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## Abstracts of Energy Literature in the Pacific Region

May 1984

Compiled by  
Lynne Freeman

**ENERGY  
PROGRAM**

 East-West Center  
Honolulu, Hawaii



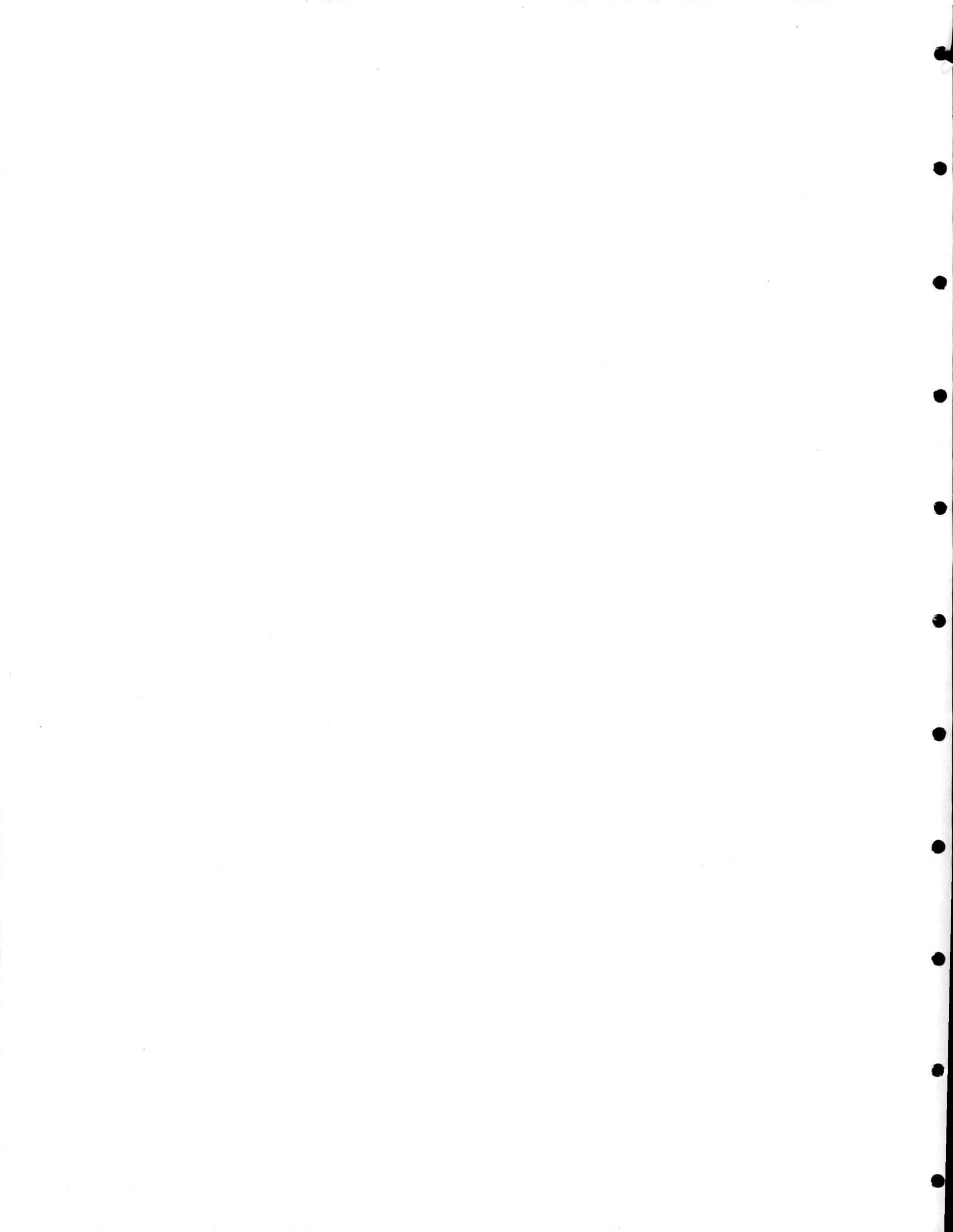
ABSTRACTS OF ENERGY LITERATURE IN THE PACIFIC ISLANDS REGION

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## INTRODUCTION

This is a companion volume to Bibliography: Energy in the Pacific Region. Entries are drawn from that bibliography. The abstracts are intended to provide a more detailed description of the documents, and results and conclusions are included whenever possible. All documents are available at the East-West Center, Honolulu, Hawaii. For more details, please see the introduction to Volume 1.

Economic and Social Commission for Asia and the Pacific (ESCAP).

(U.N. Building, Rajadamnern Ave., Bangkok, Thailand.)

**Renewable Sources of Energy. Vol. 2: Biogas.** Bangkok, Thailand: ESCAP, 1981. (Prepared in cooperation with the Asian Institute of Technology, Bangkok, and the Regional Centre for Technology Transfer, Bangkok.) EAPI/RSI/ERD

These four volumes form a series of sectoral directories on renewable sources of energy issued under the ESCAP publications program on technical cooperation among developing countries. They are concerned with solar energy, biogas, wind energy, and small hydropower development, respectively. Each volume begins with an introduction to the subject emphasizing the technology's development and utilization in the ESCAP region. An economic analysis is included where appropriate. This section is followed by an alphabetical list of experts and institutions. Each entry provides the address and a brief description of the project. Finally there is a subject index by project, as well as a lengthy bibliography for each subject.

Alward, Ron; Eisenbart, Sherry; Volkman, John. (National Center for Appropriate Technology, P.O. Box 3838, Butte, Montana, USA 59701.)

**Micro-Hydro Power: Reviewing an Old Concept.** Idaho: U.S. DOE (Idaho Operations Office), January 1, 1979. 60p. (DOE/ET/01752-1). ERD

This information package was designed as an introduction to all aspects of micro-hydro, from the first consideration of the idea through to the production of power. It includes diagrams where appropriate and simple explanations and descriptions. First, guidelines are listed for deciding whether a project is worth pursuing. The hydro potential or the flow rate and head of the site must be determined, as well as how much power is required. Flow rate is measured by the timed container filling method, the float method, or the Weir method. Techniques for measuring the head are also explained. A model for calculating the theoretical and usable power is given. The range of equipment, including various turbines, water wheels, generators, load control systems, and governors, is described. In addition, a description of other equipment such as dams and powerlines is included. Guidelines are provided for an economic analysis of the system, as well as U.S. sources of funding and regulations.

Anonymous.

**The Coconut Crop: A Prime Source of Wood Biomass.** 1982, 32p. PEP

The potential of coconut palm as a fuel in the Pacific region is examined. The accessibility of the fuelwood is a matter of economic, geographical, and social circumstances. Waste husk and shell from copra production is a substantial resource. Ultimately, the extent of collection of old stemwood and of husk and shell will be determined by cost. Where there is a potential demand for fuelwood for power generation, or industrial heat or steam raising, the rehabilitation of the coconut crop can be financed by the sale of senile coconut trees. The recovery of boardwood from senile trees enhances the economic prospects of coconut palms. Removal of senile trees would limit the infestation of the rhinoceros beetle (Oryctes rhinoceros).

Efficient copra drying may alleviate firewood shortages, produce high quality copra, and save husks and shells for other purposes. At present, the production of charcoal from coconut wood does not appear commercially attractive. Coconut shell charcoal is more dense than wood charcoal, and its production in outer islands or remote communities offers one prospect of rural industrial development in conjunction with copra production. Transportation is a critical variable in determining accessibility and delivered cost for all forms of fuel from coconut trees.

Arata, Ed. (Address not known.)

**Papua New Guinea: Micro-Hydroelectric Projects for Rural Development.**

Presented at the Energy and Rural Development Research Implementation Workshop, February 5-14, 1980 Chiang Mai, Thailand. 7p. ERD

The planning process and installation of a 7 kW micro-hydroelectric turbine generator at Baindoang, a town 40 miles from Lae, are described. Planning began in late 1975 and the project was completed in 1978. Throughout the project, villagers from the town and surrounding area and UNITECH staff and students worked closely together.

Originally, the power was to be used for lighting and visual aids for the school and for lighting teachers' and other officials' houses, at the trade store for lighting and cold storage, and at the community workshop. Later uses included a hot-water system for a community showers block. In late 1977 a small earth-filled dam was built. A Pelton wheel turbine was specially imported for the project. Classes in electricity were held for the villagers. The operation of the technology in its new setting and the impact that the technology will have over time still needs to be determined.

Ashworth, John H.; Neuendorffer, Jean W. (Solar Energy Research Institute (SERI), 1536 Cole Blvd, Golden, Colorado, USA 80401.)

**Matching Renewable Energy Systems to Village-Level Needs.** Golden Colorado: SERI, June 1980. 55p. (Prepared for the U.S. Department of Energy, Contract No. EG-77-C-01-4042, SERI/RE-744-514.) ERD

This report provides an analytic framework for the identification and development of renewable energy projects in developing countries. The report outlines a five-step matching process, briefly explains what information is needed to complete each stage, and shows how each phase will help a project planner choose the best energy technology. Seven basic human needs for energy are selected along with seven potential renewable energy technologies. Twelve criteria are developed to characterize each need and each energy system. From the matching process, technology options are identified together with additional research and development needed.

The report summarizes the advantages and difficulties presented by the needs/technology matching process. Emphasis is on how such a process can be integrated into existing development programs and how the results of the various steps can be integrated into the project identification process and the hardware adaptation programs of energy research institutions and equipment manufacturers. Because the matching process is only theoretical and general,

the method should be field-tested and subsequently modified to be usable by local-level development planners.

Bell, T.I.W.; Evo, Tevita. (Fiji Forestry Department, P.O. Box 2218, Suva, Fiji.)

**Energy Plantations in the Fiji Dry Zone.** Fiji: Fiji Pine Commission; Fiji Forestry Department, 1982. 7p. PEP

As the Fiji pine harvesting operation expands, it is proposed to use the increasing availability of sawmill wood waste as a fuel resource. This will be supplemented by high density timber from specially grown energy plantations. In an energy plantation trial, the fastest growth has been achieved by Eucalyptus camaldulensis and E. tereticornis. At one year of age, mean heights exceeded 4 m and mean breast height diameters exceeded 4.5 cm. The importance of optimum establishment techniques for eucalyptus is emphasized. These include weed control by hoeing and fertilizer treatment. These two species also have high density range. Acacia auriculiformis, which requires very little establishment maintenance, shows promise for sites where cultivation is not practical. The wood has a high specific gravity and calorific value.

Bialy, Jan. (School of Engineering Science, University of Edinburgh, Kings Bldgs., Mayfield Rd., Edinburgh, Scotland EH9 3JL.)

**Measurement of the Energy Released in the Combustion of Fuels.** Edinburgh, Scotland: University of Edinburgh, December 1979. 36p. (Occasional paper in appropriate technology, No. AT022.) ERD

The introduction discusses definitions and derivations of average heat values for various fuels. The heat values, moisture content, and hydrogen content of the following solid fuels are compared and analyzed. There are carbon C (amorphous), anthracite, bituminous coal, lignite, peat, wood (oven-dry), wood (air-dry), wood (damp), wood charcoal, and paraffin wax. Liquid fuels and gas fuels are analyzed for hydrogen and heat content. The liquid fuels are methanol, ethanol, n - Pentane, n - Octane, petrol, kerosene, and diesel oil. The gaseous fuels are carbon monoxide (CO), hydrogen, methane, ethane, propane, n - butane, 2 dimethylpropane, natural gas (North Sea), and synthetic natural gas.

Booker Agriculture International Limited. (Bloomsbury House, 74/77 Great Russell St., London, England WC1B 3DF.)

