PN-AAX-915 6330209

TRAINING NEEDS ASSESSMENT FOR RENEWABLE ENERGY TECHNOLOGIES

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Under AID Contract No. 633-0209-C-00-1024-00

Date: June 12, 1985

PREFACE

The Botswana Renewable Energy Technology (BRET) Project (number 633-0209) is jointly funded by the Government of Botswana (GOB) and U. S. Agency for International Development (AID). Technical assistance and project management are being provided by Associates in Rural Development, Inc. (ARD) of Burlington, Vermont, under AID contract number 633-0209-C-00-1024-00.

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SUMMARY

Four separate steps were followed in order to develop the information that is in this report. First, with direction from MMRWA and BRET, the current and potential organizations, ministries, etc., who are carrying out or who might develop RET activities were identified. Discussions were held with the appropriate people in these organizations (See Appendix Two). Second, the mission of each department or organization was established, and in particular how that mission related to RETs and vice-versa. Third, the specific activities that were currently ongoing or planned over the next five years were discussed with a view towards determining whether or not adequate competency levels existed for those staff who would carry out the activities. The importance of localization was always kept in mind. Fourth, where competency levels were not adequate or the personnel simply did not exist, then a training plan was suggested. In determining the content and the type of training, as well as location, various strategies were considered-always with the intent of choosing the most (cost effective) option and wherever possible building on the normal training patterns in Botswana. Overseas training is suggested only if it is the only real option.

In terms of general education of trained professionals, clearly Botswana needs more local engineers and architects. As is discussed in this report, this can best be done by integrating energy related training into their overseas degree programs in a well-planned and structured manner. Also, individuals studying for certificates in Botswana will also need some additions to their programs. This must be built into curriculum at Polytechnic and Brigades over time and with help of some outside expertise.

In terms of required skills that can be met by short-term training in Botswana, there are a variety of needs identified and plans put forth in this report. They deal for the most part with ongoing activities of BRET and with the likelihood that a number of BRET technologies will eventually (some rather soon) be ready for widescale dissemination. In most instances the instructors for such training are in Botswana and many of the training sessions have already been done at least once. Those that are new will require support and attention from the Energy Unit of MMRWA to see that they are properly prepared and accomplish their goals. Of particular importance will be those short-term training workshops or sessions that address the installation, maintenance, and repair of technologies that have been installed in the field. It is not possible to overstate the importance of this type of training. Future acceptance and the degree to which technologies spread will in large part be determined by how well this type of training is done and how well the departments who are responsible carry out their maintenance roles.

Finally, except in a very few cases, all the posts discussed in this report already exist. Most are currently filled by people who often have extensive and important training and experience related to the activities identified here. Major increases in personnel numbers need occur only with very widespread dissemination.

SECTION I

INTRODUCTION

This report provides information and analysis of training needs in the area of renewable energy. The training assessment was carried out during April and May of 1985 and builds upon the experience of the BRET project. The introduction provides the background, context, and process used for the assessment.

Over the last five years, there has been an increasing amount of activity throughout Botswana in the area of renewable energy development. Except for the area of solar hot water heating, most of this activity has been within the public sector and has been encouraged or actually supported by some form of Government of Botswana (GOB) activity project. Within Government's activities, the key mandate and the majority of activity over the last three years have been either directly or indirectly the result of work carried out by the Botswana Renewable Energy Technology (BRET) project.

Several factors have led to the carrying out of a training needs assessment at this time. First, there is now a substantial body of experience with various technologies and agencies or organisations. This means that the trained manpower strengths and weaknesses in each organisation and many technology areas have had the opportunity to be assessed through direct experience. Second, the Ministry of Mineral Resources and Water Affairs (MMRWA) has begun to develop the information to set priorities and areas of concentration in renewable energy. Some of these key areas are outlined in the new National Development Plan VI (Summary in Appendix One). Third, the BRET Project is in a period of transition, and it is timely to examine the training issue: What types of skills and training will be required both immediately and in the long term so as to have adequate, skilled manpower to carry on work in identified key areas of renewable energy?

Given interest specifically expressed by MMRWA due to the transition taking place within BRET, this assessment has focused primarily on the activities undertaken by BRET.

Especially, it focuses on the immediate training necessary to carry on the activities that MMRWA has indicated are of primary importance in the short term. This training is required to keep BRET activities going in the areas of water pumping, photovoltaics, and extension and marketing of cooking technologies. In some instances, uncertainty remains as to exact manpower needs and arrangements. The specifics have not yet been worked out as to how all these activities will be carried out and by whom. Therefore, in some cases, assumptions have been necessary about the likely direction of BRET activities.

The assessment also focuses on the more general longer term needs (5 years) of agencies that have been involved with BRET or who are likely actors in future renewable energy activities. In these cases, more general educational needs and avenues for basic related energy training have been covered. Some of these activity areas require general curriculum development/adaptation to include renewables information and training. Others are best addressed through the inclusion of certain subjects in overseas training of individuals studying for degrees under bonded arrangements.

Assessment Process:

The scope of work for the assessment and a listing of individuals consulted is contained in Appendix Two. Wherever training plans existed that were relevant, they were taken into account. In all instances the positions that have been placed on the matrices are existing posts. In all but a very few cases, such as RIIC, these posts are currently filled. When they are not, it is so indicated in the text. Should the level of activity in a certain area increase very much beyond the current level of activity under BRET, then additional posts may have to be created. That is, as the work load of certain departments or units increases, then the number of personnel required will increase. In those cases where the services related to RETs are substituting for former nonrenewable energy technologies there will be no increased personnel. But in many of the situations discussed here (outside of improved building design), the long-term trend will probably be for increased GOB services.

The vast majority of senior-level technical posts are currently held by expatriates. Where this is the case, an asterisk has been placed on the matrix next to those positions. These are, therefore, the key posts that need to be localized. Training overseas under bonded arrangements has been suggested in most of these cases as a cost-effective means of getting people trained in RETs into the posts.

Discussions were held with knowledgeable individuals, including training officers and people who have worked with BRET. The process by which individuals are normally trained in Botswana was constantly examined, and the opportunities for utilizing those processes and activities were maximized to the fullest in making suggestions for training plans. In an attempt to suggest cost-effective and reasonable plans, local long- or short-term training has been used wherever possible. However, given the need for basic technical skills at university or higher levels, the need for localization of expatriate technical positions cannot be too highly stressed. Only in this manner can long-term training and manpower requirements be effectively addressed.

Future Activities For Ministry Of Mineral Resources and Water Affairs:

The NDP VI contains five projects that relate directly to renewable energy activity. They are also under the general responsibility of MMRWA. The first of these is "WB 19" on "Appropriate Water Technology" and contains the continuation of the comparative water pumping program.

Training needs for pumping technologies fall into two general categories; first related to the continued comparative pumping tests and second, should alternative systems be found advantageous, then a stepped up training program in the choosen technologies. Training needs related to this activity are covered under discussion of the Department of Water Affairs and the water engineering section of MLGL.

The second NDP VI project is "MR OI" on "Alternative Energy Development" of local fuels in substitution for imported fuels and of improved efficiency of fuelwood use. The technologies chosen for installation and dissemination fall under a number of the agencies and organisations discussed in this report. Therefore many of the training discussions (report sections) which follow relate to this project. However, it is assumed that the Energy Planning Unit of MMRWA will be coordinating these efforts and in a number of instances be carrying out the actual dissemination. The discussion below on the Energy Unit then has special relevance to this project.

The third project is "EU 02 - Rural Energy Supplies" on developing community woodlots. A substantial wood production plan and project is to be developed, which will require training for a number of forestry and extension personnel. The training assessment that this will require will not be addressed in this report but assumedly will be done under a separate effort for the Energy Unit. However, it should be noted that experience in other countries indicates that the need for trained personnel in community woodlots projects should not be underestimated. Without adequate numbers of trained foresters and people knowledgable in the social aspects of community woodlot development, the record shows the potential for failure to be quite high.

The fourth NDP VI project, "EU 01" on "Energy Technology Substitution", covers renewable substitution in all sectors.

