panels

The photovoltaic system is working well and expected to last for many years. However, imported panels are quite expensive and will probably not pass a cost-benefit evaluation.

1.4 Charcoal Retort

The retort works well. However, inspection shows that it is fast deteriorating. The metal used is thin and is being eaten by rust. The retort could either be rebuilt with better materials, or new types of charcoal-making installations (like beehive kilns) could be introduced.

2. TECHNICAL RECOMMENDATIONS

Technical monitoring and endurance testing of the charcoal-fed gasifier-diesel engine system in an actual field application

for one year is desirable. The tests should determine the following:

(1) life of the gasifier,

(2) life of the diesel engine operated continuously with gasifier,

(3) historical record of maintenance and repair requirements and costs of the tested diesel engine,

(4) historical record of maintenance and repair requirements and costs of the gasifier,

(5) record of regular gasifier operational deviations and corresponding operator action required.

It is important that both the diesel engine and the gasifier are brand-new so as to get reliable results. Coconut shell charcoal might be a better fuel to use: it can possibly give the most satisfactory gasifier operation and is abundant in the Philippines.

The testing may be done at the IVES site, using the newly installed genset. Another new diesel engine must be purchased to replace the test engine when this project is over so that the villagers can avoid further technical problems.

The biogas system must be operated and its practical use demonstrated. The constructed biogas system, including the biogas appliances in the site, can be put to good use.

The retort must be rebuilt or else a beehive-type charcoal kiln that is more durable than the existing retort must be constructed.

APPENDIX A-9

TRAINING ACTIVITIES CONDUCTED UNDER THE IVES PROJECT

Phase	Training Conducted	Cooperating Agencies
1	Seminar on Cottage Industries (solar dryer, food preservation, and charcoal making)	Philippine Women's University Pinamuk-an Samahang Nayon Municipal Development Staff
Comment: Based on feedbacks from participants, the seminar was well-appreciated and understood.		
2 & 3	Plant Personnel Training (operation and maintenance of the gasifier, generator, and ice plant)	Energy Research and Development Center (ERDC)
Comment: The plant personnel's operation of the facilities and maintenance of equipment indicate the effectivity of the program.		
2 & 3	Technical and Administrative Aspects of Project Operation Biogas Technology Piggery Management Swine Feed Formulation Azolla for Animal Feed and Organic Fertilizer Ipil-ipil as Feeds and Fuel	ERDC
Comment: The seminars provided residents with information on technologies which they could employ to generate additional income.		

Phase	Training Conducted	Cooperating Agencies
4	Consumer Service Cooperative	Ministry of Agriculture and Food (MAF)

Comment: A total of 50 residents attended the seminar. The MAF personnel handled the lecture sessions; the PNOC/ERDC provided the food and logistics, arranged for the venue, and facilitated the whole program. The organization of the residents into a service cooperative was the main highlight of the seminar. Seven members of the board of directors were elected and a membership fee of ₱60 was set in order for the cooperative to be registered.

The seminar was conducted in preparation for the turn-over of the project to the residents of Barangay Pinamuk-an, New Washington, Aklan. Information brochures in Tagalog and the native dialect were distributed to the residents.

APPENDIX A-10

ILLUSTRATIVE GRADUATE PROGRAMS IN ENERGY ENGINEERING
UNIVERSITY OF THE PHILIPPINES-COLLEGE OF ENGINEERING

1.0 M.S. (Energy Engineering), Plan A

Course No.	Descriptive Title	Units
Subjects in the major field:		
Energy 201	Energy Resources and Uses	3
Energy 211	Energy Conservation	3
Energy 231	Energy Economics and Systems Evaluation	3
Energy 232	Energy Systems Modeling and Design	3
Energy 251	Advanced Thermodynamics	3
	Subtotal	15
Applied Mathematics:		
E.S 201	Advanced Mathematical Methods in Engineering I	3
E.S. 202	Advanced Mathematical Methods in Engineering II	3
or E.S. 204	Numerical Methods in Engineering	
	Subtotal	6
Elective (to be chosen with the approval of the Program Adviser)		3
Thesis:		
Energy 300	Thesis	6
Internship		0
	Grand Total	30

2.0 M.S. (Energy Engineering), Plan B

Course No.	Descriptive Title	Units
Subjects in the major fields:		
Energy 201	Energy Resources and Uses	3
Energy 211	Energy Conservation	3
Energy 222	Biomass Energy	3
M. E. 251	Advanced Thermodynamics	3
M. E. 252	Advanced Gas Dynamics	3
M. E. 253	Combustion	3
M. E. 254	Fuels and Heat Power	3
	Subtotal	21
Applied Mathematics:		
E. S. 201	Advanced Mathematical Methods in Eng'g I	3
E. S. 202	Advanced Mathematical Methods in Eng'g II	
or E. S. 204	Numerical Methods in Engineering	3
	Subtotal	6
Electives:		
Econ. 291	Development Economics	3
P. A. 241	Public Policy and Program Administration	3
Energy 231	Energy Economics and Systems Evaluation	3
	Subtotal	9
Internship		0
	Grand Total	36

3.0 Ph.D. (Energy Engineering)

		Units	Remarks
FIRST YEAR			
1st Semester			
Energy 201:	Energy Resources and Uses	3	C
Energy 211:	Energy Conservation	3	C
M. E. 251:	Advanced Thermodynamics	3	C
E. S. 201:	Adv. Math. Methods in Eng'g I	3	M
		12	
2nd Semester			
Energy 231:	Energy Economics and Systems Evaluation	3	C
E. S. 204:	Numerical Methods in Engineering	3	M
Specialty Course		3	S
Specialty Course		3	S
		12	
SECOND YEAR			
1st Semester			
Ch. E. 242:	Adv. Heat Transmission	3	C
E. S. 202:	Adv. Math. Methods in Eng'g II	3	M
Specialty Course		3	S
Elective		3	E
		12	
2nd Semester			
Energy 232:	Energy Systems Modeling & Design	3	C
Energy 290:	Special Project	3	SP
Elective		3	E
		9	
THIRD AND FOURTH YEARS			
Internship (One Semester)		0	
Energy 400:	Ph.D. Dissertation	12	

Legend: C - Core Course; M - Adv. Math. Course; S - Specialty Course; E - Elective; SP - Special Project

Electives - To be chosen with the approval of the Program Committee from graduate courses in such fields as Engineering, Mathematics, Physics, Chemistry, Economics, Public Administration, Business Administration and Management, Statistics, Social Work and Community Development, and Environmental Planning.

