

Chapter 3 Goals and Objectives of PV Rural Electrification Master Plan

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The Government of Botswana has established its development vision and strategy toward 2016 (50th anniversary), entitled “Long Term Vision 2016 and Strategy for Next 20 Years (Vision 2016).” Also, it has been formulating and implementing series of National Development Plans, with the eighth plan (NDP8) being underway until the end of March 2003. The PV rural electrification master plan should be formulated and implemented as an extension of the above national policies, particularly regional development policy and national energy policy. The goals and objectives for PV rural electrification are discussed in relation to the Vision 2016 and NDP8.

The terminology herein used is as follows:

- * The term “goal” is used in the sense of the end toward which effort is directed - the terminal point.
- * The term “objectives” is used in the sense of steps toward the goal, - i.e., sub-goals.

3.1 Role of PV Electrification

Botswana has been rapidly expanding grid electrification which already serves 195 (having total 191,800 households) out of 462 villages (having 228,500 households), and 267 villages (having 36,700 households) remains unserved in the end of 2001.

In addition to villages, there are large number of small settlements called localities. As of 2001, there are approximately 5,660 localities, with 282,000 population and 63,000 households.

As grid electrification progresses further under NDP9, additional 10 to 15 villages per year will be electrified in the next ten years. However, most of remaining villages/localities will not be able to benefit from grid electrification in the near future.

To achieve the national policy to promote social equality, PV electrification is considered to be a feasible solution alternative to grid electrification for the following reasons.

- 1) The cost for grid extension to most of the localities and remaining villages is much higher due to a long distance from the existing grid and a low density of electricity users.
- 2) Thus, off-grid electrification shows a clear cost advantage over grid electrification.
- 3) Among various off-grid electrification methods, PV electrification offers major advantages, i.e., use of environmental friendly technology and low costs in the long run.

In overall consideration of relevant factors, PV electrification is considered to be the most effective means to improve social equality at the minimum cost to the national economy.

As the PV rural electrification progresses, total number of households in the villages/localities where grid and PV electrification are served, will be 307,800 in 2012. The number will be 84.5% of total households in villages/localities in Botswana, where PV contributes 8.7% and grid contributes 75.8% (Refer to Table 7.6-1 of Chapter 7).

3.2 Goals for PV Rural Electrification Master Plan

In consideration of national policies in context with energy policy and rural development, described in Chapter 2, the PV rural electrification master plan should pursue the following key goals and sub-goals. Refer to Figure 3.3-1

Goal - 1 PV rural electrification should be implemented as part of efforts to improve social equity

Electricity is a fundamental energy service required for long-term development of the country's society and economy and its supply constitutes a critical element of improving social equity. The PV rural electrification project is therefore highly desirable to meet such demand. However, it cannot be financially viable on a commercial basis as judged from the current conditions of rural areas in the country (e.g., household income and purchasing power). Sustainable supply of electricity using the PV system is not feasible without government support.

Goal -2 PV rural electrification should contribute to local economic development

The PV rural electrification project alone can make moderate contribution to economic development in rural regions. Its effectiveness can be maximized in combination with development of other infrastructure facilities that are not available in most rural areas. The synergetic effect of PV rural electrification and infrastructure projects will stimulate local economies, which growth will then increase income of local people and make the PV project viable and sustainable in the long run.

3.3 Objectives for PV Rural Electrification Master Plan

In order to accomplish the goals, 4 objectives are set forth.

Objective-1 : To supply solar electricity, quickly and under affordable conditions, to households in rural areas that cannot benefit from grid electrification and other energy supply services

Objective-2 : To implement the PV rural electrification project at the least practicable cost and in a financially feasible and sustainable manner

Objective-3 : Integration with infrastructure projects required for a specific region or area