To the extent that the energy source for substitution is renewable, this report covers the key training needs, as already identified by current activities and end use applications. Again, these are found throughout the discussion of specific agency needs. However, those areas or end uses that have not yet been given priority consideration by government during the past few years, but may be addressed in the years to come, are covered to the extent possible at this time only by identifying the opportunities.

The fifth project is "EU 04" on "Rural Domestic Renewable Energy Technologies R & D and Extension Services." This project, to be managed by the Energy Unit, requires the development of a long-term R & D capability in the renewables area. Much of the training for this is based in overseas training of bonded individuals in normal degree programs. {The energy unit will need to see that those individuals who are to carry out this work (or localize existing positions) do in fact receive the renewable energy related training as part of their normal program or receive appropriate short courses before returning to Botswana.}

Related to this fifth project, as well as to some of the others, is the extremely difficult problem of training extension personnel. Given the current uncertainty as to how extension will be organised in the near future in Botswana and, especially, how extension will be carried out with renewables, the problem of addressing training needs and plans is not possible to fully resolve at this time. Extension of renewable technologies sometimes is a matter of working solely with government personnel, at other times with the general public or even almost completely with the private sector. It all depends upon the technology, its means of production, and the decision as to how best to get it accepted and institutionalized. {The energy unit will have to maintain an ongoing capability to assess nationwide extension training needs and develop appropriate training plans.}

SECTION II

MINISTRY OF MINERAL RESOURCES AND WATER AFFAIRS

This section covers those BRET activities that are likely to remain directly under MMRWA. Of particular importance is the Energy Unit. However, before proceeding with this discussion, a few comments on the purpose of the matrices that are found in this report are in order. The purpose of the matrix is to provide a summary of the training "needs" and "plans" required by the department or organisation under consideration. Activities that have been already planned, or are very likely, have been listed under the activity column. Then the competencies and the personnel required to achieve these activities are listed under the relevant column. Finally, a summary of the suggested training plan is put forth under the training requirements column.

A. The Energy Unit

Since the energy unit is responsible for overall coordination of renewable activity in government, the unit's manpower needs and requisite training are of real importance to the future of renewables in Botswana. Naturally, many of these personnel requirements are also relevant to nonrenewable energy needs as well. For example, certainly the energy unit has need for a statistician. This person should have resposibility for data on renewables as well as other types of energy data.

There are several other functions that the unit will need to be capable of carrying out but may not require 'renewable specific' people. Basic engineering assessment of documents and reports, economic and financial analysis of technologies and programs, and coordination and management of programs and activities throughout government.

These skills currently exist for the most part in the energy unit but whether adequate time is present, given limited numbers of staff and current responsibilities, is certainly questionable--especially in view of the likely developments during the next few years. One way to help resolve this would be energy-related courses (or short-term training) as part of postgraduate training of individuals going overseas under bonded arrangements for the ministry, and who upon return would be attached to the energy unit.

Depending upon the level of activity in getting the private sector to produce and sell renewable technologies, and upon the extent to which extension activities are needed with whatever variety of target groups, the energy unit will need in-house extension capability. If nothing else, this capability will be needed to assess whether or not the activities being carried out by other groups or agencies are effective and appropriate. It will be crucial to bring a solid energy perspective to the development of training plans related to any such extension activities. Otherwise extension activities may not reflect the energy focus needed. Developing the right energy training for extension activity is something in which the unit will need to be actively engaged. Therefore, extension/training personnel will be needed.

B. Water Affairs

Water Affairs will be taking over the comparative pumping assessment and all related maintenance responsibilities for the PV and wind pumping systems. As all O & M responsibilities for the other types of pumps, (e.g. animal traction, biogas) are being handled by other organizations, the only training needs at Water Affairs are related to the comparative assessment methodology and the wind and PV systems themselves.

Comparative Pumping Assessment And Windmills

As has been made clear by everyone, the current plans for an 18 month continuation of the comparative testing program will require the engagement of an engineer with the necessary range of skills to handle each of the pumping systems plus the comparative pumping methodology that ARD has developed. This is the one required post in Water Affairs that does not currently exist.

It is likely that a number of systems will no longer require any testing after this period. However it is also likely that the Ministry and Water Affairs may determine that the continuation of some type of comparative testing will be necessary. Also, depending upon the results of this testing, a decision to support the widespread installation of one or more alternative types of systems may be made. Whatever the outcome, the Department should be prepared to send one local engineer overseas on university or postgraduate training in the appropriate pumping systems through the inclusion of selected courses during the degree program or at the end of his program.

The most likely combination would be to train a mechanical engineer in windmill technology and in the analytical techniques necessary for comparative testing and analysis. Such an approach would take care of the manpower needs and training requirements of Activity number one, Matrix 1, and all of the requirements under Matrix 2. This engineer could work within the design shop and handle design, comparative analysis, and selection of the most appropriate systems for each site. Ideally, the PV- and electrical - design person, discussed below under PV pumping systems, could do much the same and provide increased depth to the design and analysis capability of Water Affairs.

As noted under Activities 2 and 3 of Matrix 1, only some in-service training will be needed. For the most part, this would consist of experience with particular brands of wind machines and with developing troubleshooting capabilities over time.

Photovoltaic Pumping

The Department of Water Affairs has requested an electrical engineer to be attached to the Department or for a post to be established. Should electrical pumps powered by the grid and/or PV pumping become more of a practice than at present, then it is clear that such skills must soon be present at Water Affairs. For the design shop, a well trained or experienced engineer could be given adequate training in PV pump system sizing, operations, etc., here in the field, if he were to work with a knowledgeable engineer for several months. Naturally, all possible attempts should be made to have this a localized post as soon as possible.

An ideal solution would be if an engineer with a mix of electrical and mechanical training were to also have an appropriate PV course or short - term training as part of overseas study, then to be followed by several months of on-the-job training in Botswana with a PV - experienced engineer. One of these approaches will very adequately answer the manpower and training needs of Activity 1 of Matrix 3.

Activities 2 and 3 of Matrix 3 will require a 2- to 3-day short course and some in-the-field training. Assuming that the pump comparison program continues for the next year and a half, this training can easily be carried out during that time. The personnel currently exist at Water Affairs that would carry out the work, except for the trainer who would presumably be the engineer in charge of the comparative test program.

MATRIX I

TRAINING REQUIREMENTS

ORGANIZATION MMRWA

DEPARTMENT WATER AFFAIRS

Department Requirements: If a sustained wind pumping program, either testing or widespread installation, is to be carried out then adequate skills to design, size, install, and maintain windmills must be created in the department. This means short term training of local staff and the localization of the engineer with training/experience in windmills as part of his overseas training.

Activities	Required Competencies	Personnel Requirements	Training Requirements
1. windmill/pump system sizing and design	- relevant engineering analytical skills - understanding of wind resources and effects on pump performance	- part time design engineer*	OVERSEAS - Basics of wind energy - Basics of system design
2. windmill installation	- basic mechanical ability - ability to work carefully - knowledge of basic windmill components and their function	Crew of 7 - 8 persons	LOCAL - Crew already available but needs upgrading of skills
3. windmill maintenance	- basic mechanical ability - knowledge of each type of system at a level to allow general trouble-shooting	Same crew of 7-8 as above and should include O + M groups at Water Affairs and BRS too.	- Upgrading of skills inservice

MATRIX 2

TRAINING REQUIREMENTS

ORGANIZATION MMGWA DEPARTMENT WATER AFFAIRS

Department Requirements: Department should hire (or localize) a mechanical engineer with BSc. or post graduate degree, or with relevant experience, to carry out comparative evaluation of pumping systems in an ongoing way for the department. Its actual methodology and instrumentation use could be taught in Botswana.

