-1- PD-AAP-559

CLASSIFICATION

PROJECT EVALUATION SUMMARY (PES) — PART I

Report Symbol U-447

1. PROJECT TITLE	2. PROJECT NUMBER	3. MISSION/AID/W OFFICE
Botswana Renewable Energy Technology Project	633-0209	USAID/Botswana

4. EVALUATION NUMBER (Enter the number maintained by the reporting unit e.g., Country or AID/W Administrative Code, Fiscal Year, Serial No. beginning with No. 1 each FY) 84-1

☒ REGULAR EVALUATION ☐ SPECIAL EVALUATION

5. KEY PROJECT IMPLEMENTATION DATES			6. ESTIMATED PROJECT FUNDING		7. PERIOD COVERED BY EVALUATION
A. First PRO-AG or Equivalent	B. Final Obligation Expected	C. Final Input Delivery	A. Total	$ 4707.3	From (month/yr.) September 26, 1980
FY 80	FY 82	FY 85	B. U.S.	$ 3304.0	To (month/yr.) December 14, 1983
					Date of Evaluation Review: January 19,1984

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

A. List decisions and/or unresolved issues; cite those items needing further study. (NOTE: Mission decisions which anticipate AID/W or regional office action should specify type of document, e.g., airgram, SPAR, PIO, which will present detailed request.)	B. NAME OF OFFICER RESPONSIBLE FOR ACTION	C. DATE ACTION TO BE COMPLETED
8. Project Recommendations		
GENERAL		
-- The USAID technical assistance contract should be extended until August 7, 1985. The contractor and the GOB should discuss how this extension can be accomplished at no additional cost. This extension, however, should be contingent on three conditions being met:	AID/MMRWA/ MFDP/USAID	March, 1984
-- that an acceptable standard of scientific research design, implementation and reporting is prepared, disseminated to the staff of the Botswana Renewable Energy Project (BRET), and incorporated into all future research activities;	ARD	Feb. 1984
-- that an Associates in Rural Development (ARD) staff member, preferably John Ashworth, meet with Eric Peterson, AID/W, to discuss this research design, and then plan a visit to Botswana to develop the design and train BRET staff, and if possible, meet with AID's Regional Energy Advisor, Anthony Pryor, in Nairobi enroute to Gaborone.	ARD	Jan. 1984

9. INVENTORY OF DOCUMENTS TO BE REVISED PER ABOVE DECISIONS

- ☐ Project Paper
- ☐ Implementation Plan e.g., CPI Network
- ☐ Other (Specify)
- ☒ Financial Plan
- ☐ PIO/T
- ☒ Logical Framework
- ☐ PIO/C
- ☐ Other (Specify)
- ☒ Project Agreement *
- ☐ PIO/P

10. ALTERNATIVE DECISIONS ON FUTURE OF PROJECT

- A. ☐ Continue Project Without Change
- B. ☐ Change Project Design and/or
- ☒ Change Implementation Plan
- C. ☐ Discontinue Project

11. PROJECT OFFICER AND HOST COUNTRY OR OTHER RANKING PARTICIPANTS AS APPROPRIATE (Names and Titles)

Mr. Freddie Motlhatlhedi, MMRWA
Ms. Rachel Turner, MMRWA
Mr. Eric Peterson, AID/W
Mr. C.A. Pryor, REDSO/ESA
Mr. Paul Tuebner, USAID/B

12. Mission/AID/W Office Director Approval

Signature: P Butler (for Guedet)

Typed Name: Paul Guedet, Director

Date: 2/3/84

AID 1330-15 (2-78)

* Annex 1, as per Mbabane 00041 from RLA.

Clearances: PTuebner
LTaylor
EButler

-- that extension activities are improved, and that more attention is given to staffing at the two test villages.	ARD	Jan. 1984
-- The Evaluation Team suggests that the Project Executive Committee (PEC) should be presented with evidence of positive steps towards meeting these conditions. The Evaluation Team recommends that PEC continue to monitor compliance during project life. A decision on a possible extension should be made be February 1, 1984.	ARD	Jan./Feb. 1984
-- It is recommended that Eric Peterson, AID/W/S&T and Anthony Pryor, REDSO/ESA, schedule a joint review of project implementation.	AID/W REDSO/ESA USAID	June, 1984
-- BRET should continue to maintain and use management procedures such as bar charts, schedules and milestones to indicate the phase of activities, progress achieved, and the inter-relationships.	ARD	May, 1984
-- The Project Paper Outputs, and Output Magnitudes should be modified and expanded, and the End of Project Status revised.	ARD/ USAID	Jan. 1984
-- The research and development of RETs in the third test village should be dropped.	BRET	Jan. 1984
-- The Contractor should prepare a revised Work Plan, and a Logical Framework incorporating the modifications being recommended in Outputs, and summarizing Output Magnitudes obtainable by August, 1985. These documents should be presented to the PEC for approval.	ARD	Jan./Feb. 1984
TECHNICAL		
-- That BRET, any other contracting research organization, and the Government of Botswana (GOB) Ministries as recipients of the information seek independent review of the work as it progresses.	ARD/GOB	Ongoing
-- That an engineer/ economist at the contractor's home office should be requested to analyze existing cost data for the candidate windmills. A decision should be made as to whether any of the 4 types to be purchased are duplicative. A total of 8 windmills should be purchased, with a preference for systems designed and/or manufactured in Africa.	ARD	Feb. 1984

-- It appears that difficulties in identifying test boreholes have been surmounted; the Ministry of Mineral Resources and Water Affairs (MMRWA) is urged to provide assistance to ensure the successful and timely completion of the planned pumping tests.	MMRWA/BRET	Feb. 1984
-- Fund the Botswana Technology Center (BTC) to do a technical feasibility assessment using their data for biogas and animal driven water pumps.	BRET/GOB	March 1984
-- A Diesel Feasibility Study and Electrical Grid extension analysis should be undertaken, to include the technical and economic performance of diesel and to some extent electrical grid feasibility studies with reference to water pumping so that the feasibility threshold for RET systems can be identified.	BRET	
-- Undertake Water Pumping Feasibility Studies, including all pumping systems: wind, photovoltaics, PV, animal traction, biogas, hand pumps and human traction. Examine entire energy delivery systems, not just energy conversion devices and compare with diesel and electric pumping. The Rural Sector Grant's possible work to assess animal pumps and diesel pumps should be assisted if possible. This report can be used by GOB to establish priorities, and identify opportunities for future funding.	BRET	August, 1984
-- Continue cooking technology demonstration and dissemination and identify and initiate field implementation procedures.	BRET	March 1984
-- Analyze individual passive solar house innovations for their respective contribution in energy savings to overall performance and cost increases.	BRET	Sept. 1984
-- Do financial analysis of present solar water heaters on BHC houses.	ARD	Sept. 1984
-- Although a fuel wood study may still be appropriate, it's design should be postponed pending further USAID and GOB consultation.	USAID/GOB	---
-- BRET should talk to the Botswana Meat Commission (BMC) and the Botswana Power Commission (BPC) to determine if it is worthwhile undertaking a feasibility study for methane production at the abattoirs.	BRET	May 1984