APPENDIX A-11

PROPOSED ENERGY AND ENVIRONMENTAL RESEARCH PROGRAM
UNIVERSITY OF THE PHILIPPINES-COLLEGE OF ENGINEERING

MISSION OF THE PROGRAM

The proposed program is envisioned to enable the University to fulfill its threefold mission of teaching, research and extension services in the fields of Energy and Environmental Engineering. A mutual reinforcement of these three functions is anticipated under the program.

This program, in cooperation with other units of the University, is committed to do the following:

1. Teaching Mission

    1.1 Provide a research-oriented faculty for the academic courses required by the graduate programs in Energy and Environmental Engineering.

    1.2 Prepare and implement development plans for Research Laboratories in Energy and Environmental Engineering.

2. Research Mission

    2.1 Undertake research and development, with or without funding, on the following topics:

        2.1.1 Rural energy planning methodologies
        2.1.2 Computer software for energy and environmental analysis

            a. Optimization techniques
            b. Forecasting
            c. Planning models

        2.1.3 Analysis of information and data on energy and environmental issues
        2.1.4 Continuing survey of manpower needs in Energy and Environmental Engineering

    2.2 Develop research (laboratory investigations or

field tests or both) proposals on the following topics for external funding:

2.2.1 Renewable energy technologies, such as solar, biomass, and wind
2.2.2 Coal utilization
2.2.3 Environmental management

3. Extension Service Mission

3.1 Play a critical role in national issues concerning energy and environment. These issues include:

3.1.1 Electricity pricing
3.2.2 National energy plans
3.2.3 Environmental standards and policies
3.2.4 Energy technologies--cost/benefit analysis, environmental risks and others.

3.2 Publish primers and monographs and develop training courses and materials on energy and environmental topics.

3.3 Establish institutional linkages and solicit external funding support.

APPENDIX A-12

FINDINGS AND RECOMMENDATIONS
SURVEY ON GASIFIERS

The following findings and recommendations are based on a survey of 64 independently financed gasifiers in the Philippines which was conducted by the Sycip, Gorres, Velayo, & Co. and DCCD Engineering Corp. in 1985.

FINDINGS

a) Engines coupled to gasifiers appear to be generally oversized for the power requirements for which the gasifier system is being used.

b) Gasifiers field tested do not actually generate cost savings when compared with alternative systems that can deliver the same required power output (see Table A-12.1).

c) There seems to be a general lack of technical field support on the current gasifier program. Technical support is needed in the operation of gasifiers relating to the reactor, gas-cooling system, and filtration.

d) Improvements are needed on the current features of available gasifiers in the market.

RECOMMENDATIONS

a) Conduct further studies on the proper matching and deration factors in running gasifier system with available and inexpensive engines and load-factor requirements.

b) Conduct further studies to improve the performance of existing gasifiers through improvement in the filtration system. The incorporation of a water or oil bath scrubber may also be considered.

c) Institute a more widespread technical service support system for gasifier users.

d) Install instruments, such as temperature and pressure gauges, to monitor the performance and efficiency of the gasifier system.

TABLE A-12.1

COMPARISON OF OPERATING, MAINTENANCE, AND AMORTIZATION COSTS OF EXISTING GASIFIER SYSTEM, ALTERNATIVE CONVENTIONAL ENGINE AND ALTERNATIVE CONVENTIONAL ENGINE CONNECTED TO GASIFIER (COST/HOUR)

SITE (Drive Equipment)	ALTERNATIVE I Existing Gasifier System				ALTERNATIVE II Conventional Engine				ALTERNATIVE III Conventional Engine Connected to a Gasifier			
	OPERATING COST	MAINTENANCE COST	AMORTIZATION COST	TOTAL	OPERATING COST	MAINTENANCE COST	AMORTIZATION COST	TOTAL	OPERATING COST	MAINTENANCE COST	AMORTIZATION COST	TOTAL
1. FPFE (Generator)	P51.73	P4.16	P28.22	P84.11	P50.29	P1.88	P12.00	P64.17	P45.84	P3.79	P40.03	P89.66
2. Hacienda Cristina (Generater)	18.88	2.22	9.92	31.03	15.00	1.13	5.38	21.51	12.03	2.38	13.85	28.26
3. Hacienda Cristina (Pump)	44.90	3.68	12.03	60.61	44.66	1.88	12.00	58.54	35.96	3.31	21.71	60.98
4. Hacienda Malaga (Generator)	31.39	3.68	12.03	47.10	22.45	1.74	11.36	35.55	18.03	3.17	21.07	42.27
5. Gamboa Hermanos, Inc. (Rice Mill)	23.75	3.71	16.94	44.40	28.69	1.74	11.36	41.79	22.60	3.17	21.07	46.84
6. Gamboa Hermanos, Inc.	78.45	3.32	15.74	97.51	70.82	2.12	16.94	89.88	55.50	3.16	24.00	82.66

Assumptions:

1. Local prices are used for fuel, charcoal, and lube oil.
2. Alternative engine used with gasifier is derated by 15%.
3. Gasifier with alternative engine runs on 50% diesel and 50% charcoal.
4. Gasifiers and engines are amortized as follows:
   - Gasifier - 25% over 6 years
   - Existing engine - 25% over 2 years
   - Alternative engine - 25% over 6 years
5. Number of operating hours per year is 2,400 hours.

e) Undertake a study to determine appropriate insulation material and applications for the reactor to avoid spot reddening and chipped-off insulation.

f) Undertake studies on the gas cooling system to prevent overheating of the engine.

g) Study changes in the fasteners of covers (from bolts to wing nuts or hand wheels) for the filters, and reactor and grate covers to remove these more easily for inspection and cleaning.