**Ramu Sugar Limited: Ethanol Feasibility Study. Vol. 1: Main Report.** London: Booker Agricultural International Limited, January 1982. 29p. PEP

The project identified and evaluated in this report consists of a distillery situated alongside the Ramu Sugar Factory and sharing common services. Most of the ethanol produced was to be marketed as anhydrous ethanol for blending with motor spirit in the proportion 20:80. The project capital cost is K3.8 m before self-generated funds of K0.5 m. It is recommended that the board of Ramu Sugar should proceed subject to confirmation of the selling

price for ethanol for blending with motor spirit, confirmation of purchase agreements for the ethanol with the oil companies, acceptance of a 20 percent ethanol motor spirit blend, and government assurances that competition will be limited. It would be prudent for the planning and development of this to be deferred. Expansion of sugar production from 40,000 to 60,000 t/y has been examined to pre-feasibility level of detail.

Borg, I.Y. (Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California, USA 94550.)

**Coal as An Option for Power Generation in U.S. Territories of the Pacific.**  
Energy 7(11): p.875-895. 1982. PEP

General considerations relating to the use of coal in U.S. territories and Trust Territories of the Pacific suggest that coal is a viable option for power generation. Future coal supplies, principally from Australia and the west coast of America, promise to be more than adequate, but the large bulk carriers (100,000-200,000 dwt) expected to serve Far Eastern markets will probably not be able to land coal directly in the territories because of inadequate port facilities. Hence, either smaller than Panama-class vessels (60,000 dwt) or some arrangement utilizing self-loading barges or lighters would have to be used. Except for Guam, with peak power requirements on the order of 175 MW, most territories have current, albeit inadequate, installations of 1-25 MW. Turnkey, conventional coal-fired, electrical-power generating systems are available in that size range. Fluidized bed combustion is another option currently being commercialized. Its use has clear environmental advantages, and a variety of fuels (e.g., coal, heavy oils, and biomass) may be employed without interruption of power generation. U.S. environmental laws such as the Clean Air Act are now applicable to Guam and American Samoa; the Trust Territories are exempt. When United Nations trusteeship terminates, the current unclear position of the Commonwealth of the Northern Marianas will cease and the laws will probably apply.

The principal problems with coal use in the U.S. territories, apart from the shallow draft of most harbors, are the limited amount of land available and the high capital costs associated with conversion. Ocean dumping of ash and sludge can be permitted under existing Environmental Protection Agency regulations, and barge-mounted power installations are not out of the question. The feasibility of converting from oil-fired to coal-fired electrical-power generating systems must be determined with site-specific information.

Bos, C. (United Nations Industrial Organization, Lerchenfelderstrasse 1, A-1070, Vienna, Austria.)

**Direct Hydrolysis of Wet Milled Cassava Roots.** Workshop on Fermentation Alcohol for Use as a Fuel and Chemical Feedstock in Developing Countries, March 26-30, 1979, Vienna, Austria. ERD

This paper describes the principles involved in converting and saccharifying raw manioca roots into easily fermentable substrate suitable for ethyl alcohol manufacture. The process consists of (1) washing, peeling, and milling the roots, (2) enzymatic liquifaction of the milled root slurry, and

(3) saccharification of the liquified roots slurry. During milling the roots are precrushed in a hammer mill and water is added to bring the starch content to 15% w/w before fine milling. During enzyme liquifaction either normal bacterial alpha amylase or heat stable bacterial alpha amylase can be used. The temperature and mechanical shear forces should be as high as possible, and a 10% w/w calcium chloride solution is added to improve the enzyme's heat stability. After liquifaction the slurry passes via a flash cooling system to a series of stirred reactors where saccharification takes place. The mass balance of a Brazilian project is provided.

Breag, G.R.; Harker, A.P. (Tropical Products Institute, 56/62 Gray's Inn Rd., London, England WC1X 8LU.)

**The Utilization of Waste Heat Produced During the Manufacture of Coconut Shell Charcoal for the Centralized Production of Copra.** London: Tropical Products Institute, June 1979. (G127). ERD

Charcoal production trials have been carried out in the Forest Products and Fuel Technology section of the Institute using a commercially available portable metal kiln.

As a result of these trials, considerable expertise has been acquired and a modified design of kiln has been developed that officers from the section have used to carry out training programs in developing countries under the Technical Co-operation program.

This report gives details of typical data obtained during the operation of the kiln using cordwood at moisture contents ranging between 27 and 38 percent (wet basis) and compares it with results from one run using coconut shell as the raw material. The methods of operating the kiln when lit from the top and bottom of the charge are described, and the advantages of each of the two methods are discussed.

Brewbaker, James L. (Department of Horticulture and Genetics, University of Hawaii, 3190 Maile Way, Honolulu Hawaii, USA 96822.)

**A Practical Guide to Growing Leucaena.** n.d., 2p. (Unpublished.) ERD

This paper describes the properties of leucaena seeds and how to cultivate them. Seeds will last for years if they are kept dry. They do not germinate unless scarified. Of three possible methods, scratching or nicking each seed with a triangular file, small scissors, or knife works the best. Leucaena seeds can be drilled for direct planting on large acreages although transplanting may be better. Bacterial inoculation is necessary for good nodulation and growth. The pH of the soil should be 5.5 or above. Elements that may be limiting to establishment include calcium, sulphur, zinc, boron, and molybdenum. Leucaena has very few pests although seed weevils may infest maturing seeds. Leucaena varieties are usually highly self-fertilizing.

Brewbaker, James L.; Hutton, E. Mark. (Department of Horticulture and Genetics, University of Hawaii, 3190 Maile Way, Honolulu, Hawaii, USA 96822.)  
**Leucaena: Versatile Tropical Tree Legume.** In "New Agricultural Crops," Gary

A. Ritchie, ed., Boulder, Colorado: Westview Press, 1979. p.207-259. (AAAS Selected Symposium 38, Reprint.) ERD

A team of experts assessed the biomass energy options for the American territories of the Pacific. Biomass options must be designed for factors such as severe storms, high construction costs, logistics problems, difficult terrain, and often nutrient-depleted soils. Analysis of the options took into account soils, rainfall and irrigation, climate, and existing vegetation including forests, grasslands, swamp forests, and marsh. In addition, environmental and social issues were considered. The greatest potential for the provision of a reliable source of fuel wood of known quality will come from the establishment of short rotation (3-5 years) fuelwood plantations. Waste wood does not have significant potential for most of the area except for specialized cases. With the possible exception of Guam, wood gasifiers should be an economical source of energy. Among the many research needs, it is recommended that tree trials be performed in different ecological zones and that 25 kW gasifiers be evaluated.

Brooks, Sarah Osgood; et al. (Address not known.)

**A Guide to Reducing Energy Use... Budget Costs. Vol. 1: Local Energy Management Program.** Washington, D.C.: The National Association of Counties Research, Inc.; United States Conference of Mayors, Fall 1979. 67p. PEP

This publication, in conjunction with A Guide to Reducing Energy Use Budget Costs (number 261 in Vol. 1) is intended to provide local officials with a comprehensive document to assist in the preparation of local plans for energy conservation. The initial document placed emphasis on assisting local governments in setting up energy conservation programs and offered specific examples of low-cost, high-return energy conservation projects. This document expands on this information in areas such as procurement, new buildings, carpooling, and existing buildings, especially where new technologies and local government experience have demonstrated ways of reducing energy use.

Case, Charles W.; Actouka, Marcelino K. (Lawrence Berkeley Laboratory, Energy and Environment Division, 1 Cyclotron Rd., Berkeley, California, USA 94720.) **Three Case Studies of Appropriate Energy Technology in the US Pacific Territories.** Berkeley, California: Lawrence Berkeley Laboratory, January 1982. 27p. ERD/PEP

From 1978 to 1981 the Department of Energy has funded 33 small energy projects in the U.S. Pacific Territories through the Appropriate Energy Technology Grants Program. Critical issues include transferring the technology to the community and minimizing adverse cultural effects. The projects attempt to be appropriate by using local labor and materials, renewable resources, simple technologies, and by being culturally sensitive.

There is a commonality between successful projects in which the technologies are more easily transferred and the cultural integrity is preserved. Three case studies are used that illustrate these common elements. These studies include a solar photovoltaic electric fence for controlling wild

pigs on an outer island in American Samoa, a solar fish drying facility on an outer island in the Truk District of the Federated States of Micronesia, and a solar demonstration project on Guam.

Case, Charles W.; Schaller, David A. (Lawrence Berkeley Laboratory, Energy and Environment Division, 1 Cyclotron Rd., Berkeley, California, USA 94720.) **Appropriate Energy Technology in the U.S. Pacific Territories.** Solar Law Reporter 2(6): p.1083-1102. March/April 1981. PIDP

Appropriate energy technology is a potential answer to the energy needs of the developing world. In some of the early projects funded by the U.S. Department of Energy (USDOE) in the Pacific area, lack of information, remoteness, lack of infrastructure, and failure to involve local governments have hindered energy technology development. Other projects have achieved success with good local direction, use of local materials and labor, and a discrete goal. Following a description of the energy problems in the Pacific and a discussion of the barriers to successful appropriate energy technology development, several case studies of projects funded by the USDOE are analyzed. These projects are a solar hot water system for a dispensary on Satawan Island, Truk district, solar dryers for fish drying on Romanum Island, Truk, and a biogas digester on Guam.

Other projects include a grant to the Yap Institute of Natural Science to develop and demonstrate a solar dryer/oven, a solar ventilator and wood burning cook stove, a series of grants to the Commonwealth of the Northern Mariana Islands to demonstrate a biomass unit, solar water distillation, a wind-powered pumping system, two solar hot water systems, and a solar-powered refrigerator. The final project examined is a study to evaluate the potential for converting tuna sludge, produced at canneries in American Samoa, to methane gas.

Coulthard, J.L. (Address not known.)

**Bioconversion Systems for Papua New Guinea: With Special Reference to Large-Scale Conversion of Sewage and Agricultural Wastes.** Konedobu, Papua New Guinea: Department of Minerals and Energy, December 1978. 44p. (Report 1-79). ERD/PEP

This paper addresses several aspects of bioconversion. Following a discussion of the basic microbial and chemical processes involved in biogas production, the failure of the Chan biogas digesters is analyzed. The author has designed Samanatic or Bizorba systems that correct many previous design faults. Byproducts of bioconversion projects prove to be good fertilizers. While in Papua New Guinea, the author visited several sites and evaluated their potential for biogas projects. A 60,000 gallon Samanatic digester was designed for Lae City sewage and Taraka ponds. The installation of the digester would end the overloading of Taraka ponds and solve the problems of the disposal of abattoir solid wastes and sewage.

Cruz, Ibarra E. (College of Engineering, University of the Philippines, Diliman, Quezon City, Philippines.)

**Producer Gas as a Fuel for the Diesel Engine.** 1977, 21p. (Unpublished). ERD

These studies show that coconut shell charcoal was a suitable fuel for a small downdraft gas producer to supply gaseous fuel to a 5-brake horsepower diesel engine. At the rated capacity, the engine ran on 90 percent of the energy from producer gas, and 10 percent from a liquid fuel, which was either diesel oil or crude coconut oil. The engine ran on 100 percent producer gas when conditions favored compression ignition of the air-gas mixture. Such conditions included a lower load than the rated capacity and a richer gas heating value.

Cruz, Ibarra E. (College of Engineering, University of the Philippines, Diliman, Quezon City, Philippines.)

**Producer Gas from Agricultural Wastes: Its Production and Utilization in a Converted Oilfired Boiler.** Resource Recovery and Conversion 2: p.241-256. 1976/77. ERD

A study was made on the performance of a fixed-bed gas producer, using agricultural wastes as fuel and air as a gasifying medium, and operated either as an up-draft or a down-draft reactor to supply producer gas to a converted oil-fired boiler. Up-draft operation, although achieving better thermal efficiencies, led to serious ash clinkering problems. Down-draft operation solved the problem of clinker formation on the grate at the expense, however, of slightly lower thermal efficiencies and reduced gasification rates.