Objective-4 : Expansion of environmentally friendly energy use

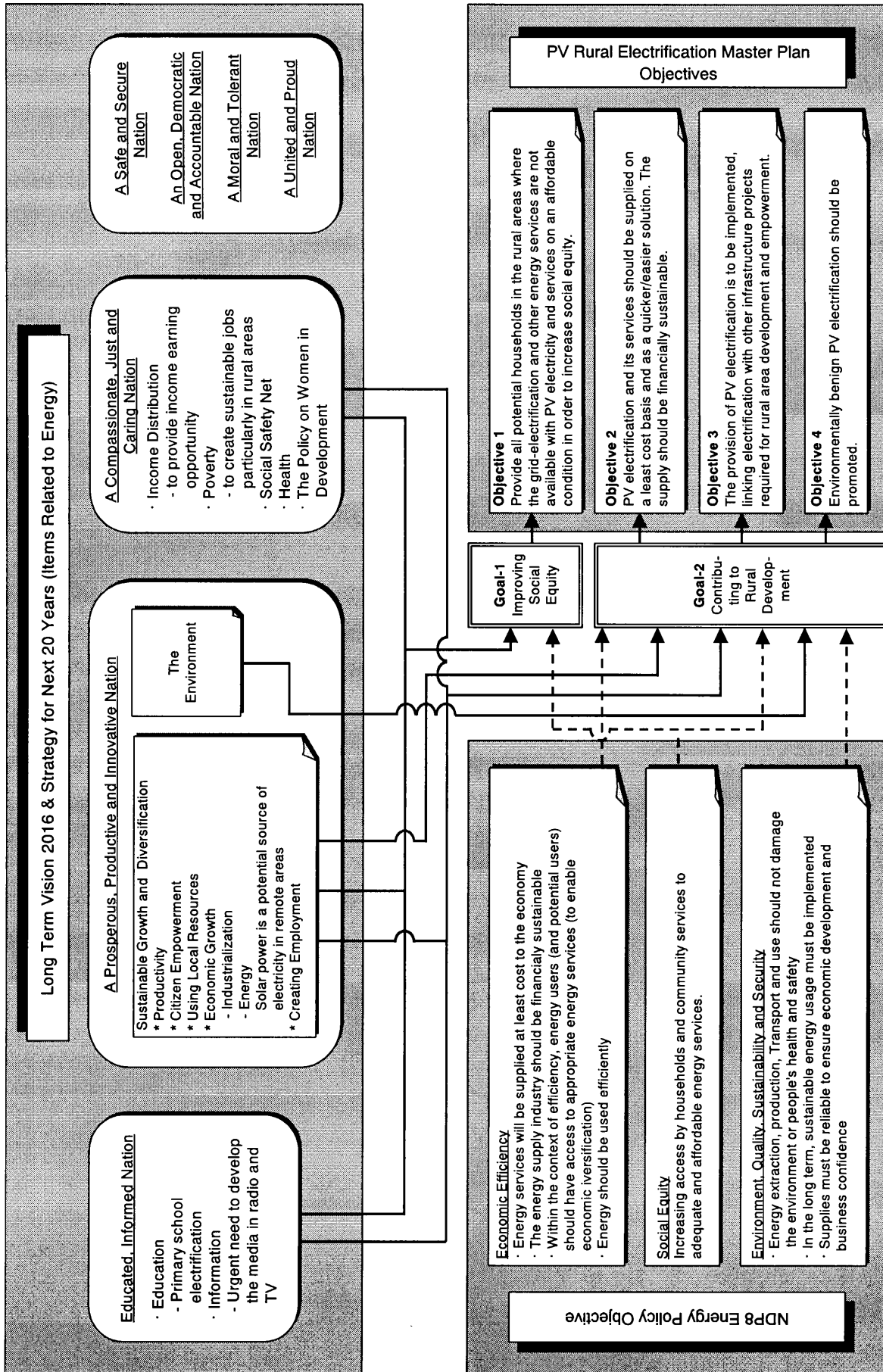


Figure 3.3-1 Objectives of PV Rural Electrification Master Plan

Chapter 4 Development Process for the Master Plan for PV Rural Electrification

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The formal process to develop the Master Plan for PV Rural Electrification is illustrated in Figure 4.1-1.

The Master Plan is intended to be used directly as the basis of developing a business plan of the PV rural electrification project that is readily executable. Essentially, the Master Plan analyzes various problems that were encountered in PV projects that had been conducted in the country, and on the basis of the lessons learned therefrom, it recommends, among other things, a new institutional homework to promote PV rural electrification, an optimal PV electrification system, and project operation and management methodology. It has also established selection criteria for villages to be covered by the PV electrification project in order to ensure that the selection is made on the basis of the minimum cost principle. The key planning parameters, such as the target electrification rate and the user charge system, are established by taking into account the results of the socioeconomic surveys of the selected (ten) villages as well as the results of the Dissemination Project conducted in the three villages – designed to check effectiveness of the programs recommended in the Master Plan. Finally, a preliminary business plan of the PV rural electrification project is formulated to incorporate all the necessary elements and its feasibility is evaluated through the financial and economic analyses. Then, necessary government support is identified to allow the project to be operated on a sustainable basis.