Activities	Required Competencies	Personnel Requirements	Training Requirements
1. Data collection and evaluation	- ability to determine important parameters - ability to determine accuracy required - ability to trouble shoot instruments - ability to assess data reliability	One Engineer*	OVERSEAS - principles of data collection - principles of instrumentation
2. Comparison of systems	- understanding and ability to do economic and financial analysis - understanding of technical limitations of various systems	One Engineer* could be same person as above	OVERSEAS - economic, financial, life cycle costing, training, etc. LOCAL - experience with the various pumping systems

MATRIX 3

TRAINING REQUIREMENTS

ORGANIZATION HMRWA

DEPARTMENT WATER AFFAIRS

Department Requirements: Department needs an engineer and field staff who understand photovoltaic pumping systems. Currently this capability does not exist and depending upon the extent of PV installations and the maintenance arrangements, the department may need to develop long term capability.

Activities	Required Competencies	Personnel Requirements	Training Requirements
1. Solar pump system design	- understanding of solar resource and related calculations - good analytical skills - knowledge of PV pumping design/sizing - knowledge of well characteristics and effects of pumping	One Engineer* part time (strong electrical background would be best)	OVERSEAS - Basics of PV and of electrical aspects of PV systems - Pump design - Basics of solar resource assessment and evaluation
2. Solar pump installation	basic mechanical skills - knowledge of DC principles related to PV	Crew of 4 - 7	LOCAL - Short course on PV basics and on pumps utilized - inservice field training on installation
3. Solar pump maintenance	ability to trouble shoot systems knowledge of pump components and basics of DC electrical - knowledge of electric motors	Crew of 3-4 but one at least must be a good technician or with some engineering training	LOCAL - Same as above plus electric motors.

Over the longer term, the O & M shop will require an engineer or senior technician with an electrical background for AC-powered pumps, and this person could also deal with the PV-powered systems.

C. Department of Electrical Engineering

This section covers DEE training needs and plans for PV lighting and refrigeration systems. There is also a brief discussion of some other technologies that the staff at DEE expressed interest in pursuing.

Training plans at DEE are complicated by the fact that there is no training officer in the existing post; and, according to DEE, therefore, no training plan. In the area of photovoltaic lighting, Matrix 4, the key long-term need will be to localize an electrical engineering position with someone who has had the basics of PV power as part of his overseas university training. This should be built into the program of a student going out under bonded arrangements.

In the short term, both engineers and field personnel need to become more familiar with PV-powered systems through reading some of the practical literature and getting experience installing and monitoring systems. Initially, DEE feels that a 3-4 day short course for staff at headquarters would be helpful. It would cover the basics of PV systems sizing, design, installation, and maintenance on a very practical level. Parts of such a course could possibly be dealt with by engineers through BRET, if held prior to September, but a fully adequate short course would require skills not currently in Botswana. In time, a more practical short course would also be given by DEE staff for regional DEE personnel (about 9 officers).

Another option might be to approach one of the manufacturing companies who give courses to do one here in Botswana, (possibly including people from nearby countries) as a promotional effort on their part; e.g., ARCO Solar, as they come out here from time to time. DEE might also consider sending out a local engineer for a short course.

Of particular importance will be the ability to carry out sound economic analysis, as well as assess the social aspects of system use. This capability needs to be given special attention.

MATRIX 4

TRAINING REQUIREMENTS

ORGANIZATION MMSWA DEPARTMENT ELECTRICAL ENGINEERING

Department Requirements: Current engineers need to become a little more familiar with PV but real need is for localization with electrical engineers. During such training persons should get short course on PV or have it built into university courses. This is because PV lighting is likely to continue as a demand in Botswana.

Activities	Required Competencies	Personnel Requirements	Training Requirements
1. PV lighting systems design	- ability to design PV lighting systems of both AC and DC types - ability to do economic and financial analysis of these systems - understanding battery systems	One part time designer*	OVERSEAS - Electrical Engineering with inclusion of basic PV and PV concepts - Solar resource evaluation LOCAL - Lighting design
2. PV light maintenance	- mechanical skills - knowledge of DC wiring	Crew of 2 - 3	LOCAL - DC electrical circuits and PV hookups
3. PV light maintenance	same as above	same crew as above	same as above
4. PV light evaluation	- understanding of purposes of evaluation and of how to measure parameters	One engineer (designer)* or an in house group	- Basic relevant policy, sociological and electrical issues

Objective analysis of the options for system design, e.g. DC current vs AC, must be carefully done. As yet, full understanding of optimal system design is not clear because the specific uses local people are going to use the systems for are still at an early stage of experimentation and understanding. Use practices can dramatically affect the costs of PV systems, depending upon what they are designed to accomplish. The Energy Unit may have to take an active role in assuring that DEE develops the approach and the capability to carry out such analysis.

The engineer listed in Matrix 5 could easily be the same engineer discussed in the previous paragraph (engineer for Matrix 4). However, a technician must be trained in the basic repair of the DC refrigerators used in PV systems. With such training, the technician could also serve as a trainer of field maintenance personnel at DEE, councils, etc. so that they could do simple repair and troubleshooting. Without someone trained to do this, it will not be possible to repair DC refrigerators in a cost-effective manner. Someone at DEE should be selected immediately to become familiar with refrigerators now in the field. Once a determination has been made as to the probable direction of PV refrigeration systems in Botswana, then the Department should develop a training plan that will allow for in-country repair of refrigerators. This might be a special course at the Polytechnic or sending a technician to a short course given by the manufacturers of the refrigerator selected as most appropriate for Botswana.

Other Technologies

Interest was expressed at DEE in improving the capability of the department to work with a variety of alternative energy technologies that would alter lower the demand for electrical energy, or increase its supply.

Examples given were 1) wind energy farms, 2) large biogas electrical generating systems, 3) institutional solar hot water heating system design, testing, and/or selection and, 4) improved capability to design effective electrical systems for input into the building design phase for govenment buildings (e.g., heating, lighting).

MATRIX 5

TRAINING REQUIREMENTS

ORGANIZATION NWRWA

DEPARTMENT ELECTRICAL ENGINEERING

Department Requirements: If the use of PV powered DC refrigerators is to continue into 1987 and beyond, or increase, then DEE or some entity will have to develop skills not currently available related to these refrigerator systems.

Activities	Required Competencies	Personnel Requirements	Training Requirements
1. PV refrigerator system design	- solar resource evaluation - knowledge of DC circuits and controls - ability to design multi-use PV systems	One Engineer part time*	OVERSEAS - basics of PV and of DC systems circuits - basics of electrical refrigerator units
2. PV refrigerator installation	- knowledge of DC circuits - basic mechanical skills	Crew of 2 - 3	LOCAL - basics of PV and of DC circuits
3. PV refrigerator maintenance	- basic electrical refrigerator operation - solid state circuit troubleshooting - basic mechanical skills	and crew of 2-3 and one repair technical at the shop	LOCAL - same as above plus refrigerator operation and repair (refrigerator repair could be specifically on a standard system that was selecte

All of these areas involve decisions concerning mandates and priorities in which the Energy Unit will be involved. It would seem that resource or technology assessments in these areas should be carried out or coordinated by the Energy Unit rather than building an overall assessment and planning operation in DEE. Naturally, such activity would be carried out with the involvement of appropriate departments. Care must be taken, as resource or technology assessments in these areas would best be carried out by consultants or individuals hired expressly for an assessment, who have extensive experience in both the technology under consideration as well as the types of designs being considered in Botswana.

Coal-fired electrical power plants or imported hydropower are likely to produce power at much cheaper rates for grid power than the closest alternative, which uses domestic or local renewable energy. Given the possibility of coal-fired electrical generation, and that current knowledge of the wind regime indicates it being rather weak for electrical generation, wind energy farms are not likely to prove cost effective. It may not even be worth carrying out an intensive assessment.

Due also to coal-generated electricity, it may be that generation of electricity from large biogas systems could only be attractive where problems of waste disposal would, if solved, contribute to the financial benefit stream. The only exceptions to this are likely to be stand alone biogas systems.

How the Energy Unit can resolve the issue of DEE personnel selecting appropriate institutional hot water systems and insuring that proper electrical consideration is given in all building designs is beyond the purpose of this training assessment, as it is not really a training issue. However, should DEE actively take the role of selecting appropriate systems for all government buildings then DEE personnel will need training in 1) basic system design, 2) how to technically assess the general performance of systems on the market, and 3) how to carry out cost/benefit analyses on these systems.