D.J. McCann and Associates. ("Rotherwood," Via Millthorpe, Australia, 2798.)  
**Cassava Ethanol in Fiji: A Feasibility Study Undertaken for the Fijian Government and Mobil Oil, Australia.** 1980, 10p. (Unpublished). PEP

The potential in Fiji for the production of fuel ethanol from cassava was evaluated. In addition, a preliminary assessment was made of the possibility of producing ethanol from sugar cane. The ethanol would be blended with 89 octane petrol in the ratio 20:80. Three possible agricultural systems were analyzed: 8 ha individual farms, 15 ha individual farms, and plantations. At least 30% of the feedstock should come from a nucleus plantation of 1,000 ha to ensure security of supply and ease of gathering tops and stalks as energy for processing; moreover, the factory effluent can be sprayed on the land via a spray irrigation system. The capital cost of a factory in the Korotolutolu Basin is \$10.48 million, and it would employ 425 families. It could be in full production in five years. A port facility would need to be opened.

DeLucia, Russell J. (Food and Agriculture Organization (FAO), Planning and Investment Studies Unit, Viale Delle Terme Di Caracalla, Rome, Italy.)

**Fuelwood Surveys: Perspectives on Defining the Scope.** December 1981, 98p. (Unpublished). (To be published in FAO Monograph, Guidelines for Wood Fuel Surveys.) ERD

Given the varying dimensions of the fuelwood problem, there are different purposes for fuelwood surveys and markedly different methods that can be utilized. Several characteristics of traditional energy systems have implications for information needs. These are their non-commercial nature, availability and access, seasonal variation, inefficiencies of end use, insufficiencies in total use, and changes with income and price. There are difficulties in establishing both the supply and demand side of traditional fuel systems. The complexities of differential access to energy and other resources, varying energy needs, and multiple demands on natural resources all suggest that it is useful to examine resource flows. Appropriate questions and answers should be related to the design of rural energy systems. Although different approaches should be taken for each situation, a few guidelines should be followed. These guidelines are to review existing work elsewhere to suggest hypotheses, to gather information on the interrelations between fuelwood and remainder of the agro-economic environment, to undertake non-survey groundwork, to make a tentative identification of candidate technologies for investment analysis, and to design the survey to focus on critical information first.

Diandas, J. (Address not known.)

**Some Aspects of Determining the Cost of Hydro-Electric Energy.** Presented at the Seminar on Energy in Sri Lanka, January 10-12, 1980, Colombo, Sri Lanka. 18p. ERD

The paper discusses the various perceptions of the cost per kWh of electric energy and of the components that make up cost. It questions the validity of assumptions made by engineers, economists, bankers, and accountants as to life-span accounting and as to discounting the value of future benefits passed on by one generation to the next. It concludes that hydro-electric energy is cheaper than it appears to be in most position papers in absolute terms and in comparison with other forms of commercial energy.

Dutt, Gautam S. (Center for Environmental Studies, Princeton University, Princeton, New Jersey, USA 08540.)

**Improved Wood Burning Stoves for LDC'S.** n.d. 3p. (Unpublished). ERD

Designs for wood-burning stoves have been developed to reduce wood consumption and sometimes the amount of smoke produced. The procedure usually used to test stoves is to heat a pot of water to just before the boiling point. However, this is not representative of normal cooking. Suitability of a stove design is determined by each particular region's constraints. If a device is "discovered" locally, there will probably be no need for formal extension work. The paper proposes an extension work scheme. In the target area, a description of some new stoves with training and equipment necessary for their evaluation would be made available. This would allow native inventors to adapt or invent designs to suit local conditions. Ideally, this program would be strengthened by supplementary basic research into cooking processes and stove characteristics.

El-Hinnawi, Essam. (United Nations Environmental Programs.)  
**Small Hydro-Electric Schemes and Rural Development.** Presented at the  
International Workshop on Energy and Environment, May 7-10, 1979, Nairobi,  
Kenya. ERD

Small hydro-power stations, with installed generating capacity less than 1,000 kW have been built in several countries; the largest of which is the People's Republic of China. In most cases, a small dam is needed to direct the water into the channel intake or to get a higher head than the stream naturally affords. If AC current is produced, the flow of water into the turbine must be regulated according to fluctuations in demand for electricity, requiring expensive equipment; while with DC power, storage batteries are used to store power. No dam or lake can be created without having some environmental impact. Physical impacts may be sedimentation, seismic activity, and changes in the natural flooding pattern.

These lead to geochemical and biochemical changes in water quality trace elements and nutrients. This in turn has biological impacts, both aquatic and terrestrial, affecting fisheries, agriculture, industry, and tourism. Small hydro-power schemes provide opportunities for accelerated development of rural areas far from the main electric grid.

Electricite de Tahiti. (Avenue de Chef Vairatoa, B.P. 116, Papeete, Tahiti, French Polynesia.)

**Presentation of the 190 kW gas Generators Feeding the Public Network of the Commune of Bora-Bora: Operation: Results.** Papeete, Tahiti: Electricite de Tahiti, 1981. 10p. PEP

In 1978 a "Delacotte Process" gas generator was installed and tested at Bora Bora. This report was written after 1,000 hours of operating experience. Although the Delacotte Process was largely successful in stopping tar, as intended, some tar did accumulate in the hot part of the supply pipe of the burner. In the future, planning needs to ensure that the pipes can be cleaned without dismounting them. Some ashes are sucked up with the gas and are partially deposited in the pipes and in the fan. Fuel consumption studies suggests that one kilogram of coconut husk was equivalent to 0.225 liters of diesel (1 coconut husk=0.160 liters). The generator requires fuel with a low moisture content. Average gas production corresponded to 35 liters per hour of diesel oil (consuming 1.5 m<sup>3</sup>/hour of husks), and it should reach 50 liters per hour. The gas generator would be capable of supplying a generator set of 250 kW to 300 kW.

Feinstein, Charles. (Resource Systems Institute, East-West Center, 1777 East-West Rd., Honolulu, Hawaii, USA 96848.)

**Wood-Fired Cogeneration for Rural Pacific Communities: Taveuni Case Study.** Honolulu: East-West Center, February 1984. 43p. PEP

In April 1979, a wood-fired cogenerating steam engine was selected for the Wainiyaku Plantation, Taveuni, Fiji. This study was conducted after three and a half years of operation. Fuel is air dried coconut husk and shell. System

components include a control box, feedwater treatment system, firebox/boiler, dual engine sets (one operating at a time), a 30 kVA rated generator, and a heat exchanger/condenser. The plant operates at about 70 percent capacity; net electrical efficiency is approximately 6 percent; electrical load factor exceeds 80 percent; and total system efficiency is approximately 50 percent.

The system's lifespan is estimated at 25 years. The financial analysis indicates that the conversion from a diesel to a wood-fired system was a highly favorable investment. Closed and open loop steam power systems were examined for viability in rural villages at a 10 kW level. Cogeneration systems will be attractive only if the village has a large or valuable agricultural product to process or if (for open loop systems) electrical utilization will be higher than is customary in village environments.

Craig, David. (Address not known.)

**Solar Water Heating Programs: Port Moresby.** Konedobu, Papua New Guinea: Department of Minerals and Energy, 1980. 16p. PEP.

A proposed solar water heating program for Port Moresby is outlined. An economic analysis is presented in support of the policy recommendations that an immediate start be made on a solar water heater retrofit program for government housing and that solar water heaters be compulsory in new housing. There are 1,600 government houses available for retrofitting. A commercially available system with a collecting area of 3 square meters can supply a household's hot water and will displace about 3,000 kilowatt-hours per year. Several contractors installing about three water heaters per day could retrofit 1,600 homes in two years. The program will add at least K1 million to the national income over six to eight years.

Loan repayments could be channeled through Elcom's billing structure to make the systems more attractive to consumers. The cost of a retrofit is K700/unit; a new all-solar system is a maximum of K250 more than that of an all-electric system. Both components of the program would result in high returns on the initial investment.

Foley, Gerald. (Earthscan, 10 Percy St., London, United Kingdom WIP ODR.) **Commonsense on Biomass Gasifiers.** London: Earthscan, 1982. 2p. ERD

Eleven common sense guidelines are listed for prospective purchasers of gasifiers and those considering entering into collaborative programs of technical assistance containing a gasifier component. The guidelines and observations are: (1) there has been no long-term testing of fuels other than dry wood and charcoal; (2) full technical specifications are necessary; (3) performance guarantee should be asked about; (4) details should be learned about operating experience with similar models under similar conditions; (5) servicing and spare parts availability should be known; (6) if the project is experimental, then there should be compensation; (7) there should be adequate support of the first gasifier for six months; (8) for the second six months it should be used without support; (9) after this time a decision should be made whether or not to proceed; (10) attaching a gasifier to a diesel generation makes the system more complicated; and (11) there should be full satisfaction

before purchase.

Fore, John. (Address not known.)

**Micro-Hydro Designed for Papua New Guinea.** Soft Energy Notes 3(4): p.20-22.  
August to September 1980. PEP

A low-cost, rugged micro-hydro system made from locally available materials was developed by the Appropriate Technology Development Group. The design is flexible and can be adapted for other countries. The system prototype consists of a penstock made of polyvinyl chloride pipe, a Pelton runner, a commercial 5 kW alternator, and a concrete base. Assembly, installment, calibration, and maintenance are simple. The Pelton runner required a head of about 80 m. The hardware and labor cost about US\$840. This does not include installation costs nor the penstock. The micro-hydro capital cost of \$438/kW is less than the \$580/kW outlay for diesel. A gasoline driven generator has a capital cost of \$145/kW, but higher operating costs make up the difference in less than a year.

French, David. (4417 Q St. N.W., Washington, D.C., USA 20007.)

**The Economics of Renewable Energy Systems for Developing Countries.**

Washington, D.C.: U.S. Agency for International Development, January 1979.  
67p. ERD

This report outlines the benefit-cost techniques that allow renewable systems to be evaluated from the standpoint of individual buyers (financial analysis) and the society as a whole (economic analysis). Special attention is given to problems of particular importance in reviewing energy systems' local measurement of costs and benefits, determination of investors' discount rates, shadow-pricing, allowance for social costs, and so on.

Detailed benefit-cost analyses are provided for three representative systems:

- . a 40-hp solar thermal irrigation pump near Bakel, Senegal;
- . a family-scale Indian biogas plant; and
- . a 5.5 kW solar cell irrigation pump on the borders of Lake Chad.

In each case, consideration is given to whether these systems would be equally (un)appealing in other places or under other assumptions as to capital costs, the price of conventional fuels, or other variables. None of these systems, shows any immediate promise for significant developmental applications. Only solar cell arrays offer promise for the relatively distant future. Some of these devices might become competitive with expensive commercial energy. Given these findings, organizations concerned with the poor might well give renewed attention to meeting basic energy needs through less sophisticated systems, village woodlots, improved wood stoves, hand or pedal pumps and grinders, hydraulic ram pumps, etc.

Fritz, Dale. (Volunteers in Technical Assistance (VITA)), 1815 North Lynn St., Suite 200, Arlington, Virginia, USA 22209.)

**Solar Water Heater.** Mt. Rainier, Maryland: Vita, 1979. 20p. (Stock No.

51E). ERD

The booklet discusses guidelines for selecting a solar water heating system, deciding on its size, and site selection. A simple solar water heating design is described along with the tools and materials needed for the system. The project requires approximately eight hours of skilled labor (metalworking, welding) and eight hours of unskilled labor.

It is easy to build and operate, heats 70 liters of water to 140°F within a 2-hour period, is portable, and has no fuel costs. Its disadvantages are that it has to be manually filled with water, has a life expectancy of two years, and only heats water on sunny days. It costs about US\$30 to \$70 including materials and labor. It was designed, developed, and tested in Afghanistan in the 1960s.

Gasmer, M.; Harwood, C. (Energy Planning Unit, Department of Minerals and Energy, P.O. Box 2352, Konedobu, Papua New Guinea.)  
**Charcoal Production and Use in Papua New Guinea.** Konedobu, Papua New Guinea: Department of Minerals and Energy, 1982. 16p. PEP

The study surveyed over 1,800 low-cost, domestic quarters, urban village, and squatter settlement households in Port Moresby. 97.8 percent of the homes surveyed used firewood or kerosene for cooking and lighting. Electricity is rarely used for purposes other than lighting because of its high cost. Almost everyone surveyed purchased rather than collected firewood since few areas in Port Moresby possess adequate firewood supplies within walking distance.