Validity of the parameters and other planning elements has been examined through the Dissemination Project which operation was thoroughly monitored by the study team, and the results are reflected in the Master Plan.

It is therefore important to follow the planning process when the Master Plan is implemented and reviewed in the future.

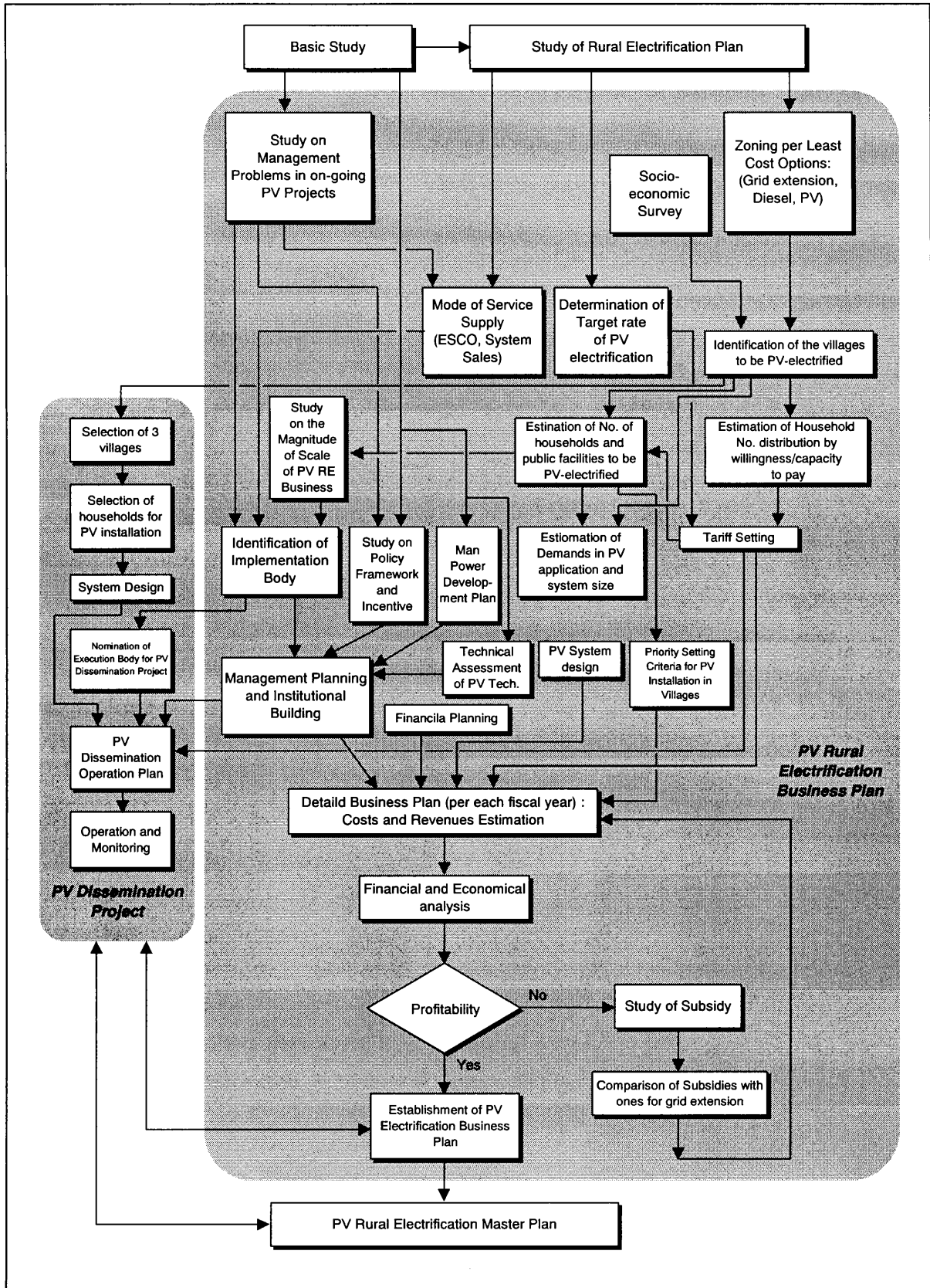


Figure 4.1-1 Process of PV Rural Electrification Master Plan Study

Chapter 5 Institutional Framework for Promotion of PV Rural Electrification

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5.1 Present Division of Authority and Responsibility Among Administrative Entities

As outlined in Chapter 2, the past and ongoing PV electrification projects implemented in the country have been involving a number of government agencies and departments, as shown in Figure 5.1-1. However, the initiatives have been taken without a general framework to maximize their overall effectiveness.

