

**PROPOSAL FOR REVIEW
GLOBAL ENVIRONMENT FACILITY**

PROJECT TITLE: RENEWABLE ENERGY-BASED RURAL ELECTRIFICATION UNDER THE POPULAR PARTICIPATION LAW

GEF FOCAL AREA: Climate Change

COUNTRY ELIGIBILITY: Bolivia deposited its ratification instrument on 25 July 1994

TOTAL PROJECT COSTS: US\$8,501,969

GEF FINANCING: US\$4,445,719 GEF Grand Total
- (US\$234,000) PDF B
US\$4,211,719 Total Project Budget

COUNTERPART FINANCING: US\$1,390,800 (Popular Participation Law)
US\$250,000 Government of Bolivia(in-kind)

CO-FINANCING/PARALLEL FINANCING:

UNDP CO-FINANCING:	US\$100,000
USER CONTRIBUTIONS:	US\$711,700
PRIVATE SECTOR FINANCIAL CONTRIBUTION:	US\$603,750
OTHER FINANCES BEING SOUGHT:	US\$1,000,000

GEF IMPLEMENTING AGENCY: UNDP

LOCAL GOVERNMENT AGENCY: Ministry of Economic Development,
National Secretariat of Energy; Rural Electrification
Implementation Group

ESTIMATED STARTING DATE: October 1, 1997

PROJECT DURATION: 4 years

GEF PREPARATION COSTS: US\$ 234,000 PDF B



PROJECT DURATION
STARTED DATE

October 1, 1997

Implementation

National Secretariat of Energy, Rural
Ministry of Economic Development

UNDP AGENCY

OTHER FINANCES
BEING SOUGHT

CONTRIBUTION
PRIVATE SECTOR FINANCIAL

USER CONTRIBUTION
LOCAL CO-FINANCING

CO-FINANCING PARALLEL FINANCING

TERMINAL FINANCING

FINANCING

PROJECT CODE

COUNTRY ELIGIBILITY

GEF FOCAL AREA

PROJECT TITLE

RENEWABLE ENERGY

FOR THE PEOPLE

ROBENT FACILITY

PROPOSAL FOR REVIEW

Attachment on

before decision
15 July 1997

1,909

US\$2,442,719 - GEF Grant Total
US\$2,511,719 - Total Project Budget
(US\$284,000) - PDB B

US\$1,390,800 (Popular Participation Fund)
US\$250,000 (Government of Bolivia-kind)

US\$100
US\$211



I. COUNTRY/SECTOR BACKGROUND/CONTEXT

A. Country Background

1. Bolivia is a landlocked republic located between 9° and 23° south latitude, and between 57° and 70° west longitude. The country borders on Chile and Peru to the west, Argentina and Paraguay to the South, and Brazil to the north and east. The total land area of the country is 1,098,581 square kilometers, about equal to the combined size of France and Spain. Geographically, Bolivia is comprised of three distinct climate regions: the lowland plains, the valleys and the highlands or *altiplano*. The lowland plains are found in the eastern region of the country at altitudes less than 5000 m above sea level. This region is under the influence of the Amazon and Pilcomayo River basins, and registers an average temperature of 25°C. The high valleys are located in a band running through the center of the country forming a temperate zone with altitudes varying between 1,000 and 3,000 meters above sea level. The average temperature in the region is 15°C. The *altiplano* (high plateau) is located in the western part of the country at an average altitude of 3,500 meters above sea level. The average temperature is 10°C.

2. According to the National Institute of Statistics, the population of Bolivia was about 6.4 million in 1992 and grew at about a 2.1 percent annual rate between 1976 and 1990. Approximately 51 percent of the population live in the *altiplano*, 32 percent in the high valleys and only 17 percent in the lowlands. This results in a much higher population density in the high valleys and *altiplano*, the areas with the least resources. In 1992, the per capita income in Bolivia was barely US\$800 per annum, among the lowest in Latin America. In the same year, it was estimated that almost 85 percent of the Bolivian population had attended one or more years of school. Approximately 42 percent of the population of Bolivia reside outside of the urban centers. The socioeconomic situation of these rural dwellers is clearly worse than that of their urban counterparts. For example, the per capita income in the urban sector was around Bs. 1,961 in the year 1992, while that for the rural area was about Bs. 1,510. Another indicator of the difference is seen in the poverty index of 52.6 percent in urban areas of Bolivia, compared with 95.1 percent in the rural sector. Only about 25 percent of the rural population has access to electricity (versus 95% of the urban sector).

B. The New Structure of the Government

3. During the past decade, the administrative and functional structure of the government of Bolivia has changed dramatically away from a centralized model--wherein the State served as a provider of goods and services-- toward a more decentralized model-- where the State exists to create an environment where market mechanisms provide goods and services through private and mixed public-private enterprises. These changes have been brought about as a reflection of the desire and commitment of the political forces to create an atmosphere within which the nation can progress economically and socially. One of the first actions taken during this period of change was Executive Decree No. 23660 of October 1993 which provided for the Reorganization of the Executive Branch and created a new order of ministerial functions

including the Ministry of Sustainable Development and Environment. This was one of the first times a government had given this level of attention to the environment and sustainable development. A second action taken was the passing of the Capitalization Law (*Ley de Capitalización, No.1544*), on March 21, 1994, authorizing the executive branch of the government to provide assets and rights of public sector enterprises in exchange for the capital paid in the constitution of new mixed (public-private sector) companies. The entities capitalized under this law were the national petroleum company (YPF-B), the national electric company (ENDE), the national telecommunications company (ENTEL), the national railway company (ENFE) and the Vinto Metalurgy Company (EMV). Other legal reforms were applied to the electrical industry sector, the agrarian sector, and the education sector.

4. In the context of this programme, possibly the most important reform resulted in the passage of the Popular Participation Law (No. 1551, signed on April 20, 1994). Under this law, 20 percent of national government revenues are channeled to municipal governments for their exclusive use. These funds are disbursed into bank accounts opened by each municipality or groups of municipalities with 5000 or fewer inhabitants. For the year 1995, the first year for which this law was binding, over \$20 per inhabitant was transferred out to the participating municipalities. Municipalities have now begun identifying priority projects which can be initiated with these new sources of funding, rather than waiting for the national government to take action. This law is seen as an important way for communities to garner resources to meet their development objectives.

C. Environmental Concerns

5. Over the past few years, Bolivia has taken significant steps related to sustainable development and environmental protection. Foremost among these is the passing of the Environmental Law (*Ley de Medio Ambiente*) Number 1333, in April of 1992. This Law established guidelines for the Environmental Impact Evaluation as a fundamental instrument in project feasibility analysis. Additionally, it provides for the protection of the environment and the conservation of the country's natural resources by establishing guidelines for the relationship between man and nature, and promoting sustainable development. The goal is to improve the quality of life of the population, satisfying the needs of the present generation without jeopardizing the ability to satisfy the needs of future generations.

D. Energy and Electric Power Sectors

6. Bolivia has a rich endowment of energy resources. These energy resources include traditional fuels (fuelwood, bagasse and animal waste), hydroelectric power (potential estimated to be in the range of 18,000 MW, of which only some 300 MW has been exploited), and fossil fuels (reserves estimated at about 24 mtoe of oil and 3.8 tcf of gas). Both solar and wind resources are abundant.

7. The electric power sector currently consists of approximately 785 MW of installed capacity. Power generation currently is divided between hydroelectric facilities (300 MW or 38%) and

thermal (486 MW or 62%), the latter being supplied by a combination of gas turbines and diesel engines. However, the very large land area of the country, the mountainous terrain and the highly dispersed population, create many physical problems and very high costs for the distribution system. As a result, only 25 percent of the rural population currently has access to electricity.

8. The primary entities authorized to develop and operate power generating and transmission facilities are the recently "capitalized" companies Guaracachi SAM (*Sociedad Anonima Mixta*), Valle Hermosa SAM, Corani SAM (with combined installed capacities of nearly 500 MW) and COBEE (with an installed capacity in the neighborhood of 140 MW). The mandate of these companies is to assure the supply of electric power to all distribution companies and to some of the large mining and industrial consumers. The annual growth rate of installed capacity is only about 4 per cent. There are nine principal electric distribution companies in Bolivia. The exploitation of country's large hydro resources remains relatively expensive, with the result that gas is the least-cost solution for expansion in the medium term. Diesel generators are the primary power source for isolated systems. These isolated systems and small, autonomous production plants account for nearly one-fourth of the total installed capacity and represent about 15 percent of the total electricity production in the country.

9. The new legal and political framework of the energy sector is characterized by the deregulation of the energy pricing mechanism; the capitalization of the national electricity company (ENDE) and the national petroleum company (YPFB); competition in the generation and transmission of electricity; and the development of a new electricity law under which electricity supply is the responsibility of mixed public-private corporations.

