Chapter 9 Operation and Management of the PV Electrification System and Service

Chapter 9 Operation and Management of the PV Electrification System and Service

9.1 Service Delivery System

The PV system can be delivered to customers in either of the following two systems.

(1) Direct Sales and Microcredit Arrangement for PV Systems

As the most common approach, described by the World Bank as the open market approach, there is a roughly unrestricted market in which PV dealers and developers can conduct direct sales and -with government, donor, and nongovernmental organization involvement- establish PV microcredit, leasing, or direct sale programs.
This approach has been applied in Botswana such as NPV-REP.

Obviously, some form of microcredit is essential in achieving a PV penetration rate beyond the level achievable through direct sales in the cash market. Otherwise, the high cost of a PV system is beyond the reach of the average rural consumers who, through perhaps in the cash economy, can only pay the amount that they already pay for the present means of lighting (candles, kerosene, dry cells or battery charging). The key success factor for the SHS industry is therefore to develop and establish a specialized financing vehicle for potential customers of PV products. However, to date, the use of such financing vehicle with market-based returns is not widespread at all in most of countries. The difficulties in marrying microfinance and SHS industries center around three concerns: insufficient loan amounts, short loan maturities and credit philosophies.

In Botswana, in order to offset such defects, the government arranged the national PV credit scheme that requires a down payment of 15% with the rest paid in 4 years at an interest rate equal to the prime rate. However, the payment conditions are still not acceptable for potential customers and the rapid dissemination has not been attained. By lowering down-payment and prolonging payment terms, it might be possible to attain the dissemination rate as recent grid connection increase. However, in this case, users need to maintain the PV system by themselves or pay a maintenance fee under a

separate agreement with the system supplier or a service company. It is necessary to raise the user's awareness of the PV system, so that the system can be operated stably. Otherwise, the system will be abandoned and the payment will fall into arrears. Due to the constraints associated with the low population density, low skill levels of villagers and remoteness of the rural communities, profitability for such maintenance will be low and adequate service cannot be expected.

(2) ESCO Approach

In the dispersed area ESCO or concession approach, applied chiefly in Argentina, the Philippines and South Africa, a public or a private electric utility, rural electric cooperative, or other institution is granted a concession for providing electricity services to unserved populations and provides maintenance and various services to the users.

Based on the experiences in developing countries, user maintenance of PV systems is not recommended, and frequent visits and diagnoses by trained maintenance personnel are the key to continuous operation.
To overcome the constraints associated with the low population density, low skill levels, and remoteness of rural communities, the most feasible approach is to provide PV-generated electricity on a fee-for-service basis by a utility rather than through the sale of hardware to individual consumers. The fee-based approach would require that the utility owns and maintains the SHSs installed in its customers' premises. Trained staff will visit the customers regularly to service the installed systems, including repair, and collect a service fee. The fee is intended to recover utility's operating costs, including a capital recovery charge. The headquarters will manage the accounts, inventory, procurement, and training.

The ESCO approach can remove the barrier to access to PV system by spreading the heavy capital cost over the service life of PV system.

The ESCO allows the relocation of the PV systems in case of arrears and users' switching power source from PV to grid-based electricity as a result of extension of the grid to the villages, if the systems have been maintained well

and the performances of the systems can be guaranteed, because the systems are the properties of the ESCO.

The concession approach by open tender is not recommended in Botswana, because scale of the business is relatively too small to attract foreign investment and private companies in Botswana have not been well qualified. Lessons learned from the PV rural electrification projects in various countries are to be referred to Appendix 2, Section 2.3.

(3) Recommendation

The ESCO approach is recommended for PV rural electrification in Botswana.

9.2 Organization of the Implementation Body

9.2.1 Establishment of the PV Project Management System and Division of Responsibilities

Following recommendation of ESCO approach in the previous section, the Implementation Body, should manage the PV rural electrification project in the following manner. Refer to Figure 9.2-1.

(1) Basic approach

NPV-REP, currently underway, encourages a supply contract with a group of households, which is fairly small. As a result, the project serves customer groups that are dispersed throughout the country, resulting in lack of efficiency and poor technical service. The Master Plan for PV Rural Electrification recommends that the project takes care of a single village as a minimum unit of service. This means, participants will be solicited from each village, and system installation and maintenance, collection of user charge, and other services will be carried out for each village. This way, the project can be implemented in an efficient and cost-effective way.

(2) Promotion and coordination setup for PV Rural Electrification in Central Government

The institutional framework for PV rural electrification is recommended in Chapter 5. PV Rural Electrification Managing Committee coordinates and monitors the operation and management implemented by the Implementation Body.

The National Electrification Coordination Committee coordinates to facilitate the consistency of PV electrification with national electrification plan and other development activities.

(3) Organization and role of the Implementation Body's head office

As the PV Rural Electrification Master Plan should be implemented on a long-term basis, a permanent organization (tentatively called the "PV-RE" Department) should be established with clear authority and responsibility. PV system installation, accounting and other specialized activities will be handled by the Implementation Body's related departments (matrix organization), while the PV-RE department should be responsible for cost control. In addition, the department should be responsible for tariff, project management, profit management, maintenance service, supervision of local offices, and other matters directly related to the project. Finally, the PV rural electrification project should be managed as an impendent account that is clearly separated from other projects.

(4) Organization and role of local offices

The Implementation Body's local offices and depots should be used as local service bases, which are staffed by full-time service personnel. Proposed concept for the implementation of PV rural electrification is that as much works and responsibilities as possible should be transferred to the local offices in order to minimize operation costs, to maintain close contact with customers and to make quicker actions for customer's needs.

The proposed scope of works and responsibilities are, among others, are shown in Table 9.2-1.

(5) Village Organization and its role

Effective implementation of rural and remote electrification projects requires a high level of commitment by local communities concerned. In the past, those projects with a high level of community involvement – consensus, support, and participation – have been the ones which have proven the most successful.

Community participation creates ownership, and ownership leads to success. Even the best crafted plan and the best funded rural electrification project can be frustrated if the local community is not brought fully into the process. Local community members are in the best position to assess their willingness to support electrification efforts and to express the intent to choose the best options, especially when they are well informed of the plan in advance.

It is recommended to have the Village Advisory Committees (VAC) established voluntarily by local residents. VAC will support the Implementation Body in the solicitation of applicants, the conclusion of customer agreements, the collection of deposit money, and the installation of PV systems in the village.

For the monthly collection of the user charge, the Implementation Body entrusts the sale of pre-paid cards to sales agents, who are mostly grocery shops in the village and get paid a certain percentage commission for sales. Therefore, incentive is given for expansion of the customer base.

For first-line maintenance of the PV systems, the Implementation Body concludes the agent agreement with a villager who monitors all the PV systems installed in the village. The maintenance person will not be able to do sophisticated repair or maintenance work, but he will hear customer's complaints and teach them the correct way of system operation, and if he cannot solve the trouble, he will refer it to the Implementation Body's local office. He also checks all the PV systems to see if they are abused.
In the villages where BCS are installed, the system monitoring agents also operate BCS, charging the discharged batteries which BCS users bring, supplying the charged batteries, and maintaining BCS systems.