Coordination/Extension

-- Work more closely with regional technical officers who have responsibility for operation and maintenance of water bore holes.	BRET/GOB	Ongoing
-- Have MMRWA designate an interested engineer or other technical person within the Department of Water Affairs, to be the coordinator at the working level on water pumping technologies.	MMRWA	April 1984
-- The GOB should organize a Botswana Renewable Energy Activities Committee, composed of appropriate operational and planning staff from other Ministries and parastatal organizations. Technical subcommittees should be organized as needed.	MMRWA/ MFDP	Jan. 1984
-- Two of the Peace Corps new recruits should have extension experience, and be located in the VTF villages. Detailed scopes of work should be developed for these positions and presented to the PEC for review.	ARD/PC	Feb. 1984
-- Work to understand and eliminate constraints to the use of the private sector in technology diffusion should be accelerated. Partnership for Productivity should be assisted in carrying out a pilot test of entrepreneurial interest in metal stove production and should be requested to prepare a discussion paper on the market, distribution and entrepreneurial environment for all candidate technologies.	BRET/PFP	Ongoing
-- Extension activities should be strengthened by extension staff maintaining continual presence in the villages, by strengthening the use of the village facilitators and improving communication with existing extension agents. There should be continuity in projects started in the villages.	BRET	Feb. 1984
-- The outreach role of the Gaborone facilitator should be clarified.	BRET	Feb. 1984

Training and Institutional Analysis

-- A training plan should be developed for each technology and for each test village. In addition, a broader training needs and implementation plan for selected technologies should be prepared for guidance to the GOB on future national implementation.	BRET	March 1984
-- An institutional description of each village -- focusing on extension personnel and entrepreneurs/ businesses -- should be prepared for the two villages.	BRET	March 1984

Administration

-- A local consultant should be provided to evaluate BRET's administrative procedures and provide staff with assistance as needed.	BRET	Feb. 1984
-- The Evaluation Team urges the GOB to define detailed and specific delineations of responsibilities and mandates for the Botswana Technology Centre (BTC), a GOB parastatal, and BRET, a MMRWA project, and to present these conclusions to BRET and BTC. GOB should monitor implementation of the responsibilities and mandates.	MMRWA/ MFDP	Jan. 1984
-- Since MMRWA has assumed title to all of BRET assets, it should also hold the renewable energy space in the new office block to be allocated initially to BRET. This would promote the institutionalization of project activities.	MMRWA/ MFDP	May 1984
-- The space in the new office block should be divided as follows: The library should be devoted to BTC's Botswana Technical Information Service (BTIS); the workshop to BRET, since the BTC is the country's primary technology coordinating and information sharing agency, it does not have need for a workshop. The GOB should work with the BTC and BRET to allocate the space equitably and appropriately, bearing in mind the financial contributions of the respective parties.	GOB/BTC BRET	March 1984
-- PEC and MMRWA should consider whether it may be useful to request MFDP to select an administrator to administer the new office block to be used by BTC and BRET. This administrator would have the responsibility for hiring the receptionist, cleaner, guard and for oversight of space and equipment used commonly by both parties. Both parties would share equally in funding these functions.	MMRWA/ MFDP	March 1984

Staffing

-- Five additional Peace Corps Volunteers should be recruited.	BRET/PC	Jan. 1984
-- Given the importance placed on improving technical research quality, the contractor should request that at least one of the Peace Corps Volunteers be an engineer with experience in field research and testing.	BRET/PC	Jan. 1984
-- The services of Eric Brunet, BRET's metal stove advisor should be extended for a period up to an additional 6 months as needed.	BRET/ MMRWA/ MFDP	Feb. 1984

-- The project should consider staffing requirements that will ensure sufficient social science skills needed to support activities to be covered under the contract extension.	ARD	Feb. 1984

Financing

-- The contractor should be requested to prepare budget estimates outlining activities that can be supported under a no-cost extension.	ARD	Jan. 1984
-- The GOB should immediately begin preparing proposals for follow-on activities, and secure adequate GOB and donor funding.	MMRWA	Feb. 1984
-- The GOB and USAID should immediately consider making available some of the Project's contingency and inflation funds to assist in supporting project activities during the extension.	MMRWA/ MFDP/ USAID	Feb. 1984
-- USAID should also discuss with the contractor the necessity for switching line items, including participant training, to cover the needs of the extension.	USAID/ ARD	Feb. 1984

Other activities or programs undertaken by the project and not specified in the above recommendations should be considered to be satisfactory.

13. SUMMARY

Project implementation has been hindered by the complexity and overly optimistic expectations of the original Project Paper, both in terms of substance and institutional organization. The Evaluation Team has concluded that most of the institutional difficulties have been or will soon be resolved, although the administrative problems have severely delayed project implementation. The establishment of the Project Executive Committee has done much to improve the quality of project review and administrative oversight.

On substance, significant progress has been achieved in certain areas: (1) the narrowing of Project focus to certain dominant technologies offers the possibility of substantial success; and (2) the contractor has been able to significantly improve the substantive focus of the project, and has made excellent progress in terms of staff morale, administration and coordination with the GOB. However, the following problems still remain: (1) Although the contractor has made definite efforts to improve the technical research and development methodology, this has yet to be rigorously structured to allow for measurable results; and (2) while strategies for the extension and promotion of technologies have been developed, they are somewhat vague and undifferentiated, partially because the delay in the R & D work limited the availability of tested and proven technologies to disseminate, and partially due to staff being unfamiliar with extension work.

The Evaluation Team does not recommend changes in Project Goal or Purpose. However, while the Team concluded that most

outputs will be substantially met by the End of Project (EOP), it did not feel that the description of Outputs and End of Project Status (EOPS) adequately addressed the Project Purpose. Therefore, the Evaluation Team has recommended additions, expansions and modifications of Outputs and EOPS to better assure achievement of the Project Purpose and monitor anticipated contractor activities.

The Team also recommends that the project be given a no cost extension for 10 months, to August 7, 1985. Substantial major work in all but one major technical area--water pumping--will be completed by then. However, technical work will need to continue with water pumping, consequently, GOB and other donors may wish to consider a follow-on-project beginning in FY 86 on water pumping technologies. (See Appendix A.)

14. EVALUATION METHODOLOGY

This evaluation represents the first mid-point evaluation, originally planned for October, 1982 in the Project Paper but rescheduled due to delays in project implementation. It includes an examination of project implementation to date as well as suggestions for modifications, including an extension of the approved contract.

The review was undertaken jointly by USAID and the GOB. The Evaluation Team included Freddie Motlhatlhedi, BRET Project Coordinator Counterpart; Rachel Turner, Planning Officer IV with the MMRWA; Eric Peterson, AID/W/S&T/EY, C.A. Pryor, REDSO/ESA; and Paul Tuebner, USAID/Botswana. Mr. Pryor acted as team leader.

The team was provided with a briefing document by BRET, including copies of the First-Year Annual Report, and the Third Quarter 1983 quarterly report. Copies of all reports published by the contractor were examined as well as various reports and other documentation in the BRET files.The team also requested and received the draft Third-Year Work Plan, financial data and other specific material.

Field visits were made to the two test villages, Ditshegwane and Shoshong, as well as the Rural Industries Innovation Centre (RIIC). Organizations and institutions interviewed in Gaborone included the Ministry of Mineral Resources and Water Affairs, the Ministry of Finance and Development Planning, the Botswana Housing Corporation, the Chief Architect's Office, the Botswana Technology Centre (BTC), the Department of Electrical Engineering, Meteorological Services, the Rural Development Unit, and Partnership for Productivity.