The average price paid for kerosene in the survey was over 13 toea per liter greater than the controlled price at the time of the survey. Kerosene purchased in small containers from trade stores can cost 4 to 5 times as much as the controlled price charged at petrol stations. Rapidly decreasing firewood supplies make this fuel more difficult and expensive to obtain each day, and many people are switching to cooking with imported kerosene. Firewood and charcoal produced from sawmill wastes and sold at community distribution centers can undercut the present energy cost of firewood by from 19 to 60 percent and the energy cost of kerosene by over 50 percent.

Goodman, Louis J.; Hawkins, John N.; Love, Ralph N., eds. (Resource Systems Institute, East-West Center, 1777 East-West Rd., Honolulu, Hawaii, USA 96848.)  
**Hydroelectric Projects for Rural Development: Planning and Management.** New York: Pergamon Press, Inc., 1981. 200p. RSI

This book focuses on the dual problems of developing small hydroelectric energy sources in rural areas and of managing small hydroelectric power development projects. Some of the cases report on multiple uses of small hydro systems such as water supply, flood control, and irrigation of crops. Key policy and research issues of small hydro energy development are analyzed. The first chapter introduces the small hydrosystem, its advantages and disadvantages in technology, multiple use potential, and impact on the environment. The integrated project cycle, a framework for examining development projects, is explained. Specific projects are documented in the

case studies. A final chapter compares planning and management approaches and examines policy and research issues raised by the case studies.

Gould, Helen; Joseph, Stephen. (Intermediate Technology Development Group (ITDG), 9 King St., London, England WC2E 8HN.)  
**Designing Stoves for Third World Countries.** October 1978, 15p. (Unpublished).  
ERD

An essential part of the stove designer's job is to determine the socio-cultural factors that will affect the success of an innovation. There is usually a trade-off between optimal socio-cultural solutions and technical solutions. Some factors that are necessary to consider in stove design are priorities in fuel use, that is, cooking and/or lighting, cooking methods, and heating methods. Innovations are more likely to be successful when people have actively participated in their design and introduction.

Gowen, Marcia. (Pacific Islands Development Program, East-West Center, 1777 East-West Rd., Honolulu, Hawaii, USA 96848.)  
**A Manual for Renewable Energy Assessment: An Energy Planner's Guide.**  
Honolulu: East-West Center, January 1984. PEP

The primary purpose of the manual is to provide energy analysts with a common set of equations for comparing fuels and conversion technologies to make general but not necessarily definitive energy and economic assessments. A second objective is to provide planners with empirical data on fuels and technologies used in tropical regions, in particular the Asian-Pacific region. A third objective is to present analysts with simple economic tools to make financial analyses of energy systems, as well as to discuss various social benefits or costs of alternative energy systems. The manual contains two main sections; (1) background on energy and economic concepts and (2) the fuel and technology assessments.

Harwood, C. (Energy Planning Unit, Department of Minerals and Energy, P.O. Box 2352, Konedobu, Papua New Guinea.)  
**Economic Evaluation of a 240 KVA Durant Gasifier-Engine Generator at Kavieng, New Ireland.** Konedobu, Papua New Guinea: Department of Minerals and Energy, 1981. 9p. PEP.

An economic analysis for a 195 kW Durant gasifier system located indicates that a marginal rate of return would be obtained. The rate of return would be 4 percent for 10 years and 9 percent for 15 years. If a few variations are made on cautious assumptions, such as fuel and maintenance costs, and if diesel consumption specified by the manufacturer is achieved, then the internal rate of return becomes satisfactory.

Another site is examined as a possible location. This site has the advantage that the gasifier can be located adjacent to a large sawmill, so there is no transport cost for the wood feedstock. This would increase the internal rate of return to 12 percent over 10 years.

The second site is not part of the central grid system--at present and the PNG Government buys surplus power from the sawmill company's diesel generators. If the Duvant system is installed, a cooperative arrangement on financing of civil works and power sales will have to be reached between the company and the Government.

Hyman, Eric L. (Environment and Policy Institute, East-West Center, 1777 East-West Rd., Honolulu, Hawaii, USA 96848.)  
**Methodology of the Woodfuels Survey and Guidelines for Conducting Other Rural Energy Surveys in a Developing Country.** 1982. (Unpublished). ERD

A survey was conducted in the Philippines to investigate the consumption and uses of wood and charcoal fuels. The methodology was analyzed and the following guidelines were developed to help ensure the success of a rural energy survey in a developing country; (1) know the objectives of your study and focus on the information needed for policy making; (2) understand the characteristics of the fuels and how they are acquired and used; (3) target questionnaires to specific subgroups; (4) use stratified random samplings; (5) coordinate with local and regional officials and leaders; (6) rely on local surveyors using the local dialect; (7) choose educated surveyors and train them well beforehand; (8) anticipate possible responses and precode the questionnaires; (9) be comprehensive because there are economies of scale in a major survey effort; (10) consider possible problems with strategic, instrumental, and hypothetical bases; (11) make thorough introductions to respondents; (12) identify the most appropriate respondent in the household for a particular section of the questionnaire; (13) separate consumption by uses; (14) convert commonly used units into standard ones by taking physical measurements, preferably weights of solid fuels and volume of liquids; (15) focus on recent activities rather than distant history; (16) break down questions into their smallest components; (17) do not accept answers blindly, particularly if they pertain to income; (18) investigate the reasons for variations in prices; (19) look at land tenure arrangements; and (20) use computer analysis and statistical tests.

Hyman, Eric L. (Environment and Policy Institute, East-West Center, 1777 East-West Rd., Honolulu, Hawaii, USA 96848.)  
**Wood and Charcoal as a Direct Energy Source for Domestic Consumption and Cottage Industries in the Philippines.** 1981. 61p. (Unpublished). Presented at the 28th Natural Resources Management Forum, February 19, 1981, Diliman, Quezon City, Philippines.) ERD

The characteristics and uses of wood and charcoal as fuels were examined. In addition, the market and travel shadow price of woodfuels in the Philippines were studied. It was concluded that the significance of a woodfuel shortage depends on the possibilities for substituting alternative fuels. Capital and operating costs are two key factors motivating fuel choice. Even when the total life cycle costs are lower, high initial investment costs may preclude selection of a particular fuel or technology of use. The efficiency of combustion is not of primary concern to users; instead users are concerned

about the following characteristics: cost, local availability, renewability, storability and ease of transport, low requirements for auxiliary equipment, safety (real and perceived), adaptability, convenience, speed of use, appropriateness of technology, simplicity of use, cleanliness, and environmental compatibility.

Policy options for dealing with woodfuel energy problems include substitution of alternative energy forms; conservation; improved wood stoves and charcoal kilns; subsidies and taxes; provision of silvicultural inputs; expanding the amount of land in forest production and its intensity of management through conversion and reforestation of government lands; and establishment of private community woodlots, agroforestry sites or commercial energy plantations; creation of property rights to forests and markets for woodfuels; and regulations. Before suitable policies can be developed, much more needs to be known about the amounts, types, and costs of the fuels that are used in specific locations.

Institute of Energy Economics. (No. 10 Mori Building, 18-1 Toranomon, 1-Chome, Minato-Ku, Tokyo, Japan.)

**Electronic Load Controller: A New Development for Low Cost**

**Micro-Hydro Electric Systems: Project Bulletin.** London, England: ITDG, February 1980. 2p. ERD

The document describes energy supply and demand in Fiji, Tonga, Western Samoa, Papua New Guinea, Kiribati, the Cook Islands, and the Solomon Islands. The review is based on the survey results of the Asian Development Bank's Regional Energy Survey of 1980. The topics covered in detail are energy and the economy, energy pricing policy, rural electrification, and energy conservation. Renewable energy development projects in the region are described. These include hydropower, fuel alcohol, wood utilization, and a few other programs.

International Labour Organization (ILO). (Rural Development and Policies Branch, Employment and Development Department, 4 Rout des Marillons, CH-1211, Geneva 22, Switzerland.)

**Charcoal Making for Small Scale Enterprises: An Illustrated Training Manual.** Geneva, Switzerland: ILO, 1975. 26p. ERD/PEP

This manual describes methods of charcoal making requiring low capital inputs. The construction and operation of earth and portable steel kilns are described in detail and illustrated with photographs and diagrams. Necessary tools and component parts are listed. The choice and preparation of raw material for charcoal making are discussed. Models are given for calculating production costs and marketing strategies, such as cooperative or independent, and are evaluated.

Isaak, David T.; Fesharaki, Fereidun. (Resource Systems Institute, East-West Center, 1777 East-West Rd., Honolulu, Hawaii, USA 96848.)

**The Pacific Refinery Concept: A Preliminary Analysis.** Honolulu: East-West

The technical and economic feasibility of a new refinery in the South Pacific is reviewed. Four reasons for constructing a domestic refinery are examined. These are to enhance energy security, to provide petroleum products at lower costs than product imports, to capture the value added from refining, and to provide profits and foreign exchange earnings from the export of refined products. After an examination of the current petroleum industry situation, it appears that excess worldwide refining capacity has made it a bad business and it makes little sense to add capacity to the overcrowded, money losing Pacific refining sector.

Because of the structure of demand in the Pacific Islands, it is not possible to construct an economic refinery that can supply the types of refined products needed in the region. Refined products will still need to be imported and exported to balance supply with demand after the refinery is constructed. The economic analysis shows that even if loans could be obtained and capital costs kept under control, subsidies would still be needed to keep the refinery going or, alternatively, they must control prices to make the refinery profitable.

Johnston, Peter; et al. (Central Planning Office, Government Buildings, Suva, Fiji.)

**Use of Wood Waste for Rural Electrification.** Presented at the ESCAP South Pacific Regional Workshop on Biogas and Other Rural Energy Resources, June 6 to July 8, 1977. Suva, Fiji. 11p. ERD

Preliminary studies indicate that a large quantity of waste wood exists in Fiji at reasonable costs. Within a decade, considerable amounts of pine waste will be available on small, isolated islands. Generation of electricity by means of wood-fueled boilers and steam turbines at scales exceeding 200 kW may be economically viable, despite high capital costs, especially if a use can be found for the low-pressure turbine exhaust steam. At the village scale of 20 kW, wood gas fueling conventional diesel generators appear to be attractive although firm costs are not known.

Kalma, J.D. (Address not known.)

**A Wind Resource Assessment for Papua New Guinea: Report to the Energy Planning Unit of the Department of Minerals and Energy.** Canberra, Australia: CSIRO, Institute of Earth Resources, 1979. 25p. (Technical Memorandum 79/9.) PEP

A survey of wind climates in Papua New Guinea indicates that well-exposed coastal locations in the Central and Western Provinces and selected island locations in Manus, New Ireland, West New Britain, and Milne Bay Provinces should seriously be considered as sites for wind power utilization. General topographical and theoretical wind conditions, as well as observation from stations throughout PNG, were considered in the analysis. Commercial wind energy conversion systems were evaluated.

It is recommended that Dunlite 5 kW wind energy conversion systems be installed at Amazon Bay, Daru, Gizarum Plantation, Port Moresby, and Misima and

that their performance be closely monitored for at least one year. Integrating-cup anemometers should be installed at the climate stations in Wewak, Kieta, and Momote; contact-closure anemometers with totalizers and printers should be installed at Amazon Bay, Daru, Gizarum Plantation, Port Moresby, Misima, Samarai, and Namatanai.

Windpower research in PNG should be based on more adequate spatial and temporal data on windspeed and wind direction variability.

In particular, the complementary nature of solar and windpower must be studied carefully.