As pointed out in Chapter 3, a PV rural electrification project has a limited impact on economic development in a region, which lacks basic infrastructures. The PV electrification project must therefore be combined with such infrastructure projects if it is to produce effective results. Regional economic development is also needed to increase personal income and thus make the PV electrification service affordable, thereby helping the project to become commercially viable on a sustainable basis.

In this conjunction, Botswana Energy Master Plan (June 1996) proposed policy objectives to introduce the PV system in the country in an orderly way with adequate coordination with related government and other organizations, institutional and financial support, and the establishment of financing and technical standards. For the policy measure, it proposed to include PV electrification in the national electrification planning process and to entrust responsibility for rural electrification to a competent organization.

According to the proposed policy, EAD has been promoting several PV dissemination projects as mentioned in Section 2.2.5. However no national electrification plan has been formulated and a general framework to ensure coordinated efforts with regional development initiatives has still to be fully established.

Concerning the responsibility for PV rural electrification, Energy Master Plan suggests that responsibility for PV electrification needs to be centrally located if it is to address the national needs optimally and be integrated effectively with the national electrification program. BPC is the most appropriate organization for this undertaking, as they have planning, technical, infrastructure and financial capabilities required to

accomplish it, and will be implementing the national electrification program of which PV forms an integral part.

However, after the Master Plan was drafted, RIIC undertook National PV-Rural Electrification Program (NPV-REP) as the Implementation Body. BPC is now devoting its effort to grid electrification. Refer to Appendix 5, Section 5.1 on details of present division of authority and responsibility among administrative entities.