15. EXTERNAL FACTORS

The major external factor affecting this project to date has been the change in status between BTC and BRET. The GOB has decided to place BRET directly under the MMRWA, with no direct BTC oversight. This decision has demonstrably improved the project administration. However, the operational relations between BTC, RIIC, BRET and the GOB have yet to be completely clarified.

Other factors, such as socio-economic conditions and government interest and priorities have remained substantially the same.

16. PROJECT INPUTS

Project inputs include $3,304,000 from AID Project 633-0209; Peace Corps contribution of $225,000; and GOB contribution of $1,178,300. AID inputs include: technical assistance, $1,693,700; local staff, $62,000; staff travel costs, $105,000; research activities, $539,900; local training $91,600; construction, $266,000; support costs, $168,000; other costs, $550; and inflation and contingencies, $377,350. The GOB contributions include $108,000 for extension staff; $53,000 for GOB ministerial staff time; $249,000 for Batswana counterparts of AID-funded technical specialists; $213,00 for commodities; $300,000 for research and development; $44,000 for land; and $12,600 for housing.

This evaluation has identified certain significant problems in the delivery of project inputs; there have been serious delays in the provision of technology research and development, caused in large part by external factors described in Section 15. The original Chief of Party (COP) resigned in 8/82 and was replaced in 1/83; a changeover in staff and uncertainty of organizational responsibility between BRET and BTC were responsible for significant delays in R and D activities. Training and other activities have been similarly delayed.

The present COP has done much in improving project morale, in directing and concentrating R and D efforts, and in promoting work on promising research areas which have arisen during project implementation. Short term technical assistance has been on time, but given the overall delay in project implementation, has in some instances been premature. In

addition, the Evaluation Team concluded that some of the short term technical assistance was not of sufficient quality, based on an assessment of the final reports prepared for these consultancies and the utility of these findings to the project and to the GOB.

Local hire and counterpart assistance has been of superior quality; the recent additions of an administrative assistant and a technical coordinator are excellent staffing decisions. These additions should immeasurably improve the quality of project administration, and should help to ensure the rapid provision of inputs necessary to complete the objectives of the project.

Peace Corps inputs have been timely, although the Evaluation Team concludes that the requisite skills of volunteers should emphasize both extension and outreach training as well as technical expertise; new volunteers recruited during the final part of this project should reflect this change in emphasis. Appendix B presents more information on recommended PCV qualifications. In addition, the Evaluation Team strongly urges USAID to assist the contractor and the GOB in eliciting from the Peace Corps, requests for two engineers experienced in applied research, as well as three volunteers with experience in extension work. Training in Renewable Energy Technologies (RETs) is not deemed to be as important as RET field experience or solid technical or extension skills. These staffing inputs are considered to be of fundamental importance if the project is to achieve its planned goals.

17. PROJECT OUTPUTS

The Evaluation Team substantially agreed with the outputs as presented in the Project Paper, however the magnitudes of outputs presented in the log frame were in many instances unrealistic and misleading. If the contractor devoted its efforts to meeting these output magnitudes, the most important output, improvement of Botswana capacity beyond the project, would be seriously compromised.

The Evaluation Team strongly believes that Project Purpose can only be met by developing a capacity within the GOB for promoting technologies and providing long-term encouragement to entrepreneurs; the production of a finite number of RETS during the life of the project is no guarantee, and in fact may hinder the widespread application of RETs. The Project Paper does not clearly outline the steps between the production of pilot technologies and diffusion. The Evaluation Team concluded that the Purpose could best be met through outputs that more realistically reflect the realities of technology diffusion and the role of a pilot project in stimulating long term entrepreneurial development and GOB change.

Therefore, the Evaluation Team is recommending that the outputs be restructured and expanded. These changes do not alter the basic thrust of the outputs as presented in the PP; the attainment of the modified outputs will more directly promote Project Purpose. The specific output magnitudes have been changed to more realistically reflect the potential achievements of a pilot project. The Team wishes to restate our

concern that the continued emphasis on the Project Paper's Output Magnitudes will most probably ensure failure in achieving project purpose.

17. PROJECT OUTPUTS

Project Paper Statements	Evaluation Commentary Status
1. Energy Needs Assessment Data Collection Data collection of energy use in three districts and publication of village Energy Needs Assessment surveys.	Survey assessments completed for two villages (Ditshegwane and Shoshong). Future Activity A third village assessment should not be undertaken. Instead, an Urban Energy Needs Assessment should be undertaken. Recommendations It is recommended that the output be revised to "Energy Needs Data Collection and Analysis for use in technology selection and development."
2. Village Awareness Campaign Use of mass media and popular theater to introduce the need for wood conservation and new improved cooking and heating practices. At the end of the campaign, demonstration units of earthen stoves, solar earthen stoves, solar water heaters, thatch insulation, and evaporative coolers will be installed. Campaign to affect 8,000 individuals in the three pilot areas.	Status Awareness campaign not fully developed and needs to be altered in concept to that which it was originally designed. Number of individuals now reached is less than 100. Future Activity It is doubtful that the output as presently defined, can be realized by the end of the project. Thatch insulation and evaporative coolers are being dropped by the project. Recommendations The Evaluation Team recommends that solar

water heaters be restricted to present effort. Metal stoves are being demonstrated and should be added as a desired output.

Modified Output

It is recommended that the output be redefined as "village awareness and outreach campaign. This will include outreach-extension strategies for each technological system, for entrepreneurs and the two test villages."

3. Village RET and Institutional RET Training

Project will train BRET project personnel, GOB extension workers and village entrepreneurs. Specific outputs include 100 pumper mechanics; 200 government extension workers and villagers, and 50 village entrepreneurs; 10 entrepreneurs trained in production of institutional solar hot water heaters; 12 maintenance trainees in photovoltaic water pumps; 50 GOB personnel and villagers trained in fuel woodlot maintenance; 24 MMRWA and MOH workers trained in electrical

Status

The training program has been delayed; as of this evaluation, only 20 pumper mechanics have received training, as well as 5 villagers in earthen stove construction and 7 villagers in simple solar water heater construction. Four BRET staff have received 15 months of overseas training; however over 25 person months of overseas short-term training remain.

Future Activity

It is doubtful that the outputs as presently defined can be achieved, however the Evaluation Team has concluded that the original output magnitudes are unrealistic and are not based on any

generation, 16 entrepreneurs trained in pedal powered sorghum dehuller maintenance and 4 in pedal powered dehuller production.

analytical framework.

Modified Output

It is recommended that the output be revised as follows:

"The preparation of a training needs and skills availability assessment for BRET, relevant GOB offices, the two test villages, the two demonstration districts and any other groups, including entrepreneurs, in Botswana of importance to project implementation. This broader assessment should include a summary of training needs for the entire energy sector. On the basis of this assessment, to be reviewed by PEC, specific training outputs will be determined for relevant groups, including:

° Department of Water Affairs and Council Water technicians in regions where water pump systems are installed for testing;

° GOB extension workers in the two villages and demonstration districts;

° entrepreneurs in the production of solar hot water and metal stoves; and

° MMRWA, MOH, MLGL, and Electrical Brigades (s) on PV electrical generation,

installation and maintenance at health centers. All other certificate training listed in the original log framework is to be excluded."