Kingan, Stuart G. (Scientific Research Division, Rarotonga, Cook Islands.)  
**Small Power Plants for Isolated Areas.** n.d. 12p. (Unpublished). ERD

This paper examines small hydroelectric systems. With careful design at any flow/head ratio, it is possible to make a water turbine that even at 200 watts operates at 60 to 75 percent efficiency, thus producing 120 to 150 watts. Power losses occur from gearing, friction, and the power needed to energize field windings. Power is also lost due to heating of the copper windings and because of magnetic hysteresis in iron cores. All of these losses can be minimized. From 20 kg-m/sec of water, 60 to 70 watts of electricity can be produced. At this level, storage in lead-acid batteries is essential, although this reduces the usable energy to 45 watts. Cooking, boiling water and heating rooms is impossible at this level of power but many small appliances and lights are feasible. Small hydropower systems are compared with wind and solar systems. In all the systems, the lead storage battery is the weakest link. A plan for a simple water turbine is described.

Lloyd, C.R. (Institute of Natural Resources, University of the South Pacific, P.O. Box 1168, Suva, Fiji.)  
**Nadi-Lantoka Survey: Report: February 1982.** 1982. 37p. (Unpublished).  
(Draft). PEP

A survey of energy use in 826 households in the Nadi-Lautoka area was conducted. Petrol was the most used source of energy (41%), followed by wood (22%), kerosene (18%), gas (LPG) (6%), and diesel (5%). End uses were cooking (43%), transport (43%) lighting (7%), refrigeration (5%), and other uses (2%). Fifty-five percent of commercial energy was used for transport. Energy use is linear with income, particularly with regard to transport. Nearly 50 percent of households often or always use wood for cooking. The percentage of kerosene use did not vary much from urban to the rural sector. Two-thirds of the households used electricity. The results are related to income, area, and other factors. No attempt was made to include air or sea transport. Information was gathered to find future trends and areas that might be amenable to energy conservation measures.

Mansell, D.S.; Atkins, G.P.; Kiek, S.N. (Department of Civil Engineering, Papua New Guinea University of Technology, P.O. Box 793, Lae, Papua New Guinea.)

**Micro-Hydro: Civil Engineering Aspects.** Presented at the Society of Papua New Guinea and Papua New Guinea University of Technology Seminar on Rural Electrification, September 26, 1975. 11p. ERD

The paper sets out to identify some of the aspects of small hydroelectric schemes that are of particular concern to the civil engineer and to provide some guidance to non-engineers who wish to build such power sources. The low-flow rate must be calculated during the dry season. A simple method and formulas are described. The design low flow is estimated using local knowledge of how low the stream usually is on a dry year. Flood flows must be estimated in order to protect the intake structures.

The cost of transporting water is a factor that may make a small hydro-scheme unfeasible. It is often best to use earthen flumes, but features of terrain and climate may make this impractical. Penstocks should be short and not too narrow. Testing of soils for dams and of aggregates for concrete is a worthwhile investigatory precaution. It is possible to build small dams with reasonable certainty of success with the use of a little simple technology. Such dams should not exceed 5 meters in height. Some rules of thumb are included in the paper to help initial appraisal and planning of potential micro-hydro schemes.

Mayer, Peter C. (Chief Economist, Department of Commerce, Government of Guam, Agana, Guam.)

**Preliminary Financial Analysis of Guam's Electricity Generating Options.**

Agana, Guam: University of Guam, 1983. 5p. (MARC Working Papers No. 39).  
PEP

Seventy-seven percent of the island's electricity is produced by two remarkably efficient generators. The remainder is produced at 40 percent higher costs. Since electricity consumption is declining and the existing plant is in good repair, for financial feasibility, any alternative source of power must have lower total costs than the fuel costs of the existing plant. A modification of an existing generator would result in nearly all of Guam's power being produced by efficient use of fuel oil. Unless a large environmentally acceptable coal-fired generator proves feasible, this modification should be made.

Municipal wastes or garbage could provide over 8 percent of the island's power with the added benefit of reducing the use of Guam's landfill. It appears that such a generator will be built. Waste gases from Guam's oil refinery could provide over 4 percent of the island's power. The outfall of Guam's northern sewage system is a small but economical hydroelectric resource. The relevant agencies have shown little interest in developing this resource. Although a private organization may build a small OTEC plant for development purposes, OTEC does not appear to be financially viable at this time. Although windmills may be useful for special purposes, land costs will prevent windmills from having a significant impact on the island's electricity usage. The combustible gases from sewage processing are a limited but probably usable resource.

Mendis, Matthew S. (The Mitre Corporation, Metrek Division, 1820 Dolly Madison Blvd., McLean, Virginia, USA 22102.)

**Wood Fuel Use in Papua New Guinea: An Assessment of Industrial Combustion Equipment.** McLean, Virginia: The Mitre Corporation, November 1980. 154+p. (MRTR-80W231. EPU Report No. 7/80.) ERD

This report presents the results of an engineering and economic assessment of new and retrofit industrial combustion equipment for wood fuel use in Papua New Guinea. Existing industrial combustion equipment and practices in Papua New Guinea are appraised. Potential industrial wood fuel systems that utilize wood, wood wastes, charcoal, and pyrolytic oils and that are particularly applicable to Papua New Guinea are identified. An economic assessment of wood fuel systems is conducted for 11 case studies that are representative of a cross-section of Papua New Guinea industry. Conclusions and recommendations are presented to aid both government and industry in Papua New Guinea in fostering the development of appropriate wood fuel technologies and thereby help displace the consumption of imported petroleum.

Mendis, Matthew S.; Talib, Abu. (The Mitre Corporation, 1820 Dolly Madison Blvd., McLean, Virginia, USA 22102.)

**An Assessment of Wood Gasification/Combustion Systems for Retrofit or Replacement of Small Oil-Fired Boilers in Papua New Guinea.** October 1981, 53p. (Prepared for the Energy Planning Unit, Department of Minerals and Energy, Papua New Guinea). (WP-81W578.) PEP

The study evaluates two wood gasification systems (BIO-THERM Gasifier/Burner and Forest Fuel Gasifier/Burner) intended as retrofits and one direct wood-fired combustion system (Ray Burner Package) proposed as a replacement for the oil-fired combustion system currently generating steam at the South Pacific Brewery in Lae. BIO-THERM is economically the most attractive having the fastest payback, the highest net present worth over the project life, and the lowest initial capital investment. In addition, BIOTHERM is mechanically the simplest. It accepts wood sizes under 2.54 cm in length with a moisture content under 30 percent. However, the control panel may not be adequate to provide an efficient load-following capacity, and there is less field experience than with the other system. In comparison, the Forest Fuels gasifier used more hardware and moving parts. It has an induced draft system and a moving grate, and the air to fuel ratio can be adjusted. It can tolerate fuels with a higher moisture content.

National Conference of State Legislatures. (Energy Program, Small-Scale Hydroelectric Project, National Conference of State Legislatures, 1405 Curtis St., Suite 2300, Denver, Colorado, USA 80202.)

**An Introduction to Small-Scale Hydroelectric Power in the State of Hawaii.** June 1980. (Report Prepared under U.S. Department of Energy Grant No. DE-FG03-78RA23220.) ERD

This is a survey of 33 U.S. solar projects. These are low cost and either community built or "do it yourself." Both air and water heating systems are

included. The information provided includes the address and contact person for the project, a diagram of the system, and if available, the costs, labor requirements, and tools needed.

Newcombe, Ken J. (Energy Assessment Division, World Bank, 1818 H. St. N.W., Washington, D.C., USA 20433.)

**Charcoal Production System: Coconut Log Wood: Tonga.** Canberra, Australia: Centre for Resource and Environmental Studies; Australian National University, 1980. 10p. PEP

The economics of coconut log wood charcoal in Tonga is analyzed. Estimates are based on 400 trees giving 3.73 tonnes of charcoal. The costs of the logs for carbonization, carbonizing, bagging and loading, and dispatching to the store and unloading into the store total A\$87.98. The additional kiln capital charge is \$13.33, bringing the total cost per tonne of charcoal to \$101.31. If there are already cleared dry logs, the costs are \$77.80. Alternatively, if there are sawmill operations, the cost is \$77.40. Calculations to establish the public value of charcoal equivalent to diesel show charcoal at 1.83 cents/kWh and diesel at 11.64 cents/kWh.

Charcoal is an ideal fuel for gasification for power generation and domestic and industrial cooking. Many people can participate in the charcoal industry using the Tongan kiln, a refashioned 44 gallon drum. However, in Tonga, charcoal stoves and ovens of suitable quality and efficiency have not been available.

Newcombe, Ken J. (Energy Assessment Division, World Bank, 1818 H St. N.W., Washington, D.C., USA 20433.)

**Cocoa Drying Data: Revision. (Papua New Guinea Case Study.)** Canberra, Australia: Centre for Resource and Environmental Studies; Australian National University, 1983. 2p. PEP

Cocoa drying data (from the PNG case study) were revised following information provided by Dr. C. Harwood, EPU, DME, PNG. Diesel drying applies to 50-70 percent of the cocoa industry. Total diesel in a reasonably well-managed oil-fired drier arrangement is 5.27 GJ/te. Woodfired burners use about 350 kg wood, husk and shell per te of dried cocoa which is roughly equivalent to diesel. Samoan indirect wood-fired driers used by village-level producers require at least twice the wood as a direct fired drier.

Newcombe, Ken J. (Energy Assessment Division, World Bank, 1818 H St. N.W. Washington, D.C., USA 20433.)

**Energetics of Combined Copra-Cocoa Plantations.** Canberra, Australia: Centre for Resource and Environmental Studies; Australian National University, 1982. 2p. PEP

- The energetics of drying both copra and cocoa produced in a "typical" plantation arrangement are examined. The plantation produces 50 te of copra and 150 te of cocoa beans as well as waste coconut husk and shell.

Disregarding power production on site and use of husk and shell for domestic cooking, the theoretical surplus energy is the equivalent of between 205,000 liters and 276,000 liters per year of diesel for power production.

Newcombe, Ken J. (Energy Assessment Division, World Bank, 1818 H St. N.W., Washington, D.C., USA 20433.)

**Notes on the Economics of Charcoal Production.** Canberra, Australia Centre for Resource and Environmental Studies; Australian National University, 1982. 3p. PEP

The most proven method of charcoal production in the Pacific Islands is by large and small kilns. The economics of large commercial kilns of TPI design with 2 tonne per week operation were analyzed. The life of the equipment is five years. Total capital cost, plus recurrent expenses such as labor and some maintenance, is A\$43,050. The cost per tonne of bagged charcoal is \$93.90. A rough retail price might be US\$180/te. An analysis was also made of cost of production from drum kilns using coconut shell charcoal. Production is 46 te/year. Over five years, replacing the drums twice, the undiscounted costs of production are \$32,000 or US\$140/dry tonne. Retail prices may be US\$290/te.

Newcombe, Ken J. (Energy Assessment Division, World Bank, 1818 H St. N.W., Washington, D.C., USA 20433.)

**Revision to Western Samoan Wood-Electricity Study UNDP SPU-78-OUI) Re: Excess Energy from Coconut Husks and Shells.** Canberra, Australia: Centre for Resource and Environmental Studies; Australian National University, 1982. 2p. PEP

The proportion of the coconut composed of the main components (meat, husk, shell, and water) appears to vary greatly. The effect of the difference is to under-rate the energy available per tonne of copra produced in the case of the UNDP Western Samoa study. Data are compared for PNG coconuts in the UNSW study, the Samoa UNDP study and FAO data from 1975.

Newcombe, Ken J.; Holms, E.G.; Pavoke, A. (Energy Assessment Division, World Bank, 1818 H St. N.W., Washington, D.C., USA 20433.)

**Palm Energy: Alcohol Fuel from the Sago and Nipa Palms of Papua New Guinea: The Development Plans.** Konedobu, Papua New Guinea: Department of Minerals and Energy, 1980. 40p. PEP

A study was conducted of the potential for Nipa and Sago palm products. These palms represent a renewable source of fuel alcohol and other products such as sugar and vinegar. They are located by-and-large in the less developed areas of Papua New Guinea. It is estimated that 48,000 hectares of Nipa swamps in the Gulf Province could produce  $144 \times 10^6$  kg of sugar annually. A plantation has been found to yield several times more than the wild swamps. It is estimated that the potential for alcohol production is  $206 \times 10^6$  liters annually. The major barrier is the cost of sap production, which is labor intensive. The manufacture of vinegar appears to be attractive. Preliminary

surveys of the Nipa swamps around Baimuru and preliminary tapping experiments have been conducted. Tapping is currently uneconomic. If rough productivity estimates for wild sago are used, it appears that the Sepik and Gulf Provinces sago resources could yield from 207 to 1270 million liters of ethanol per year. Given escalating fuel prices, the ethanol production process is economically attractive.