E. Rural Electrification

10. Grid extension is still the most common means of rural electrification for those areas within the reach of the national grid. For many rural communities, this remains the most economical option. However, given Bolivia's rugged terrain and decentralized population distribution, much of the country is too decentralized to be economically connected to the grid.

11. In Bolivia, power generation for decentralized, small communities traditionally has been undertaken through the use of small diesel generators. These systems are normally inexpensive to acquire and install. However, the cost of operation and maintenance tends to be much higher than that of systems which employ renewable energy sources. Even with the past practice of subsidizing the cost of diesel, transportation costs for bringing the fuel to the decentralized generators have made electricity costs high and the supply situation erratic. With the deregulation of the price of diesel, the provision of diesel fuel to these remote areas will become even more expensive.

12. Although the government of Bolivia has a solid commitment to rural electrification, a number of barriers appear to prevent the Government from achieving its stated goal of 78% rural electrification by the year 2001. Complete rural electrification has been estimated to require

more than US\$ 1 billion (one thousand million) over the next 30 years. At the national level, there is and will continue to be a clear need for greater financial resources to be mobilized for rural development in general, and rural electricity provision, in particular. Such an enormous quantity of resources can only be made available for rural electrification if the private sector can be mobilized to support rural electrification in addition to the flow of resources already available from the public sector.

13. Another way to demonstrate the magnitude of the need for additional help in financing rural electrification is to examine the projects put forward for implementation by local communities for financing by departmental governments or under the popular participation law. For this year, over three hundred rural electrification projects were identified. Although most of these projects involve either grid extension or small diesel or natural gas-based generation, some of them involve rural electrification *via* renewables. Of the US\$65 million identified as being necessary for implementing these projects, only about US\$ 15 million is available. Thus, at the present moment, a large number of rural electrification projects are not being implemented for lack of financing. There appears to be a significant "pent-up" demand for electricity in rural areas brought about by limited capital flows to rural areas and limited financing alternatives to harness that willingness to pay through time.

F. Technical Basis for Assistance

14. This project has been prepared using PDF resources on the basis of past projects and experiences with renewable-based rural electrification in Bolivia. A large number of renewable-based rural electrification projects have been undertaken in the past, and many lessons have been learned from these projects. The Government of Spain sponsored a rural photovoltaic demonstration project in the late 1980's. Not only did this project demonstrate the viability of PV's for electrification in Bolivia, it also showed that if properly trained, rural people can maintain PV systems and keep them in operation for a long time. Many of these systems are still in operation today and have not even needed new batteries. The GTZ-sponsored PROPER project has assisted in providing information on renewable energy systems throughout Bolivia. Much of the awareness of and familiarity with renewable energy systems found throughout Bolivia can be traced to this project. US AID, through the National Rural Electrification Cooperative (NRECA), has sponsored a large number of renewable-based demonstration projects over the past decade. These demonstrations have successfully shown that small hydro, biomass, and sunlight can serve as the basis for successful electrification. The Netherlands Ministry of Foreign Assistance has also sponsored a PV project in the Department of Santa Cruz. This project, which promotes PV-based electrification through the rurally-based cooperative, Cooperativa Rural de Electrificación (CRE), has moved from a programme subsidizing the installation of 1000 PV systems to a programme seeking to install 5000 PV systems through private-sector channels. It has demonstrated that the forces of the private sector can be directed toward renewable-based rural electrification if given sufficient incentives.

15. Despite these past initiatives, it is clear that greater effort needs to be directed toward rural electrification if the ambitious goals of the country are to be achieved. The goal of the national

programme being initiated through this GEF project is to remove the barriers which have been identified as preventing the replication of renewable electrification. The PDF activities undertaken to prepare this project have identified five barriers which need to be overcome to enable rural Bolivians to utilize the resources at their disposal to electrify rural areas using renewable energy sources. The project is designed to remove these barriers and test a financing mechanism which, it is hoped, will enable many more households and communities throughout rural Bolivia to achieve their electrification objectives on a sustainable and renewable basis. The effectiveness of these barriers can be seen in the fact that fewer than 2000 photovoltaic systems (about 50 We each or 100 kW total) and one small hydro system are sold commercially in Bolivia each year. The purpose of this programme is to remove the identified barriers to enable the market to grow beyond its current nascent stage.

16. The PDF activities undertaken to prepare this project have identified five barriers to the sustainable financing of rural electrification through renewable energy technologies. These barriers have been identified by a process involving both a careful analysis of the Bolivian situation and a consultative process involving the effected rural communities. The barriers identified are listed below.

Institutional Barrier: For a rural community wishing to electrify through renewable (or non-renewable means), the best form of organization in order to guarantee financing and ensure adequate maintenance over time is not clear. The new electricity law indicates that only public-private mixed enterprises (SAM's) can generate electricity in quantities over 300 kW. However, for many rural villages wishing to electrify, their small size would dictate that such enterprises may not yet be financially viable. And yet, some form of profit-making enterprise is necessary to obtain the requisite financing, ensure long-term system maintenance, and qualify for the resources available under the Popular Participation Law. Once identified and established, these institutions will have to be made familiar with the process of renewable energy system procurement, operation, and maintenance.

Finance-Institutional Barrier: Bolivia's finance institutions have been inactive in financing rural electrification. Although a number of reasons can be advanced for this limited activity, it is clear that national goals for electrification can be achieved only if this situation is changed, allowing private and public-sector financial resources to be directed toward renewable rural electrification. Banking practices restrict financing to companies with a significant credit history; a large, existing capital base; and a limited set of known investment types. High interest rates (18-24%), short payback periods (3-4 years) and unnecessarily strict collateral requirements (200% guarantees) are all deterrents to bank financing of this type of project. Financial institutions have little or no familiarity with the technical and economic performance of renewable energy systems and will require considerable technical assistance, capacity-building and some capitalization if they are going to become involved in financing projects of this kind. Even "second-story" financial entities (that is, a financial organization or non-governmental organization that operates particularly as a financial intermediary for micro-finance in the

rural areas) are unwilling or unable to make loans of this kind. Technical support is needed to enable the financial sector to evaluate and make loans for renewable rural electrification.

High Capital Cost or “First-Cost” Barrier: In many cases, renewable options for decentralized rural electrification are less expensive (on a discounted life-cycle basis) than are conventional options. However, the capital costs or initial costs of small-hydro systems, PV systems, and small wind generators are frequently higher than those of the more conventional alternatives. In such cases, particularly when dealing with poorer rural communities, the renewable option will not be chosen over the conventional option.

Given the complex of other barriers relating to institutions and finances (mentioned as barriers above), rural households will have little or no ability to pay the high capital or “first costs” associated with renewable energy installations. Financing is required to get over these “first-cost” barriers. Establishing a revolving fund will, in combination with the technical assistance to the financial sector, enable these activities to obtain financing and demonstrate their suitability for long-term commercial profitability.

Human Resource Limitations: Human resource limitations serve as a significant barrier to rural electrification with renewables in the rural areas. Although the population at large is familiar with renewable energy technologies, those who do not now receive their electricity from those systems have no idea how such systems operate, how they are built, what their maintenance requirements are, and what their likely costs are. In addition, they have no familiarity with mixed public-private enterprises and other likely institutional forms judged necessary to implement such projects. In addition, technicians and managers will have to be identified and trained to operate and maintain these renewable energy systems.

Technical Barriers: Previous demonstration projects have shown that renewable energy systems can operate soundly in Bolivia over extended periods of time. However, there are still no firm standards for PV installations, and there are no capabilities to verify that installations are made according to standards. As a result, some installations being made in Bolivia are being undertaken in an unprofessional manner. The result is that solar and small-wind installations get a bad reputation among the rural population, and they are unwilling to invest their money in such systems. Although the PDF activities sponsored to prepare this programme have helped push forward the process of developing standards, codes, and certification procedures, much still remains to be done

17. This overall program of rural electrification with renewable energy-based power sources, using the popular participation process, has been designed as an integrated set of activities which, taken as a whole, will address all of the identified barriers. Each of these barriers and the manner in which the project intends to attack it, is enumerated in the sections which follow. The PDF-supported activities have drawn on a wide range of experience and experts, both

nationally and internationally, in an effort to insure that the latest technology and methods are available to the rural communities targeted for inclusion in this pilot project.