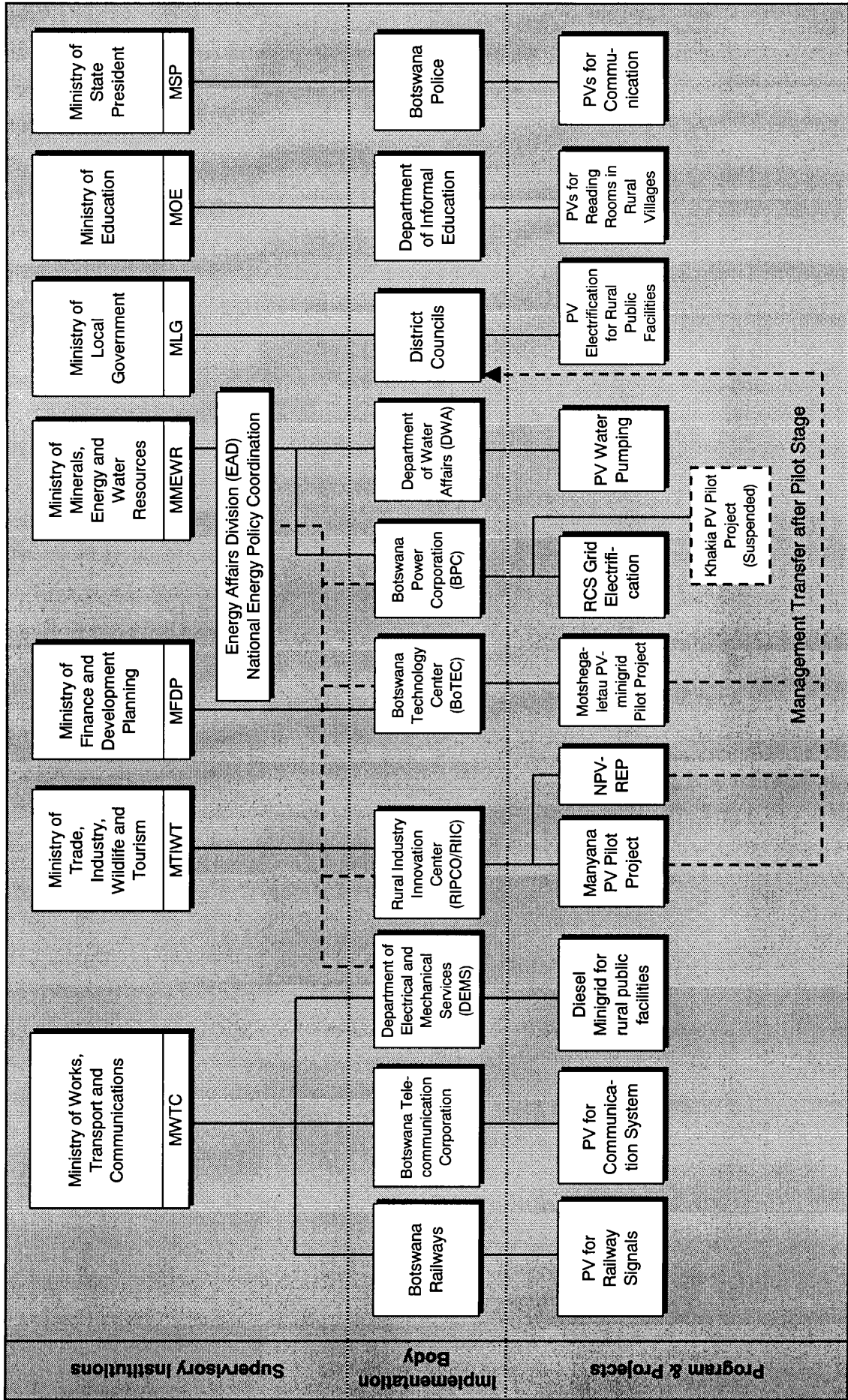


Figure 5.1-1 Organizational Structure of the Rural Electrification Frame Work

5.2 Establishment of the New Institutional Framework for Implementation of PV Rural Electrification

5.2.1 Management Lessons Learned from Ongoing PV Projects in Botswana and Other Countries

Lessons learned from PV Projects in Botswana and other countries are useful and suggestive to formulate the plan of institutional framework for PV dissemination in Botswana. Refer to Appendix 2.3.2 and Appendix Document 2.3-1 and 2.3-3. The followings are the discussion on application of such lessons for Botswana.

(1) Centralization or Decentralization of PV Projects Management

Botswana Energy Master Plan (1996) proposes that responsibility for PV electrification needs to be centralized if it is to address national needs optimally and be integrated effectively with national electrification program. Ongoing PV projects have been promoted by EAD and its implementations have been undertaken by RIIC and BoTeC which are centrally organized and therefore, the management has been centralized. PV projects in most of developing countries have been promoted by central governments or national utilities.

On the other hand, it is also pointed out in the evaluation of the ongoing national PV project in Botswana, NPV-REP, that PV systems scattered all over the country make it difficult to respond to system troubles or customer needs adequately and dissemination in collaboration with local communities has not been sufficiently established.

PV electrification, especially of SHSs, is in its nature to be expanded and maintained in a geographically sporadic manner, as opposed to grid extension that forms continuous patterns.

Therefore, it is clear that centralized management of PV systems in such sparsely located villages in Botswana becomes very difficult and uneconomical.

In many PV projects in the world, actual implementing organizations are locally based.

From such lessons, the planning and overall management should be centralized, while actual implementation should be decentralized.

(2) Private Entity or Governmental Organization

World Bank puts stress on supporting the sustainable commercialization of PV based energy services by private companies. Many reports points out that the entire SHS program should be executed with significant private sector participation and as little reliance on government involvement including subsidies as possible.

However, in case of Botswana, pre-conditions for launching PV programs and business on a commercial basis are not satisfied and the private sector has not been well developed and their creditability is still very low. It will be difficult to promote PV rural electrification without government involvement including allocation of appropriate subsidies. However, private sector participation can be made in its equipment supply, installation and maintenance services. Participating such activities, private sector in Botswana will increase their capacities and then, they will be able to undertake such concession approaches as implemented in South Africa, Argentina, etc. or BOT (Build, Operate and Transfer) and BOM (Build, Operate and Maintain) approach, etc.

(3) Electricity Utility or Other Organization

It will be better to contract with a utility which has planning, technical, infrastructural and financial capabilities to undertake PV rural electrification. However, PV electrification, especially SHS does not require high level of professional technologies and technicians for this can be trained on short-term training basis.

Besides technology, the organization should have financial and operational management capabilities.

Looking at cases in other countries, many PV rural electrification projects are implemented by local cooperatives, local governments other than utilities.