This assessment and plan have already been designed by BRET staff. The Evaluation Team approved this plan, subject to minor alterations. The purpose of this assessment is two-fold: to define specific training targets needed to carry out the other components of BRET; and to guide the GOB as to future training requirements if the technologies under study are to be widely diffused.

4. Two model solar passive cooled and heated buildings built

The COP house was to be completed by 1/81 and the BRET/BTC office block completed by 9/82.

Status

The COP house was completed in April 1983. Construction of the office block has begun; completion is now estimated for May 1984. The delays in construction are in part due to the external factors discussed in Section 15.

Modified Output

This output should be redefined as "Urban and rural passive solar buildings designed, constructed, monitored and evaluated."

The Evaluation Committee recommends that the magnitude output be redefined as "Two

5. Development and research on institutional RETs

The design of a portable wood stove prototype and 10 entrepreneurs producing them. 100 institutional solar water heaters installed by GOB district groups; 2 photovoltaic water pumps installed by BRET; 2 integrated water pumping systems installed by BRET for village water needs; 8 pedal-powered sorghum dehullers installed by village entrepreneurs and cooperatives; 6 health posts upgraded with RET cold chain and 3 clinics provided with photvoltaic systems; 2 pilot fuel woodlot sites funded under the Rural Sector Grant.

urban model passive solar cooled and heated buildings; and passive solar-designed model rondavals at the two test villages, in addition to four conventional houses at the RIIC headquarters in Kanye."

Status

As of the evaluation, the following have been achieved:

° 1 prototype portable wood stove designed and production techniques identified, 3 entrepreneurs located;
° 1 test solar water heater installed and local manufacturers funded to do R & D on low and medium cost systems;
° No PV water pumping systems installed;
° 1 integrated water pumping system installed.
° 3 clinics have PV lighting;
° No woodlot sites;
° Literature survey done on pedal-powered sorghum dehuller and report available.

Modified Output

The Evaluation Team recommends that Output 5 should be revised as follows: "Design, testing, and pilot diffusion of rural domestic technologies, including

metal and mud stoves, bread ovens, retained heat cookers, and small batch solar hot water heaters. Specific outputs include a report for the GOB on each technology, outlining the state of the technology, cost factors, potential, effective demand, institutional and skills constraints to diffusion, and BRET's guidance to GOB for possible widespread activities in the future. Report should also identify the role of local entrepreneurs, distributors, credit facilities and other village characteristics drawn from Output 1 and new Output 10.

- No woodlot sites should be supported.
- The possibility of Methane production at BMC should be reported on.

Once each technology is tested, and if deemed appropriate should be incorporated into village training in Shoshong and Ditshegwane."

6. Installment of village domestic technologies

One thousand village technologies will be installed by villages and entrepreneurs.

Status

Output is unrealistic and provided no assurance that RETs will spread beyond the two test villages.

Modified Output

The Evaluation Team recommends that

	the Revised Output 6 should be defined as "Research, development and field testing of water pumping systems. Specific outputs would include the selection and testing of 16 windmill-pumping systems; the design, purchase, installation and monitoring of 15 existing hand pumps, the improvement, installation and monitoring of 8 human traction pumps, the funding and monitoring of 2 animal pumps, and data gathering and evaluation of the RIIC biogas powered pump. Output also includes the preparation of final report on each technology, with recommendations for GOB concerning the implementation during the recommended second phase (see Section 23). The testing of animal pumps should be undertaken in cooperation with USAID's Rural Sector Grant project. Diesel pumping systems will also be examined to provide comparative data."
7. Installment of small scale wind systems 8 small wind-hand pumps installed by local farmer and development groups in 8 small villages or cattle posts.	Status As of this evaluation, 1 small system has been installed. It is likely that this output should be met by EOP. Modified Output However, the Evaluation Team does not

consider this output to be satisfactory and has revised it under output 6 above.

Revised Output 7

The Evaluation Team recommends that the revised Output 7 be defined as "Research and development of photovoltaic and solar hot water for institutional and urban household use. The specific outputs include the design, testing, field testing and monitoring of the following: photovoltaic installations, six health clinic-posts, three street lights, and four school rooms; solar water heaters, both lab and field testing of new Botswana produced low and medium cost heaters and other commercial units imported into Botswana, field test and evaluation of existing units irstalled on BHC houses. Outputs include a final report on both technologies, with implementation/poilicy guidance for the GOB."

8. Batswana capacity to manage and implement ongoing extension, training and research

Six counterparts will be trained and four facilitators to implement the project after the USAID assistance ends.

The Evaluation Team regards skills development as an on-going process and should be achievable by the EOP.

	However, the Evaluation Team does not find the original output to be satisfactory or sufficient. It is recommended that the output be redefined as "Batswana and GOB capacity to manage and implement on-going extension, training and research after the RET project". The Team also urges the GOB to consider the hiring of one BRET staff member (the counterpart project coordinator) into the Energy Unit, and the incorporation of other staff and equipment into appropriate end use-oriented ministries or projects.
9. National Energy Assessment Study A national Energy Assessment Study will be carried out using five months of short-term consultants.	This study has not been undertaken and may not be necessary, given recent planned work funded by other donors. The project Paper specified that other studies be prepared as needed; therefore we recommend that these alternative studies be undertaken. The definition of precise outputs utilizing the five person-months of short-term consultancies will be made during PEC meetings. These studies will include the wind and solar insulation studies in conjunction with Meteorological Services, and the woodlot/on-farm forestry study, subject to REDSO review.

10. The Evaluation Team recommends the addition of another output; "an institutional assessment and guide for each of the two villages, including the identification of all extension personnel, GOB interactions, entrepreneurs including shop owners, teachers and others."
This institutional assessment will serve several purposes: provide operational guidance for BRET staff during the design and implementation of village technology testing and demonstration; help to identify factors or individuals that may be promoters or constraints to widespread diffusion; and provide a methodological guide for GOB work in other villages.

11. Promotion of Passive Solar Architecture
It is recommended that new Output 11 be defined as "Design, monitoring, analysis, reporting and promotion of passive solar office buildings and houses."
Individual passive solar house innovation should be analyzed to calculate their respective contribution energy savings to overall performance and cost increases.

The contractor should prepare a new Log Frame based on revised outputs with estimates of output magnitudes. This new Log Frame should be presented to the PEC by February 1.

18. PROJECT PURPOSE

The Project Paper lists two related purposes:

1. The first purpose is to introduce village renewable energy technologies which are easily reproduced and inexpensive.
2. The second Project Purpose is to research, develop and put into use RETs which are more suitable for institutions and/or entrepreneurs, and more geared toward reducing dependence on fossil fuels.

This evaluation has concluded that the project purpose is still valid, but there may be difficulties in meeting the planned End-of-Project Status (EOPS) , even if a contract extension is granted to 8/85. This is caused in large part by difficulties inherent in the EOPS. The Evaluation Team recommends modified EOPS to more closely reflect Project Purposes.

EOPS No.1 -- Villagers aware of decreasing fuel wood supply.

"Villagers in eight sites are able to relate this deficiency to inefficient use of fuelwood and aware of other energy sources such as solar and wind."