APPENDIX A-13

POTENTIAL BIOMASS FUELS IN SELECTED PROVINCES
SUMMARY OF ASSESSMENT RESULTS

1. ILOILO PROVINCE

RESOURCE	HEATING VALUE (BTU/LB) DRY BASIS	GENERATION/ PRODUCTION (MT/YR or B.O.E.) [1]	NET AVAILABLE (MT/YR or B.O.E.)	UTILIZATION (MT/YR or B.O.E.)	SELLING PRICE (Pesos)
COCOHUSK	8096.00	21735.85 55654.64	6999.20 15252.59	14736.65	620.00/TON 650-DELIV.
COCOSHELL	8453.70	9781.13 29217.22	1190.66 3552.72	8590.47	.65/KGP.U. .85/KG DEL.
RICE HULL	6153.00	87575.53 (P) [2] 98805.69 (R)	[3] -	2343.36	-
RICE STRAW	7506.00	875755.03	-	1314.35	-
BAGASSE	-	422034.73	NO EXCESS	422034.73	NOT SOLD
FIREWOOD	8478.00	2797 CU.M.	-	575671.00	-
WOOD CHARCOAL	13474.00	-	-	38754.83	20.54 PER SACK
ANIMAL DUNG					NOT SOLD
- HOGS	-	587173.14	-	-	-
- CATTLE	-	74228.29	-	-	-
- POULTRY	-	7930.91	-	-	-
- CARABAO	-	575873.52	-	-	-
- DUCK	-	270679.57	-	-	-

1/ B.O.E. - BARREL OF OIL EQUIVALENT
2/ P - RICEHULL PRODUCTION FROM PALAY TURNOVER
R - RICEHULL PRODUCTION FROM RICEMILLS
3/ NO DATA AVAILABLE

2. BATANGAS PROVINCE

RESOURCE	HEATING VALUE (BTU/LB) DRY BASIS	GENERATION/ PRODUCTION (MT/YR or B.O.E.)	NET AVAILABLE (MT/YR or B.O.E.)	UTILIZATION (MT/YR or B.O.E.)	SELLING PRICE (Pesos)
COCOHUSK	8234.00	15199.24 38712.86	2039.75 6092.96	484.93KG/USER-YR	-
COCOSHELL	8383.00	6803.60 20323.22	5140.30 13161.74	733.14KG/USER-YR	-
COCOSHELL (CHARCOAL)	13507.00	-	-	23.13KG/USER-YR	-
RICE HULL	5865.75	18989.51	33551.66	80.01	-
RICE STRAW	6026.50	334481.77	-	415735.00	-
BAGASSE	-	420875.67	5140.45	11374.00	NOT SOLD
FIREWOOD	8220.00	-	-	175765.75	3.00/BUNDLE
WOOD CHARCOAL	11758.00	-	-	17593.44	-
ANIMAL DUNG	-	-	1009733	-	-
- HOGS	-	408644.50	-	-	-
- CATTLE	-	335490.00	-	-	-
- POULTRY	-	129734.00	-	-	300-500 PER
- CARABAO	-	135576.00	-	-	TRUCKLOAD
- DUCK	-	288.05	-	-	

3. QUEZON PROVINCE

RESOURCE	HEATING VALUE (BTU/LB) DRY BASIS	GENERATION/ PRODUCTION (MT/YR or B.O.E.)	NET AVAILABLE (MT/YR or B.O.E.)	UTILIZATION (MT/YR or B.O.E.)	SELLING PRICE (Pesos)
COCOHUSK	8301.88	368839.13 944228.04	254939.69 652773.08	1515 KG/USER-YR	35-44/TON
COCOSHELL	8696.75	165977.52 495791.27	56584.87 169024.60	602.09 KG/USER-YR	.60/KG
COCOSHELL (CHARCOAL)	13614.00	-	-	22.19 KG/USER-YR	1.80/KG
RICE HULL	6118.00	41454.85 (P) 20098.50 (R)	- -	- -	- -
RICE STRAW	5978.00	414548.50	-	-	-
FIREWOOD	8615.00	-	-	26438.00	10/SACK
WOOD CHARCOAL	-	-	-	6026.90	13.40/SACK
ANIMAL DUNG					
- HOGS	-	2961791.04	-	-	4.50-10.00
- CATTLE	-	543398.39	-	-	PER SACK
- CARABAO	-	589288.51	-	-	
- POULTRY	-	41623.13	-	-	

NO BAGASSE FIGURES BECAUSE THERE IS NO SUGARMILL IN QUEZON.

4. LAGUNA PROVINCE

RESOURCE	HEATING VALUE (BTU/LB) DRY BASIS	GENERATION/ PRODUCTION (MT/YR or B.O.E.)	NET AVAILABLE (MT/YR or B.O.E.)	UTILIZATION (MT/YR or B.O.E)	SELLING PRICE (Pesos)
COCOHUSK	8263.31	140085.63 358689.28	138702.70 355148.27	1382.93 3541.64	2/KG
COCOSHELL	8846.00	63038.61 188302.58	45992.30 137384.62	17127.53 51416.90	2/KG
COCOSHELL (CHARCOAL)	13453.00	-	-	-	4/KG
RICE HULL	5959.60	30150.75 (P) 31404.07 (R)	11455 (P) 12708.51 (R)	18695.57 5884.23	- -
RICE STRAW	5993.00	302082.55	296196.32	-	-
BAGASSE		82-83/225138 83-84/208996	NO EXCESS 6926.99	225138.63 208069.03	NOT SOLD
FIREWOOD	8306.00	3714.62	-	125058.09	-
WOOD CHARCOAL		-	-	37455.35	-
ANIMAL DUNG	-	-	-	-	NOT SOLD
- HOGS	-	661115.34	-	-	-
- CATTLE	-	39929.43	-	-	-
- POULTRY	-	95985.85	-	-	-
- CARABAO	-	40380.84	-	-	-
- DUCK	-	13824.74	-	-	-