II. PROJECT OBJECTIVES

18. The overall project objective is to remove barriers to the successful implementation of rural electrification projects using renewable energy technology. It is hoped that by focusing on the financial, institutional, technical and human resource barriers, a programme can be initiated which will be sustainable and replicable in other areas of the country. Because of the diversity found in rural Bolivia, the institutional uncertainties, and the innovative nature of the project, the experiences in each community will be carefully documented and evaluated in order to identify the best possible solutions to meet the goals of renewable rural electrification. In this way, it is hoped that this small project will pave the way for future, investment-scale projects.

19. The proposed project is intended to promote the widespread adoption of renewable energy in rural Bolivia by removing barriers to its replicable implementation. As such, it is consistent with the goals of GEF Programme 6. By itself, the renewable electrification of the villages identified for inclusion in this project will result in the avoidance of CO₂ emissions amounting to 21,100 tonnes over 20 years. Using the revolving fund to initiate an additional 44 projects over 25 years (for 69 projects total), will result in the avoidance of 34,090 tonnes CO₂. (If all rural Bolivians outside the economic reach of the grid were provided with electricity from the renewable sources, the potential total CO₂ savings comes to 664,950 tonnes CO₂ over 20 years.) The project will provide an effective model for the large-scale use of such renewable energy technologies, and if successful in stimulating replication throughout Bolivia, the actual quantity of greenhouse gas emissions avoided would be greatly increased.

III. PROJECT DESCRIPTION

20. During the implementation of the PDF activities for this project, a participatory process for rural electricity provision was identified and initiated. The strategic focus of the Government of Bolivia is on sustainable development, participation, and partnerships between the public and private sectors. As a result, the programme being initiated in this project seeks to test out a process whereby rural communities can develop an organization to obtain financing for their renewable electrification investments, procure the renewable energy services from private sector providers, oversee installation of those systems and contract for the maintenance of those systems. For this process to be sustainable, the households and communities must be satisfied with the electricity services provided while paying back the principal and interest to the relevant financial institutions.

21. From an initial list of over 100 rural communities interested in obtaining access to electricity from renewable sources, the PDF activities have identified 25 municipality-based projects where the use of renewable energy technologies to meet household, community, and productive demands is both economically and financially viable. The purpose of this project is to provide

technical assistance and incremental financing to enable these community-based projects to be implemented, thereby piloting or testing the identified process for sustainable renewable electrification. Given the complexity of the Bolivian rural sector, the number of technological options that will be required to electrify the rural villages (PV, small hydro, and small wind generators) and the institutional mix that is required to finance these initiatives on a sustainable basis, obtaining the track record, repayment history and experience from these 25 pilot projects will be important to test the concept and verify whether or not the approach identified is at all feasible.

22. As part of the PDF activities, the institutional, financial, "first-cost", human resource, and technical barriers to the implementation of renewable rural electrification were identified. Project activities were designed to eliminate those barriers and to provide the foundation for a long-term sustainable programme of renewable-based rural electrification. In carrying out the PDF, the team of consultants visited each local community to discuss their options with them, to carry out a pre-feasibility or feasibility study, and to confirm the willingness of the municipal authorities to allocate funds to each of the rural communities for rural electrification using the funds made available under the Popular Participation Law. For most installations, the funds available under the Popular Participation Law will account for nearly 20 percent of system capital costs. Within each individual project area, it has been assumed that about 60 percent of the village will have both the willingness to participate and the requisite down payment or user contribution. The user contribution amounts to about 10 percent of the system costs and is a pre-condition to participation in the programme.

23. Five project activities have been designed with the aim of removing the barriers to successful renewable rural electrification. In addition, one activity has been designed to ensure adequate management of the overall programme and detailed monitoring of project activities. These programmatic activities are summarized below:

Activity 1: Evaluation of Institutional Options for Implementing Renewable-Based Rural Electricity Companies. This activity, to be undertaken with the support of UNDP, will help identify potential rurally-based electrification companies to serve as the basis for procuring, financing, and maintaining renewable rural electrification systems. Although the electricity law specifies that mixed public-private corporations should be used for larger electricity installations, the lack of economies of scale may prevent such corporations from being economically established for smaller, rurally-based initiatives. This activity will examine existing best practices for mixed public-private enterprises, especially using successful experiences from the water-resource sector; identify options for harnessing public funds through the Popular Participation Law; and draft and formulate standard contracts and terms of association for each options identified. The goal is to be able to present to rural communities a number of institutional options through which rural, renewable energy-based electricity services can be provided. These may include NGO provision, direct private contract, and perhaps municipality-based options, all as a prelude to the eventual formation of larger mixed public-private corporations.

Activity 2: Removal of Barriers to the Efficient and Effective Operation of the Financial Sector for Renewable Energy-based Electrification Projects. The Bolivian financial sector still is organized in a manner which precludes it making loans to rural entities. This activity is designed to remove some of those barriers and help circumvent others. Under this activity, technical assistance will be provided: 1) to evaluate rules and procedures hindering the financing of renewable energy-based rural electrification projects; 2) to strengthen financial institutions interested in becoming involved in renewable rural electrification; 3) to evaluate the possibility that exists to lengthen amortization periods for renewable energy systems; and 4) to strengthen the coverage of financial entities working on renewable energy in rural areas. In addition, a small revolving fund will be established to help alleviate the high capital or "first-cost" barrier for the initial 25 pilot projects.

Activity 3: Training to Strengthen Local Electricity Companies. This activity seeks to overcome human resource limitations to the widespread dissemination of renewable energy-based rural electrification. In particular, training will be provided at four levels: all project participants will be trained in the rudiments of renewable electricity generation and use; potential members of the boards of directors of local electric companies will be trained in business operations; training will then be provided to skilled and semi-skilled workers to carry out functions within the electric utilities; and training will be provided to the managers of the firms or companies chosen to work with the renewable electricity sources.

Activity 4: Development and Installation of Pilot Renewable Energy Facilities: Although all selected communities were visited during the PDF activities, they have still not been re-visited to receive the results of the pre-feasibility studies; to be able to evaluate their options in a participatory manner; and to commit themselves and their resources to the project. In addition, the local electric companies, whatever their final institutional form, will need assistance in finalizing the financing of the projects, obtaining estimates of the costs of installing the facilities and verifying that they are installed in a competent manner. Under this activity, the project team will assist each community in finalizing the feasibility studies; evaluating the institutional, financial and economic options for project implementation; obtaining competitive quotes for system installation in accordance with the feasibility studies; utilizing their own resources and GEF incremental cost resources to pay for the installation of the systems; and establishing long-term maintenance contracts with private-sector providers. In the 25 communities which have begun participating in this programme, 16 of them are suitable only for PV-based electrification (two of these will include a small wind energy installations) and 9 of them are suitable locations for small hydro facilities.

Activity 5: Development of Standards and Certification Procedures: Although Bolivia does not now have national standards for photovoltaic or wind energy equipment, the Bolivian National Institution of Standards and Quality (IBNORCA) has begun

working on them in consultation with international experts. Under this project, technical assistance will be provided to ensure widespread participation in and review of the finalization of this process and to establish a certification programme for installers of rural renewable energy systems.

Activity 6: Project Management, Supervision, and Monitoring: This activity will ensure that SNE has adequate capabilities to supervise and monitor the projects. The monitoring component of the programme is particularly important as it will have to document the different institutional and technological choices made by the communities and keep track of the repayment record. This is essential to enable the financial sector to develop confidence in the creditworthiness of the technologies.

24. The chart in Annex 1 shows a diagram of the institutional arrangements and a possible arrangement for the flow of financial resources into project financing. The project activities will center on the local electricity company, although Activity 1 will identify in greater detail exactly what the options for that company may be. Community preference will also play a role in determining the final form of this institution. In this scheme, there is participation by the public sector in the placement of funds which are non-reimbursable transfers, and the private sector in the handling of credit funds. It is suggested that program funds be channeled through an institution that has the ability to work with financial operators regardless of whether they are registered with the Superintendent of Banks.

25. One of the most difficult tasks in the design of a rural electrification project and its financial components, is the determination of energy "rates" or tariffs which will permit the electricity company to cover both its operational costs and its financial obligations, without overburdening the economies of the families involved in the project. To determine the sustainability of the program, sensitivity analysis was applied for each project. This involved the development of a typical economic cashflow analysis to determine project viability. Second, a financial cashflow was prepared to establish the user-rates to be set at a level which would guarantee sufficient income to the Electricity Company to cover operating costs and repay loan monies to a revolving fund. The sensitivity analysis then calculates the Net Present Value (NPV) of the cashflow, considering the amount of investment to be recovered as the amount of loan funds employed. The endogenous variables in this analysis are the amounts of loan funds and transfers used in financing the project and the rates of interest. However, the upper limit for the monthly payments is constrained by the limited income levels of the rural population. Successive trials were run to determine the minimum levels of investment capital necessary in order to permit the establishment of user-fees at levels acceptable to the population.