This EOPS is based on the assumption that Batswana villagers are unaware of problems related to energy issues affecting their day to day lives. The results of the village survey completed by BRET indicate that this assumption is not entirely valid; however, the villagers were not aware of options that could measurably improve their energy situation.

The project will not carry out activities in eight pilot sites, however the Evaluation Team concluded that a significant number of Batswana will be aware of energy options at the village level, and material available for use by the GOB should have a major impact on awareness throughout the country after the project.

Revised EOPS No. 1 --

We recommend that the original EOPS 1 be modified by the following:

> A process for end use assessment, technology selection, testing, monitoring and evaluation will have been thoroughly tested and revised, and made available to the GOB for future guidance. A proven system of technology adaptation, demonstration and training at the village level, as well as guidance on ways to promote entrepreneurs in the diffusion of RETS will be in existence, and available for designing future GOB and donor action.

EOPS No 2 -- Installment of village level RETs at private individual or group expense at eight pilot sites.

The Evaluation Team recommends that the distinction between institutional RETs and village RETs be redefined, as indicated in Section 17, outputs 5, 6 and 7. The revised scope for EOPS 2 would therefore include earthen stoves, metal stoves, bread ovens, and retained heat cookers (wonder boxes). The revised EOPS 2 is as follows:

Revised EOPS No. 2 --

> "Earthen stoves, metal stoves, solar water heaters, retained heat cookers and bread ovens will have been adapted, tested, and monitored in two test villages, and their related districts, and a structured demonstration, training, extension and awareness program will have encouraged the manufacture and/or marketing of such technologies on a pilot scale within the villages, and their purchase and use by villagers.

Entrepreneurial tests will have been conducted and entrepreneurs trained, and the existing GOB extension programs will have been used and promoted."

With this revision, the Evaluation Committee concluded that revised EOPS 2 could be met by the end of the project.

EOPS No. 3 -- Installment of institutional and entrepreneurial RETS, at entrepreneurial or institutional expense in three pilot districts.

The Evaluation Team recommends that institutional RETs be redefined, to focus on pumping systems (Revised EOPS 3) and domestic/public institution use (EOPS 4).

Revised EOPS 3 --

"the detailing, monitoring and evaluation of alternative pumping systems, and the presentation of policy choices for GOB." The Evaluation Team believes that this EOPS is achievable.

New EOPS No. 4 --

A new EOPS 4 should be added and specified as "the design, testing, instrumentation, and pilot deployment of RETs of priority interest to urban consumers, business institutions, and public institutions such as schools." It would also include the promotion of the private sector where appropriate, and final recommendations and specifications for each technology prepared for GOB policy makers. Technologies covered under EOPS 4 would include solar hot water, passive solar architectural design, photovoltaic lighting, and refrigeration.

The assumption presented in the Project Paper for EOPS 2 stated that "RETs are socially and economically feasible to

different areas of Botswana." The Evaluation Team agreed that this assumption is implicit in the methodology used to produce many of the modified outputs; to identify, monitor and improve technologies potentially applicable in rural areas, including an examination of the technical, social and economic attributes that may affect their feasibility.

For EOPS 3, the assumption is that "selected RETs do decrease consumption of petro fuels." The Evaluation Team agreed that this assumption should have been an output and defined as follows: to evaluate options for reducing petroleum fuel consumption, identify the potential role renewable energy technologies could play, and then test, monitor and evaluate candidate technologies.

The Evaluation Team believes that these EOPS modifications more closely reflect the energy situation in Botswana and mirror the evolution of project activities initiated by the contractor. With these alterations the contractor's projected work plan will be considered adequate and should substantially meet the project's output and purpose by September, 1985. However, a revised workplan should be prepared by the contractor and provided to the PEC for review.

19. PROJECT GOAL

The Project Goal is to improve the economic welfare of lower-to-medium income Batswana by increasing their spending and earning power through the introduction of RETs. The project will have an auxilliary effect of minimizing dependence on imported petroleum and decreasing the use of fuel wood.

The Evaluation Team concluded that the primary goal is achievable, if a contract extension is provided and the project implementation plan is amended as recommended. It is not certain at this time as to whether the project can fully achieve the auxiliary goal, given the pilot nature of the project. USAID, The GOB and other donors may wish to consider the need for other activities promoting the production of on-farm fuel and multipurpose trees. However, the Evaluation Team concluded that the project has the potential for providing guidance to the GOB as to the potential role of the widespread introduction of RETs in the substitution of imported petroleum or the stabilization of fuel wood supplies.

20. PROJECT BENEFICIARIES

This project has several categories of beneficiaries: rural women; small villages and settlements; users of rural institutions including health centers, clinics, schools, training centers and other institutions; borehole and livestock owners; and national beneficiaries, through the improvement of self-sufficieny and the improvement of national income and rural employment. The Project Paper lists approximate numbers of beneficiaries but notes that precise numbers depend upon the outcome of the village surveys, the extension process, the spread effect of the demonstration projects, and the effectiveness of the public awareness campaign.

The Evaluation Team concluded that the Project will benefit the categories of individuals as originally designed and that the estimates of beneficiaries to be served by the end of the Project are valid.

21. UNPLANNED EFFECTS

The Project Paper emphasizes the cooperation between the BRET project, BTC and RIIC, including the sharing of staff and facilities, and the overlapping of functions, mandates and responsibilities. A significant proportion of the project's methodology relied on the successful development of this relationship.

The relationship between BTC and BRET was never able to evolve as expected in the Project Paper; unresolved managerial and programmatic problems, and differences of opinion on management and technical matters led to severe problems, ultimately resolved on May 2, 1983 by the formal separation of BRET from the BTC.

This situation has had the unplanned effect of severely hindering cooperation between these institutions and limiting the technical support from other Botswana institutions necessary to follow the methodology of the Project Paper. This also led to the project's neglect of the strengthening of the BTC and the RIIC, and necessitated changes in the Grant Agreement and the contract with ARD.

While this situation has in principle been remedied, two problems still remain; while the consolidation of BRET under the MMRWA has lessened conflict, it has limited cooperation; and while there appears to be general consensus on the part of the GOB as to the appropriate roles and mandates for BRET, the BTC and the RIIC, the mandates/roles do not appear to be fully accepted by all parties, thus causing unnecessary duplication of efforts.

The Evaluation Team urges that the GOB seriously consider the implications of this in terms of possible financial waste,

the best utilization of scarce technical resources, and the likelihood of achieving the Project Purpose. Since the BTC and BRET are governmental entities, the Team urges that the GOB establish clear and defined roles for these organizations and hold each accountable to these roles. In addition, it is recommended that the GOB ensure that donor assistance programs are consistent with these mandates.

22. LESSONS LEARNED

Renewable energy technology projects supported by USAID should consider the process normally followed in the adaptation, research, development and dissemination of technologies. This project reflected the commonly incorrectly perceived concept that RETs, based on older technologies, needed little development to become "cheap" sources of power for development.

The process for developing an improved technology is the same as for developing any other improved product. An improved water pumping windmill that operates economically in a lower wind regime than those commercially available requires a development process that is scientifically disciplined. A windmill is particularly difficult because it must tolerate exposure to the extreme elements and must address a variable energy resource and work requirements (various well depths, and well characteristics) to meet a large variety of needs (water for irrigation, cattle feed and community supply).