Northern Marianas, Office of the High Commissioner. (Saipan, Mariana Islands 96950.)

**Energy Plan: Trust Territory of the Pacific Islands: Conservation of Energy.**  
Saipan, Northern Marianas: Office of the High Commissioner, December 1979.  
90p. PAC

The plan presents and recommends immediate, and long-range measures to counter the potential adverse impacts of oil and fuel curtailment on economic, social, and political activities. The basic concepts, measures, and objectives of conservation are discussed in this plan. The main objectives are a reduction in the inefficient use of energy and maximization of the benefits from oil, fuel and electricity, education of the public regarding energy issues, and the involvement of communities in the implementation of conservation programs, the establishment of energy conservation policies and guidelines by the government, and the development of programs and projects that use indigenous and other energy sources to supplement or replace imported fossil fuel. This plan presents areas where the government can initiate conservation programs, specifically in such functions and facilities as government-owned single and multi-family dwellings, schools and hospitals, power plants, and transportation. The major elements of this plan include reduction of peak power demand, achieving an informed public regarding conservation methods and alternative energy sources, development of indigenous energy resources, conservation in land and sea transportation systems, tax programs and standby allocation, and installation of energy efficient equipment. The Energy Emergency Plan provides policies and guidelines to be used in case of complete stoppage of fuel oil supplies to the islands.

Pacific Energy Program. (Joint program of ANU, EEC, ESCAP, EWC, SPEC, UNDP.)  
**Energy Mission Reports.** Honolulu: East-West Center. 1982. 87p.  
PIDP/RSI/EWCPEP

These reports examine planning and policy issues and renewable and non-renewable energy sources with specific conclusions and recommendations for each country. Each covers patterns of energy supply and use including petroleum fuels, electricity, biomass, indigenous energy resources for small, medium, and large systems, industry, commerce, transportation, and household use, and petroleum and fossil fuels supply, storage, and pricing. The aspects of electricity covered are institutional arrangements, the power system, planning and management issues, pricing, and rural electrification. In addition, the reports examine conservation and management, as well as the present arrangements, issues, and options of energy administration and planning.

## **KIRIBATI**

Excluding aviation fuels, between 45 and 50 percent of petroleum fuels can be displaced by renewable energy sources. One-half of this contribution can come from woody biomass used in power generation on Tarawa and charcoal produced on the outer islands. Coconut oil can displace up to one-half of the road transportation fuel used within 10 years. The most substantial gains will result from rational electricity pricing, more effective petroleum supply contract negotiation, and petroleum price control.

## **SOLOMON ISLANDS**

Wood fuels can substitute for diesel in power generation, in heat and steam raising, and in industry. Savings can result from the improved use of solar water heating and wood fuels in the domestic and commercial sectors. Little prospect exists for the economic replacement of petroleum in road, marine, or air transport. The emphasis must be on effective management. There is a need for tighter petroleum price control and equitable petroleum supply contracts. Energy conservation can have a near-term impact, although the greatest barrier to beneficial change is the lack of forward planning.

## **TONGA**

Approximately 25 percent of the present level of oil imports could be displaced if the two wood fuel power systems were implemented over the next five to seven years and by eliminating diesel and LPG for heat and steam raising. The most urgent problem is the continued supply of firewood for household use. More than 2,000 ha of firewood plantation could be established on Tongatapu during the next four years. Constraints to effective energy management are the absence of an energy planning administrator and the underpricing of electricity.

## **VANUATU**

Development of wood fuels for power generation, industrial uses, and steam raising during the next eight years could reduce petroleum imports by 20-25 percent. Coconut oil and ethanol can substitute for a small proportion of diesel and motor spirit used for road transportation. There is economic potential for the use of modern wood and charcoal stoves. The most urgent issues facing the government are the ownership and skilled management of the local power utility and the rationalization of the electricity pricing. Significant gains are likely to be made through more effective petroleum price control and supply control negotiation and energy conservation.

## **NIUE**

Wood and woody residues are the most abundant and economically attractive source of energy to displace imported fuels. Constraints are the absence of a full-time energy manager/planner and the lack of capital to purchase the power plant to use fuelwood. The underpricing of electricity is a significant barrier to beneficial change. It is possible that up to one-half of the anticipated 1990 demand for imported petroleum

can be substituted with locally available fuels.

#### **FEDERATED STATES OF MICRONESIA (Ponape)**

Many options are available to reduce the cost of power generation including the use of wood fuels and more efficient use of diesel fuel. More economical local energy forms such as solar and wood fuels for cooking and water heating should be used. The single most important barrier to reform is the underpricing of electricity. The selling price of electricity should be raised leading to full cost pricing in two years.

#### **WESTERN SAMOA**

The most substantial gains to be made in displacing imported fuels are through enhancing hydropower generation and the use of wood fuels for dry season generation. If well managed, within 7 years, wood fuels could replace diesel for heat and steam raising in industry. Wood, charcoal, and solar used for cooking and water heating can displace kerosene and LPG. The advent of a large coconut oil production facility creates the prospect for a long-term major substitution of diesel by coconut oil-based fuels. A small, efficient energy policy planning administration at a high level in the administration will help effect these measures.

#### **COOK ISLANDS**

The Cook Islands Government has an excellent prospect of greatly reducing the cost of energy to the national economy during the next 8 years through the use of locally available energy sources and improved energy management and pricing in the petroleum and power sectors. Careful renegotiation of petroleum storage and wholesaling is prudent, and positive steps have already been taken.

There is an important biomass resource on Rarotonga and some of the outer islands that can be considered for use as a fuel; for larger-scale energy demands, fuelwood plantations might be established and appear to be economical. A wood-fueled steam power plant of 3 MW (2 x 1.5 MW) is an economical and desirable substitute for diesel power generation on Rarotonga.

#### **TUVALU**

The most substantial local energy resources are solar and biomass, although the wood resource needs careful management to ensure that it remains renewable. By 1990, or perhaps earlier, these could replace all the kerosene needed for domestic purposes (50 kl/yr) and a substantial fraction of the distillate used for electricity generation (50 kl/yr). Although individual consumers would not be paying much less for energy, this could give savings to the nation of A\$50-150,000/annum. Careful management of energy resources is needed. A half-time energy planner, assisted by a coordinating committee, is needed.

Pacific Gas and Electric Company (PG and E). (77 Beale St., San Francisco, California, USA 94106.)

**Energy Saving Tips: A Money Saving Guide for Small Businesses.** San Francisco: PG and E, 1981. 28p. PEP

Energy conservation techniques are described for lighting, heating, ventilation and cooling, water heating, and food preparation and storage. These tips are intended for businesses and would not alter normal business operations. Operation, maintenance, and improvements to save energy are listed. Different types of lighting including incandescent, fluorescent, high-intensity discharge, mercury vapor, metal halide, and high-pressure sodium lamps are described. The conservation techniques are generally, simple and inexpensive maintenance checklists for food preparation and storage, are included, as well as a form divided by monthly, quarterly, semi-annual, and annual maintenance tasks.

Pak, Simon J.; Taylor, Charles R.H. (World Bank, 1818 H St. N.W., Washington, D.C., USA 20433.)

**Critical Factors in Economic Evaluation of Small Decentralized Energy Projects.** Washington, D.C.: World Bank, 1976. 7p. (Science and Technology Report Series No. 25.) ERD

The economics of small energy technologies are location specific. They tend to require proportionally larger initial investments, but smaller maintenance and operating costs than large technologies. In assessing alternative energy sources, it is necessary to consider secondary economic effects, and all costs, benefits, and the risk of accident should also be estimated. The benefits expected from decentralized alternative energy sources are frequently overestimated. In theory, it may be possible to achieve high utilization rates; but in practice it has proved difficult. First, the physical quantities of usable output must be estimated and then an economic unit value established. To estimate costs, (which may or may not be market prices) values must be assigned to inputs. Inputs may be land, labor, equipment, spare parts, maintenance, raw materials, or appliances. It is useful to distinguish inputs that are tracked internationally and those that are not.

Ravenholt, Albert. (American University Field Staff, 4 West Wheelock St., Hanover, New Hampshire, USA 03755.)

**Geothermal Energy in the Pacific Fire Belt.** Common Ground IV(4): p.43-53. Winter 1978. ERD

Geothermal energy development in the Philippines and New Zealand is described. In Rotorua, New Zealand, many buildings have used geothermal heat since 1935. Wairakei, N.Z., has been developed since 1950 and currently electricity is generated at two stations with a capacity of 102.6 MW and 192.6 MW, respectively. Problems with deposits in pipes and concentrating low-pressure steam have been encountered. In the Philippines, Union Oil of California, which operates "The Geysers" in California, works through Philippine Geothermal, Inc., a wholly owned subsidiary. Currently, Mount Luzon is being developed. A joint venture has been established with the Philippine government's National Power Corporation. The cost of developing the production well to supply the steam turbines is shared by the two companies. Total cost

of producing electric power, including amortization of investment in all installations is calculated at 17 mil per kilowatt hour. In the Philippines there is a shortage of qualified technicians, as well as a need to maximize incentives for private sector participation. Further development of geothermal power in New Zealand has great potential.

Rizer, James P. (Pacific Islands Development Program, East-West Center, 1777 East-West Rd., Honolulu, Hawaii, USA 96848.)  
**Ponape: Household Income, Expenditure and the Role of Electricity.** Honolulu: East-West Center, November 1983. 119p. PEP

The purpose of this study is to assess the impact of electricity on culture, income distribution, and development. It attempts to establish a baseline to facilitate the design of rural electrification projects in the Pacific. This study focuses on the household as the unit for analysis and places the role of electricity in the context of a household's utilization of all of its resources. Household resources that have been detailed include income, both subsistence or non-market production and cash, economic activity or employment, and the use of time. The use of electricity and energy, in general, are assigned minor roles. It was found that electricity is a desired service, but trails improved sanitation, water supply, and roads in priority.

Income and educational levels are major determinants in the amount of electricity consumed and the range of its uses/applications. Electricity is seen as widening the divisions between income groups and rural and urban areas, given that only those in the higher-income groups are able to fully exploit it. However, the impact of these widening divisions on Ponapean cultures cannot be ascertained. Given the low tariff structures, subsidization consumes over 20 percent of the State's total annual operating budget. Increased tariff rates are justified although this could negatively affect the flow of cash and goods.

There is a need to develop an educational campaign emphasizing the safe use and conservation of electricity. Analysis should be undertaken on raising import duties for electrical appliances and should incorporate criteria based on energy efficiency and substitutability options.

Schaller, David A.; Larson, Ronal W. (Black Hawk Associates, 2960 Vince St., Denver, Colorado, USA 80210.)  
**Photovoltaic Applications for Remote Island Needs.** Denver, Colorado: Black Hawk Associates, January 1983. 169p. PEP

Electric power supply options available to many of the Central and South Pacific island governments are severely constrained by remoteness, limited infrastructures, a corrosive natural environment, and the high delivered costs of many conventional energy sources. Photovoltaic energy systems offer a currently available, practical, and cost-effective source of electricity for many stand-alone applications in remote areas of the Pacific. Photovoltaic system definitions and cost analyses are provided for selected applications in the Republic of Palau, the Federated States of Micronesia, the Republic of the Marshall Islands, and the Territory of American Samoa.

Semana, Jose A.; Laxamana, Nieva B. (University of the Philippines at Los Banos, Forest Products Research and Industries Development Commission, Laguna 3720, Los Banos, Philippines.)