5. CAVITE PROVINCE

RESOURCE	HEATING VALUE (BTU/LB) DRY BASIS	GENERATION/ PRODUCTION (MT/YR or B.O.E.)	NET AVAILABLE (MT/YR or B.O.E.)	UTILIZATION (MT/YR or B.O.E.)	SELLING PRICE (Pesos)
COCOHUSK	-	22036.91 56425.49	-	COCONUT RESIDUES ARE NOT WIDELY USED IN CAVITE	-
COCOSHELL	-	9916.63 29621.96	-		-
COCOSHELL (CHARCOAL)	-	-	-	-	-
RICE HULL	-	13265.811	-	-	-
RICE STRAW	-	8032.0623	-	56.347	-
BAGASSE	-	-	-	-	-
FIREWOOD	-	495.29	-	111295.82 HH 289.53 SERVICES 3692.5 MFG. 11.09 AN. FARMS	
WOOD CHARCOAL	-	-	-	-	-
BIOGAS					
- HOGS	-	65544.48	-	-	-
- CATTLE	-	61281.01	-	-	-
- POULTRY	-	5788.65	-	-	-
- CARABAO	-	35480.78	-	-	-
- DUCK	-	292.40	-	-	-

Source: BED/NCRD Monitorer's Report, 1986. The data were taken from a study conducted by the ERDC under subproject AID 7814-G.

APPENDIX A-14

SAMPLE MEMORANDUM OF AGREEMENT
(THE IVES PROJECT)

MEMORANDUM OF AGREEMENT
BED Project No. AID-7807-L

KNOW ALL MEN BY THESE PRESENTS:

This agreement entered into and executed this day of , 1983 at Merritt Road, Fort Bonifacio, Metro Manila, Philippines, by and between:

The BUREAU OF ENERGY DEVELOPMENT, hereinafter referred to as the BED, with principal office at Merrit Road, Fort Bonifacio, Metro Manila, Philippines, represented in this Agreement by its Acting Director, ATTY. WENCESLAO R. DE LA PAZ;

-and-

The PHILIPPINE NATIONAL OIL COMPANY-Energy Research and Development Division, hereinafter referred to as the Proponent, with principal office at Don Mariano Marcos Avenue, Diliman, Quezon City, Philippines, represented in this Agreement by its Manager, DR. IBARRA E. CRUZ;

W I T N E S S E T H

WHEREAS, the BED is mandated by law to undertake a continuing national program for the development of indigenous cenergy resources with the overall objective of achieving self-reliance with the country's energy needs;

WHEREAS, the Philippine National Oil Company-Energy Research and Development Division has been created principally with the task of conducting energy research as needed by its various units and as contracted by external agencies;

WHEREAS, the Proponent has proposed to conduct a project which is considered highly relevant to the BED program, and that the Proponent is willing and able to undertake the implementation of the project;

NOW, THEREFORE, in consideration of the above premises and their mutual convenants hereinafter set forth, the parties have agreed as follows:

1. PROJECT TITLE: The said project, which is more particularly described in the Project Proposal hereto attached as

Annex "A" and made an integral part hereof, shall be known as BED Project No. AID-7807-L entitled "Integrated Village Energy System (IVES)". (Annex A is not included in this report).

2. OBJECTIVES OF THE PROJECT: The Project shall essentially have the following objectives:

a. Develop and apply a generalized methodology to demonstrate and transfer potential applications of integrated renewable energy technologies to rural Philippine villages;

b. Develop and supply a generalized methodology for village participation in all aspects of the technology definition, implementation and operational program including the design, construction, operation, maintenance and evaluation of the system;

c. Demonstrate appropriate integrated renewable energy technologies in a village setting, within the context of available village resources;

d. Develop a methodology for monitoring and evaluating the technical performance of the system as well as the changes in the economic, sociocultural and ecological spheres;

e. Provide both technical and non-technical inputs for possible replication of the integrated renewable energy concept, where applicable, elsewhere.

3. OBLIGATION OF THE BED:

a. The BED shall provide financial assistance to the project in the amount of TWO MILLION FIVE HUNDRED FOUR THOUSAND SIX HUNDRED TWENTY FOUR PESOS (P2,504,624.00). TWO MILLION THREE HUNDRED SEVENTY TWO THOUSAND SIX HUNDRED TWENTY FOUR PESOS (P2,372,624.00) of this financial assistance shall be chargeable against the loan component of the USAID-GOP Joint Project on Nonconventional Energy Development for which BED is the overall coordinator for the Philippines. The balance of ONE HUNDRED THIRTY TWO THOUSAND PESOS (P132,000.00) shall be chargeable against the GOP Counterpart Fund for the USAID-GOP Joint Project on Nonconventional Energy Development. All of the above funds shall be disbursed by BED to PNOC-ERDD in accordance with the Disbursement Schedule hereto attached as Annex "B" (This Annex is not included in the report.) subject to the proper bonding of the Project Director or his duly designated representative, in compliance with government accounting and auditing rules and regulations, other pertinent policies of the BED and the submission of the project reports stated in Article 4 of this Agreement.

b. the BED shall provide at no cost to the Proponent:

(1) Technical assistance relevant to the pursuit of the Project from personnel within the BED with the necessary expertise, as available;

(2) Consultation with foreign experts brought to the country by BED in connection with the present Project or other projects within the Program, as available;

(3) The use of BED's technical and library facilities for specific work items certified by BED to be directly relevant to the conduct of the project;

(4) Assistance in coordinating with other government agencies in matters requiring their attention or cooperation insofar as these are directly relevant to the Project and as are within the capability of the BED.