As the original project contemplated, the initial user/needs survey was required to establish the output performance of the energy conversion/delivery system. However, the PP did not structure a defined process for assessing the

resource nor the energy delivery system nor the information decision makers need for their planning. In the future, projects should consider incorporating the following:

a) Linking RET requirements to end user needs --

b) Defining and assessing the energy delivery system -- Not only R & D of improved energy conversion devices but the entire system needed to deliver the service to the user.

c) Energy resource assessment -- Meteorological Services do not have the sophisticated instrumentation and data analysis capabilities necessary to supply the basic information for the resource assessments necessary for wind energy or PV. Work should be undertaken with existing Meteorological Services to identify which data they now collect and which additional data is required.

d) Preliminary Feasibility Assessment -- Feasibility assessments of existing systems that meet the user's economic needs and define the critical parameters for the energy conversion system, enabling more cost-effective engineering and identifying the need for further R & D.

e) Detailed energy conversion system analysis -- This is required if the feasibility assessment indicates the inability of existing RET systems to meet the user needs technically and economically. It should identify potentially profitable R & D areas and define their requirements.

f) R & D Program Development Implementation -- If R & D is deemed feasible, then it should require laboratory and field testing which should produce a development prototype.

g) Commercial Prototype Development -- A commercial prototype should evolve following successful completion of the R & D phase. This will involve demonstration testing under actual field application conditions. During this process, modifications will be analyzed and incorporated into the energy conversion system and its performance will affect the overall energy delivery system.

h) Reporting -- The final report should be composed of a summary report, including summary, findings and recommendations supported by a host of appendixes, (mostly previously published) each of which addresses a different aspect of the project and is capable of standing alone. Reports should be considered to be the principal project output and form the basis for administrative implementation decisions. They must be seen as tools for action and not solely project documentation.

i) Implementation -- Depending on the host country's approach to development, appropriate government ministries should be encouraged to use the information (reports developed) to plan implementation and develop scenarios. The Government itself may decide to implement or encourage private sectors or semi public sectors to do so.

Because of the lack of qualified technical expertise in most countries, there is a need for access to outside independent TA and review. This TA is needed to lay out, and/or critique the project approach, define the technical expertise needed and review project outputs (reports) for progress, accuracy, and completeness.

23. SPECIAL COMMENTS OR REMARKS

A. The Budget -- (Assuming P1 = $1.26--Exchange rate at time of signing of project agreement)

The Evaluation Team recommends a no cost extension to August 7, 1985. This is based on the following findings and assumptions. As of September 30, 1983 a total of P186,165 had been spent from the Domestic Development Funds allocated to the project and P194,915 via the GOB development fund. Expenditure from September, 1983 to September 1984 has been projected on the assumption that project activities will continue beyond September, 1984 and therefore no need for winding down will be required during 1984. The estimated expenditure for September, 1983 to September, 1984 is only approximately P223,000 (DDF) and P468,761 (USAID), This will leave a balance of P372,878 (DDF) and $605,616 (P480,647) (USAID) on September 30, 1984. The balance should be adequate for a one year extension. It is not anticipated that between September, 1984 and September, 1985 there will be a large increase in the rate of expenditure over the 1983 to 1984 rate. (See Table.)

There will be a need to switch funds between line items. For USAID funds, it will be necessary to switch funds from Staff Travel Costs to cover staffing and administration. It will also

be necessary to increase funding for Local Training and Research and Development. For DDF funds, it may also be necessary to use funds under the inflation item to cover rent for increased costs of office accommodation if space at the BTC/BRET Headquarters does not prove sufficient or suitable. Depending on the Government's Wage Policy over the next two years, it may also be necessary to switch funds to cover an increased wage bill.

The remaining budget for Associates in Rural Development was $886,000 at the end of September 1983. The current rate of expenditure is approximately $33,000 a quarter. There will be a large increase in expenditure under the Training and Commodities items over the next two years. The contractor has been asked to determine if funds will be sufficient to cover all items for a ten month no cost extension and if not, within which areas a shortfall is expected. The Evaluation Team does not anticipate any serious shortfalls.

AT EXCHANGE RATE OF P1 = $1.26 ASSUMED THROUGHOUT

	ITEM	FUNDS AVAILABLE PULA	EXPENDITURE TO 30/9/83 PULA	BALANCE AT 30/9/83 PULA	ESTIMATED EXPENDITURE TO 30/9/84 PULA	ESTIMATED BALANCE (DEFICIT) 30/9/84
USAID	Staffing (Administration)	49,206	25,957	23,249	40,291	8,915
	Staff Travel Costs	83,333	16,329	67,004	17,019	66,314
	Research and Development	428,492	14,859	413,633	374,676	53,816
	Local Training	72,698	3,418	69,280	18,918	53,780
	Construction	211,110	134,352	76,758	212,772	(1,662)
	Inflation and Contingency	299,484	NIL	299,484	NIL	299,484
	TOTAL USAID	1,144,323	194,915	949,408	663,676	480,647
GOB	Staff	198,000	76,464	121,536	121,166	76,834
	Commodities (includes Petrol)	168,000	95,250	72,750	144,830	23,170
	Land	35,000	141	34,859	141	34,859
	PCV Housing	10,000	2,625	7,375	5,400	4,600
	Research and Development	333,000	11,685	226,315	137,585	190,415
	Inflation	133,000	NIL	133,000	NIL	133,000
	TOTAL GOB	782,000	186,165	595,835	409,122	372,878
	GRAND TOTAL	1,926,323	381,080	1,545,243	1,072,798	853,525

B. Future Scenario for the BRET Project after 1985

The Evaluation Team recommends that the ARD contract be extended in its present form until August, 1985. After 1985 it is recommended that the research and development program in alternative pumping systems for water be continued as a development project under the Deparment of Water Affairs. The other existing functions of the project should be absorbed into existing GOB institutions.

During the evaluation of the project a number of suggestions for the continuation of the BRET project were made by various parties. These options are listed below with the comments of the team.

1. That the BRET project be continued in its present form, i.e. as a development project under MMRWA, for another two or three years. The project would be directly responsible to a Renewable Energy Coordinator in the MMRWA energy unit. The staffing of the project would continue as now -- the presence of expatriates would depend on the donor funding received. GOB contribution would be required for local staff (approximately P80,000 per year), support costs and development, training costs, etc. Project activities would be concentrated in the following three areas:

i) Advising policy makers, and planning implementation
ii) Research and development
iii) Dissemination, training, and extension work

Extension work carried out by a BRET extension team working closely with existing extension cadres. Over the 2 or 3 years of the project, efforts would be made to strengthen the GOB's institutional capacity (via training, etc.) to deal with RETs.

2. The project be continued as a separate entity under the MMRWA energy unit. Either within an implementing energy department or, if no such department is formed, as direct employees of the MRMWA H.Q; staffing and activities would essentially be the same as those for option 1. The major difference between these options is that option 2 requires recurrent expenditure on salaries etc., and the creation of a large number of new establishment posts. This may be difficult due to recent ceilings imposed by MFDP. There would still be a need for some development expenditure for any further research and development required.