Note that the organization and division of responsibilities should be modeled after by all the villages that will be PV-electrified in the future.

The scope of works and division of responsibilities is to be referred in Table 9.2-1. Refer to Appendix 15.6-3 on the samples of Agent Agreement.

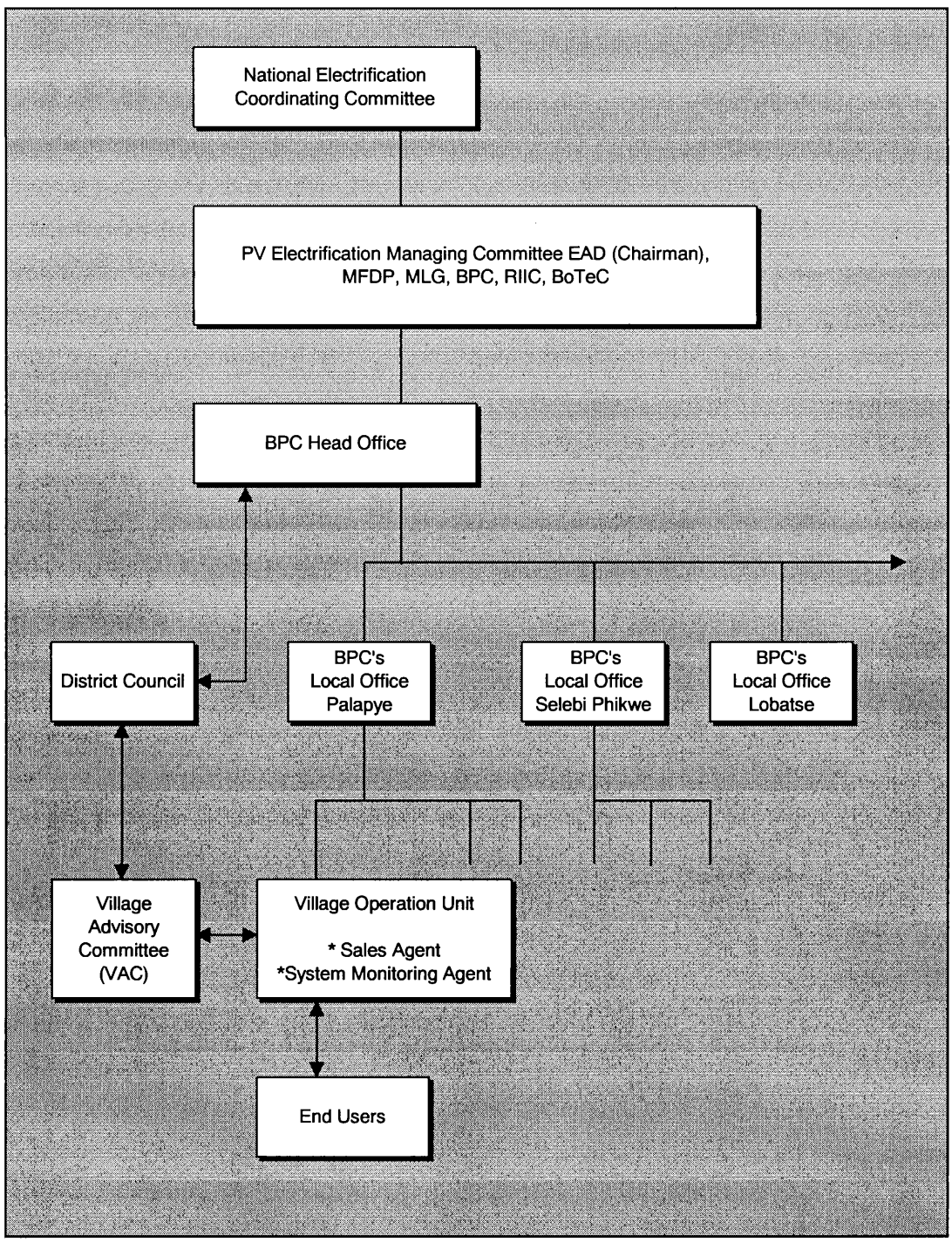


Figure 9.2-1 Organization of Implementation Body for PV Rural Electrification

Table 9.2-1 The Scope of Works and Split of Responsibilities for Implementation of PV Rural Electrification

Items	Implementation		Village		
	Head Office	Local Office	Sales Agent	System Monitor	VAC
<u>General</u>					
* Consultation and acquisition of necessary approvals and permits with the related authorities	◎	○ Assistance			○ Assistance
* Monitoring and steering the progress and key issues of the projects	◎				
* Contract with Agents	◎ Conclusion of contracts	○ Assistance	○	○	○ Assistance
<u>Sales</u>					
* Promotion of sales activities and concluding Agreements with customers	◎ Approval of applicants	◎ Sales activities ◎ Confirmation of applicant's requests	○ Assistance ○ Solicitation of applicants and requests		○ Assistance ○ Solicitation of applicants
* Preparation of budget	◎ System design ◎ Budget preparation				
* Conclusion of Agreement with customers	◎ Signing the Agreement	○ Confirmation	○ Assistance		○ Assistance
<u>Financial</u>					
* Money collection	○ Collection from Local office	○ Collection from Sales Agents	◎ Collection from customers		○ Assistance
* Book Keeping	◎ Customer data recording	○ Data collection from Sales Agents	○ Recording	○ Assistance	
* Variation of Agreement (Relocation, Cancellation system size change, etc.)	◎ Approval and decision	○ Data collection and report to Head Office	○ Collection of Customer's requests	○ Assistance	○ Assistance
* Audit and Budget control	◎				
<u>Construction</u>					
* System design and tender preparation	◎				
* Contractor Selection	◎				
* Construction Management	○ Monitoring progress	◎ Supervision		○ Assistance	○ Assistance

Items	Implementation		Village		
	Head Office	Local Office	Sales Agent	System Monitor	VAC
Maintenance * Collection of customer's claims		○ Collection of records		◎ Collection and records	
* First-line maintenance (system checking)				◎ Checking and report to Local office	
* Remedial maintenance works		◎ Works and records		○ Assistance	
* Management of spare parts	○ Replenishing Parts	◎ Spare parts control	○ Stock spares at their shops	○ Assistance	
* Maintenance Recording	◎ Collection of data and record keeping and analysis	○ Collect and report to Head Office			
Prevention of theft and vandalism		○		◎ day to day checking	◎ Call attention at Kgotla meeting
Training and Education	◎ Training of technicians and officers (with the assistance of the contractors)	◎ Training of System Monitors and Sales Agents ○ Training of customer		◎ Training of customers	

(6) Private Company and its role

In Botswana, it is mandatory requirements for governmental and parastatal organizations to minimize their manpower. For this reason, it will be very effective to fully utilize private companies for such services that the private companies can substitute Implementation Body's works. However, as discussed in Chapter 5, the private PV industries in Botswana are still underdeveloped and company creditability is still in low level. Therefore, it is recommended that some parts of local office's roles of Implementation Body may be contracted out to the contractors who undertake purchasing and installation of PV systems in the respective zones proposed in Chapter 7. Some of their roles will be daily works such as maintenance and tariff collection supervision including conclusion of contracts with the sales agents and the system monitors in place of Implementation Body and spare part control. In this case, 7 to 8 technicians and officer can be reduced from the manpower requirement shown in Table 13.1-2 for the regional offices of Implementation Body. The manpower required for village operation units should not be reduced, because of cheaper cost and necessity of close contact with clients.