4. OBLIGATIONS OF THE PROPONENT:

a. The Proponent shall provide a counterpart fund of not less than TWO HUNDRED EIGHTEEN THOUSAND SIX HUNDRED FIFTY PESOS (P218,650.00) for relevant personnel services, equipment, supplies, etc. as stipulated in the Project Proposal, hereto attached as Annex "A".

b. The Proponent, through the Project Director shall:

(1) Exert all efforts to attain the general and and specific objectives of the Project as stated in this Agreement and in the Project Proposal within the stipulated time period of three (3) years beginning on the month the first schedule of funds is released to the Proponent;

(2) Keep a complete and factual account of the daily activity, operation and progress of the Project, including data actually taken in a logbook or other appropriate form, which shall be open for inspection at any time by the representatives of BED. During monitoring, observation and inspection, BED representatives shall be allowed free access to the project site;

(3) Submit to the BED every three (3) months as required by BED reports on:

(a) Expenditures of BED funds, duly supported by receipts certified by the accoun-

ting officer and verified correct by the COA representative for the proponent agency, if any. The financial reports shall include an accounting of expenditures made out of the Proponent's counterpart fund for the Project.

(b) State of usability of apparatus, equipment and other facilities forming part of the BED assistance to the Project.

(c) The progress of the Project containing all relevant technical findings, activities, work accomplishments and problems in accordance with Project Implementation Schedule and Milestones Schedule.

(4) Submit to BED comprehensive annual report in publishable form within one month from the last day of the project year;

(5) Ensure the Project's continuity by securing BED's approval before allowing senior project personnel, including the Project Director, from leaving his station for abroad or for another assignment involving a period of more than ten (10) consecutive days;

(6) Submit to the BED within sixty (60) days from the completion of the Project:

(a) A comprehensive Technical Report in the prescribed publishable Final Report Form in thirty (30) copies which shall indicate among others, technical findings and problems encountered.

(b) The Financial Report of all disbursements made out of the funds herein granted together with all supporting receipts/documents certified by the accounting officer and verified correct by the COA representative for the Proponent agency.

(c) The Proponent is hereby authorized to sub-contract whole or in part its undertakings under this Agreement to an Agency which it may deem competent, provided that nothing herein contained shall free or release the Proponent from complete and satisfactory performance of its undertaking and obligations under this Agreement.

5. PROJECT PERSONNEL: The Project Personnel shall be hired by the Project Director on a contractual basis consistent with the provisions of this Agreement, the approved Project Proposal and BED Circular No. 10 hereto attached as Annex "C" (This Annex is not included in the report.) and made an integral part hereof; Provided, however, that the Project Director shall submit to the BED a copy of such contract together with the job description and qualification guides of the position involved. It is understood that the services of all Project Personnel shall be discontinued upon the termination of the Project.

6. OWNERSHIP OF PROPERTIES: All non-expendable materials and properties purchased out of funds granted by the BED for the project shall exclusively belong to the BED. They shall be inventoried and copy of such inventory furnished to the BED within thirty (30) days from the date of purchase, provided that all non-expendable materials and properties purchased for the Project out of funds granted by the BED shall be marked as such.

7. INSURANCE: The Proponent shall secure and maintain in the name of BED appropriate insurance for all non-expendable properties purchased out of funds granted by the BED or for such assistance directly granted by the BED in-kind immediately upon receipt of such properties against appropriate losses such as fire, theft, etc. in an amount not less than the amount or cost of such properties, from the Government Service Insurance System. The policy shall thereafter be delivered to the BED. The insurance premium shall be shouldered by BED's fund release to the Project.

8. RIGHT TO DISCOVERIES AND INVENTIONS: Right to discoveries and inventions arising directly out of the conduct of the present Project shall be governed by the provisions contained in Annex "D" which is made an integral part hereof. (This Annex is included in the report)

9. COMPLIANCE WITH PROJECT AGREEMENT: The Parties hereto understand that the funding made available under the USAID-GOP Joint Project on Nonconventional Energy Development is subject to the terms and conditions of the Project Agreement under which the funds are provided, and the Proponent shall comply with all such applicable terms and conditions including the requirement to maintain books and records on this project for the life of the project and three years thereafter.

10. COMPLIANCE WITH LAWS: The Proponent shall comply with all laws, local or national, city or municipal ordinance, building and construction codes, and all government regulations insofar as they are binding upon or affect the parties hereto, the work or those engaged thereon, and shall obtain the required

licenses and be responsible for all damages to person or properties which may occur in connection with the prosecution of the Project.

11. CLAIMS OF PERSONNEL: The Proponent or personnel hired under this Agreement shall hold BED safe and free from all and any liability, suits, actions, demands, damage, cost of personnel or properties or properties of any loss resulting from or caused out of the Project under this Agreement, or any loss or death of or injuries to other persons and/or their properties resulting from or caused by the fault or negligence of the Proponent or its personnel under the Project.

12. FIDELITY BOND: The Project Director or his duly designated representative hereby agrees and binds himself to put up in favor of the BED immediately upon the execution of this Agreement, a Fidelity Bond from the Bureau of Treasury the amount equal to the amount granted by the BED for the faithful performance of its undertakings in this Agreement. BED agrees and binds itself to release and cancel said bond thirty (30) days upon completion of the Project and upon submission of all required reports.

13. WARRANTY CLAUSE: The Proponent hereby warrants that it or any of its officials or representatives has/have not given or promised to give any money or gift to any employee/official of the BED to influence the decision regarding the awarding of this Agreement, nor the Proponent has or its officials or representatives have exerted or utilized any unlawful influence to solicit or secure this Agreement, through an agreement to a pay commission, percentage, brokerage or contingent fee. The Proponent agrees hereby that breach of this warranty shall be sufficient ground for the BED, either at the BED's discretion, to terminate or cancel this Agreement or to deduct such commission, percentage, brokerage or contingent fee from the contract price without prejudice to the Proponent's or any other person's civil or criminal liability under the Anti-Graft Law and other applicable laws.