**Techniques of Determining Wood Characteristics and Properties as Basis for Mass Selection of Fuelwood Species.** Fixing Criteria for Mass Selection of Fuelwood Species Seminar, March 4-7, 1981, University of the Philippines at Los Banos.  
ERD

The paper explains sampling techniques and tests used to assess a wood's potential as a fuel. Important characteristics of fuelwood that have to be determined from the strictly fuel point of view, in order of their priority, are (1) moisture content and specific gravity, (2) heating values, (3) the proximate chemical composition including the fixed carbon volatile matter and ash content, (4) ash fusion point, and (5) ultimate chemical composition. The minimum tests necessary are for specific gravity and moisture content. Proximate chemical composition is used to determine the quality of a wood for a given purpose. If fuelwood is to be used for boiler fuel or other large scale uses, the ash fusion point must be found. Ideally fuelwood should have high heating value, low ash content, and low moisture content. Wood for household cooking should not emit smoke or objectionable color.

SETS, Incorporated. (507 Varsity Building, 1110 University Ave., Honolulu, Hawaii, USA 96826.)

**Suitability of Salt-Gradient Solar Ponds for Electric Power Generation in the U.S. Trust Territory of the Pacific Islands, Guam and American Samoa.**  
Honolulu: Sets, Incorporated, 1982. 116p. PEP

This report describes the procedures and findings of a study to assess the suitability of salt-gradient solar ponds for base-load (firm) electricity generation in U.S. Trust Territory of the Pacific Islands (TTPI), Guam, and American Samoa. The general conclusion is that Solar Pond Power Plants (SPPPs) are viable both technically and economically for some applications, possibly including atolls. The most practical immediate application would be for small and intermediate power users such as villages and airports.

It is recommended that (1) at least one small SPPP be built immediately on a dry land site such as for the main village on Peleliu, Palau, or at other identified feasible sites and (2) that a design study be conducted to adapt the technology to atoll sites.

Although diesel generator systems are somewhat cheaper to install (\$3,000 to \$4,000 per kW) than SPPPs (\$5,000 to \$25,000 per kW), the high operating costs of diesel plants (25 to 50c per kWh) compared to SPPPs (5 to 10c per kWh) makes SPPPs the more dependable and economical option over the long term (5 to 20 years). SPPPs also eliminate the problem of uncertain fuel supply and reciprocating combustion engine maintenance.

Financial analysis of the SPPP design was compared to base-load power plants using diesel and photovoltaic cells. SPPP systems appear to be more economical than a similar sized diesel power plant. Stand-alone PV firm power systems are much more expensive than either SPPP or diesel plants. Solar Pond Power Plants might be considered in combination with other energy conversion

techniques to increase overall efficiency and to reduce cost and land usage, such as photovoltaic cells, wind generators, or OTEC.

Siwatibau, Suliana. (Address not known.)

**Methodologies for Quantifying the Production and Use of Non-Conventional Sources of Energy.** Economic and Social Commission for Asia and the Pacific (ESCAP), Pacific Subregional Workshop on Energy Statistics, January 2-8, 1982. 32p. PEP

The methods of quantifying the availability and the potential for non-conventional sources of energy in the Pacific are discussed. These resources are sea energy, wind, hydropower, solar, biomass, and wastes including agricultural and household wastes and wood resources. Various methods of assessing social factors such as questionnaires and data sheets are reviewed. The problems associated with deciding which statistics to collect and collecting them are assessed. In a final section, survey methodology is described.

Siwatibau, Suliana. (Address not known.)

**Rural Energy in Fiji: A Survey of Domestic Rural Energy Use and Potential.** Ottawa: International Development Research Centre, 1981. 132p. (IDRC-157E). PAC/PEP

The project's aims were to survey current energy use and needs in selected rural areas of Fiji and to evaluate alternative sources of energy supply. The project used a variety of secondary sources to supplement primary data obtained in field surveys carried out from a sample of the 115 households in four representative villages and seven isolated homesteads. A brief survey of a periurban area near Suva was also made for comparison. Of the homes surveyed, 92 percent cook with wood over an open fireplace.

Most rural people will continue to use wood for cooking because it has no financial cost and is readily available. In a few areas, however, supplies will become critical within the next 10 years. There is a need for a cheap, clean, wood-burning stove for rural cooking. Of the interior rural peoples interviewed, 100 percent would welcome some means of keeping their homes warm without having to sleep in smoky, thatched bures.

People will continue to buy the less efficient kerosene cookers, which present the greatest fire hazard, because they are the cheapest available. Consumers are generally unaware of the safety and efficiency features of the cookers on the market. Of the households surveyed, 74 percent use kerosene and benzine lamps. Of these, 43 percent use kerosene lamps only. For better lighting, diesel electric generation is going to be a further drain on the meager cash incomes in most villages. If electricity generation is not concurrently utilized for productive activities, kerosene trolley lamps will be of greater benefit to most rural people.

The majority of people interviewed (91.3%) wished to have hot water readily available in their homes for cooking, washing, bathing, and steam baths. They were all willing to make cash contributions toward either community or individual systems. The economic analysis of pig waste-fed

digesters shows that at present levels of use, all but one (7.5 m<sup>3</sup>) show disappointing economic returns. This is largely due to underloading and underutilization. For villages and small farmers without animals biogas possibilities lie in the utilization of vegetable wastes rather than animal wastes.

The social assessment showed a high degree of motivation for better material comforts, improved self-sufficiency, and sufficient enterprise among villagers. Significantly, however, aspirations for material comforts can only be satisfied through increased participation in the cash economy.

Siwatibau, Suliana. (Address not known.)

**A Survey of Domestic Rural Energy Use and Potential in Fiji.** Suva, Fiji: University of the South Pacific, October 1978. 299p. (Report to the Fiji Government and the IDRC, Ottawa, Canada.) ERD/PAC

This comprehensive report consists of an extensive survey of domestic energy use and potential energy sources in Fiji. Common domestic end uses of energy are cooking, baking, crop-drying, food preservation, ironing, and lighting. Observations, conclusions, and recommendations are made in all energy sectors including wood electricity, biogas, kerosene, socio-economic aspects, cooking, and energy conservation. The greatest use for energy is cooking. Wood is and will continue to be the primary cooking fuel, but in a few areas supplies will be critical within the next 10 years. A cheap, clean wood-burning stove is needed. A switch to kerosene for cooking with an increase in cash income is evident. Safety and efficiency requirements for kerosene cookers need to be established and local construction or importing of more kerosene tilley lamps should be encouraged.

For villages and small non-animal farmers, bioconversion possibilities lie in the utilization of vegetable wastes. The majority of diesel electricity-generating systems for villages are not going to be economically viable; and if the electricity is for lighting alone, subsidized benzine or tilley lamps will be of greater economic benefit to the majority of villages.

Solly, Richard K. (School of Natural Resources, University of the South Pacific, P.O. Box 1168, Suva, Fiji.)

**Study of Methane Digestors in the South Pacific Region.** Appropriate Technology 3(4): p.23-25. February 1977. ERD/PEP

Most working digestors in the South Pacific are of similar design (diagram provided). Pig waste is the most common input material. Major disadvantages are the high cost and relatively sophisticated labor needs. In addition, pipes are prone to blockage, and slurry stratification occurs. These are flow-type digestors and often, due to human error, the working biomass is flushed from the digester during a heavy rainstorm. Samples were taken from several digestors over a 14-month period. Considerable stratification was noticed when the gas holder was removed for maintenance resulting in low gas production. The dominant factor was the diluted nature of the slurry. Maximum value was 0.8 percent volatile solids.

Very little reduction was measured in coliform bacteria counts for the

inlet slurry compared to the outlet slurry. The number of digestors throughout the Pacific is small. The major reason is economic since capital costs for the installation of digestors were not justified upon the basis of visible returns. The prime incentive to individual digester operators is utilization of the gas.

Only if gas yields may be guaranteed for a substantial period of time, if operation is consistent with social aspects, and if a reliable advisory service is available, can a dependence upon the gas be developed.

Solly, Richard K. (School of Natural Resources, University of the South Pacific, P.O. Box 1168, Suva, Fiji.)

**Utilization of Coconut Oil as a Fuel for Petroleum Diesel and Kerosene Substitution.** South Pacific Regional Technical Meeting on New and Renewable Sources of Energy, September 28 to October 2, 1982, Papeete, French Polynesia. 23p. PEP

The utilization of coconut oil as a fuel for diesel engines has been tried in many of the island countries of the Pacific. In all cases, the engines operated successfully for at least a short period. Coconut oil is currently produced in a number of island countries in the Pacific, and a processing plant for its production is available on an "off-the-shelf basis." Coconut meal from the coconut oil extraction process is a valuable byproduct.

Coconut oil may be used directly as a fuel for standard unmodified diesel engines or mixed in any proportion with petroleum diesel fuel. Mixing with petroleum fuel minimizes the problem of the formation of solid particles in the coconut oil during the cooler months. Particles form in coconut oil in the temperature range 25-20°C (68-77°F).

The factors responsible for the formation of engine injector deposits are not fully understood. The potential for saving foreign exchange and the rejuvenation of the coconut industry provides much incentive for using coconut oil or "COCOHOH" as a fuel. Expansion or introduction of high-yielding oil palms may greatly increase indigenous liquid fuels. It is recommended that coconut oil only be used as a fuel at locations where trained expertise is available for regular monitoring of engine performance.

Production of "COCOHOH" from chemical combination of coconut oil and ethanol will also yield glycerol as a valuable byproduct. "COCOHOH" is equal or better than petroleum diesel fuel and may be used in domestic appliances fueled by kerosene (paraffin). The performance of "COCOHOH" is equal to kerosene in "pressure" appliances. It is a much safer fuel than kerosene due to a lower volatility and a higher flame flash point.

South Pacific Commission. (B.P. D5, Noumea, New Caledonia.)

**Energy Information No. 4: Solar Pumping.** Noumea, New Caledonia: South Pacific Commission, September 1980. 3p. PIDP

A solar pumping demonstration was set up September 1980 at the SPC Headquarters in Noumea. The pump's purpose was to supply water to isolated households, for agriculture, small communities and for livestock. The New Caledonia company that set up the system produces a non-submersive pump for a 40 to 400 watts power range producing flows of up to 52 m<sup>3</sup>/day for a head of 5

meters and a submersive pump with a non-submerged motor for a 600 to 6,600 watts power range giving flows of the SPC in pump for a head of 40 metres. Average flow of the SPC's pump has been 8 m<sup>3</sup>/day.

South Pacific Commission. (B.P. D-5, Noumea, New Caledonia.)

**Energy Information No. 3: Solar Still.** Noumea, New Caledonia: South Pacific Commission, August 1980. 3p. PIDP

Two simple, inexpensive solar stills for converting seawater to freshwater are described. They use static distillation. A black plastic tank contains the seawater, and a sheet of glass or plexiglass covers the tank. As the water evaporates because of the absorbed heat of the sun, it condenses on the inner surface of the glass and flows into a gutter where it can be collected. Stills of these types have been installed on the atolls of Rangiora and Tikehau in French Polynesia. A still has been set up at the SPC Headquarters in Noumea.

Tack, Cheryl. (Department of Horticulture, University of Hawaii, 3190 Maile Way, Honolulu, Hawaii, USA 96848.)

**Environmental and Societal Issues in the Development and Utilization of Biomass Energy Resources of the American Territories of the Pacific.** October 1982. (Unpublished.) PEP

This overview of demographic, economic, sociological, and topographic issues relates to energy in the U.S. Trust Territory, Guam, and American Samoa. There are local energy resources that are currently untapped due to a lack of coordinated effort to develop them on a scale that suits the islands. Thinking small is the key to developing energy self-sufficiency in the territories. Plans for economic development depend to a great extent on a secure energy future. Renewable energy development is also a matter of education.

Tatom, J.W. (Address not known.)