9.3 Customer Service to be Provided by the Implementation Body and Tariff System

9.3.1 Content of Service

(1) Granting of the right to use the PV system

The Implementation Body will install the SHS, batteries, and the PV system for public facilities, which remain its property. Customers are granted of the right to use electricity generated by the SHS installed at each household.

(2) Monitoring and maintenance of the installed system

The Implementation Body will periodically monitor each PV system installed and provides maintenance service, including corrective maintenance, for users. It will also replace BOS (auxiliary equipment), such as batteries and controllers, which require periodical replacement.

(3) Collection of the user charge and contract renewal

In consideration of the services in (1) and (2) above, the Implementation Body will collect the service charge. For the SHS, the pre-paid card will be used. For the BCS, a fixed charge will be collected while a coupon will be purchased for battery charging. The service contract will be renewed periodically upon the customer's request.

(4) Removal of system equipment

The Implementation Body will remove or relocate the PV system and auxiliary equipment when the contract is terminated upon the customer's request or failure to pay the charge.

(5) Intermediary service for household equipment and wiring

The Implementation Body will supply intermediary service to sell and/or install, directly or indirectly via suppliers or contractors, electrical equipment (fluorescent lights, radios, TVs, connecters, cords) and wiring required by users.

9.3.2 Tariff System

(1) Monthly service charge

The customer will pay to the Implementation Body a fixed fee, as determined according to capacity of the installed PV panel, for electricity supplied from the PV system and system maintenance service. (Refer to Table 9.3-1)

(2) Deposit

The customer will initially deposit with the Implementation Body the amount equivalent to three months of the above fixed fee as the collateral for failure to pay the monthly fee or damage to the system due to the customer's negligence. The deposit money will be reimbursed, without interest, when the PV service is terminated. (Refer to Table 9.3-1)

Table 9.3-1 Fee for Services

System category		Capacity	Monthly tariff (P/month)	Deposit (P)
For Households				
Solar Home system	Class 50	50Wp	40	120
	Class 100	50Wp×2 sets (100Wp)	80	240
	Class 150	50Wp×3 sets (150Wp)	120	360
	Class 200	50Wp×4 sets (200Wp)	160	480
	Class 250	50Wp×5 sets (250Wp)	200	600
Battery Charge System		Battery 30Ah	P5/fixed fee P1/charge	–
For Public facilities				
	Class 500	50Wp×10sets (500Wp)	600	1800
	Class 1000	50Wp×20sets (1000Wp)	1200	3600

Note 1) The deposit means "Security money" corresponding to 3 months tariff.

- This money to be allotted in case the users arrears monthly payment.
- This money to be allotted for the loss/damage of the facility due to users fault.
- The balance to be returned to the user on surrender (No interest).

Note 2) Battery System: Households who wishes to participate in the project, but are difficult to pay such monthly charge as above, can be supplied battery. The centralized PV system with capacity of Class 500 or 1,000 and battery charging station will be installed in the village. These are always equipped with full charged spare batteries. Beneficiaries shall pay P5.0/m as a fixed fee and will be able to replace discharged battery with a fully charged battery at P1.0.

9.4 Contract and Operation Manuals

(1) Service charge collection, system maintenance, and customer management manuals

See Appendix Document 15.6-1-1, in which a set of standards and procedures are shown for conceivable cases.

(2) User contract

It is recommended to conclude a user contract that sets forth the terms and conditions of service that include the content specified in Appendix 9-4.

9.5 Supplier Contract

9.5.1 Scope and Duration of the Supplier Contract

The PV system should be supplied and installed by a supplier who has been selected through the bidding process and is responsible for a specific district or region. The supplier will also be responsible for customer training, maintenance, supply of equipment and materials, and other auxiliary services on a long-term basis. The long-term and area-wide contract is inevitable as the supplier is expected to establish a local office and service organization in order to ensure reliable and high quality service on a long-term basis.

Chapter 10 Manpower Development

Chapter 10 Manpower Development

10.1 Present Status of Manpower Development for PV Electrification

10.1.1 Manpower Development in Central and Local Government Level

(1) Central Government Level

Energy Affairs Division (EAD) of MMEWR is responsible in working out the policy of promoting the electrification by PV system in the level of the Central Government. With regard to the manpower development of the personnel to be engaged in the PV electrification, EAD, as the core administrative center, such parastatals as RIIC, BoTech and other organizations are involved. However, so far no significant development is yet to be seen. At the moment, no concrete and constructive policy has been worked out to address the shortage of personnel to be engaged in the PV electrification Programs.

Department of Vocational Education and Training (DVET) of Ministry of Education (MOE) has many Technical Colleges (TCs) and Brigades at different districts in Botswana. At these TCs and Brigades, vocational training on different trades are conducted. However, not many of TC and Brigades have 'Electricity' classes, which are considered to be most close to PV system technology. However, Madilero Training and Testing Centre(MTTC) of Department of Labour and Social Security, Ministry of Labour and Home Affairs has established jointly with EAD 'The New and Renewable Sources Committee'(NRSC) which is currently developing 'module' to meet the various different training needs of Renewable Energy in Botswana from Central Level as well as Local Level

(2) Local Government Level

Among the equipment in relation to new and renewable sources of energy (NRSE), equipment related to the use of Solar Energy are biggest in its number. Many District Councils in Botswana show very positive attitude to introduce the PV systems. However, when it comes to manpower issue, almost all district councils are facing keen shortage of technical personnel to disseminate further the PV systems even in their own districts. Needs and requirement for the well trained personnel are observed in all level of

technical staff, namely, technician, supervisor, decision maker and professionals.

Whereas, the necessary training facilities in relation to PV system in the country are far beyond the satisfactory situation. In particular, technological training in relation to NRSE are rarely incorporated in the existing training facilities Programs in the training Botswana. Especially, training facilities in relation to PV systems are very few to find. However, it is also true that some TC and Brigades, for instance, Madia Brigades in Mahalapye and TC (Technical College) in Palapye are trying to introduce the training courses on PV system.