14. EFFECTIVITY: The effectivity of this Agreement shall be subject to the availability of funds.

IN WITNESS HEREOF, the parties hereunder set their hands on the date and place first above written:

BUREAU OF ENERGY DEVELOPMENT

By:

WENCESLAO R. DE LA PAZ
Acting Director

PNOC-ENERGY RESEARCH AND DEVELOPMENT CENTER

By:

IBARRA E. CRUZ
Manager

SIGNED IN THE PRESENCE OF:

GREGORIO U. KILAYKO
OIC, BED-NCRD

ZENAIDA R. MONDEJAR
Acting Section Head
Project Monitoring
& Evaluation Section

MARCELO L. TECSON
Acting Chief
BED Accounting Division

ANNEX D for Appendix A-14

RIGHTS TO DISCOVERIES AND INVENTIONS

Discoveries and inventions arising directly out of the conduct of projects financially assisted by the BED shall be owned (1) by the government of the Republic of the Philippines through the BED and the PROPONENT in case the PROPONENT is a government institution; or (2) by the PROPONENT in case the PROPONENT is a private entity, which shall have a free industrial and commercial disposition thereof, provided, however, that the PROPONENT turns over to the BED a royalty in an amount not exceeding fifty percent (50%), to be determined by the BED, of the benefits of all nature which the exploitation of the said discoveries and inventions will bring about in whatever country in any form be it sale of patents, concessions of license, direct exploitation, shares of stocks in a corporation, etc; provided, further, that the PROPONENT pledges and binds himself or itself (1) to submit to the BED all contracts concerning the sales of his or its patents or concessions of licenses and not to enter into any contract without obtaining the written consent of the BED, (2) in case of shares of stocks in any corporation, to transfer to the BED not exceeding fifty percent (50%) of the rights of all nature which will be conferred to him or it as renumeration for his or its shares of stocks, and (3) to make mention of the provisions of this agreement in any contract he or it may enter into, be it sale of patents or concessions of license of all nature and to stipulate that the buyers and concessionaires shall pay directly to the BED the aforesaid royalty which does not exceed fifty percent (50%).

In executing the present Memorandum of Agreement, the PROPONENT agrees to represent that each of his or its staff member has entered into a contract of employment wherein the PROPONENT and each staff member shall:

1. Bind himself and his heirs, successors and assigns that any and all discoveries and inventions which he solely or jointly with others, has conceived or made, or thereafter may conceive or make, during the period of his employment by the BED and/or proponent pertaining to or resulting from or suggested by (a) any work which he has done, or thereafter may do, in connection with his employment by the BED and/or Proponent or (b) any of matters which, during the period of his employment, has been or hereafter shall be the subject of experimentation or investigation shall be the property of the BED and/or Proponent pursuant to Article 8 of this agreement; and to that end, assign or agree to assign to the BED and/or PROPONENT all such inventions and discoveries and to

agree from time to time, at the request of the BED and/or PROPONENT to sign any and all instruments of assignment or transfer which may be reasonably requested to him in order that the intent hereof may be fully carried into effect;

2. Promptly disclose and deliver to the duly designated representative or representatives of the BED and/or PROPONENT all information and data at any time in his possessions necessary to impart a full understanding of said discoveries and inventions; and not to disclose or deliver any such information or data to any other person or persons unless authorized in writing by the BED and/or PROPONENT;

3. Assist the BED and/or PROPONENT in every way in obtaining and enforcing patents for the benefit of the BED and/or PROPONENT covering the said discovery or invention in any and all countries, and to that end, execute and deliver to the BED, PROPONENT and/or sponsor any services needed in connection with the prosecution of any application for patents, and any interferences and/or litigation involving the same or any patent or patents issued therefrom even beyond the termination of his employment with the BED and/or PROPONENT;

4. Agree that these obligations shall be binding on his executors, administrators, and legal representatives and shall insure to the benefit of not only the BED and/or PROPONENT but also of the successors and assignees of the same.

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APPENDIX A-15

BENEFICIARIES OF THE PARTICIPANTS' TRAINING PROGRAM
USAID-GOP NONCONVENTIONAL ENERGY DEVELOPMENT PROJECT

PARTICIPANT	PROGRAM PARTICULARS
1. Domingo L. Siazon, Jr. Chief of Mission and Permanent Representative to the International Atomic Energy Agency (IAEA) and the UNIDO	Edward S. Mason Program in Economic Development, Harvard Unversity, 1979
2. Laurie Bautista Senior Project Engineer BED/NCRD	Denver, Colorado Host: Foundation for Urban and Neighborhood Development (FUND), Denver, Colorado, April 11 - May 19, 1979 Visited: San Luis Valley Solar Energy Association Sandia Laboratory Solar Energy Research Institute Rocky Flats Wind Systems Division Colorado State University solar facility Jackson Hole, Wyoming-FUND Training on Social Impact Assessment Soltec Denver Research Institute Atlanta, Georgia Host: Georgia Institute of Technology, Atlanta, Georgia, May 20 - June 20, 1979 Attended: 1. ISES Conference 2. Short courses on solar heating and cooling Visited : University of Florida - Dr. E. Farber

PARTICIPANT	PROGRAM PARTICULARS
	New Haven , Connecticut Host: Earth Metabolic Design, Inc., New Haven, Connecticut, June 21 - July 21, 1979 Attended: Appropriate Technology Training Program Visited : New Alchemy Institute, Woods Hole, Massachusetts The East Eleventh Street Project, New York Sunny Institute of Energy Research, Stony Brook, N.Y. Brookhaven National Laboratories Other solar installations
3. Francisco B. Sta. Ana Senior Test Engineer BED/NCRD	Georgia, Atlanta Host: Georgia Institute of Technology Georgia, Atlanta, May 20 - June 20, 1979 New Haven, Connecticut Host: Earth Metabolic Design, Inc., New Haven, Connecticut, June 21 - July 21, 1979 San Francisco, California Host: Farallones Institute, San Francisco, California, July 21 - August 8, 1981 Visited: Rural Center, Farallones Institute, Occidental, CA Energy Incorporated, Cover D'Alene, Idaho
4. Ernesto Balleser Draftsman/Cartographer BED Technical Services	Training on Solar Architecture: Architecture firm of Jim Pearson, Honolulu, Hawaii, July 5 - 28, 1979 California Office of Appropriate Technology, July 30 - August 31, 1979