SECTION III

OTHER MINISTRIES IN THE GOVERNMENT OF BOTSWANA

This section covers the current and most certain future activities that will be carried out by ministries other than MMRWA, in relation to renewable energy and subsequent training needs.

A. Ministry of Local Government and Lands (MLGL):

Photovoltaics

Training of nurses to operate the PV system (Matrix 6) associated with a health clinic or post can be accomplished for the BRET installations at the time of installation and immediately afterward during follow-up visits by the responsible maintenance and monitoring person or crew. This will most probably be carried out by DEE once the PV lighting and refrigeration operations are switched from BRET to DEE. Any decision to install substantial numbers of refrigeration systems should probably wait until at least another year of experience is carried out monitoring the currently installed systems (although PV for lights, battery and radio use might be done immediately). At that time, the most appropriate refrigerator and system design could be standardized for dissemination.

Then it would probably be advisable to have ULGS run a short course for nurses, who might be stationed at PV sites, as part of their in-service training. Depending upon location and the speed of new clinic and health post expansion, it is certainly possible that up to 100 clinics and 200 health posts might be eventually considered for PV systems.

The capability required under Activity 2 will have to be worked out between DEE, MLGL and Councils. Whatever the final arrangements a minimal repair capability is required on a district basis and can be easily set up and instruction given by DEE personnel.

MATRIX 6

TRAINING REQUIREMENTS

ORGANIZATION MLGU DEPARTMENT ULGS

Department Requirements: Operation of PV powered health clinics and posts will required training of nurses. This can be accomplished in the short term on an installation by installation basis, but if the technology spreads a more comprehensive approach will be required.

Activities	Required Competencies	Personnel Requirements	Training Requirements
1. Operation of 8 or more PV powered sites during '85 and on	read min/max thermometers correctly (proven already that all nurses do not read them correctly) - check status of switches and warning lights - check fuses	one trainer who can run courses on operation and simple maintenance (possibly from DEE)	1 day on site training
2. General electrical maintenance of system	- understanding of how system is put together and how it works - ability to troubleshoot and know when to call in outside help	One person per district or sub-district where there is an installation	Short course by DEE personnel (to include regional repair people in DEE or with contractors, brigades, etc.)

Hand Pumps

Assuming that district councils take over all hand-pump installations and maintenance, a short training course will have to be run for each of the districts where hand pumps will be used (Matrix 7). This can easily be carried out by the current Water Affairs crew, who have been installing hand pumps during the past two years with BRET. The Water Affairs crew could carry out the training by installing one new hand pumps in a district as a training activity with the council crew. All steps as well as maintenance procedures could be covered in about three days. Due to the simplicity of the pumps and the familarity of council crews with pumps in general, this would be an adequate training program. Currents plans are to begin this process by early June, as part of the installation of 15 new Mark II hand pumps. It is our suggestion that a schedule be set up by Water Affairs to carry out this training with all districts and sub districts that currently have, or will be soon installing, handpumps.

Other Pumping Systems

Once the current comparative pumping program is over, a number of these systems may be turned over to councils for operation and maintenance. DEE and Water Affairs will help with major repairs or stocking of spare components. The more that goes to the district level, the more that people at this level will have to be trained for repairs. In other words, the detail and length of training for council and other district level people can only be determined at that time. The expertise should exist in Botswana to satisfy such training requirements. Matrix 8 outlines the training needs.

Should particular systems eventually be chosen for wider application, then the figure of 20 to 50 people trained at the district level becomes a necessary target. Pumpers, senior operators, mechanics or repair crews, and water technicians and operators would all have to be trained at varying levels of maintenance expertise. Such training could be made part of normal in-service training sessions. In addition, basic training in PV or windpumpers (as appropriate, given the choice of technologies for dissemination) should be made part of relevant programs at the Polytechnic, at both the craft and technical levels. Further discussion of this is provided in the later section regarding the Polytechnic itself.

MATRIX 7

TRAINING REQUIREMENTS

ORGANIZATION MLGL

DEPARTMENT WATER ENGINEERING

Department Requirements: It appears logical that district council water units should take over all hand pump work. Current crews need short term training, probably by Water Affairs Unit that has been doing the work to date.

Activities	Required Competencies	Personnel Requirements	Training Requirements
1. Hand pump installation	- basic mechanical skills - understanding of basic hand pump operation and construction	crew of 3 in each unit - total of about 40 people	2 - 3 day in service training
2. Hand pump maintenance	same as above	same as above and same people	same as above
3. Hand pump siting	basic understanding of water needs, pump performance and well characteristics situated to water use at site.	Water Technician in each	probably none

MATRIX B

TRAINING REQUIREMENTS

ORGANIZATION MLGL

DEPARTMENT WATER ENGINEERING AND DISTRICT COUNCILS

Department Requirements: If current alternative pumping systems are handed over to Councils, or if decisions are made to install particular alternative systems more widely, then MLGL personnel would need to train district water unit in maintenance, (perhaps with the help of DEE, Water Affairs, or Pol,technic).

Activities	Required Competencies	Personnel Requirements	Training Requirements
1. Maintenance of windpumps at at district sites	- ability to pull pipes, check towers and machine for loose or broken parts, change oil and grease. - identify major problems and need for adjustment	4 people in each district (plus the operator of each system) that has an installation, total of 20 to 50 people in time	- week course in-service
2. Maintenance of PV pumps at district sites	- check batteries and all electrical voltages and amperages - check continuity - determine what component may be at fault (in case of failure) and change component	same as above	same as above

B. MINISTRY OF WORKS, MLGL, BOTSWANA HOUSING CORPORATION AND SHHA, REGARDING: Energy-Efficient Building Design:

Due to the centralized nature of responsibility for design and construction in Botswana, probably 90% of those individuals who design non-traditional buildings are within, or design for, three organizations of government. Moreover, there is substantial similarity in training needs for design departments of MLGL, Ministry of Works, and Botswana Housing Cooperation. Therefore, a general discussion of training plans is presented under this section, including the training requirements matrices, and discussion of manpower needs. Of particular importance is the report by Scott Matthews entitled, "Encouraging Climate-Responsive and Energy Efficient Design in Botswana," as it contains an extensive discussion of training needs in this general area. Rather than repeating that information here, it should be used as a further guide to energy design training ideas and plans.

MWC

The numbers of architects and technical officers and the training needs for the Ministry of Works is contained in Matrix 9, and for the BHC on Matrix 10.

MLGL

One local architect will eventually be needed in the Council Architects Office of MLGL. Four to five architect positions in various councils need to be localized, and eventually most councils will have an architect. Each of the town councils will also need localize their architects' positions. At the council and town council level, both chief technical and senior technical officers will also need training (and/or localization) in energy-efficient building principles. Matrix 11 sums up the general manpower training needs of the various levels of MLGL and councils.

TRAINING OUTLINE

Those who design non-traditional (modern) buildings can be reached through formal training of three groups:

ARCHITECTS AND ENGINEERS

Expatriate architects and engineers in Botswana have varying degrees of knowledge in the energy area. The only way to be assured of a high skill level with this group's work is by including energy design as part of required qualifications for employment. Repeating workshops like BRET's is probably not possible unless a highly trained architect in energy-efficient design were brought into Botswana and conducting this seminar made part of his job. This might be considered as an option. However, for extensive architectural training, seminars and workshops are not nearly as productive as formal education because attendance is uneven, work responsibilities are distracting, and there is not enough time for homework.

The best training plan is to make this part of architecture degree training or for specialised post-graduate energy design education abroad. US universities, which have strong energy design faculties, include Massachusetts Institute of Technology, Berkeley, California Polytechnic and Arizona State. Programs should be designed with some care and faculty briefed on issues important to Botswana. A knowledgeable architect could design such a program, write faculty briefing papers and contact schools. This step is necessary so that all concerned get what they need.