10.1.2 Manpower Development in the District Councils for PV Electrification

District councils and town councils are one of the major consumers of solar devices. The applications include Solar Water Heater (SWH) for the housing sector, clinics, schools, and PV systems for street lighting, lighting in the house, clinics, health posts, schools and for radio communication with their offices in rural locations. As a general practice, maintenance is done in-house, and when major problems arise which cannot be tackled by in-house teams, outside agencies are called in. According to the report of the consultant team of Botswana University, all Councils are very much concerned about the lack of trained manpower in this area, and are very supportive of the launch of NRSE training Programs in solar technology at the levels of artisan, technician, supervisory and decision making staff. Some cases are cited below which introduce how the present status of manpower of District Councils and how they are addressing this shortage of manpower in solar energy technology.

(1) Central District Council, Serowe

The Council uses PV systems for lighting at 168 locations (as of 1997) which may have several systems (up to 10 or more) at each location. These include council houses, health posts, maternity wards, school administration blocks and class rooms. Radio equipment in clinics at 33 locations is powered by PV. Recently street lighting was introduced at three locations in Serowe as a pilot project, and if successful shall be replicated at other locations throughout the district.

As to maintenance aspect, PV systems have some problems. Most of the problems are due to invertors burning out because of lack of ventilation (poor design). Maintenance is done in-house electricians who are not specifically trained for repair and maintenance of PV systems. Presently, technical staff of the Council does not have sufficient practical training. There is preference for employment of artisan from the Brigades who have better practical experience. There is a need for trained manpower for solar technology within the Council as well as for the external agencies to serve for the general public. The District requires at least 5 NRSE technicians (artisans) and one supervisory staff in each of the 5 sub-districts, and one supervisory staff at decision making level at the headquarters of the Councils.

(2) Southern District Council, Kanye.

SWH (Solar Water Heater) are used in Council houses and clinics, and PV systems are used in schools, clinics and for communication. SWH are without electrical back-up because they are in rural areas where there is no electricity. Usage of both the systems started 1991/92, and presently about 500 to 600 units of each type are in use. Usage of solar devices is on the increase and is going to expand in future. According to the new policy, SWHs are going to be installed in all new constructions, and PV lighting shall be provided in all schools, clinics and teachers and clinic staff houses in rural areas where there is no electricity.

There are no major problems faced with the performance of maintenance of SWHs and the PV systems. The main problems with PV systems arise due to over/undisciplined use. The maintenance is in-house. There is few staff who has been trained at the former and the Madiba Brigades. There is need for more trained staff. Current requirement is at least one artisan/technician for each of the four sub-districts and one supervisor for the headquarters.

10.1.3 Needs of Manpower Development for the PV Electrification

The majority of the population of Botswana live in thinly populated remote rural areas where the conventional sources of energy such as electricity, coal and petroleum products are not easily accessible. Use of NRSE devices is considered to be a feasible solution. This is demonstrated by the decision of most Rural District Councils to expand the usage of solar energy devices to rural areas under their

jurisdiction. In addition, some other sectors, such as communication, already rely heavily on solar power. However, there is a severe lack of trained manpower for maintenance, repair, system design, sizing, product evaluation and specification in the area of NRSE, and specifically so in solar energy technology which represents the bulk of NRSE usage in the country. The lack of manpower is experienced by all sectors; the manufacturers, suppliers and installers, the consumers, and the maintenance departments.

This lack of trained manpower has led to large scale failure and malfunction of the devices, resulting in large monetary losses in repair and replacements. The usage of devices is also restricted, and some organizations, for example, the Botswana Housing Corporation, have been forced to abandon their use.

In order to minimize losses due to failure and malfunction of the NRSE devices currently in use, to support the envisaged expansion of their usage, and to support the commercial sector, there is a need for trained manpower at the following levels of responsibilities:

i) Technicians and artisans for maintenance, repair and upkeep of the systems.
ii) Professionals/supervisory level for design and sizing of the system and to provide effective leadership.
iii) Decision making level for product evaluation and specification.

Although the R&D organizations such as BoTeC and RIIC were considered under organizations capable of providing support for practical training, these organizations themselves together with the manufacturing sector also require trained manpower at the professional level with research and development capabilities.

10.2 The Status of Vocational Training

(1) Vocational Training System and Administrative Office

1) Vocational Training System

In Botswana, technical training for the artisan level, which lead to 'Trade Certificate C and B' is conducted at Brigades and technical training which leads to 'National Crafts Certificate (NCC) is conducted at Technical College (TC). Training and education which lead to Certificate, Diploma and Degree are conducted at Botswana University (previous Botswana Polytechnic).

Training Programs at the Brigades and TC are monitored by Department of Vocational Training and Education (DVET) of Ministry of Education and certification and testing are done by the Madirole Training and Testing Center (MTTC).

2) Department of Vocational Education and Training (DVET), Gaborone

DVET is the basic and administrative-legal frame work of vocational training in Botswana and ensures the inventory, development, and planning and management of resources. DVET acknowledges the need for training in NRSE technologies with emphasis on solar energy, and hopes that if a Program in NRSE is accepted, it would be arranged so as to conform with the new setup of Program arrangement at which DVET is currently working.

(2) Status of Vocational Training on PV Technology

1) Brigades

Brigades are the community based training institutions which largely depend on community based projects, and conduct various income generating production activities. They offer training Programs for artisans at Trades Certificate C and B levels. Some of the trades in which training Programs are available include carpentry, brick laying, plumbing, auto-mechanics, auto supplies and services, general mechanics, metal fabrication, welding, electrical, horticulture, forestry/nursery, office skills etc. Trades offered by different Brigades depend on the community needs and their resource limitations.

The structure of these training Programs is as follows:

i) Basic Certificate Course

This course covers only practical training, with no theory component. The entire training is carried out in house, with no industrial attachment. The course is targeted at unskilled labor with no educational background, who have been working in the industry for long periods with no prospects of technical progress. The certification of such course is done by the concerned Brigade itself, and it gives the holder of the certificate an opportunity to move from the unskilled labor cadre to a skilled artisan cadre post.

ii) Trade "C" Certificate Course

This course is of 2 years duration. Intake is JC (Junior Secondary Certificate) holders, fresh from school with no work experience. The Program is divided into three components; namely, (a) Theory courses, (b) Practical component, (c) Industrial training/attachment.

iii) Trade "B" Certificate Course

This course is a one year course which builds on the 'C' certificate. It is also run on a similar arrangement and includes class work, practical training and industrial training.

Name of Brigades	Number of Students in 'Electricity 'Class		Total
	Male	Female	
Kanye	29	9	38
Lobatse	22	6	28
Madiba	30	7	37

2) Technical College (TCs)

TC offers 4 years NCC (National Crafts Certificates) apprenticeship Programs in trades like electrical, mechanical, building and construction, auto-mechanics, welding and fabrication, office skills and secretarial, carpentry, computer courses etc. Like Brigades these Programs also are monitored by DVET and certificates are awarded by MTTC. The entry requirement is JC (Junior Secondary Certificate), fresh from school, but because of prevailing conditions for employment or further education a large number of students (up to 30 %) are senior secondary O-level certificate holders.