PARTICIPANT	PROGRAM PARTICULARS
5. Ramon Benet 6. Zenaida Mondejar 7. Rosalinda Polida BED/NCRD	Training on Alternative Energy Development, Georgia Institute of Technology Atlanta, Georgia, September 30 - December 21, 1979
8. Aldwyn Santos BED/NCRD	Energy Management Training, State University of New York Stony Brook, N. Y., September 12 - November 14, 1979 Training on Alternative Energy Development, Georgia Institute of Technology, Atlanta, Georgia, November 14 - December 21, 1979
9. Ma. Cristina Baticados Renato Cayetano BED/NCRD	Alternative Energy Development Course, Georgia Institute of Technology, Atlanta, Georgia, June 1 - August 23, 1980
10. Angelito V. Agoncillo Legal Officer BED	Solar Law Course, University of Colorado, Boulder, Colorado, January to March, 1981
11. Sergio Macasieb Systems Development Engineer National Power Corporation	Training Program in Utility Application of New and Renewable Energy Technologies Olympic Associates, Co. Seattle, Washington August 17 - September 10, 1980

PARTICIPANT	PROGRAM PARTICULARS
12. Marcelo L. Tecson Chief, Finance Division Ministry of Energy	Financial Tracking and Reporting Systems Management (February, 1981) a. Solar Energy Research Institute, Golden, Colorado b. Bonneville Power Administration c. Seattle City Light
13. Gregorio U. Kilayco BED/NCRD	M.S. in Energy Management and Policy and Master's in Business Administration, Wharton School of Business, University of Pennsylvania January 1980-December 1981
14. Gricela Reyes BED/NCRD	M.S. in Energy Management and Policy University of Pennsylvania January 1981-December 1982
15. Elpidio Gamboa Chief Negotiations Division, BED	Course on Oil and Gas Law and Taxation Host: Southwestern Legal Foundation, University of Texas
16. Noel Ventigan Philippine National Alcohol Commission	USAID Nonconventional Energy Training Program Muscatine, Iowa, U.S.A.
17. Ernesto del Rosario BIOTECH	Observation of Alcohol Distilleries and Fermentation Research, April 25-June 1985 Host: Brazil Familiarization with New Brunswick Equipment, United States Host: Cornell University - Observation of Current Alcohol Fermentation Research Georgia Institute of Technology

PARTICIPANT	PROGRAM PARTICULARS
18. Arturo Hernandez MERALCO 19. Antonio Ingco National Power Corporation	USAID Nonconventional Energy Training Program in Cogeneration Technology, July 15-August 30, 1985 Host: Muscatine, Iowa, U.S.A
20. Ferdinand Manegdeg UPCE	UP-UW Interdisciplinary Graduate Program in Energy, Ph.D. Fellowship, University of Wisconsin, April 1984 - December 1986
21. Rolando P. Dayco 22. Fernando A. Pecso 23. Edwin N. Quiros University of the Philippines	UP-UW Interdisciplinary Graduate Program in Energy, MS/Ph.D. Thesis Support, University of Winconsin, April 1985 - December 1986
24. Nestor Rañeses University of the Philippines	UP-UW Interdisciplinary Graduate Program in Energy, Faculty Training, University of Wisconsin, April 1984 - May 1984; September 1985 - December 1985
25. Ruben Garcia University of the Philippines	UP-UW Interdisciplinary Graduate Program in Energy, Faculty Training, University of Wisconsin, Autumn 1981
26. Teodoro Festin 27. Leonardo Liongson 28. Francisco Viray University of the Philippines	UP-UW Interdisciplinary Graduate Program in Energy, Faculty Training, University of Winconsin, April 1984-May 1984

PARTICIPANT	PROGRAM PARTICULARS
29. Mark Quebral BED/NCRD	UP-UW Interdisciplinary Graduate Program in Energy, MS/Ph.D. Thesis Support
30. Inigo Camacho 31. Valentino Tiangco IRRI	UP-UW Interdisciplinary Graduate Program in Energy, MS/Ph.D. Thesis Support, University of California at Davis, July 1985 - December 1986

APPENDIX A-16

SUMMARY OF NEW PROPOSALS
SUBMITTED BY THE ENERGY RESEARCH AND DEVELOPMENT CENTER (ERDC)

1.0 Project Title : Utilization and Evaluation of Locally Developed Fuel-Saving and Alternative Fuels for Internal Combustion Engines

Project Duration : Three years

Specific Objectives

1. To provide an equitable and exhaustive battery of tests through which a fuel-saving device or nonconventional fuel blend might be granted official sanction for public consumption;

2. To discourage the proliferation of cheap imitations, useless engine and-ons, and fakes in the local market;

3. To provide some assistance to local developers and inventors of technically and economically viable products so that such products may be refined and improved;

4. To enhance the development of these and similar products by showing the government's concern for the industry;

5. To provide a mechanism by which these devices and nonconventional fuels might be properly documented--to facilitate the dissemination of information to the general public; and

6. To indirectly promote the widespread application of selected devices and alternative fuels, or both, and promote fuel savings.

2.0 PROJECT TITLE : Performance and Endurance Testing of a Direct-Heat Gas Producer System

PROJECT DURATION : 12 months, starting October 1986.

Specific Objectives

1. To conduct performance tests in order to establish the operating characteristics of the direct-heat gas producer system fabricated under the UNDP/BED-funded

project on "Assistance to Energy Production from Biomass Materials (Phase B)";

2. To determine the reliability and safety of direct-heat gasifier systems over an extended period of time, through the conduct of a 24-hour-per-day endurance test on the same gas producer system; and

3. To establish the preliminary economics of direct-heat gasifier systems using the results of the performance and endurance tests, as well as primary data obtained from surveys on actual furnace and boiler operations in various companies.