26. As part of the approach to creating a long-term, sustainable effort in the area of renewable energy-based rural electrification, the financial concept of the Program is structured so as to constitute a Revolving Fund which will permit the recovery of project funds to be destined for the financing of additional projects of this type. The details of Revolving Fund Operation are discussed in Annex 3.

IV. RATIONALE FOR GEF FINANCING

27. The proposed Program is consistent with the GEF Operational Program 6, "Promoting the adoption of renewable energy by removing barriers and reducing implementation costs".

28. A PDF-B for the amount of US\$234,000 for technical assistance in the preparation of the project was approved in March of 1996. Bolivia ratified the United Nations Framework Convention on Climate Change (UNFCCC) on July 25, 1994. The government requested assistance for UNDP/GEF to design and implement a program for decentralized rural delivery of renewable energy-based electrical service to support social and economic development.

29. GEF support is required to remove the identified barriers to the sustainable financing of renewable energy-based electrification and to identify which approach to renewable rural electrification is the best candidate for successful replication throughout Bolivia. This technical assistance project will have important ramifications in shaping future rural electrification projects being supported by other donors and multi-lateral development banks. The National Energy Secretariat expects that the model being tested here will serve as the basis for all future rural electrification programmes.

30. The proposed GEF project is, in effect, a pilot program which will lead to the development and implementation of larger scale efforts based on the demonstration of community-driven financing for the use of low-carbon energy technologies to support rural development.

31. The Government of Bolivia is providing substantial support to the development and implementation of the Program and to guarantee its long-term sustainability. The National Secretariat of Energy of the Ministry of Economic Development dedicates a substantial amount of its resources to renewable energy activities.

32. Local (Municipal and Department level) governments, through the recently implemented Popular Participation Law and the Administrative Decentralization Law, have newly acquired powers and financial means for the design and implementation of development activities. Depending on the magnitude of monetary transfers received by these local governments, and the development priorities of the communities and local populations, investment required for the rural electrification projects can be provided in varying amounts for co-financing. For the most part, these funds will be used by the project for non-reimbursable financing.

33. The Program has significant long-term innovative and demonstration value. Many of the components of the various projects of the Program will be unique in the Bolivian experience. These include: (1) a new approach to the capture and management of national funding for the financing of renewable rural electrification, (2) the development of local public-private sector companies which will assume the responsibility for the administration and long-term operation of the local systems, (3) the employment of decentralized, community level, small hydro systems in some communities and independent (PV) systems in others, (4) the demonstration of financial and economic advantages of the use of renewable energy-based electricity supply in contrast to

the higher costs and longer implementation periods for central grid expansion to rural areas, and (5) the linkage of investments in power systems with investments in social and economic development.

34. This program will leverage resources of the Government of Bolivia, international and bilateral organizations, and other sources to support rural electrification and the use of renewable energy resources. At the moment when financing for the program is being arranged, coordinators will consider the possibility of additional matching grant contributions to the revolving fund activities from other sources. Participation from these sources may be in the form of cash or in-kind contributions, ranging from equipment and materials to technical assistance. The incremental costs of the project and the need for GEF support are summarized in Annex 2.

IV. SUSTAINABILITY AND PARTICIPATION

A. Government Commitment

35. The Program has strong country support. The Government of Bolivia has requested the assistance of UNDP/GEF in the preparation and financing of the proposed Program. The Program has the full support and approval of the Government (Ministry of Economic Development and the National Secretariat of Energy). At the request of the Government, and with GEF funding and UNDP support, a consulting company was contracted to provide the preparatory assistance for the development of the Program components and overall design. Based on this work, the present proposal incorporates many of the original recommendations of that firm. The present project brief was prepared in close collaboration between the firm, the Office the United Nations Development Program in Bolivia and the National Secretariat of Energy.

B. Technical and Financial Support after GEF Project Completion

36. The project activities proposed in this brief are intended to remove barriers to the widespread adoption of renewable-energy based rural electrification. As pointed out by the technical reviewer (see para 49 ff), the one barrier which may not be removed through this project is the low-volume, high production cost barrier. Because of the relatively low annual turn-around of the Bolivia producers for PV's and small-hydro systems, the production costs of these technologies may still be higher than that found in other countries. While this may be less of a problem for small hydro systems (which are compared to the decentralized diesel electrification baseline), for PV systems (which are considered to demonstrate a positive incremental cost when viewed against the baseline of continued kerosene, candle and battery purchases), some incremental costs will remain. Industry analysts expect the costs of PV systems that are produced in Bolivia to fall due to the increased turnover brought about by this project. Whether the incremental costs of PV systems will approach zero or whether they will

justify additional support can only be determined by constant monitoring and continual re-evaluation.

37. Direct technical support will be provided by the National Secretariat of Energy, through the Programme Implementation Group, as the ongoing implementing agency and, to the extent possible, by the private sector with financial support from the Government. In addition, it is recommended that the Program provide support to the Secretariat in order to reinforce its internal capability for the purpose of inter-institutional and inter-project coordination. The group would be responsible for the development and maintenance of a national-level renewable energy database, available for consultation by any interested party. The database should contain, at a minimum, information related to the location and extension of the electrical grid in Bolivia, data related to on-going renewable energy projects and programs, directories of who is involved in what as it related to renewable energy, lists of commercial, technical and public entities in the area, etc. Further, it is recommended that this unit be developed in close coordination with UNDP's Sustainable Development Network (a programme designed to link-up developing country participants to international electronic networks).

C. Institutional Provisions

38. The National Secretariat of Energy of the Ministry of Economic Development will be the Executing Agency for the Program and will be responsible for Program coordination. Implementation of the Program will be supervised by a contracted, private sector firm, with the implementation of individual projects contracted through a process of public bids.

39. The UNDP Country Office in La Paz will provide support to the Program, including convening the Tripartite Reviews, providing assistance in the design and conduct of international competitive bids for equipment and services under ICB rules, in the procurement of expert technical assistance, and in the arrangements for in-country collaboration with international technical assistance sources.

D. Stakeholder Commitment

40. The Ministry of Economic Development and the National Secretariat of Energy are important stakeholders. They are responding to a national commitment to supply electricity to 78 percent of the rural population by the year 2001. They also have a stake in providing such services at the lowest possible cost in view of the extremely low level of incomes in the rural areas of the country. Renewable energy-based electricity supply options are viewed as potentially superior to both grid-based supply options and decentralized (small-scale) fossil-fuel supply options in economic, environmental and logistic terms.

41. Local communities, beginning with the target projects in the five departments of the country, have a real stake in contributing to the implementation and protection of the renewable energy systems, and will benefit directly from their availability, not only for household uses of

electricity, but for important community services (expanded potable and agricultural water supply, health posts, schools, lighting of streets and market places, etc.) and economically productive activities (especially in increased and improved agricultural and livestock production, artisan activities, small industry, and the like). It is expected that many of the local communities will contribute a important portion of the equity in the electricity supply systems and that all will cover the operating and administrative costs of the service.

E. Public Involvement and Local Participation

42. The local electricity company, with participation from the municipal government and oversight by the *Organización Territorial de Base (OTB)* will coordinate the effort to ensure that the Program and project include activities aimed to help community residents understand how to use (and to not abuse) the energy systems, and to ensure that the community and each user of the service pay the agreed-upon fees.

F. Information Dissemination

43. The Program will support information dissemination activities as part of this GEF effort. A portion of this effort will be directed toward the reinforcement of the capacity of the National Secretariat of Energy in the area of information acquisition by means of subscription to electronic communication networks wherein personnel of that organization can easily maintain themselves abreast of the goings-on in the world of renewable energy. At the same time, renewable energy groups in other parts of the world would be enabled to find out what is happening in Bolivia. In order that this same information is available to local users, the National Secretariat of Energy should build and maintain a renewable energy database, accessible on a cost-reimbursable basis to interested persons in both the public and private sector. Additionally, it is suggested that the Secretariat of Energy develop and implement a program of news releases wherein it advises the public of progress being made in the renewable energy field, related to both technical breakthroughs and advances in the use of this technology in practical situations.

G. Incentive and Regulatory Issues

44. There is a limited, but growing, private sector capacity in the renewable energy area in Bolivia. In order to identify and involve reliable local private sector firms in the implementation of renewable energy projects, the government may need to devise a system of incentives and/or promote the establishment of international joint ventures to assure the success of this phase of the Program.

H. Lessons Learned

45. A review of previous renewable energy, and other types of isolated electrification projects, demonstrates that local communities rarely are able on their own to operate and maintain energy systems on a sustainable basis. These projects show that a local professional capacity for installation, operation, maintenance and repair of equipment, such as PV home

systems and small hydro-electric plants, is essential for sustainability. It is evident from these studies that local communities often have the financial resources to pay for operation and maintenance, if the infrastructure is available.