First two years of the NCC Program are sponsored mainly by the government and in a few cases by industry. For the second half of the Program (years 3 and 4) a student must find a sponsor from industry. If a sponsor is not found, a student must drop out after year-2 and discontinue. Generally there is a large drop out rate because of the non availability of sponsorship. In case of drop outs, MTTC may grant a trade C certificate after due testing and assessment.

The Program structure is such that each year students spend 13 weeks on campus for institutional training during which period theoretical components and workshop training are covered. Rest of 39 weeks in the year is spent on

field work for industrial training which is generally with the sponsoring industry. During the first two years, when majority of students are government sponsored, an efforts is made to place such students also with an industry for the industrial training. In case industrial attachment cannot be arranged, they obtain the corresponding experience and training in workshops and practical training facilities within the institute.

Name of TC	Number of Students in 'Electricity 'Class						
	Male			Female			Total
Jwaneng	2	12	0	7	3	0	24
Gaborone	37	43	0	7	12	0	99
Selebi/Phikwe	32	12	0	7	4	0	55
Palapye	15	36	0	3	2	0	46
	●	◎	■	●	◎	■	

Note: ●Full Time ◎Apprentice ■Part Time

(3) Research and Development at Botswana University and Other Related Organizations

1) Botswana University

Both the Faculty of Engineering and Technology and Faculty of Science of the University do not have any classes on NRSE. However, it is anticipated that in connection with environmental studies, some R & D activities would be started shortly.

2) Botswana Technology Center (BoTeC), Gaborone

Research and development in solar energy technology and devices is one of the major areas of activities of BoTeC. BoTeC plays an important role in practical training in NRSE by the following manner.

a) Failure of utilization technology including PV systems is not necessary due to a flaw in the technology itself, but more often it is managerial component of human factor that fails technology. BoTeC, therefore, views managerial training as an essential component of the overall NRSE training strategy.

b) The Technology Information unit of BoTeC shall be able to provide input to the course contents for the managerial training courses, and the

Industrial Development and Technical Assessment Section shall provide support for conducting training wherever possible.

c) The issue of standards and specification of devices and equipment should be covered at all levels of training

3) Rural Innovation Center (RIIC), Kanye

RIIC has been engaged in the R&D activities in the past years, PV does not necessarily major portion of the past activities. They have laid more emphasis on the desalination using solar energy, and biogas development, development of the portable/batch solar water and windmill power generation. Portable/batch solar water are low cost simple units for rural application.

10.3 Strategies for Manpower Development

Total manpower requirement for PV rural electrification is shown in Table 13.1-2 of Chapter 13. The strategies for the manpower development are as follows:

(1) Manpower Development for Operation and Management

It is essential to operate and manage PV rural electrification project efficiently with minimum manpower.

1) Dissemination of "Cost Conscious" Way of Doing Business

As described in Chapter 13, the costs required for Implementation Body accounts for significant portion of total costs of the PV electrification project. The saving of the costs contributes to increase profitability of the project.

It is commonly criticized that the institutional framework and management in parastatals are apt to lack for "cost conscious" way that was observed in operation of the Dissemination Project (Refer to Appendix 15).

It is recommended that extensive education and training for all member of the Implementation Body should be made as an in-company training course.

2) Provision of Complete Managing and Accounting Tools

It is indispensable to equip complete managing and accounting tools for contract management with the users, bookkeeping of monthly fee and deposit, records of user complaints, records of maintenance, spare parts management and budget and stocktaking, etc. It is also important to periodically train personnel in charge as an in-company education course.

3) Training of Local Staffs

It is required that as much works and responsibilities as possible should be transferred to the local offices. A local officer should act as a multifaceted staff. For instance, he visits a village as a salesman, money collector and maintenance person. The transfer of power and responsibility and training should be made for the purpose.

(2) Fostering Local Technician

BPC has sufficient in-company training course for electricians and, therefore, it will not be so difficult to add PV technology to such training course.
Lecturers from PV contractors should be invited for such training.

(3) Training of First-line Maintenance Personnel

As for countermeasures for lack of manpower in Implementation Body, difficulty to respond user's complaints due to remoteness and cost saving, it is proposed that unskilled persons in the villages are fostered as first-line maintenance personnel by means of on-the-job training in the course of PV installation and operation. Trainers will be local staffs of Implementation Body and PV installation contractors.
Preferably Brigades in the Districts are utilized for such purpose.

(4) User Training

Users should be trained by the local stuffs PV installation contractor and first-line maintenance personnel in the course of PV installation and operation.

(5) Fostering Contractor's Technical Personnel

It is urgent necessity to foster engineers and technicians in PV contractors who have taken professional education in the technical collages and university.

Full-scale project implementation of PV rural electrification will attract talented personnel. Campaign on PV rural electrification sponsored by EAD and Implementation Body will be important for such purpose.