For Buildings Department, BHC, and District and Town Council designers to be localized, a program should be designed, and long-term arrangements with specific schools set up, so that curriculum would respond to southern Africa conditions as well as well-rounded professional education. Energy design should be made an integral part of curriculum or students should go elsewhere. The GOB should look for schools which have strong core programs in design basics (structure, drawing, environmental factors, social factors, energy issues, etc.), and then look for studio offerings relevant to Botswana: Housing design, institutional buildings, site planning, etc.

It should be noted that MLGL, ULGS, MWC, and BHC all currently have architects in the U.S. or Europe for training under bonded arrangements. Every attempt should be made to contact these individuals and see if any possibility exists to provide them with energy-related training. Furthermore, at least one individual is about to go out under bonded arrangements for ULGS, through the AID-funded BotswanaWorkforce And Skills Training project (BWAST).

The ULGS training officer was alerted to the need for energy-related architectural training, as was the BWAST coordinating officer at AED. Training arrangements under BWAST should be explored for architects, following the suggestions given in this report.

NON-PROFESSIONAL DESIGNERS:

Many low-cost buildings are actually designed by graduates of Ramotswa Brigade, currently trained as draftsmen and providing most of that help at MWC, BHC and private firms. Energy design courses should be included in their core curriculum, at the same level as the 1984 BRET workshop for SHHA and Council Technicians. Teaching materials should be prepared, including audio visual, hand-outs, and teaching manuals. Libraries should be stocked with relevant references and basic books. Also, a few texts such as Koenigburger might be bought in bulk for students.

TECHNICAL ASSISTANTS:

This group will have to be reached by special short courses aimed at basic concepts, simple buildings, and inexpensive options. BRET has the preparation of most materials for this type of course in a plan stage. It will need further work and development of teaching materials, etc. However, there would be no references or texts.

In order for the short courses and the materials to eventually be included in Polytechnic and Brigade training, a consultant would have to take the current BRET material and work with Polytechnic and Brigade instructors to develop the specific material and curriculum outlines. The consultant would then run a training seminar for the teachers themselves so that they could use the material in their classes. The whole process might take three to four months, perhaps a little longer depending on institutional scheduling.

Both Brigades and Polytechnic seem to be very interested in doing such a program and including this material in their future curriculum. If a consultant is not engaged to do this then perhaps an architect with Brigades can be engaged to carry out such an activity as part of his scope of work over a year or two. Naturally, an architect with the appropriate background would have to be hired.

MATRIX 9

TRAINING REQUIREMENTS

ORGANIZATION MINISTRY OF WORKS

DEPARTMENT BUILDING DEPARTMENT
CHIEF ARCHITECT'S OFFICE

Department Requirements: Architects who are overseas under bonded training need solar design training as part of their program. Senior and junior technical officers (draftsmen for example) should have basics of these design principles taught to them during training.

Activities	Required Competencies	Personnel Requirements	Training Requirement
Design of all government building.	a. passive design principles - ability to analyze effects of climate on buildings. - principles of site planning and building orientation - basic theory of building thermo-dynamics heat loss and gain, and characteristics of materials - solar geometry - basic characteristics and operation of building mechanical systems (lighting, ventilation, heating, and air conditioning)-	4 - 5 architects*	part of overseas degree program
	b. Same as above except for site planning	3 - 4 technical officers*	part of overseas degree program
	c. understanding of simple passive design principles, site planning solar geometry	8 - 10 jr. level technical officers (in part because they do design work on the side)	part of Polytechnic or Ramotswa Brigade

MATRIX 10

TRAINING REQUIREMENTS

ORGANIZATION BOTSWANA HOUSING CORPORATION

DEPARTMENT ARCHITECT'S OFFICE

Department Requirements: Architects and especially technical officers who have solar design training.

Activities	Required Competencies	Personnel Requirements	Training Requirements
Design of upper and middle income housing	a. passive design principles: - ability to analyze effects of climate on buildings - principles of site planning and building orientation - basic theory of building dynamics, heat loss and gain, and characteristics of materials - solar geometry	2 - 3 architects*	a. part of overseas degree program
	b. same as above	3 - 4 sr. technicians*	b. part of overseas degree program
	c. understanding of simple passive design principles, site planning and solar geometry-	3 - 4 jr. level technicians (mainly draftsman)	c. part of Polytechnic training

MATRIX II

TRAINING REQUIREMENTS

ORGANIZATION MLGL

DEPARTMENT COUNCIL ARCHITECT'S OFFICE

Department Requirements: Architects going for overseas training need solar and energy efficient design training as part of their programs. Technical officers should also have the basics of these design principles. Positions needing this are in MLGL and at district level and in the town councils.

Activities	Required Competencies	Personnel Requirements	Training Requirements
Design of council and local government building and of low cost housing	A. Passive design principles: - ability to analyze effects of climate on buildings - principles of site planning and building orientation - basic theory of building thermodynamics, heat loss and gain and characteristics of materials solar geometry	10 architects*	Part of overseas training
	B. same as above	10 chief technical officers*	Part of overseas training
	C. understanding of simple passive design principles, site planning, and solar geometry	10 - 15 senior level technical officers	Polytechnic and brigade training
	D. General understanding of advantages of good design and its attractiveness - Increased understanding of need for good policy decisions	Council Secretaries and Senior Administrative staff at district and town councils	One day workshop

SELF HELP HOUSING AGENCY (SHHA)

As already mentioned above, any of the technicians who work at SHHA are trained at the Ramotswa Brigade and, if energy conservation design is taught there, they will get a very adequate background. However, assuming that the demonstration SHHA houses (which will show SHHA plot holders what they can do with little or no cost increase) do get built shortly, then SHHA technicians who are at these sites will need to be able to explain the building. They should be able to explain all the major features and also answer all the most likely questions that plot holders would ask. It is hoped that all SHHA areas and towns would have a demonstration unit in the very near future.

The necessary training could occur in a two- to three-day workshop, although a week-long workshop would be even better. It would be similar to the workshop that ARD and BRET gave last year to SHHA people and others. The basic principles of siting, insulation, ventilation, etc., would be taught, as well as detailed instruction on the features of the demonstration house. Participants would also practice explaining the house and answering questions. The workshop could easily be taught by one of the architects who has taken the solar seminars given by BRET. Training needs are summarized in Matrix 12.

Policymakers

Item d under Matrix 9 contains a particularly important training activity. Although the training of local government council administrative staff and decision makers is not training in the normal sense, it is included here because of its importance and relevance to educational activities. If the council secretaries, town clerks and other key decision makers can be brought to understand the attractiveness of solar design and energy-efficient building principles, then they and their staffs will make better decisions regarding the design, siting, and construction of council and local government buildings. A one-day workshop on the principles and advantage could go a long way to changes in practice at the local level. This is also true of most of the renewable energy technology activity carried out by BRET. As technologies reach the council level for widespread use, such workshops should be held and run by trained and knowledgeable technical staff (perhaps MLGL architects) for council secretaries and other key decision makers.

MATRIX 12

TRAINING REQUIREMENTS

ORGANIZATION SHHA

DEPARTMENT

Department Requirements: SHHA in each of the Town Councils should have technicians and supervisors who can explain the benefits of improved low income housing design and construction steps.

Activities	Required Competencies	Personnel Requirements	Training Requirements
1. Explanation of improved building concepts to SHHA plot holders	- ability to explain siting concepts - ability to explain insulation and ventilation concepts - ability to explain other simple innovations - ability to explain the financial costs/savings of these steps	- 5 to 10 supervisors - 40 - 50 technicians	a 2 to 3 day workshop on the improved home design and on modifications to existing houses

C. Meterological Services

A summary of training needs for Meteorological Services is contained in Matrix 13. It would appear that some of the department's technical staff are already capable of installing anemometry stations.

However, training of more staff may be necessary, either by present Meteorological staff or by an outside technician. In any case, the installation of these systems is not very complicated, and there are numerous people who could undertake to run the training. A larger problem is the maintenance and field troubleshooting of both the anemometry systems and the solar radiation equipment.