46. Sustainable provision of electricity services in rural areas generally requires that energy services be provided by an energy service company (either public or private), rather than expecting rural communities to own and operate the equipment on their own. The suppliers of energy services must establish partnerships with local communities to ensure that the equipment is not abused or misappropriated. Lastly, local communities must be willing and able to pay for the full-cost of energy services for these to be sustainable. To date, most renewable energy projects in Bolivia have neither attempted to incorporate available local financial resources into project financing nor have they required users to pay for the services provided.

47. In the late 1980's, a project sponsored by the Government of Spain involved the installation of some 900 PV systems. The project demonstrated that PV technology is accepted by users for their basic electricity requirements. However, the systems were heavily subsidized and users were not required to pay back the subsidy. In effect, a number of systems were actually sold by the original beneficiaries to users outside the project area for a profit. The Chimboata Project in Cochabamba, a 60-system project sponsored by the French Government and implemented by Energetica, demonstrated that credit financing of renewable energy projects can work when initial and installment payments are gauged to the seasonal abilities of users to pay. This project found that there is better system maintenance if the systems are credit-financed, provided that user fees are linked to their payment capabilities. The NRECA project, sponsored by USAID provided results similar to those of the Chimboata project. The Dutch Government sponsored a small hydro-electric plant in Totorá (90 kW) in 1982. The project was organized through a cooperative. Problems which occurred in this project revealed the need for skilled personnel (and training) for accounting and mechanics. More training and care is required in the determination of user rates based upon the real costs of system administration, operation and maintenance. Projects will also require additional financing to expand coverage to a larger number of users, as successful projects consolidate the electricity markets in the area. More recently, the Dutch-sponsored project in the Department of Santa Cruz (implemented through the *Cooperativa Rural de Electricidad-CRE*) has shown that the private sector can function effectively in the rural electrification area. PV systems, even when subsidized, must be marketable so that they may be bought, sold, or transferred within a project area. It has also shown that the financial sector has a long-way to go before it is adequately attuned to the requirements for financing renewable energy projects.

I. Project Financing and Budget

48. The estimated total project costs are US\$8,267,969. The GEF is being asked to provide US\$4,211,719 as support for the incremental costs of the project. UNDP is providing US\$100,000 for project activities relating to the institutional arrangements for accessing funds under the Popular Participation Law. Under the Popular Participation Law, approximately US\$1,390,800 will be made available for the municipality-based projects. Users will be required

to provide approximately US\$711,700 for project activities as a precondition for acceptance into the project. Other donors will be asked to contribute about US\$1,000,000 to the project for the endowment of the revolving fund. The Bolivia private financial sector is expected to contribute approximately US\$603,750 to the project as part of their activities. Details of the estimated budget are shown in the attached tables. The cost of project preparation to date, not including co-financing, is US\$234,000 and has been met through a PDF-B.

J. Response to Technical Review

49. The STAP Technical Review is enclosed as Annex 4. In general, the reviewer's opinion is that this is "a well formulated project that fits with GEF Operational Program #6." Through an iterative process of interchange with the reviewer, the comments were responded to and the issues which lacked clarity were clarified. In addition, a new set of calculations on the potential CO₂ savings from the project were initiated and included in the brief. The reviewer also raised a question about the disposition of the revolving fund at the end of the project life. As indicated in Annex 3, the funds that remain may be devoted to capitalize a national rural electrification fund, at the discretion of the project steering committee. The reviewer also points out that while the project will remove the barriers it targets, it may not be large enough to raise the volume of business for PV and small hydro systems to a scale that would result in significantly lower production costs for these technologies in Bolivia. In other words, the cost of PV and small hydro systems may still represent a barrier at the end of this project. Although industry analysts seem convinced that this project will result in some price decreases, future support may be necessary to increase the volume sufficiently to bring about the more dramatic price decreases. This situation will have to be monitored and the potential need for future support (and the appropriateness of continued GEF support) will have to be iteratively considered as project implementation proceeds.

V. Incremental Costs

50. The project is estimated to have incremental costs of approximately US\$4,089,048 million, as demonstrated in the Incremental Cost Annex, Annex 2. When combined with the Executing Agency Support costs, the raise the full costs of the project come to US\$4,211,719. The GEF Grand Total Contribution of US\$4,445,719, which includes the costs of the PDF Block B.

VI. ISSUES, ACTIONS AND RISKS

A. Key Issues and Project Response

51. The Government of Bolivia has a growing pool of experience in the development of technical and policy guidelines for the implementation of low-carbon community energy projects. The Program will reinforce this by offering to provide additional training, local capacity,

experience and means to design and implement large-scale projects of renewables for community electricity services.

B. Project Risks and Risk Mitigation

52. The use of rapidly evolving commercial equipment, such as PV systems and small hydroelectric plants, requires considerable technical capability and experience. Without this support, there is a strong risk of technical problems delaying project implementation and limiting project effectiveness. The programme has been designed to ensure that the necessary in-country technical expertise will be established, and that the organizations implementing the projects have full technical support from collaborating institutions.

53. The Bolivian private sector does not presently have the capacity to support implementation of the project goals. There is a risk that the project may not catalyze sufficient private sector participation to ensure in-country supply of equipment and associated services during the post-project period. Special efforts will be made to provide information and training to qualified local companies, and to facilitate or broker international joint ventures with the private sector.

VII. INSTITUTIONAL FRAMEWORK AND PROJECT IMPLEMENTATION

A. Implementation and Oversight

54. Project implementation will be led and coordinated by the the Rural Electrification Program Implementation Group of National Secretariat of Energy. (See the Organization Chart in Annex 1. The Secretariat will contribute from its strong staff in the area of renewables. The Group will work with and coordinate the contributions of other participating organizations and institutions, both national and international, including NGOs, academic institutions and the private sector. To support this effort, the Program will create an Executive Oversight Committee. Initially, the members of this Committee will be named on an individual basis by the offices or institutions listed below. Once formed, the committee, with the advice and consent of the UNDP Resident Representative and the Sub-secretariat of Energy, will develop its own internal operating regulations. Committee members will serve indefinite terms. The internal regulations of the Committee will include procedures for replacing members who resign. Committee members will receive no salary or per diem. Members living in cities other than La Paz will be reimbursed for travel to that city for the purposed of announced committee meetings.

The following persons should name one person and one alternate to the Committee: the Coordinator of the Rural Electrification Programme (to serve as Secretary of the Committee); the UNDP Resident Representative; the President of the Association of Equipment Vendors; the Secretary General of Pupular Participation; the President of the Naitonal Association of Municipal Governments; the Secretary General of Sustainable Development; the Director of the Fondo de Inversiones in Nuevas Energias; and the Secretary General of the National Secretariat of Energy. The members of the committee will elect a chairman from within.

55. It is anticipated that the Secretariat will contract an experienced consulting firm to assist in coordination and oversight during the implementation phase of the Program. This will be necessary due to the size and complexity of the Program, and to the importance of ensuring that this demonstration effort is successful.

B. Monitoring and Evaluation

56. The Program will be monitored by the Secretariat of Energy, the contracted Program Supervision firm, and by experts selected by UNDP/GEF. UNDP's extensive experience in monitoring large programmes will be drawn upon to ensure that the project activities are carefully documented and monitored.

57. The Program team will collaborate with several other related UNDP and GEF projects, and with the anticipated future World Bank rural electrification project.

ANNEX 1 RURAL ELECTRIFICATION PROGRAM INSTITUTIONAL FRAMEWORK

The model which has been developed for the rural electrification using renewable energies, centers on the identification (or constitution) of a local entity in the case of each participating municipal section which would be charged with the implementation of the project and its later operation and administration. This entity has been given the name of the "Local Electric Company". It is anticipated that the Company will be organized as a *Sociedad Anónima Mixta (SAM)*, with participation by both the public sector (Municipality) and the private sector (local firms and/or individuals) on a share purchase basis. The Company will be staffed with a minimal number of executive, administrative and technical personnel. System maintenance will be provided through the contracting of a firm specialized in this area. This same firm should provide technical and administrative support to the Company.

The Company will provide electric service to users on a fee basis. In the case of PV projects, a flat monthly rate will be charged to users for the provision of a free-standing, household PV system. For small hydro-electric projects, rates will be based on the number of metered kWhs consumed each month.

Technical assistance during the early stages of Program and Project implementation will be provided on a non-reimbursable cost basis by the Program Supervision Contractor through the Program Implementation Group. In later years of the system life, administrative and technical support will be acquired by the Company under the same contract as maintenance. It is visualized that this should be a longterm relationship.