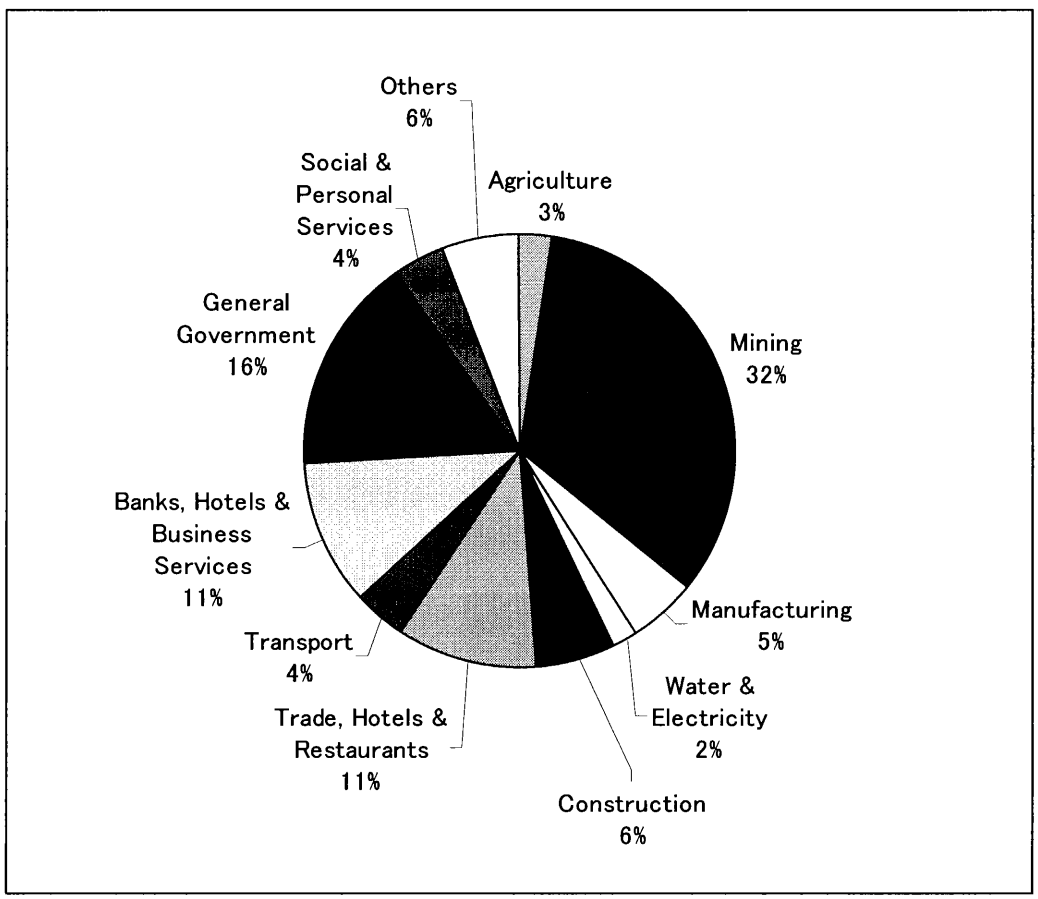
Chapter 11 Financial Planning

Chapter 11 Financial Planning

11.1 Situation of the Finance Sector of Botswana

The finance sector of Botswana is composed of the Bank of Botswana (Central Bank), four commercial banks, five parastatal banks mainly aimed at funding development, and security market such as stock exchange.

The size of the national economy is 25,208 million Pula in terms of GDP (provisional 1999/2000) and the finance sector including insurance business accounts for some 11% of GDP.



(Source: Annual Report 2000 Bank of Botswana)

Figure 11.1-1 GDP (1999/2000)

Pula, the legal tender of Botswana, is approximately equivalent to USD0.1866 in December 2000, month of this survey, hence the size of the country's economy is worth some 4,703 million USD.

The total assets held by the commercial banks are worth 8,553.8 million Pula (about 1,596 million USD) at the end of 2000, showing an increase of 4.8% from the previous year. The outstanding balance of lending, which accounts for more than half of the total assets, has seen a considerable growth of 20%, illustrating a rapid growth of the finance sector as well as the industrial sector.

Table 11.1-1 Assets of Commercial Banks

(Unit: million P)

		1995	1996	1997	1998	1999	2000
Assets	Balances at Bank of Botswana	70.3	67.9	129.5	185.5	150.0	49.5
	Balances due from other banks	215.8	475.7	847.6	1,444.2	1,334.7	1,603.7
	Bank of Botswana Certificates	831.9	1,192.4	1,571.9	1,322.1	1,717.7	1,241.1
	Bills purchased and discounted	81.1	69.5	43.8	204.7	129.8	123.3
	Cash	103.1	130.1	156.5	160.1	229.1	217.2
	Loans and advances	1,650.6	1,674.4	1,794.8	2,717.4	3,946.9	4,749.0
	Others	197.9	231.5	233.8	474.2	653.2	570.0
	Total	3,150.7	3,841.5	4,777.9	6,508.2	8,161.4	8,553.8
Annual growth (%)		4.1%	21.9%	24.4%	36.2%	25.4%	4.8%
Liabilities	Deposits	2,445.9	2,931.7	3,806.0	5,394.4	6,690.3	6,805.8
	Balances due to other banks	95.1	158.7	149.6	155.4	196.8	306.7
	Capital/Reserves	337.3	401.8	463.9	567.9	732.1	842.7
	Other liabilities	272.4	349.3	358.4	390.6	542.1	598.6
	Total	3,150.7	3,841.5	4,777.9	6,508.2	8,161.4	8,553.8

(Source : Annual Report 2000 Bank of Botswana)

On the other hand, even Botswana Development Corporation, the largest in size of assets of the parastatal development banks, had an asset worth 742 million Pula (about 138 million USD), playing a limited role in the finance sector.

Table 11.1-2 Assets of Major Parastatal Development Banks

(Unit: million P)

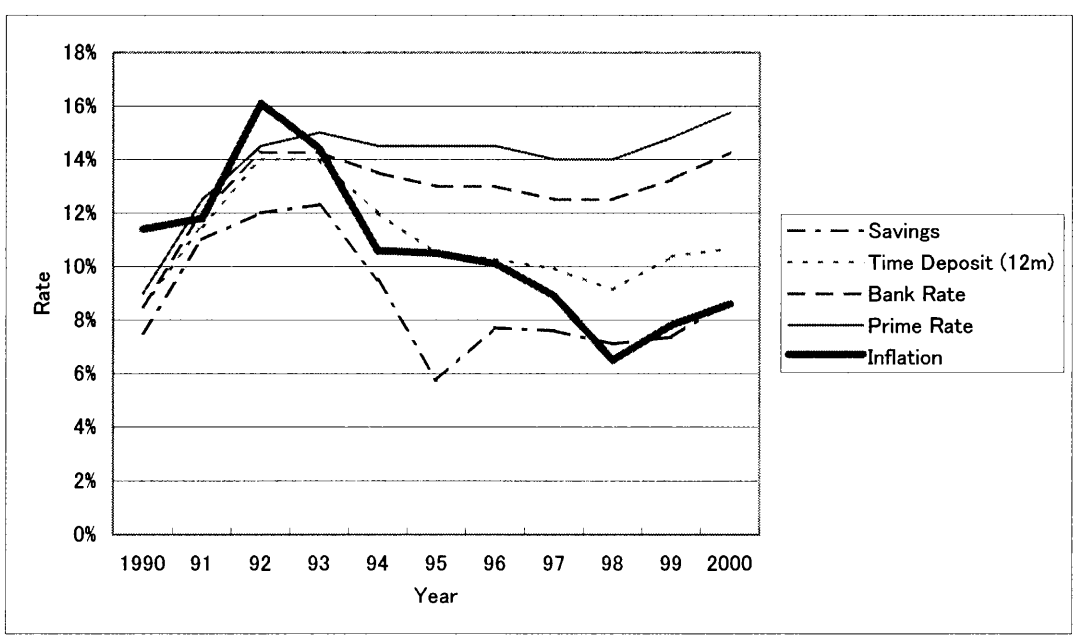
	1995	1996	1997	1998	1999	2000
Botswana Building Society	334.4	346.4	349.2	363.4	377.1	424.2
Botswana Development Corporation	606.5	621.6	783.8	820.0	683.9	741.6
National Development Bank	125.8	148.6	177.9	230.0	271.0	289.6

(Source: Annual Report 2000 Bank of Botswana)

The stock exchange, the core of the capital market, was first created privately in 1989 and it was not until 1995 that the stock exchange was established officially. According to the 2000 Annual Report of the Bank of Botswana, the number of the listed companies was 16 companies and the market capitalization of the domestic companies' index rose by 7.6% year-on-year, to 5,244.7 million Pula (about 978 million USD) at the end of December 2000.