3.0 PROJECT TITLE : Development of Small Gas-Producer Systems

PROJECT DURATION : 36 months

Specific Objectives

1. To design simple and inexpensive gas producer systems appropriate for small internal combustion engines used in many rural and agricultural activities;

2. To conduct trial runs in the Gasifier Test Facility to determine the performance of the system under varying loads;

3. To conduct a survey in order to obtain operational data from potential recipients;

4. To install three pilot or demonstration units in various regions of the country in order to obtain operational data as well as to establish the acceptability of small gas producer systems;

5. To periodically evaluate the economic feasibility of small gas producer systems using data obtained from the test facility and the pilot units; and

6. To prepare case studies on the pilot units at the end of the project.

APPENDIX A-17

ACRONYMS

AA	-	Advice of Allotment
AERC	-	Agro-Energy Resources Corporation
AFP	-	Armed Forces of the Philippines
AIM	-	Asian Institute of Management
AMU	-	Ateneo de Manila University
BAI	-	Bureau of Animal Industry
BED	-	Bureau of Energy Development
BEU	-	Bureau of Energy Utilization
BIOTECH	-	National Institute of BioTechonology & Applied Microbiology
CDC	-	Cash Disbursement Ceiling
COMVOL	-	Commission on Volcanology
DLSU	-	De La Salle University
DSI	-	Development Sciences Inc.
EDC	-	Energy Development Corporation
EDF	-	Economic Development Foundation
ERDC	-	Energy Research and Development Center
ERDD	-	Energy Research & Development Division
ES	-	Earthman Society
FORI	-	Forest Research Institute
FPRDI	-	Forest Products Research & Development Institute
FSDC	-	Farm System Development Corporation
GIA	-	Grants-in-Aid

GOP	-	Government of the Philippines
HSC	-	Human Settlements Commission
IVES	-	Integrated Village Energy Systems
MAPECON	-	Manila Pest Control, Inc.
MEC	-	Ministry of Education and Culture
MERALCO	-	Manila Electric Company
MHS	-	Ministry of Human Settlements
MOE	-	Ministry of Energy
MOE/PS	-	Ministry of Energy/Planning Services
NCRD	-	Nonconventional Resources Division, Bureau of Energy Development
NEC	-	National Engineering Center
NFA	-	National Food Authority
NIST	-	National Institute of Science & Technology
NRMC	-	Natural Resources Management Center
NPC	-	National Power Corporation
NSTA	-	National Science and Technology Authority
PA	-	Public Affairs
PAEC	-	Philippine Atomic Energy Commission
PAGASA	-	Philippine Atmospheric, Geophysical, Astronomical Services Administration
PCIERD	-	Philippine Council for Industry and Energy Research and Development
PI	-	Project Implementor
PIC	-	Philippine Investors Commission
P&G-PMC	-	Proctor and Gamble-Philippine Manufacturing Corporation
PNAC	-	Philippine National Alcohol Commission

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PNOC	-	Philippine National Oil Company
PSB	-	Project Santa Barbara
PWU	-	Philippine Women's University
REAP	-	Renewable Energy Association of the Philippines
RF	-	Reliable Farms, Inc.
SGV	-	Sycip, Gorres, Velayo & Co.
SITECH	-	SITECH Resources Group, Inc. (SITECH stands for Systems Innovations with Technology, Education and Economics, Communications, and Human...Resources)
SMC	-	San Miguel Corporation
SU	-	Silliman University
TES	-	Trans Energy Systems
UDA	-	Urban Designers' Associates
UP	-	University of the Philippines
UPCE	-	UP College of Engineering
UPERDFI	-	UP Engineering Research & Development Foundation, Inc.
UPFI	-	UP Foundation, Inc.
UP/ISSI	-	UP Institute of Small-Scale Industries
UPLB	-	UP Los Baños
USC/WRC	-	University of San Carlos/Water Resources Center
UW-Madison	-	University of Wisconsin at Madison
ZFI	-	Zambayan Factors, Inc.

APPENDIX 18

SITECH'S EVALUATION TEAM

Dr. Corazon Pe Benito-Claudio, Project Director and Leader for Tasks 1, 4, 5, and 6; Chairman of the Board and President, SITECH Resources Group, Inc.

* Ph.D., Engineering-Economic Systems (Stanford University)
* M.S., Engineering-Economic Systems (Stanford University)
* ITP Certificate (Harvard University and International Schools of Management)
* M.B.A (Ateneo de Manila University)
* B.S., Chemical Engineering (Feati University)

Dr. Leopoldo Abis, Leader for Task 2, Associate Consultant; concurrently Executive Director, National Engineering Center, University of the Philippines.

* Ph.D., Mechanical Engineering (Kansas State University)
* M.S., Mechanical Engineering (Kansas State University)
* B.S., Mechanical Engineering (University of the Philippines)
* B.S., Electrical Engineering (University of the Philippines)

Professor Nestor Raneses, Leader for Task 3, Associate Consultant; concurrently Assistant Professor of Industrial Engineering, University of the Philippines - College of Engineering.

* M.S., Industrial Engineering and Operations Research (Georgia Institute of Technology)
* B.S., Industrial Engineering (University of the Philippines)

Engr. Ramon Abracosa, Assistant Leader for Task 6, Associate Consultant

* Ph.D. (cand.), Civil Engineering (Stanford University)
* M.S., Land and Water Resources Engineering (University of the Philippines)
* M.S., Civil Engineering (University of the Philippines)
* B.S., Agricultural Engineering (University of the Philippines)

Mr. Liberato de Lumen, Associate Consultant

* Graduate Diploma in Economics (Cambridge University)
* M.A., Economics (University of Connecticut)
* A.B., Economics (University of the Philippines)

Mrs. Celine A. Quinio, Director for Communications

* M.B.A. Studies (Ateneo de Manila University)
* M.A.(cand.), History (Ateneo de Manila University)
* A.B., History (Maryknoll College)

Engr. Eugene Refuerzo, Associate Consultant

* M.B.A. (University of the Philippines)
* M.A., Urban and Regional Planning (University of the Philippines)
* B.S., Mechanical Engineering (University of the Philippines)

Mr. Roberto A. Espino, Associate Consultant

* B.S., Geology (University of the Philippines)
* B.S., Chemical Research (Adamson University)

Ms. Rebecca Alvano, Staff Assistant

* B.S., Applied Economics (Polytechnic University of the Philippines)

Ms. Meda F. Yuson, Administrative Officer

* B.S., Business Administration (Philippine Women's University)

Ms. Teresalin C. Dayo, Administrative Assistant

* B.S., Business Administration (Philippine Women's University)