Project implementation will be led and coordinated by the the Rural Electrification Program Implementation Group of Secretariat of Energy. The Secretariat will contribute from its strong staff in the area of renewables. The Group will work with and coordinate the contributions of other participating organizations and institutions, both national and international, including NGOs, academic institutions and the private sector. To support this effort, the Program will create a Executive Oversight Committee. Members of this Committee will be named on an individual basis and will serve indefinite terms. **These will be non-salaried positions.** The following persons should name one person and one alternate to the Committee: the Coordinator of the Rural Electrification Programme (to serve as Secretary of the Committee); the UNDP Resident Representative; the President of the Association of Equipment Vendors; the Secretary General of Pupular Participation; the President of the Naitonal Association of Municipal Governments; the Secretary General of Sustainable Development; the Director of the Fondo de Inversiones in Nuevas Energias; and the Secretary General of the National Secretariat of Energy. The members of the committee will elect a chairman from within.

It is anticipated that the Secretariat will contract an experienced consulting firm to assist in coordination and oversight during the implementation phase of the Program. This will be necessary due to the size and complexity of the Program, and to the importance of ensuring that this demonstration effort is successful.

The Program will be monitored by the Secretariat of Energy, the contracted Program Monitoring firm, and by experts selected by UNDP/GEF.

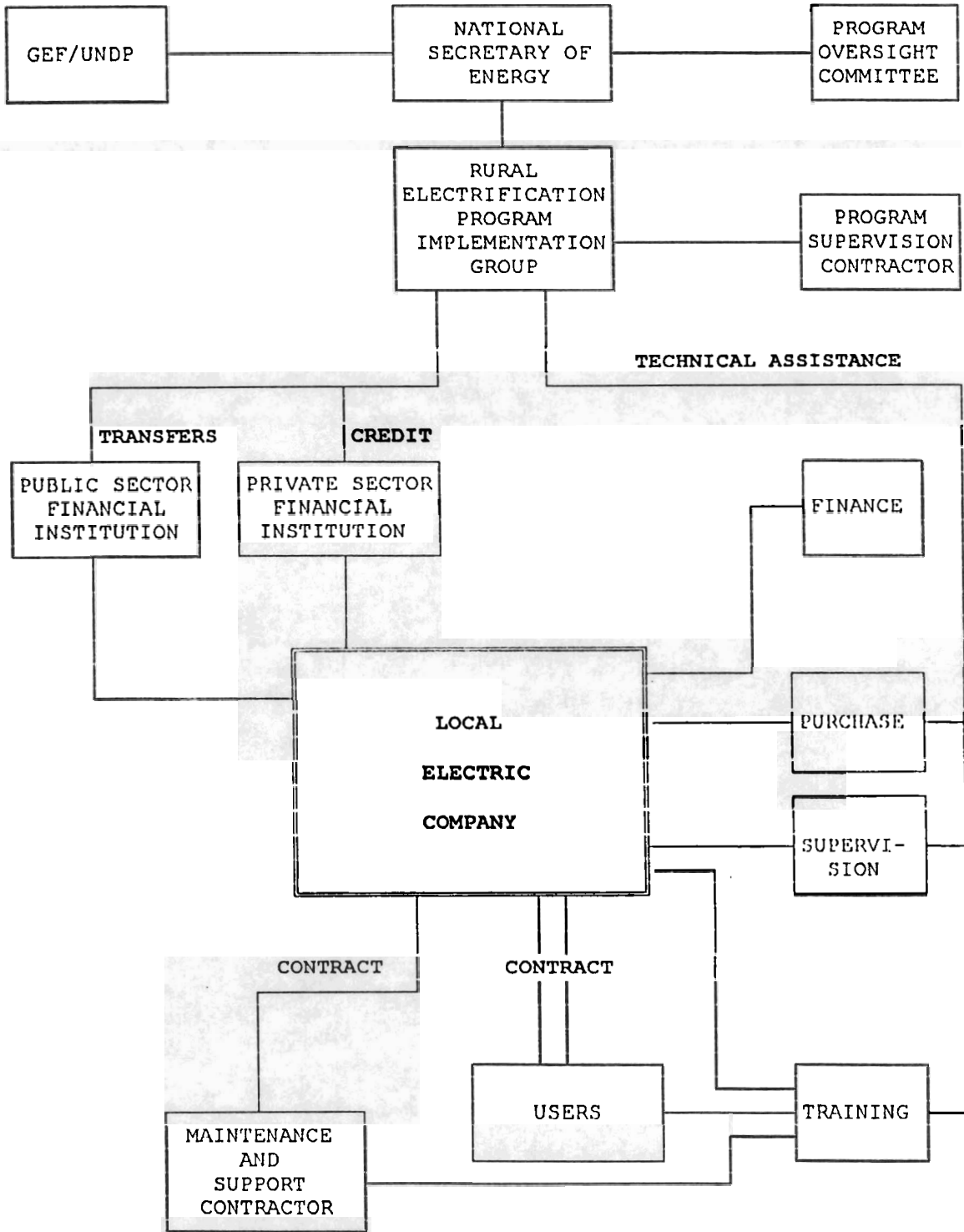
Financing of the projects will be arranged through the combination of monies from a variety of sources. A portion of the funds will come from initial fees (down-payments) charged to users (about 10 percent--if households wish to contribute more up front, that can be accommodated). The details of the financial sources are found in Annex 3.

In addition, it is anticipated that GEF will provide some amount of funds to the program through a grant to the Bolivian Government. Initially, these funds will be utilized to offset the costs of barrier removal in creating the conditions under which this type of Program can be implemented.

This will include costs of institution building, training, reinforcement of the financial mechanism in rural areas of the country, supervision of program implementation in the early years, creating a capacity for long-term maintenance and support.

In the Organizational Chart, credit monies are handled through financial institutions in the private sector, while non-reimbursable transfers are channelled through a public sector financial group.

Figure 1-1 Project Organization Chart



FROM
CASHIERS
COMMITTEE

INTERNATIONAL
BUREAU OF
ENERGY

OFFICE

PROGRAM
SUPERVISOR
CONTRACTOR

GENERAL
REGISTRATION

INTERNATIONAL
BUREAU

CREDIT

TRANSFER

INTERNATIONAL
BUREAU
INSPECTION

INTERNATIONAL
FINANCIAL
REGISTRATION

INTERNATIONAL
BUREAU

INTERNATIONAL
BUREAU

INTERNATIONAL
BUREAU

CONTRACT

INTERNATIONAL
BUREAU

INTERNATIONAL
BUREAU

CONTRACTOR



Annex 2 Incremental Costs

2.1 Broad Development Goals:

The broad development goal being pursued by this project is the provision of basic electricity services to the remote rural population of Bolivia. At present, approximately 25% of the rural population has access to electricity. The Government has goal of ensuring that 78% of the rural population gains access to electricity over the coming ten years. However, such a goal can only be achieved if the private sector is mobilized to provide these electricity services on a sustainable basis using both public and private resources.

2.2 Baseline:

Under the baseline, there will be some investment in rural electrification. A large number of communities have placed a high priority on rural electrification. However, the larger part of this investment will be in decentralized small diesel generating sets and in connection to the grid. Even so, insufficient resources are available to meet the financing needs of these conventional projects. **As a result, there is significant pent-up demand for electricity in rural areas.** The problem becomes one of helping rural communities muster the resources and obtain the financing to implement these projects. Under the baseline, conventional rural electrification is liable to continue. Communities with financing under the Popular Participation Law will be able to invest using those resources. However, those investments will be unlikely to extend to renewable electricity as most electrification involves either grid extension or decentralized diesel generation.

For some of the 25 communities initially targeted for support under this programme, the baseline extends only to a continuation of the current use of kerosene, candles and batteries for lighting and electricity needs. For others, the baseline will likely be a small diesel generating set. The differences depend upon the nature of the community, its settlement pattern, the local resource endowment, and the financial resources available to the community.

2.3 Global Environmental Objectives:

The global environmental objective being pursued is the reduction of present and future greenhouse gas emissions through the expanded utilization of renewable energy. The municipal-level projects proposed as part of this programme are envisaged as being profitable and sustainable **once certain barriers are removed.** This project is therefore consistent with GEF Operational Programme 6 to Promote the Adoption of Renewable Energy through Removing Barriers and Reducing Implementation Costs.