3. The project not be continued as a separate entity but absorbed into existing GOB institutions at the Ministerial, Departmental and District Levels. The Energy Unit would have a senior coordinator, a research and development person, and an extension coordinator. The extension activities of BRET would be integrated into existing extension cadres within other ministries. There would be technicians with RET training in the relevant end use departments; Department of Electrical Engineering (DEE), Department of Water Affairs (DWA), etc., and a Renewable Energy Coordinator in the MMRWA Energy Unit. The Energy Unit would also be responsible for coordinating and implementing any further research and development on RETs deemed necessary. This could be done in a number of ways utilizing the capabilities of RIIC, or the trained personnel within end use departments, or short term consultants working with these departments or for the Energy Unit. Since it is planned that the major R&D work necessary (i.e. on water pumping) will be covered by a separate development project there should not be a major need for future R & D.

Comments:

Option 1 does not solve the problem of what to do eventually with energy activities in Botswana. If this option is chosen it will be necessary after 2 or 3 years to pursue either option 2 or option 3. If it is thought that after 1985 the project will not be ready to be absorbed and needs to be continued, then this option would be advisable, and GOB should immediately begin to seek donor funds. The Evaluation Team thinks that the R & D, training and institutionalization of RETs will have reached a stage by 1985 when most of the project can successfully be absorbed into the GOB.

Options 2 and 3 are the two alternatives for integrating RET activities in the Government. Option 2 can be considered as either a short or long-term measure -- i.e. to maintain the GOB Renewable Energy Effort as an identifiable unit for only a few more years or as a permanent solution. If it is only a short-term measure, the team has the following view: The longer BRET is allowed to continue working as a separate entity the more difficult it will eventually be to incorporate fully RET activities within other GOB departments.

Option 2 may also be seen as a long-term measure. The Ministry of Mineral Resources has the mandate for energy, and in line with this mandate it may be thought that all renewable energy activities should be within the MMRWA energy department. The team thinks that this would not be the optimal solution for getting RETs into production and use. By definition all activities require some in-put of energy. Renewable energy activities carried out in isolation from the end users are less

likely to be used by these end users. It is obviously not possible for an Energy Department to have specialists in all the end uses of energy. The team recommends that energy extension work could best be carried out by the relevant existing extension cadres. For example, there could be renewable energy specialists within the Agriculture, Health, Non-Formal Education or Assistant Community Development Officers' extension cadres. Another Rural Extension (RE) specialist could be located with the Rural Industrial Officer (RIO) cadre where they are likely to have a greater impact on production and selling of RETS than someone located in an Energy Department.

The suggestions contained in option 3 are not contrary to MMRWAs mandate for control of the energy sector. MMRWA should consolidate as many energy related areas as possible within the Energy Unit and/or Energy Department, bearing in mind the concerns mentioned above. The Ministry could continue to fulfill a coordinating role with all departments, districts and ministries, either through the use of committees or the use of seconded staff.

In conclusion, the Team recommends that option 3 be pursued. This option is thought to be the most useful in terms of maintaining successful RE efforts, and also given the very real constraints of manpower and more especially recurrent funds, the most realistic. See Annex C for a detailed suggestion for absorption of current BRET staff into GOB.

ANNEX A

Possible Project Proposal: Research and Development into Alernative Pumping Systems

The purpose of this project will be to identify alternative options for pumping water, to determine the most suitable areas for installation, and to develop scenarios for implementation.

Estimated Project Duration: 1985 to 1987.

Estimated Total Cost of Project (1983/84 Prices): P312,000

1 ENGINEER (to analyze data & produce recommendations)	2 years @ P10,000 =	P 20,000
1 ALTERNATIVE PUMPING SYSTEMS TECHNICIAN (to be filled by BRET wind/water technician)	2 years @ P8,000 =	P 16,000
2 ASSISTANT TECHNICIANS (Existing Department of Water Affairs technicians to be trained during 1984)	2 years at P5,000each =	P 20,000
REPAIR AND MAINTENANCE OF PUMPING SYSTEMS (using existing DWA crew)		200,000
N.B. These pumping systems will be installed by BRET during the life of the existing project. Pumping systems will be handed over to DWA at the end of the BRET project.		
OVERHEAD COSTS (Administration, Staff Travel, etc.)		50,000

VEHICLE SUPPORT & MAINTNENANCE	6,000
(BRET landrover to be made available at end of project)	
TOTAL COST	P312,000

The Evaluation Team recommends that a Project Memorandum be prepared for submission to donors.

ANNEX B

The following are the Peace Corps positions as required by the project. Four of the positions are replacements, the fifth position is a contract continuation and the sixth position of technical research assistant is an addition which is essential to enhance the technical writing and research and development aspects of the project.

REQUESTED BY BRET	RECOMMENDATION
1 Wind Water Technician	-- Not needed. The PCV holding this post has extended his contract.
1 Solar Technician BS in engineering or Physics with Research Experience	-- Needed. To replace existing solar technician
2 Village Technicians (Stoves) College degree or technical certificate with extension experience	-- Needed. Experience in extension more important than experience in renewable energy.
1 Documentor	-- Not needed. Duties could be covered by existing staff and proposed PCV Technical Research Assistant.
1 Technical Research Assistant Degree in engineering or Physical Sciences with research experience	-- Needed. Should have scientific/technical research experience. This is more important than renewable energy experience.

ANNEX C

Absorption of existing staff

It is proposed that this be done as follows:

	LOCATION	POST	ACTIVITY	SALARY
*	MMRWA H.Q. Energy Unit	1 Renewable Energy Coordinator	To Coordinate RE activities at Government level	PR 3-4
	Department of Electrical Engineering	1 PV Technician	To monitor, repair, etc. existing PV installations and provide the expertise for assessing potential new installations	T4
*	Botswana Technology Center	1 R.E. Scientific Report Coordinator and Editor	to coordinate all technical reporting on RETS (research development and pilot testing) and to maintain a high standard of scientific reports	PR 4
	Ministry of Agriculture	1 RE specialist in the Agriculture Extension Team	to provide expertise on agriculture related RETs (including water pumping devices) and to develop and maintain awareness of domestic RETS within this extension cadre	9A 3/4

Ministry of Health	1 RE Specialist in the Health Extension Team	to provide expertise on operation of PV Clinics and to develop and maintain awareness of domestic RETs within this extension cadre.	9A 3/4
Ministry of Commerce and Industry	1 Rural Industrial Officer	to provide expertise on RETs, especially with respect to encouraging production and selling of Rets	9A 3/4

It should not be concluded that this is the limit of Renewable Energy work needed after 1985. During the remaining time of the project, BRET staff will assess and describe the exact requirements for GOB to continue RE work.

* Those posts marked with an asterisk are new posts. It is anticipated that the other people trained in renewable energy will be able to fill existing establishment posts.

ANNEX D

We thank the following people who were interviewed during the course of the evaluation.