The stock exchange also deals with bonds. Botswana Development Corporation and Botswana Telecommunications floated bonds with a total nominal value of 100 million Pula (about 19 million USD). In addition, a South Africa bank, Invested, issued short term paper with a value of 182 million Pula (about 34 million USD), and just before the end of 2000, the Botswana Building Society floated a 50 million Pula (about 9.3 million USD). Beside, the Bank of Botswana issues Bank of Botswana Certificates but this is used for money supply control.

The above facts conclude that the security market, in stock and bond, is very small in size and is still on the way to full-fledged development.
The Figure below shows the recent trends in inflation rate and interest rate in the country's finance market: call deposit (savings), 1-year term deposit, bank rate and prime rate.



(Source: Annual Report 2000 Bank of Botswana)

Figure 11.1-2 Interest Rate and Inflation Trends

11.2 Possibilities of Financing from the Financial Sector

11.2.1 Lending Conditions of Financial Institutions

In order to explore possibilities of financing from the country's financial sector, interviews were made with representative financial institutions to examine their lending conditions.

(1) Commercial Banks

The lending conditions of the commercial banks are as follows:
The interest rate is a prime rate plus about 10%, subject to risks involved in business and security and repayment period is a maximum of 7 years.
The legal limit of the maximum interest rate is 35%.
It is to be noted that commercial banks are unlikely to finance businesses that is considered as a high risk.

Interest rates for bank deposits range from 5.75% to 9% in call deposit and from 9.75% to 10.75% in term deposit.

(2) Parastatal Development Banks

National Development Bank (NDB) is mandated to provide funds for individual medium-small size enterprises, not large size enterprises or large-sized businesses which have characters of project type. It should be noted that, unlike commercial banks, NDB also finances high-risk sectors such as agriculture. The interest rate for lending is prime rate plus 4%.

Botswana Development Corporation (BDC) finances large-medium size enterprises with its main lending to the manufacturing sector. The interest rate for lending is 15% and the repayment period is 10 years at maximum.

11.2.2 Possibilities of Financing PV Rural Electrification

As the financial analysis made in Chapter 13, it indicates that the PV project viability cannot be attained in case of high loan with 14% interest rate.
Therefore, it will be difficult to finance from the country's financial sector.

11.2.3 Possibilities of Direct Finance

As mentioned above, stock and bond market is very small sized and is yet to be developed. It is not realistic to raise funds from the capital market for PV rural electrification.

11.3 Financial Planning

(1) Source of Finance

As discussed above, it is difficult to obtain funds from the financial market, so that the remaining possibility is to inject funds from the fiscal budget, which may include foreign aid, grant or concessionary loan.

(2) Total Required Fund

Total required fund for 10 years from the start of operation, derived from the financial analysis of the PV rural electrification business plan, are shown in Table 11.3-1 with the breakdown of each supply source.

Table 11.3-1 Total Required Fund for PV Rural Electrification

(Electrification Rate : SHS/BCS : 40%/20%) (Unit : kP)

Year	1	2	3	4	5	6	7	8	9	10	11	12	Total for 10 years	Total for 12 Years
Subsidy	11,045	12,420	11,219	10,636	8,894	9,399	9,712	9,582	9,229	9,369	5,998	4,020	101,504	111,522
Fixed Capital Expenditures	4,180	3,452	2,805	2,659	2,223	2,350	2,428	2,395	2,307	2,342	1,749	1,317	27,142	30,208
Equity	2,761	3,105	2,805	2,659	2,223	2,350	2,428	2,395	2,307	2,342	1,749	1,317	25,376	28,442
Capital Increase for Previous Deficit	1,419	347	0	0	0	0	0	0	0	0	0	0	1,766	1,766
Long Term Loan	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Required Fund	15,225	15,872	14,024	13,295	11,117	11,749	12,141	11,977	11,536	11,711	7,747	5,337	128,646	141,731

Chapter 12 PV Rural Electrification Project Planning and Implementation Procedures

Chapter 12 PV Rural Electrification Project Planning and Implementation Procedures

12.1 Project Planning and Implementation Procedures

Project planning and implementation procedures are shown in Figure 12.1-1.

1) After the formulation of the Master Plan for PV Rural Electrification, EAD and the Implementation Body will conduct a detailed socioeconomic survey of un-electrified villages and localities throughout the country in order to make adjustments for the ability to pay (average for households in a village), total electricity demand including public facilities, and the potential ability of system operation and management, and other key parameters.
   As described in Chapter 6, the socio-economic study on PV rural electrification was already made in November 2000 for the purpose of the master plan formulation. However, it is recommended to conduct detailed socio-economic survey for PV rural electrification business plan. The reasons are as follows:

   a) More than 2 years have passed since last survey.
   b) It is necessary to offer the exact terms and conditions proposed in the Master Plan to the villagers in order to obtain or confirm willingness and ability to pay or desired system size.
      The results obtained by the last socio economic survey apt to be too optimistic since the respondents might not be so serious without official announcement of PV rural electrification.
   c) Whether or not public facilities join the project and its installed PV capacity will affect project feasibility. It is required to fully consult with District Administration in order to obtain precise figures. The former survey was not satisfactory on such points.
   d) Implementation Body should conduct, on his own responsibility, the market survey that is socio-economic survey for his own business planning.

2) Based on the Master Plan and the results of the socioeconomic survey, the Implementation Body will formulate the PV Rural Electrification Project Plan, which will be reviewed by the steering committee (tentatively named PV-REMC under EAD) and approved by the planning committee (tentatively named NECC). Note that local governments will be involved in the planning process.

3) Upon the approval by NECC, subsidy will be budgeted and an annual implementation plan will be developed in consultation with local governments and community organizations and approved by PV-REMC.

4) The project plan will be subject to review and approval on a periodical basis.
Yearly project plan shall be formulated based on the monitoring and evaluation of the previous year's track records of operation and management.
The above mentioned monitoring and evaluation shall be carried out by the Implementation Body. Final evaluation and approval shall be made by PV-REMC. Monitoring and evaluation shall be carried out by third party entrusted by PV-REMC at an appropriate interval (e.g. every 3 years).