2.4 GEF Project Activities

The GEF Project activities are described in the body of the project brief. They have been designed to overcome five barriers encountered in the provision of rural electrification services through renewable energy. These barriers include the lack of a responsible institution to serve as the financial base for the investments which will make use of both private and public funds; the limited experience and background of the financial sector for dealing with rural renewable energy; the high capital cost or "first-cost" barrier of renewable energy where it is more expensive in the

short-run but more economical over the medium to long-run; the lack of technical standards and codes of conduct in the renewable energy industry; and the limited human resource base for undertaking a widespread deployment of renewable energy. As a result of these barriers, rural communities either get no access to electricity, or they gain access to electricity through either diesel gen-sets or grid connection. Unless these barriers are systematically removed through the activities proposed in this project, the market for renewable energy will remain limited.

Through the activities proposed in this programme, these barriers will be removed through a number of technical assistance activities and through the initiation of 25 community or municipality-based renewable energy electrification projects. These small projects will make use of a revolving fund mechanism which will facilitate the expansion of the project to additional communities. This mechanism is intended to ensure that the market for renewable energy in Bolivia grows and that the experiences of one community are used to benefit those of other communities.

2.5 System Boundary

The system being discussed in this case is the Bolivian energy system. The incremental costs presented below represent the costs of removing the specified barriers to renewable energy-based rural electrification.

2.6 Additional Domestic Benefits

The activities to be undertaken as part of this project will lead to few additional domestic benefits. There will be a very small reduction in emissions from diesel generating sets and a small reduction in CO₂ emissions from kerosene from the 25 community-based projects to be undertaken as part of this project. Once the barriers are removed and renewable energy is able to be disseminated throughout rural Bolivia, the quantity of local emissions reductions will be larger. However, they are not considered as a benefit against the account of this project.

2.7 Incremental Cost Matrix

The incremental costs of project activities are summarized in the incremental cost matrix, Table 2-1. Activity 1, which is the evaluation rural electrification institutional options, is considered to be a baseline activity, and so it is being supported by funds from UNDP's IPF. Activity 2, focusing on the needs of the financial sector to be able to finance renewables, is described in more detail below. Activity 3 focuses on training the participating population, technicians, and members of the rural electricity companies in the building, operation, and maintenance of renewable energy systems. Without the project, none of these activities will be undertaken. Activity 4 focuses on implementing the initial 25 community-based projects identified as part of this project preparation.

The baseline financing from the communities own contribution will be combined with revolving-fund resources to ensure adequate financing of these activities. The GEF resources are used for technology assessments and the participatory appraisal of each community's options. Activity 5 seeks to allow the completion of the establishment of renewable energy standards and codes of practice. Although some work has already been done on this task, without the support of this project, the process would not be completed in a participatory and transparent manner, and the

results would not then be widely publicized. Activity 6 focuses on project management. The National Secretariat of Energy is making an in-kind contribution of office space and support.

Activity 2 focuses on the removal of barriers in the financial sector to the expanded financing of renewables. In addition to technical assistance activities directed at the financial sector, this will involve the creation of a revolving fund mechanism using both GEF and non-GEF resources. The details of the revolving fund operation are presented in Annex 3. In addition to technical assistance activities to remove barriers, there are two separate financial requirements involved under this activity. The first of these has to do with the incremental costs of the proposed projects, particularly for solar photovoltaic systems. The second focuses on the need to establish a revolving fund to overcome the "first-cost" barrier.

With respect to the incremental costs of the proposed projects, two types of projects are envisioned. The first are the small hydro projects, making up 9 of the 25 projects. The second are the photovoltaic systems, which makes up 16 of the 25 projects (NB: two of the PV projects may include a small wind generator, whose incremental costs are considered to be 0). For the villages which will be electrified via the harnessing of small-scale hydro resources, in the baseline, they are assumed to obtain electricity from a decentralized diesel mini-grid. Approximately 1177 households are expected to be served by the small-hydro mini-grids. Over a twenty-year period, the costs of installing and operating the small hydro systems comes to about \$3.5 million. The costs of providing the same households with identical quantities of electricity from diesel mini-grids is estimated at \$3.9 million. Since the cost of the small hydro facilities is less than the cost of providing the same quantity of electricity through diesel generating sets, there are no incremental costs associated with the small hydro installations.

With respect to the PV systems, the project expects to install approximately 4,600 photovoltaic-based systems. For the households that will utilize these systems, the baseline would not involve electrification beyond that which is currently available. Energy needs would continue, as at present, to be met through the use of kerosene, candles, and batteries. Expenditure surveys show that rural households in project areas spend approximately US\$7.1 per month (\$85/yr) on kerosene, candles and batteries (excluding equipment costs, but including VAT). Excluding the 13% VAT, the annual expenditure on batteries, candles and kerosene comes to US\$6.16/month or US\$74/year. Over the course of 20 years, the present value of these expenditures comes to approximately US\$ 631.04. At current prices, a 45 W PV system costs about US\$850 in Bolivia.

The PV panel constitutes about 50% of the cost of the system and is subject to a 15% import duty and a 13% VAT. Removing these costs from the c.i.f. value of the PV gives a net value of US\$332. The balance-of-system (BOS) accounts for the remaining half of the value of the PV system (\$425), and is subject to a 13% VAT (the BOS is entirely produced locally in Bolivia, including deep-cycle batteries). The value of the BOS net of VAT comes to US\$376. The value of the capital cost of the system comes to US\$708. For the system to last 20 years, batteries must be replaced twice (year 8 and year 16) and cost about \$80 each time (~\$71 excluding VAT). The present value of the PV system (at 10% discount rate) comes to approximately US\$755.46. The incremental cost per 45 W PV system therefore comes to US\$124.40. Since the projects plan to install 4600 of these, the incremental costs of the PV systems comes to approximately US\$572,248. This amount represents an incremental cost payment for the households purchasing a PV system under the project. Although estimates are not firm, it is anticipated that the local price of PV systems will decrease through the sectoral growth experienced as a result of this

project. Industry analysts estimate that the price decline may be expected to run as high as \$50 per system. However, Bolivia may still face the low-volume, high-cost trap endemic to countries with incipient PV markets with low annual inventory turn-around.

In addition to these incremental costs, funds will be made available for the projects under the popular participation law (about US\$1.39 m) and from the users themselves (US\$711,700). However, in order to overcome the "first-cost" barrier and make adequate funds available for implementing the projects, additional contributions of US\$2million are required to provide a revolving fund to meet the full cost of the projects identified (the total costs of all projects comes to US\$4.67 million). Of this required amount of US\$2 million, one half (\$1 million) is requested from GEF and one half (\$1 million) is being requested from other sources, either bilateral donor funds or commercial funds. These will be repaid according to the terms agreed upon. The remaining US\$2.67 million will represent down payments made either by the municipality or the users, and will therefore not be repaid.

The implementation of the 25 projects identified for initial inclusion in this programme will result in the avoidance of approximately 21,100 tonnes of CO₂ over a 20-year lifespan. However, assuming that all funds are paid back into the revolving fund, an additional 44 projects can be implemented over 25 years. The total quantity of carbon avoided by these 69 projects will amount to approximately 34,090 m t of CO₂ over 25 years. The total Bolivian potential for CO₂ emission avoidance through renewable rural electrification has been estimated at 664,950 tonnes of CO₂ over 20 years (assuming that only rural households located beyond the economic reach of the electricity grid are provided with renewable electrification at low load levels).

Table 2-1 Incremental Cost Matrix

<i>Component</i>	<i>Cost Category</i>	<i>Costs</i>	<i>National Benefits</i>	<i>Global Benefits</i>
<i>Activity 1: Evaluation of Rural Electricity Institutional Options</i>	Baseline	\$100,000	Development of institutional framework for financing rural energy & dev't using popular participation law funds	Institutional Options for renewable and conventional renewable electrification are identified
	Project Case	\$100,000		
	Increment	0	Institutional Framework Developed	
<i>Activity 2: Financial Sector Mobilization and Strengthening</i>	Baseline	\$1,603,750	No financing of renewable energy--	Funds under Pop. Participation Law available but not used for renewables
	Project Case	\$3,115,950	Financial institutions strengthened to handle renewable energy projects	Funds under Pop Part Law combined w/ GEF resources to reduce incremental costs and remove first-cost barrier
	Increment	\$1,512,200	Strengthening financial organizations	Renewable energy financing can take place
<i>Activity 3: Training for Local Electricity Companies</i>	Baseline	-0-	Ltd personnel familiar with renewable energy	No renewable energy training
	Project Case	\$649,600		Training lays foundation for future renewable energy deployment
	Increment	\$649,600		Human resource barrier removed
<i>Activity 4: Development & Installation of Rural Renewable Projects</i>	Baseline	\$2,102,500	Communities invest resources in conventional electricity	
	Project Case	\$3,164,748	Communities invest in renewable energy	market for small hydro, PV's and wind expands
	Increment	\$1,062,248	Communities obtain electricity through sustainable financial avenues	Renewable energy projects established--Bolivia renewable energy market expands
<i>Activity 5 Standards & Certification</i>	Baseline	-0-	Lack of standards hinders renewable market	
	Project Case	\$85,000	Standards developed	
	Increment	\$85,000	Consumer confidence in renewables increases	Installers and manufacturers produce better quality product
<i>Activity 6: Project Management and Supervision</i>	Baseline	\$250,000 (in-kind)	Ltd project mgt skills	
	Project Case	\$1,030,000	Project management imp'd	Monitoring of project experience needed
	Increment	\$780,000	Project is carefully managed	Accurate record of project experiences obtained
<i>Total</i>	Baseline	\$4,056,250		
	Project Case	\$8,162,050		21,100 t CO2 avoided by 25 initial projects alone
	Increment	\$4,089,048		Revolve fund leads to total avoidance of 34,090 t CO2