One or perhaps two people who are already competent repair people (and who have an understanding of electronics) will need some short-term training in the repair, troubleshooting, etc., of the anemometry equipment. This could be done by an electronics instructor here in Botswana or, if a technician were in the U.S., at the Natural Power Company in New Hampshire. Any serious problem with a system would most easily be corrected by sending the equipment back to the manufacturer for repair. A field technician also needs to be trained in the calibration of anemometers. This can be easily done in a few hours here in Botswana by the BRET staff engineer.

Any major problems with the solar equipment would be best repaired by the manufacturer, but the basic troubleshooting and simple repairs can be carried out by already present departmental technicians. Ability to communicate with manufacturers regarding information on the equipment is all that is required.

Number 3 on Matrix 13 concerning training of a computer programmer to process wind and solar data will require some short-term training as well. In the wind area, some help could be obtained from the BRET engineer and some help on solar from ARD staff member, Blair Hamilton. However, the best long-term solution for learning how to store the data in the most appropriate formats, and how to provide reports on the data, could best be learned during a short course overseas.

MATRIX 15

TRAINING REQUIREMENTS

ORGANIZATION METEOLOGICAL SERVICES

DEPARTMENT

Department Requirements: Training of data processing staff in data processing and anlysis of wind and solar data being coloicted by Met. Services. Also, trining of staff in wind and solar equipment maintonance.

Activities	Required Competencies	Personnel Requirements	Training Requirements
1. Maintenance of anemometry systems	- calibration of anemometers - installation of compilator and recorder	2 technicians	2 day course in Botswana
2. Repair of wind compilator and chart recorder	- troubleshooting in field and shop - repair of system when broken	1 technician* (one of above)	possible short course in Botswana or short course at NP 1 in New Hampshire, USA
3. Wind and solar data processing	Knowledge of data collection is to be stored, processed, and reported Knowledge of format of how data is to be stored, processed, and reported		two weeks short course in U.S. following end of degree program
4. Checking operation of solar equipment	- ability to check and troubleshoot equipment to see if it is working properly and to isolate the component responsible for any problem	1 technician (same person as 2 above perhaps)	Review of equipment operation with ARD staff member Hamilton and communication with suppliers of equiprent

Since current plans are for a computer programmer from Meteorological Services to go to the U.S. for a graduate degree in programming, this training need could easily be included in that training. A short course at the univeristy where the programmer is studying, if the appropriate capabilities are present, would be adequate. A short course with the U.S. Meteorological Services might also be arranged. The student should have the specifications of the equipment here in Botswana with him/her, and the training should be arranged by GOB Metecrological Services.

D. District Councils

Previous sections have dealt with council activities in the areas of watcrpumping and PV applications. However, the areas of cooking devices and other potential household RETs have not been addressed. One of the most effective ways for RETs to be spread, or to provide information to the general public, is through the various extension groups and organizations under council leadership. Early work with the metal stove indicates that this a very worthwhile and important avenue.

Any item which must be purchased or built by an individual or household must be promoted in some manner at the local and district level. Information that is to be put out so as to inform people, as well as to educate (for example, the growing depletion of wood) and change opinions or views, must in some planned way go through council personnel. All of this means that any continuation of BRET activities that are to reach the general public must make use of council extension people. In order to do this, these council level people must be trained in the RETs and provided the related information. BRET extension people will need to continue to contact MLGL to arrange for training extension workers and to also carry out direct contact with councils.

Several groups at the council and local level can help with the dissemination of RETs that are ready. Community Development Officers (some 200 or more), Rural Industrial Officers (they can be especially helpful with producers and marketing/selling), Family Welfare Educators, clinic staffs, and the Tirelo Sechaba participants.

Should the stove program go to a nationwide program, then all these groups should be brought in so that they can carry out a role most suited to their particular activities and other responsibilities in the community. Many of these individuals could be given demonstration stoves as part of the program.

Training sessions would have to be arranged that ran from one day to 3-4 days,depending upon the material and technologies that were to be covered. This is a major training program. However, it involves simple RETs,and the knowledge and experience required to do this training is readily available in the current BRET staff and can be augmented very easily should a particular extension program call for increased staff.

E. Ministry of Education

It would be excellent if the Ministry of Education could include the general concept of energy, its importance, finiteness, and the need to conserve it, in appropriate curriculum. Conversations with people in the ministry indicate that some key people are very aware of this issue and are in fact trying to do something about it. To the extent that this issue, and its importance, can be discussed at the ministerial level, then even more emphasis can be brought to bear. Putting important key concepts about energy into the curriculum is not a large task. The information is already available here in Botswana, the people who could develop curricula are here, and all it takes is the interest and will to do it.

For example, the simple idea of heat trasfer is already included in primary science. Using the BRET stove as a real example would serve a number of purposes at the same time, including putting the idea of energy coversation and protection of natural resources into a very real context. In fact, the idea of doing this is now being considered by science curriculum developers for inclusion in primary teacher guide books. Supplying information and helping develop a program for teachers (including perhaps supplying a free stove to the school) is something that BRET extension should help with once the stove goes to full-scale disseminaton. The same thing should be done at the secondary level.

Also at the secondary level, in integrated science and in physics, the basic facts about photovoltaics and windmills could be introduced. They could be given as examples and exercises in electrical and mechanical power. When those parts of the curriculum that deal with seasonal change (also included in primary) are covered, information regarding improved buildings could be used. For example, the SHHA pamphlet (or a version of it) could be used to show practical application of climatic and heat transfer principles. These and other possibilities should be explored.

F. Agriculture-Related Activities

This Ministry was not included in the original list of organizations that might be carrying out RET activity. However, Agriculture is one of the ministries with the most to gain, in the long run, from BRET and RET innovation. So a brief review seems in order. An immediate need and obvious application of the pumping technologies is for animals and for gardens. If the Ministry starts a technology or mechanization unit, such a unit could develop an alternative pumping program. Until then it would seem that the Agricultural Field Services unit should take an interest. Certainly they should be encouraged, at the ministrial level, to at least begin consideration of alternative pumping devices as one of the services they offer farmers. Also, training in alternative pumping systems could be included in the training given at the Rural Training Centers of the Ministry. Again, this is something that the BRET staff and MMRWA staff should work on during late 1985 and 1986. The agricultural engineering program at the Agricultural College has a 3-month section on pumping (3 to 4 hours a week) and alternative pumping systems should be included in that curriculum. Stoves and cooking devices should also be included in the curriculum of the home economics students at the new Teachers Training College in Molepolole.

Another place where cooking devices and rural domestic RETs should be included is in the new home economics program being developed in the Faculty of Social Science at the University. The addition of practical devices and approaches to the students' training would help them greatly later on in the field and should be welcomed by the faculty. Again, help must be provided to the university in the way of information and some stoves.

SECTION IV

NONGOVERNMENTAL ORGANIZATIONS

There are a number of nongovernmental organizations which have either worked with BRET during the past few years or who have ongoing programs that have elements of renewable energy activity. Training needs in these organizations vary greatly and will certainly change over time as their programs develop. This section outlines some of the general renewable training that can be identified at this time.

A. Rural Industries Innovation Center (RIIC)

RIIC has been extremely active in the area of renewable energy. They have made it a priority area for their program, and they intend to continue with an equal emphasis over the next five years. Given that during the past three years the majority of project funds for this activity have been supplied by BRET it is difficult to know exactly how the program will unfold.

However, for our purposes let us assume that RIIC will find the project funds necessary to carry out proposed work plans and will need the trained staff they have projected in the area of renewable energy. RIIC has recently reorganized and is still in the process of determining how it will be operating in the future. Of major importance is that current thinking leans towards RIIC being almost exclusively a research and development organization, and giving up attempts at manufacturing products or technologies developed at RIIC. This would require that RIIC spin off manufacturing operations either as separate subsidiary organizations or that RIIC convince a current, or prospective manufacturer to make and sell the RIIC developed item. This plan is currently under consideration for most if not all of RIIC pumping systems, including the windmill. Should RIIC decide to make such a strategy policy, then some new personnel with entrepreneurial and marketing skills will also have to be brought onto the staff.