Electricity utility has service stations and depots in rural areas. It is necessary for the Implementation Body to be able to facilitate such facilities. Profitability of PV rural electrification is very poor, due to a low level of revenues because many rural households cannot afford to pay electricity charges. Therefore, such facilities and cost of operations should be cost-minimized. Existing facilities and organization should be fully utilized. The Implementation Body should be the one that meets such requirement.

(4) Integration of PV Electrification with Local Development

Not only supplying light to the community, but also integrating it with the rural development plan will be important.

Such integrated approach will be necessary in rural areas of Botswana. The Implementation Body is preferably suitable to incorporate such comprehensive activities.

5.2.2 The Proposed Institutional Framework: Desirable Division of Responsibilities and Roles and Effective Alliance with Related Organizations

(1) Central National Electrification Coordination

As discussed in Chapter 3, it is necessary to integrate and optimize national electrification and national development plans. As part of its efforts, the National Electrification Coordinating Committee (NECC) is to be established. The main objective of the NECC is to advise Minister on the national electrification (NE) to reach the goal of targeted access and to integrate electrification with other development initiatives. In addition to the above mentioned, NECC will:

- consider all issues relevant to the legislation, funding, planning, monitoring and evaluation of sustainable, integrated NE, aimed at the targeted access to a basic, affordable electricity service;
- facilitate the integration of grid and non-grid electrification with other infrastructure development activities
- investigate and make recommendation on the allocation of institutional responsibilities to implement and manage the electrification program.

Members will be represented by MMEWR-EAD (chair), MFDP, MLG, all related Ministries such as MLHE, MTIWT, MOE and MOA, BPC, DEMS, RIIC, BoTeC, representatives of users and NGOs.

(2) Central Management of PV Rural Electrification Projects

As mentioned in Section 5.2.1, PV project management should be centrally controlled. The Management Committee of PV Rural Electrification should be established under EAD's chairmanship. The Committee should preferably be composed of EAD, MFDP, MLG, BPC, RIIC, and BoTeC, representatives of users and NGOs and will be responsible for:

- approval of project plans
- monitoring and audit on project implementation
- technical and management support for the implementation body

The committee will be represented by the following organizations, each of which will assume the following role.

1) EAD

It is responsible for development of a basic plan for PV electrification and project formation, while issuing necessary direction and policy guidance to the Implementation Body.

2) MFDP

MFDP examines the business plan as to its consistency with the National Development Plan, approve the project budget, and audit its financial management.

3) MLG

It is responsible for coordination with District Councils and village authorities in relation to the Implementation Body's PV promotion activities in the selected villages, in order to ensure that promotion activities are carried out smoothly in each community. It also coordinates priority setting in consideration to the ongoing regional development plans.

4) BPC

BPC ensures coordination of the project with rural electrification plan to extend the grid and provides technical support for the Implementation Body, including project management.

5) RIIC

RIIC provides technical support for the Implementation Body on the basis of its experience in PV-based rural electrification.

6) BoTeC

On the strength of its experience in PV rural electrification, it supports the Implementation Body in standardization of PV technology, training of technical staff, and promotion of private enterprises.

7) Representatives of Users and NGOs

As the representatives of demand sector, they will advise and review the planning and implementation.

5.2.3 Selection of the PV-based Rural Electrification Project Implementation Body

(1) Selection Criteria

In selecting an Implementation Body for the PV-based rural electrification project, the following criteria were established on the basis of basic requirements for the Implementation Body.

- a) The Implementation Body should be a government or public organization, provided that it cannot be the central government in consideration of the decentralization policy of the Botswana government.
- b) The Implementation Body should maintain close relationships, including a proper route of communication, with the central government (particularly EAD as the agency in charge of energy policy) and local communities.
- c) The Implementation Body should have the ability to manage the national project, i.e., the well-established organization, resources and experience in project management.
- d) The Implementation Body should have expertise and experience in rural electrification, especially PV-based electrification, provided that technology required for SHS electrification should not be as high as that used for grid operation and management.
- e) The Implementation Body should require minimum levels of organizational reform and new investment to achieve its objective.
- f) The Implementation Body should actively use and promote the private sector for sustainable growth of PV-based electrification and have successful experience in cooperation with the private sector.
- g) The Implementation Body should have the ability to integrate PV-based rural electrification with development of local communities.

- h) The Implementation Body should be firmly committed to implementation of the PV-based rural electrification project.