**Feasibility of Industrial Fuel Production from Pyrolysis of Wood Wastes in Papua New Guinea.** Konedobu, Papua New Guinea: Department of Minerals and Energy, 1979. 36p. PEP

This study is of the overall feasibility of the production of synthetic industrial fuels, that is, charcoal and synthetic oil, via pyrolysis of wood residues in Papua New Guinea. The study included a survey of the available wastes and involved visits to a number of sawmills and logging operations. In addition, a limited evaluation of the Papua New Guinea industrial fuel market was made. This latter work included visits to a number of industrial plants and a demonstration in Lae of the combustion of a petroleum oil/char slurry. Finally, conceptual designs have been prepared for a completely integrated sawmill-pyrolysis plant and a small demonstration pyrolytic convertor system, together with economic analyses. The study indicates the practical, economic, and technical feasibility of the concept in Papua New Guinea. Therefore, the implementation of a 25 tonne/day demonstration program in Lae is recommended.

Tevita, S. (Address not known.)

**Wood Fuel Electricity Generation.** September 1981, 4p. (Unpublished.) PEP

Two alternative ways are considered of generating electricity from wood, that is, steam generation or producer gas engines. The electricity produced is intended to supply the shortfall in hydropower during the dry season. Two feasibility studies were carried out. During 1978/79 it was concluded that it would be economically feasible to install a 2 x 2.5 MW plant at Mulifanua, Western Samoa. In 1979 Sploff and Associates proposed a 10 MW steam plant to be located on the south side of the island. Since that time two important developments have occurred. High oil prices have stagnated electricity demand and there have been major technological developments in gasification units.

United States, Department of Energy (U.S. DOE). (Assistant Secretary for Conservation and Solar Applications, State Energy Conservation and Solar Applications, State Energy Conservation Programs Division, Washington, D.C., USA 20585.)

**Saving Money with Energy Conservation: An Energy Audit Workbook for Apartment Buildings.** Washington, D.C.: U.S. DOE, July 1980. 31p. (DOE/CS-0139). PEP

Energy conservation methods appropriate to each particular type of building are described. Each booklet covers heating, cooling, lighting, water heating, and ventilation. Many methods requiring either no or very little capital input are included. A form designed for managing energy conservation and ways to calculate savings are provided in each of the manuals.

Vanuatu, Government of. (P.O. Box 741, Port Vila, Vanuatu.)

**Charcoal Power Project: Electricity Production from Charcoal in Vanuatu, 1982.** Port Vila, Vanuatu: Central Planning Office; Prime Minister's Office, 1982. 5p. PEP

The most immediate source of an alternative to diesel fuel in Vanuatu is charcoal. Charcoal production can utilize waste timber from bush cleaning operations up and down the island group. A pilot-scale project is proposed to demonstrate the overall system of production and utilization. Moreover, a small investment would create a lot of employment for unskilled labor.

Charcoal is easily transportable and could stimulate the local transport industry. Charcoal is developing as an alternative to kerosene for low-income groups. The company that currently produces electricity has expressed a willingness to gradually switch to dual fuel operations. For several reasons the preferred site for the pilot project is the island of Tanna. An economic analysis shows that it does not appear to be economical at present to ship charcoal from the outer islands to Vila. It is hoped that more accurate figures would be derived from a pilot project so that a reassessment could be made.

Vanuatu, Government of. (P.O. Box 741, Port Vila, Vanuatu.)  
**The Tannakol Project: A 100,000lpa Ethanol Plant Utilizing the Subsistence Production of Manioc on the Island of Tanna, Vanuatu.** Port Vila, Vanuatu: Central Planning Office, 1981. 13p. PEP

The general specifications and management conditions for an ethanol plant in Vanuatu are described. The plant will consist of three semi-batch operated 1,200 gallon cooker/fermenter tanks with distillation in two 12-inch packed column stills. Heat for the plant will come from a wood-burning stove with an output of 71,500 BTU/hour. The heat transfer medium will be thermal oil. The plant is designed to use a minimum of water, with process water coming largely from the recycling of stillage. The major items of the plant will be made locally. The process of washing the manioc, chipping, cooking, liquifaction and saccharification, fermentation and distillation is described in detail. Reasons for the design specification are explained. Suggested maintenance procedures, possible problems and solutions, and assembly guidelines are included.

Volunteers in Technical Assistance (VITA). (1815 North Lynn St., Suite 200, Arlington, Virginia, USA 22209.)

**Making Charcoal: The Retort Method.** Mt. Rainier, Maryland: VITA, 1980. 28p. ERD

This description examines a charcoal retort for charcoal production, lumber drying and wood preservation, and pest control (the byproducts). It is easy to build and maintain, is portable, produces high-quality charcoal and useful tars, cuts in half the charcoal production time, and requires less fuel than other methods. The retort has a two-year lifespan and is more expensive than traditional methods. It was designed and tested in the West Indies and can be made from oil drums and other inexpensive equipment. The tar can be collected and used for various purposes, or alternatively gases produced during the charring process can be used to finish the process, which saves fuel.

Volunteers in Technical Assistance (VITA). (1815 North Lynn St., Suite 200, Arlington, Virginia, USA 22209.)

**Family Size Non-electric Refrigeration.** Mt. Rainier, Maryland: VITA, n.d. 5p. (VITA Technical Bulletin No. 43). ERD

A small, non-electric, continuous-action refrigerator is described. It uses an alcohol-water solution and cools by evaporation in a low-pressure cycle. The water-alcohol solution in the generator is heated within the separator where the alcohol vapors and the water are separated. The alcohol vapors continue up to the condenser where they are condensed back into a liquid. The liquid alcohol flows down to the evaporator, where it is evaporated by the air passing over it. This is where the cooling takes place. The air and alcohol vapors continue down and pass into the absorber where the water absorbs the alcohol vapors. The air flows back to the evaporator and the water-alcohol solution flows into a reservoir that supplies the generator as needed.

Walterson, R.C. (Energy, Mines and Resources Canada, Conservation and Renewable Energy Branch, 580 Booth St., Ottawa, Ontario, Canada K1A 0E4.)  
**Industrial Energy Conservation Potential in Papua New Guinea.** Konedobu, Papua New Guinea: Department of Minerals and Energy, 1980. 63p. (Report No. 2-80.)  
PEP

A national energy conservation program is proposed that could potentially reduce per unit industrial energy consumption by approximately 20 percent within seven years. During the first year, a nation-wide awareness program would be launched, followed by the implementation of an organized goal setting and reporting system. In this phase, industry will begin to eliminate wasteful practices, repair energy leaks, and make minor process changes. This will result in savings of 10-12 percent. From the third year, capital investments with an average payback period of three years will be made. Immediate steps should be considered to improve the lagging electrical power factor. Bouganville Copper Limited is the major industrial energy consumer and as such constitutes a key element in the program. Government incentives, financial and in research, may make the difference between an acceptable and unacceptable energy conservation investment. If possible, indigenous fuel sources will be suggested to partially or totally supplement imported fuels. An institutional support system for the program is described, as well as specific measures each industry can take.

Weiss, Charles; Pak, Simon J. (World Bank, 1818 H St. N.W., Washington, D.C., USA 20433.)

**Developing Country Applications of Photovoltaic Cells.** Washington, D.C.: World Bank, 1976. 10p. (Science and Technology Report No.7). ERD

Following a survey of a few potential uses of solar power in developing countries, it was concluded that solar photovoltaic cells can compete economically with primary batteries and with gasoline generators. The non-oil exporting developing countries should be a significant potential market.

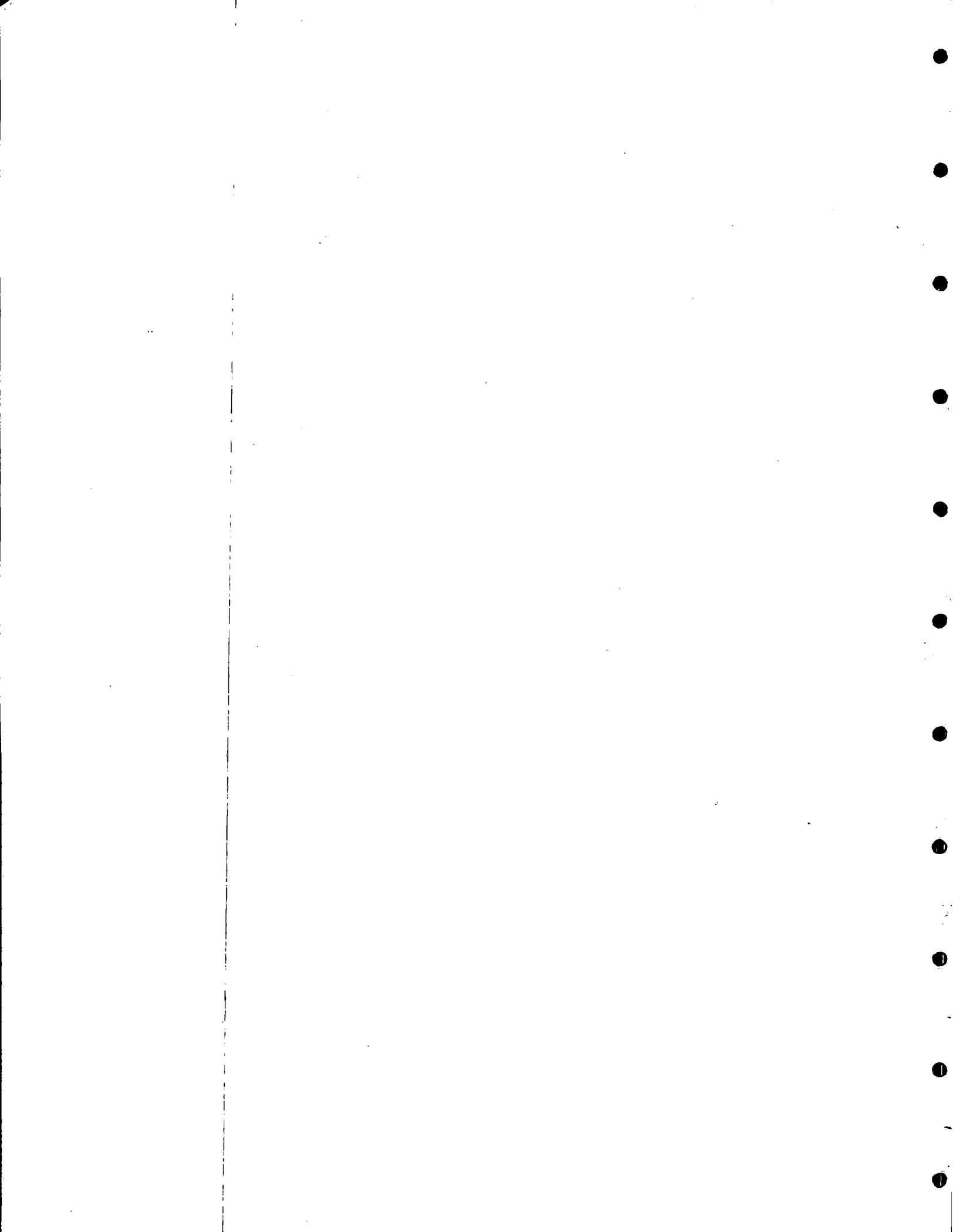
The problems are examined that a small manufacturer of photovoltaics would face in developing markets in third world countries. The government is usually the largest potential market. Generally, the developing country buyer wants a reliable device and prefers a complete package. The system should be operable and maintainable by local people, have a guarantee of back-up service and replacement, and at least a six-year lifespan. Because it is a capital-intensive product, the cost and availability of capital will be a major concern.

World Bank. (1818 H St. N.W., Washington, D.C., USA 20433.)

**Rural Electrification.** Washington, D.C.: World Bank Publications, October 1975. 79p. ERD

The report examines three main topics; (1) the prospects for successful investment in rural electrification, (2) approaches to investment from the point of view of economic justification, and identification of projects'

financial, technical, and institutional problems, and (3) implications for the World Bank's policy and procedures. The consumer response data relate to periods before the petroleum price increases of late 1973 and 1974; 1972 cost and price data are also used. The report indicates that there is ample scope for successful investments in rural electrification, provided that the projects are properly selected and prepared. An approach is outlined for undertaking such investments. Pricing policy requires compromises between economic, social, and financial aims. The establishment of good institutions is essential for the success of a program.



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