As a result of RIIC's redirection, two particular areas are of importance for future BRET activities. First, is the repair and maintenance of RIIC technologies such as the windmill. In time, the manufacturer, or licensed dealer, of the RIIC windmill would take over all installation and servicing activities.

MATRIX 14

TRAINING REQUIREMENTS

ORGANIZATION RIIC

DEPARTMENT

Department Requirements: Overseas training for specialized technical personnel and for localization of technical and managerial positions.

Activities	Required Competencies	Personnel Requirements	Training Requirements
1. Research work in solar technologies: desalination, water heaters, solar cookers	Knowledge of these technologies and the necessary research skills to carry out and report on research	1 Engineer	Overseas training for localization
2. Windmill research technician engineer	Experience and training in windmill design, construction and testing	1 Engineer	Same as above
3. Biogas research	Knowledge of the variations on this technology and relevant agricultural applications to Botswana	1 technician	Regional training on biogas
4. Management of animal driven pump project	Basic knowledge of how pump works and managerial and extension skills	1 project manager/technician	Overseas or local admin training experience or training, especially with the pump

For the present, RIIC staff have indicated that during this ongoing R & D stage, they will continue to service all RIIC machines and repair under warranty any machine not working, (unless the repair is cause by owner negligence). This situation is likely to continue, according to RIIC staff, for at least the next two years. It would seem that this approach will work if there is adequate project funding for the windmill project but may become a problem should such funding not be forthcoming.

Second, RIIC does not intend to develop an extension service apart from their current format and types of activities in that area. RIIC will continue to work with government and nongovernmental organizations and to provide such staff training in RIIC technologies. However, RIIC does not see itself developing an extension capability with the general public. This means that RIIC extension will maintain major contact with government organizations, but for BRET items, like the metal stove, RIIC will only be helpful as another organization that can contact multiplier groups.

RIIC staff training needs are summarized in Matrix 14. In some instances, it is a matter of localization and in others hiring a staff member for a position that is not currently filled. The solar technical officer (Activity one on the Matrix) is currently vacant. In addition to a major emphasis on solar desalination under NDP VI, this officer is to help direct the R & D on an inexpensive solar water heater, which will eventually be spun off to a private manufacturer(s).

RIIC would like to localize the windmill technician at a later date (current funding calls for a British national), as they feel that even if the machine is being produced elsewhere, they will want to continue some research and refinement activities. They would like to localize the biogas technician as soon as possible, and they are currently looking for a manager for the animal driven pump. Details of RIIC's staffing and manpower development and training plans are well put forth in a report titled "Manpower Plan 1983-1990," dated November, 1982, and it is still considered a very accurate plan.

B. Brigades Development Committee (BRIDEC)

The main area of need for training in the brigades, related to renewable energy, is with energy efficient buildings. BRIDEC is very interested in seeing the basics of good energy-efficient building design and construction put into their curriculum.

As it is not possible for them to really wait until full localization occurs, or Polytechnic or the university could turn out trained instructors at some time in the distant future, the syllabus and the material, etc., will have to be developed with current staffing patterns. Some funding should be sought (perhaps the BWAST project of AID) to have two consultants build on the workbook already developed by BRET and ARD staff. The consultants, one engineer in solar design and a specialist in materials development (for BRIDEC level and type curriculum), should complete the course materials and then train the teachers who will be incorporate the materials in their courses. This activity is also discussed on the preceeding pages 23 to 31 on building design activities. Matrix 15 summarizes the activity for BRIDEC.

The only other major areas of activity which have already been identified for the brigades is in production of the metal stove and in PV electrical installations. In both these areas, the relevant brigade has the necessary training and has performed the work already. Any further training can probably be carried out by brigade staff, unless Madiba Brigade wants to give more in depth PV instruction; that is, sizing and systems design.

C. Botswana Technology Center (BTC)

The major activity in the area of renewable energy (a projected continuing focus of BTC activity) will be research and analysis of new or potential developments/technologies for Botswana. For the most part, these are likely to be desk studies with some field data gathering, generally along the lines of recent BTC work. Current plans at BTC are that field activities will be minimal to non existent during NDP VI, in line with their mandate. It is unclear what the further activities of the electronics lab will be beyond development of PV related control equipment intended for eventual manufacture in Botswana.

No training plan exists and the director stated that no plans exist for further training of present staff. BTC does hope to localize its staff and technical positions, but as the current plan is to hire staff who already have the necessary skills, rather than send them out for training, it may be some time before experienced technical graduates can be found. Three particular areas were mentioned: an electrical engineer with PV training, a mechanical engineer with training in testing procedures, and an economist with training in technology assessment.

MATRIX 15

TRAINING REQUIREMENTS

ORGANIZATION BRIDEC

DEPARTMENT CONSTRUCTION AND BUILDING

Department Requirements: To put simple solar design awareness and principles into the training program for trainees going into the building trades, especially draftsman.

Activities	Required Competencies	Personnel Requirements	Training Requirements
Teaching of 700 to 800 trainees over the next 5 - 6 years for building industry. Ramotswa is the most important.	Teachers must have understanding of: - basic solar design principles - heat transfer and loss principled - local materials performance	10 instructors and 10 managers at least	1. Consultant/Educators to develop curriculum and materials for courses. (same material for Polytechnic) 2. A two week seminar for teachers after material is prepared.

Without sending people out under bonded arrangements for specific training in these areas, it is highly unlikely that Batswana will be found with such training and skills anytime in the forseeable future.

Of the groups visited, the BTC indicated the least clear long-term plans concerning localization of posts. It is highly recommended that BTC develop a long - term localization plan that includes both local training and sending of selected individuals overseas. Clearly, these plans should take into account the long-term (5 to 10 year) directions of BTC's focus.

D. Botswana Polytechnic

Polytechnic needs to have the capability to teach students in a number of renewable energy areas: 1) Energy -efficient building design, 2) Photovoltaics, and 3) Windpumping are the most important. The current curriculum is, however, extremely rigid due to its being modeled on the British City and Guilds courses. It would be very difficult to put appropriate renewable energy modules into the curriculum as it is now designed. In the future, Polytechnic intends to slowly begin developing its own courses and curriculum certificate program, but for the near future, other options must be considered.

Polytechnic has a history of offering short courses in particular requested areas and even longer-term or full-year programs that are specially organized. In cooperation with the appropriate departments and ministries of government, and with the private sector, Polytechnic should develop a series of short courses in the three areas mentioned above. Content has been discussed in previous sections of this report. In all instances the specific teaching expertise does not currently exist at the institute, although the necessary general academic backgrounds and training do exist on the faculty (with the possible exception of building design). Therefore, Polytechnic staff will need assistance in preparing these short courses, but once prepared and the teachers trained (all of which could be done in Botswana), they could proceed to carry out all instruction. If GOB policy is set to proceed with these three renewable technologies, or a demand for skilled personnel is felt in government or the private sector, then Polytechnic should be urged to begin setting up these courses. As is normally the case, Polytechnic should work with those institutions that will be employing their graduates.

APPENDIX ONE

WB 19 (101/319) APPROPRIATE WATER TECHNOLOGY:

The equipment on boreholes for Major and Rural Village Water Supplies in Botswana has been standardised to monopumps driven by diesel engines. During NDP V, research was undertaken into alternative methods of pumping water. A monitoring and evaluation programme of installed test technologies including windmill, solar pumps, animal powered and biogas powered pumps will continue under the Botswana Renewable Energy Technology Project (BRET) until September, 1985.

With the aim of reducing reliance on imported diesel fuel and providing a cheaper method for pumping water, the Department of Water Affairs (DWA) assisted by the Botswana Technology Center will continue monitoring and evaluation of alternative technologies for a further year. Those technologies which prove to be economically superior to diesel pumps will then be installed.

The project will also cover small-scale desalination. New posts will be needed within the department, and vehicles will be provided from the BRET project.

MROI (101/131) ALTERNATIVE ENERGY DEVELOPMENT:

The Botswana Renewable Energy Technology Project started in 1982 with the aim of identifying and introducing technologies to increase the energy available to the majority of the population by improving the efficiency of fuelwood use and substituting indigenous energy sources for fuelwood, and to assist in the substitution of indigenous fuels for expensive imported oil and diesel fuel.