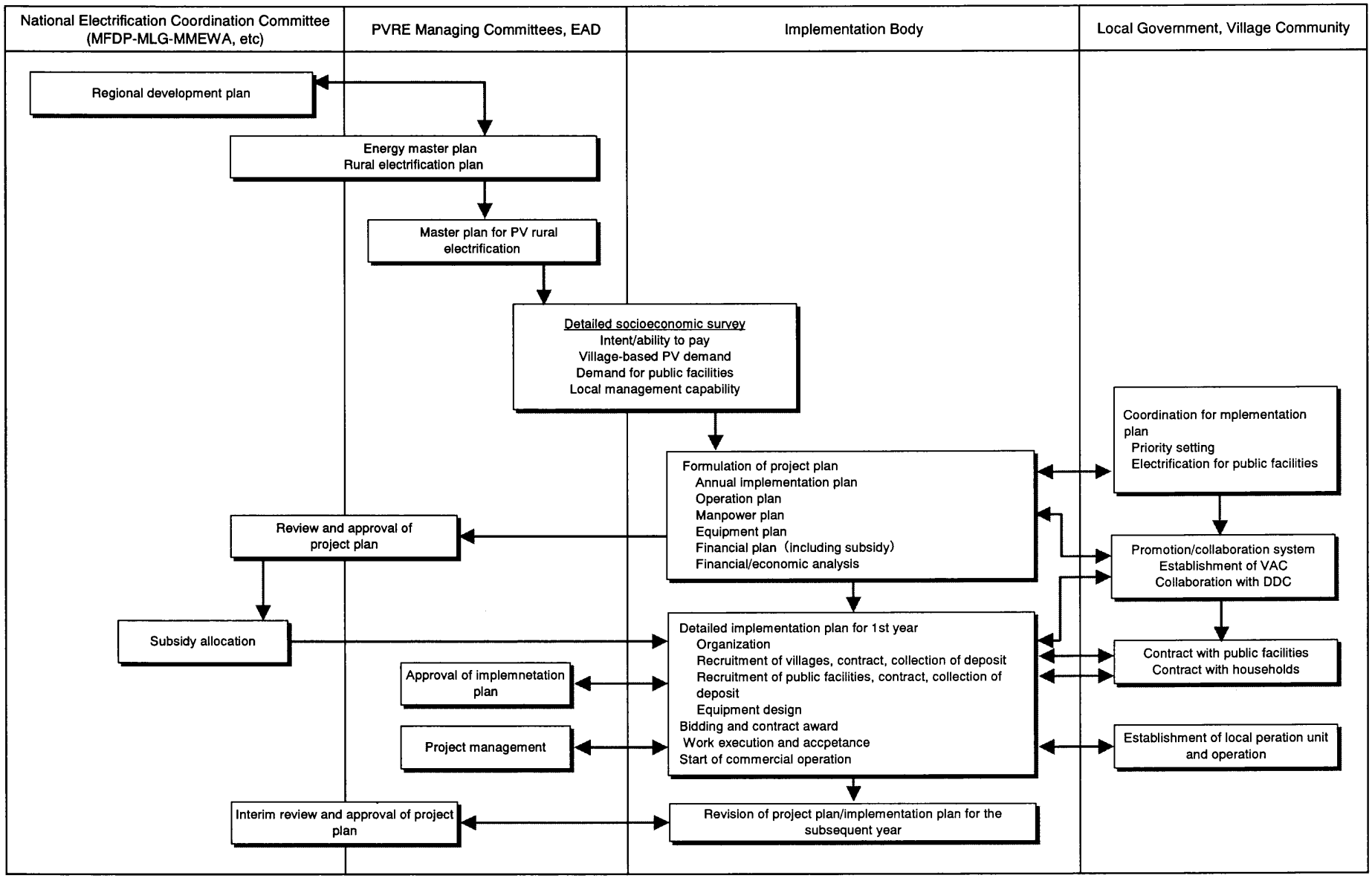


Figure 12.1-1 PV Rural Electrification Project Planning and Implementation Procedures

12.2 Implementation Schedule

The preliminary implementation schedule for the PV rural electrification project is shown in Figure 12.2-1.

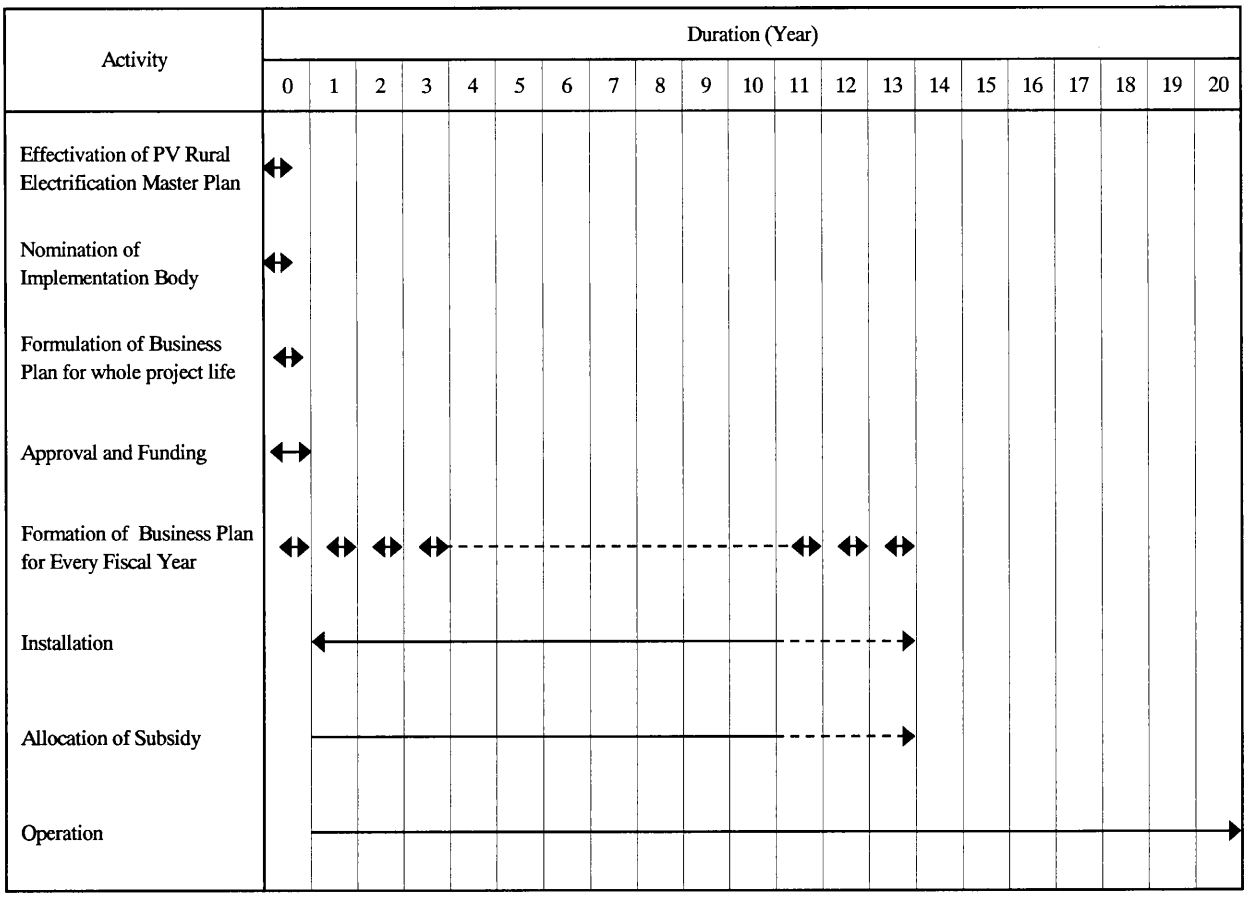


Figure 12.2-1 Implementation Schedule for the PV Rural Electrification Project