Under the above selection criteria, the study team selected five candidate organizations (BPC, RIIC, BoTeC, DEMS and MLG/District Councils) for review and evaluation. EAD was excluded because it was responsible for promotion and coordination of the PV-based rural electrification project. Also excluded are new organizations that are to be established for the project in consideration of minimum cost requirements.

5.2.4 Evaluation of the Candidate Organizations

Based on the above criteria, the study team evaluated the candidate organizations.

- (1) MLG/district councils were a primary candidate because the project would benefit their own communities and they are expected to actively promote it, albeit low levels of feasibility. Nevertheless, they should be disqualified for the following reasons.

- a) While MLG and district councils maintain close communication, it is not warranted that district councils can establish effective communication with EAD that is responsible for planning and promotion of energy-related projects. Also, district councils and district administrations are highly bureaucratic organizations and spend fairly long time for decision-making.
- b) District councils are said to be reluctant to collection of electricity charges from local residents, accompanied by law enforcement including punishment. They cannot be expected to manage the project in a fair and objective manner.

- (2) RIIC was the secondary candidate because of its long experience in PV rural electrification.

Nevertheless, RIIC is disqualified for the following reasons.

- a) RIIC has a degree of capability of collecting repayment of finance that had been provided to the end-users in NPV-REP.

- b) It was found that when localities are included RIIC does not have the manpower and managerial capabilities to sustain enlarged PV electrification projects.
- c) RIIC/RIPCO reports to a Ministry of Communications, Science and Technology (MCST) other than MMEWR (EAD). This situation makes control and delegation of power by EAD difficult. If problems occur it will be difficult to take remedial action quickly and efficiently.
- d) RIIC is involved in implementation of NPV-REP, which has had problems in the initial phase. Audit results indicate that the existing managerial system is not suitable for large-scale PV projects.

(3) Recommendation

The study team recommends BPC as the most suitable Implementation Body for the PV-based rural electrification project for the following reasons.

- a) BPC was originally mandated to grid construction and management. EAD has a mandate to carry out PV rural electrification, and EAD thus makes it possible for BPC to promote PV rural electrification, since BPC is under direct control of MMEWR (EAD).
- b) BPC is fully capable of undertaking PV rural electrification on the strength of its infrastructure in rural areas.
- c) On the other hand, BPC is highly centralized in its approach to rural electrification. Its top-down approach can and probably will cause problems when it is applied to the projects in the rural villages and localities. Instead, BPC should take a bottom-up approach using the existing rural organizations or their ways of doing things. BPC is willing to take the approach.
- d) BPC shows a strong intention to drive PV rural electrification, due to the fact that some of the remaining un-electrified villages and the localities will not be connected to the grid in future, making the planned effort economically viable.

5.2.5 Alliance with Related Organizations

(1) Alliance with District Institutions

The PV project should be implemented for a village or a locality as the minimum unit of service coverage. In the selection process, candidate villages should be rated according to priority in consultation with the District Council. Also, PV electrification of public facilities in villages, which has been promoted by the District Council, should be transferred to the Implementation Body, and the budget should be allocated to ensure its active promotion.

Also, full consideration should be given to local development plans made by the District Development Committee and the Village Development Committee, and efforts should be made to develop application of PV systems not only for SHS but also for water pumping, street lights and so on.

As for education and training of maintenance personnel, budget allocation should be made to train field maintenance staff by sharing resources with Brigades or other facilities managed by the District Council.

(2) Encouragement of the PV Electrification Related Industries

To promote supply and installation of PV equipment and systems throughout the country, it is important to develop the industrial base that can meet the needs for system supply, installation and servicing in the commercially competitive manner. At present, existing contractors in the country are not capable of serving rural regions, including the organization and technical capability to provide after-sales service, not to mention qualified personnel.

In addition, the market should be developed to supply and service consumer electrical appliances at reasonable costs, such as lamps, radios and TVs, which demand will grow rapidly with PV electrification. Availability of such products and services will further promote the installation of PV systems.

(3) Involvement of NGOs and Other Organizations

NGOs have played important roles in assisting villagers in various infrastructure projects and village empowerment in various countries (Refer to Appendix Document 2.3-3).

The better management of the PV project in a village maximizing community involvement will be attainable in collaboration with NGO's grass roots activity. NGO's participation in PV rural electrification is recommended.

Refer to Appendix 5 for the detailed studies on the subjects related to Chapter 5.