The project will continue until September, 1985, when activities centered on dissemination and installation of proven technologies will be continued under new projects implemented by the Energy Unit, Department of Electrical Engineering, etc.

EU 02 (101/110) RURAL ENERGY SUPPLIES:

The availability of wood fuel, the primary source of energy for the rural population, has now reached a critical level in certain areas of astern Botswana and is becoming critical generally. Where the situation is severe, live wood is cut and used as fuel as are crop residues and cow dung. The people most vulnerable to wood fuel shortage are those in the lower income brackets who are unable to purchase wood and do not have the means by which wood can be collected from areas beyond walking distance.

During NDP 5, a study was mounted to provide a forecast of rural energy requirements, assess current resources and future development potential, and present an evaluation of alternative supply options together with a fully costed investment action plan; that is, rural energy supply strategy. The study necessarily concentrated on the use of wood as an energy source.

Under this project, funds are provided for further necessary design and study work and for implementation of the investment plan. It is envisaged that investment will be required in pilot woodlot pojects, particularly projects with a community orientation, in evaluation of tree species; and in the training of agricultural extension officers. Implementation will take place in close collaboration with the Ministry of Agriculture.

EU 01 (101/1019) ENERGY TECHNOLOGY SUBSTITUTION:

During NDP 5, considerable resources were devoted to the evaluation of alternative energy technologies with a view to reducing dependence on imported diesel and fossil energy and to increasing the use of indigenous resources, as well as increasing the energy available to the majority of rural people.

Under this project, funds will be made available to substitute energy technologies where proven economic. The project will also provide funds to implement the recommendations of energy audits. Particular attention will be paid to reducing the recurrent cost burden of energy supply. The project will cover the whole spectrum of central govenment activities with the exception of water pumping (which is covered under the appropriate water technology project).

Examples of substitution include substituting photovoltaic cells for diesel generation (the project will cover the continued monitoring and analysis of currently installed PV systems and relevant training), solar water heaters for electric immersion heaters and coal-burning stoves for electric or gas cookers. Some funds will be available for this purpose under the normal programme of replacement, but in some cases, these funds will be insufficient, given that existing installations may be replaced before the end of their physical lives with installations of higher capital. Each particular case will be subjected to detailed appraisal.

EU 04 (101/112) RURAL DOMESTIC RENEWABLE ENERGY TECHNOLOGIES AND EXTENSION SERVICES:

During NDP V, the Botswana Renewable Energy Technology project (BRET) established a technology development process, and BRET and RIIC have completed various steps in that process for a number of rural domestic technologies; for example, stoves, desalination units, solar water heaters and retained heat cookers.

In order to increase the energy available to the majority of rural people by introducing technologies which utilise indigenous resources and increase the efficiency of wood fuel use, this project will fund further R & D and adaptation of technologies. The project will also cover dissemination, training and provision of equipment for extension services and activities related to energy-saving building designs.

The Energy Unit will be responsible for project implementation through relevant institutions, such as RIIC and/or outside consultants.

After September, 1985, this project will cover certain activities currently covered under the alternative Energy Department Project.

SCOPE OF WORK

TRAINING PLANS ASSESSMENT

a. Review current Government of Botswana activities and plans for RET activities for next 5 years with Ministry of Mineral Resources and Water Affairs and other Government of Botswana agencies. Identify other possible RET activities or need for further development of plans and activities.

b. Review capabilities, including strengths/weaknesses, of all relevant agencies, organizations, departments, who Government of Botswana consider potential actors to carry out RET activities/programs.

c. Based on above, carry out assessment of manpower and training needs for relevant ministries, departments, e.t.c. Needs assessment will be carried out via interviews with appropriate Government of Botswana and agency personnel.

d. Based on the above needs assessment, develop training plan. This will be carried out with involvement and support of BRET and MMRWA personnel and involvement of other Ministries when appropriate.

e. Prepare draft plan for review by Government of Botswana prior to departure from Botswana.

f. On return to ARD, revise draft report and submit final report to BRET and MMRWA.

APPENDIX TWO

LIST OF PERSONS CONTACTED

Aarsse Bart Mr, Director, BTC
Benedetti David Mr, Director, Academy for Education Development
Bruton John Mr, Technical Director, RIIC
Coombs Mr, Chief Architect, MWC
Cox R. Mr, Principal, Polytechnic
de Gruyl Willem Mr, BRIDEC
Ellison Ken Mr, Rural Development Unit, MFDP)
Glass Tom Mr, Chief Architect, B.H.C.
Horner Mal Mr, MLGL
Huggins P. H. Mr, DEE
Inger David Mr, Managing Director, RIP
Jones Dr., Ministry of Education
Kamsma Mieke Mrs, Acting Principal, BRIDEC
Kemsley Edward Mr, Principal, Botswana Agricultural College
Kenyon J.L. Dr., Head, Department of Mechanical Engineering, Polytec
Knudsen Paul Mr, Council Architects Office, MLGL
Kokorwe Gladys Ms., Training Officer, ULGS
Mattsson Mr, Water Affairs
Mmualefe Mr, Directorate of Personnel
Morei Kit Mr, General Manager, RIIC
Moremi Ms, Assistant Coordinator, Rural Development Unit (MFDP)
Ngidi Mr, MFDP
Nord Mr, Water Affairs
Prasad B. N. G. Mr, DEE
Rabana Mr, Architect, B.H.C.
Ramothwa Mrs, Director, Meteorological Services
Rokas Bob Mr, BRIDEC
Sebiya Dr., Ministry of Health
Sekgoma Mrs, Training Officer, MMRWA
Sesinyi B.G. Mr, Town Clerk, Gaborone
Settergren G. Mr, Water Engineer, MLGL
Stewart Child Mr, Acting Director, Water Affairs
Taylor R.G. Mr, DEE
Varghese P.V. Mr, DEE
Windham Doug Mr, USAID Consultant to BWAST

CENTRAL DISTRICT COUNCIL

Moremi Selebogo Mr, Assistant Council Secretary, Mahalapye
Oageng Broer Mr, C.D.O., Mahalapye

SOUTHERN DISTRICT COUNCIL

Leteane Mr, Council Secretary

KWENENG DISTRICT COUNCIL

Khiba A.M., Chief Community Development Officer
Mabua L L Mr, Council Secretary
Montsho J.K. Mr, Chief Technical Officer
Mpedi K.C. Mr, Council Planning Officer
Nthebolang E.K. Ms., Matron
Pelekekae M K Mr, Acting Deputy Council Secretary

KGATLENG DISTRICT COUNCIL

Mabuthoe J.R.G., Chief Planning Officer
Maforaga Michael G. Mr, Deputy Council Secretary
Matome Malope P Mr, District Officer (Development)
Morobane T.D. Mr, Chief Technical Officer
Olsson Karl Mr, Senior Technical Officer (Water)
Pule Thomas D. Mr, Acting Principal Administrative Officer
Simonda E.K. Mr, Council Secretary

GABORONE TOWN COUNCIL

Hoaneng Neo Radi Ms, Assistant Planning Officer
Huang L.Y. Ms, Planning Officer
Valashia Mrs, Acting Housing Officer (SHHA)

TRAINING PLAN
1985 – 1987

MINISTRY OF

DEPARTMENT OF

NAME OF EMPLOYEE	TITLE GRADE OF POST	LENGTH OF SERVICE	SPECIFIC SKILLS COMPETENCIES TO BE DEVELOPED	HOW COMPETENCY WILL BENEFIT MINISTRY PURPOSE OF TRNG	TITLE GRADE OF POST AFTER TRNG	LENGTH OF TRAINING	PREFERRED DATES OF TRAINING	DATE BY WHICH TRAINING MUST BE COMPLETED	INTERNAL: NAME OF INSTITUTION	[illegible]	[illegible]	CONSULTANT TRAINING ASSISTANCE	CONFERENCES	FORMAL TRAINING	EXTERNAL	[illegible]	[illegible]

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