Department of Water Affairs

Gulam Quarashi, Director

BRET

Botswana Housing Corporation

Ralf Blair, Architect

RIIC

Kit Morei, General Manager
Sonja Barret, Solar Researcher
Max Ewens, Windmill Researcher
Hatibu Mbwana, Biogas Researcher
Eina Anderson, Animal Traction Researcher

Molepolole District Council Office

Joseph Montsho, Chief Technical Officer
Reuben Tema, Technical Officer
B. Molated, Council Water Technician

Distshegwane

Kegakgametse Bathobasele, BRET Village Facilitator
2 Women with stores
Chief Moruwanare, Chief of Sitshegeane Kgotla - House Compound

Department of EE & Ministry of Mineral Resources & Water Affairs

B.N. Prasad, Acting Chief of E.E. Assistant

Department of Meteorological Services & Ministry of Works & Communications

Boitshoko Sekwati, Acting Director
Mr. Ramchandran, Advisor Senior Met. Officer
Mr. Paul Vossen, Agrometrologist Data Processing
V.P.P. Bhalotra, Met. Advisor

Shoshong

Chief Monamodi, Chief of Shoshong
T. Mosinyi, Deputy Chief
B.R. Oageng, Senior Community Development Officer
M.M. Tlale, VTC Chairman
Kgamane (Mrs.), Teacher

Ministry of Works & Communications

K. Kove, Principal Architect
Tullet, Building Service Engineer
Anders Blomberg, Education Projects

Rural Development

Mrs. E. Mathe, Coordinator Rural Development Unit
Ms. T.C. Moremi, Deputy Coordinator Rural Development Unit

Botswana Technology Center

Mr. Bart Aarse, Managing Director

Ministry of Finance and Development Planning

Mr. L. Mothibatsela, Chief Economist

Ministry of Mineral Resources and Water Affairs

Mr. J. Diphaha, Deputy Permanent Secretary

ANNEX E

Revised Implementation Schedule

December 83 --Mid-term evaluation. Evaluation Team's findings presented to the PEC. The Project Executive Summary completed and sent to the GOB.
--Peace Corps Scopes of Work presented to GOB.

January 84 --Contractor prepares report on engineering costs and specs of potential windmill systems.
--ARD staff member meets with Eric Peterson, AID/W to discuss research design.
--ARD staff member discusses research design with REDSO Energy Advisor.
--ARD staff member visits ARD team in Gaborone to develop research methodology design and train Gaborone staff.
--Extension approach design prepared.
--Extension approach design and research methodology design presented to PEC for review.

February 84 --Borehole selection by MMRWA completed.
--PEC Committee meeting reviews contractor reports and makes decision concerning contract extension.
--PEC designs and assists in organizing a Botswana Renewable Energy Activities Committee.
--Energy Sector training assessment begun.

March 84 --GOB confers on institutional mandates and meets with BTC and BRET, so as to develop operational implications of mandate.
--GOB decides on administration and space allocations of new office block.

	--Peer review committee organized between Botswana institutions and those outside the country.
	--Administrative consultant assists BRET staff in reviewing administrative procedures.
	--Metal cookstove tests with entrepreneurs completed by PFP.
	--Training assessment recommendations implemented.
April 84	--Pumping program designed; begin testing. Pumping systems subcommittee organized.
	--BTC/BRET headquarters opened.
	--Extension Subcommittee organized.
May 84	--RIIC report on biogas system completed.
June 84	--Informal evaluation by Pryor and Peterson.
July 84	
August 84	
September 84	

October 84

November 84

December 84 --Pryor technical visit

January 85

February 85

March 85

April 85

May 85

June 85

July 85 --Final Project Evaluation

August 85 --Contract completed.

--COP leaves Botswana

September 85

September 85 --PACD

EXECUTIVE SUMMARY

Project: Renewable Energy Technology (633-0209)

Country: Botswana

Cost: $4,707,300

I. What constraints did this project attempt to relieve?

Rural life is severely constrained by a lacl of affordable and available energy. Increasing fuel wood scarcity not only is adversely affecting the urban and rural poor but is one of the causes of continued loss of agricultural and range productivity. Agriculture and livestock depend on pumped water; the scarcity and expense of pumping systems seriously constrain productivity. The continued dependency on imported petroleum is creating serious economic difficulties. The project attempts to relieve these constraints by promoting new energy technologies utilizing renewable resources.

II. What technology did the project promote to relieve this constraint?

Various energy technologies suitable to household domestic use, such as earthen stoves, metal stoves, solar hot water heaters and retained heat cookers are being tested and if found to be suitable are being promoted. For pumping, several technologies are being examined: hand pumps, animal driven, human traction, windmills, photovoltaic and biogas. The use of passive solar architecture, photovoltaic electrification and solar hot water are being evaluated as means of reducing the demand for imported petroleum.

III. What technology did the project attempt to replace?

Most women in villages cook over open fires and spend considerable time in collecting wood for fuel. Few other energy sources are available in rural areas. Most pumps are diesel powered, prone to external cut-offs, and expensive to operate. There are few-other alternatives presently in use. The urban population has little access to cheap energy.

IV. Why did project planners believe that intended beneficiaries would adopt the proposed technology?

The purpose of the project is to identify those technologies that could be adopted by benficiaries, and to identify and promote those factors or intermediaries that influence adoption. The project planners did not presuppose which renewable energy technologies would be adopted but assumed that adoption would occur if energy alternatives were more economical than current practices without diminishing effectiveness/convenience.

V. What characteristics did the intended beneficiaries exhibit that had relevance to their adopting the proposed technology?

The beneficiaries for the rural domestic technologies are aware of the great amount of time required to collect wood, and the fact that supplies are diminishing. In many areas of Botswana, beneficiaries have some access to a small amount of funds for purchases of new/improved technologies. Pumping syndicates and organizations are well developed and supported, by the GOB; these should facilitate the adoption of improved pumping technologies.

57

VI. What adoption rate has this project achieved in transferring the proposed technology?

Since the beginning of the project, implementation delays have limited the adoption rate. However, the evaluation concluded that planned adoption rates were unrealistic and would not ensure that renewable energy technologies could continue to be promoted and adopted after the end of the project. The project is both a pilot and testing project, as well as an institution-building effort to ensure long-term adoption.

VII. Has the project set forces into motion that will induce further exploration of the constraint and improvements to the technical package proposed to overcome it?

The Project has been modified to focus on support to the GOB, including existing extension services. Training Courses are being initiated to train entrepreneurs to develop small manufacturing enterprises. Initial conflicts and organizational problems between existing groups delayed and to some extent hindered the development of ongoing research, development and extension activities.

VIII. Do private input suppliers have an incentive to examine the constraint addressed by the project and to come up with solutions?

A major component of the project is to develop technologies, in particular the metal wood stove, suitable for small-scale manufacture and, with assistance from Partnership for Productivity, to encourage several entrepreneurs to begin manufacture and marketing. Other Project assistance to the

private sector includes a small grant to assist a small company to research and improve solar water heaters for urban markets.

IX. What delivery system did the project employ to transfer technology to intended beneficiaries?

The project initially planned to devlop a cadre of trained villagers and entrepreneurs, and to work with existing research and development institutions such as BTC and the RIIC. The evaluation has suggested modification by placing more emphasis on other existing extension networks as well as entrepreneurs. The relationship between the BTC and the RIIC has yet to develop although improvement of central government capacity is now being addressed.

X. What training techniques did the project use to develop the delivery system?

The project includes a major training component designed to build up a cadre of villagers and entrepreneurs, mechanics, technicians, and to give specialized training to architects and other specialists. It also included U.S. participant training both for BRET staff and GOB specialists. The hiring and intensive training of counterpart staff is a key element. The evaluation has recommended that the project carry out a further assessment of training needs both long-term and short-term before specific training approaches and magnitudes can be fully determined.

XI. What effect did the transferred technology have upon those impacted by it?

It is too early to determine the effects of the transferred technology on beneficiaries.