Annex 3 Revolving Fund Operation and Project Finances

In order to carry out the 25 municipally-based projects identified as part of this project, it will be necessary to establish a revolving fund to overcome the "first-cost" barriers which prevent renewable energy investments from being undertaken. The total amount of funding necessary for carrying out these projects is estimated at approximately US\$4.674 million. Part of these funds will represent initial down-payments from either public or private sources. Another portion will represent a revolving fund loan which will be repaid according to the credit terms established as part of the project. A final portion of the financing will be limited to photovoltaic installations and will represent a one-time, initial grant made to compensate for the incremental costs of PV systems (about US\$124.40 per system). The sources of this financing are listed below:

<u>Source</u>	<u>Amount</u>	<u>Terms of Repayment</u>
1) Popular Participation Law Funds	\$1,390,800	Grant from municipality--not repaid
2) User contribution from households	\$ 711,700	User fee--treated like down payment
3) GEF Revolving Fund Contribution	\$1,000,000	Repaid into revolving fund--no interest rate, but admin costs
4) Other Revolving Fund Contribution	\$1,000,000	Repaid into revolving fund--terms dictated by donor or financier
5) GEF PV Incremental Cost Contribution	\$ 572,248	Only for PV households--grant funds
Total	\$4,674,748.	

The revolving fund will be supervised by the project steering committee, but will be managed by a designated financial entity, possibly a second-story financial institution. Payback periods, interest payments, and administrative payments will be specified by the project steering committee keeping in mind the barriers targeted as part of project implementation. At the end of the project period, the funds will be used as capitalization for the national rural electrification fund, as considered appropriate by the project steering committee.

Because the PV systems being installed contain an incremental cost, the financing available to them is somewhat different from that for small hydro systems. The user contribution will be a requirement for project participation. For PV systems, the approximate breakdown of costs is estimated as follows:

1) Popular Participation Law Funds	20%
2) User Contribution	10%
3) GEF Revolving Fund Contribution	27.5%
4) Other Contribution	27.5%
5) GEF PV Incremental Costs	~15%
Total	100%

For the small hydro facilities, the financing mix will be slightly different. The approximate breakdown of these costs is as follows:

- 1) Popular Participation Law Funds 20%
- 2) User Contribution 10%
- 3) GEF Revolving Fund Contribution 35%
- 4) Other Contribution 35%

Total

100%

Annex 4 - Technical Review
Bolivia
Program for Rural Electrification
with Renewable Energy Using the Popular Participation Law

1. Overall Impression.

This is a well formulated project that fits with GEF Operational Program #6--overcoming barriers to renewable energy implementation, and fits well with the goal of the Bolivian government to increase rural electrification. The difficulty of sustainable financing of dispersed rural renewable energy projects is one key barrier (of several) that the project seeks to overcome using an innovative approach. Aspects of the approach are specific to Bolivia, but there is sufficient generality in the approach (e.g. use of revolving fund and capacity building in financial institutions) to overcoming financing and related barriers to dispersed, small-scale renewable energy projects that the effort has relevance for countries other than Bolivia as well.

2. Relevance & Priority.

Providing high quality energy (electricity) to rural areas is a Bolivian-government priority. It is a major development challenge in Bolivia and many other countries. Renewable-energy systems of the types that will be implemented in the proposed project are important for meeting this challenge without contributing carbon to the atmosphere.

3. Background and Justification.

The motivation for the project is clear and clearly stated. Good background information is provided.

4. Scientific and Technical Soundness.

The project will address barriers to greater implementation of PV and mini-hydro technologies. The emphasis in the project is (appropriately) on non-technical barriers to greater implementation of these commercially-available technologies.

5. Objectives.

The project proposes to address Institutional, Financial, First-Cost, Human Resource, and Technical barriers to greater implementation of rural renewable energy projects. These are all important barriers to be removed. There is some overlap in the definitions of the barriers, especially the first-cost and financial barriers. Overall, the emphasis is (not inappropriately) on overcoming inability of end-users to pay up-front capital costs for projects that are “economically and financially viable” (¶21) by working with financing institutions to increase their ability and comfort level for loaning to rural communities and households for renewable energy projects.

6. Activities.

The activities are well conceived to meet the project objectives. The activities include: (1) Identifying creative institutional arrangements for entities that can provide rural energy services; (2) improving the possibility for having financing available to such entities by strengthening the capacity of financial institutions to loan money for rural renewable energy projects. A key element of this part of the project will be the revolving fund from which loans will be made for project implementation. The fund will, evidently, be administered through one or more financial institutions who in the longer term will provide loans from their own resources. The revolving

fund is to be partially capitalized by GEF money. It will be important to try to have private-sector funds make up the balance of the capitalization--ideally money belonging to the financial organization administering the revolving fund. This will provide greater incentive for the financial organization to succeed in its lending efforts; (3) training of personnel at all levels associated with renewable-energy service provision; (4) implementation of 25 pilot PV and mini-hydro projects; (5) development of PV and wind-energy technology standards to elevate level of technology quality; and (6) project management and monitoring.

7. Participatory Aspects.

Stakeholder and community participation are critical to the success of the proposed project. An effort has been made in the project design to include such participation.

8. Global Benefits.

Resulting CO₂ avoidance of 21,100 tonnes (over 20 years) (¶19) from the 25 pilot projects at a GEF cost of \$4.4 million corresponds to \$765/tC (\$219/tCO₂). This is relatively high cost carbon savings, but if this project is successful, the proposal envisions that no additional GEF funds would be needed to achieve additional CO₂ reductions from future projects. Given that grid extension is the most economical means for electrifying "many rural communities" (¶10), how large is the total potential carbon savings that would come from maximum penetration of rural, decentralized renewable electrification in Bolivia? This figure could be used to give a better indication of the cost of saved carbon that might be associated with this project.

9. GEF Strategies and Plans.

The project fits within the GEF Operational Program #6--overcoming barriers to renewable energy implementation.

10. Replicability.

The chances for replicability within Bolivia appear reasonable, especially because of the use of the revolving fund, repayments into which should be available for future such projects. Once financial institutions are comfortable with lending for rural renewable energy projects (and there are capable organizations to deliver, install, and maintain the services), larger commercial loan funds can be expected to be committed for such projects.

11. Capacity Building.

All of the proposed project activities have significant capacity building included. This is natural, since improving the ability of a variety of organizations (financial, technical, service, etc.) to be involved with rural renewable energy projects is a key overall objective of the project.

12. Project Funding.

Funding appears to be sufficient for the proposed activities. Limiting the number of projects to 25 in a pilot phase is a good approach. One issue unresolved in the proposal is the source of the non-GEF half of the revolving fund capitalization. However, the proposal suggests that there will be little difficulty in identifying a source of these funds. (See comments in ¶6 above.)

13. Time Frame.

Four years seems like a reasonable time frame for carrying out the project.

14. Secondary Issues.

- a. No obvious linkages to biodiversity or international waters issues.
- b. No direct linkages to other programmes and action plans at regional or sub-regional level are discussed in the proposal. ¶54 mentions collaboration with other related UNDP and GEF projects and with a future World Bank electrification project, but does not give specifics.
- c. The idea of a revolving fund is a key innovative aspect of the project.

15. Additional Comments.

- 1. The fate of the revolving fund in the longer term is not discussed. Once financial institutions in Bolivia fully absorb the role of financing rural renewable energy projects using their own resources, the revolving fund would no longer be needed. What will happen to the fund at that point?
- 2. There is mention (in ¶50) of the risk that the project may not catalyze sufficient private sector participation to ensure in-country supply of equipment and associated services. One result of insufficient private sector participation in the PV, wind, and mini-hydro business is higher-than-necessary costs for such systems (due to low production volumes, lack of local manufacturing content, lack of marketing and delivery infrastructure, lack of competition among suppliers, etc.) This project by itself may be too small to have a significant cost-reduction impact on such factors, but it is of sufficient size to begin to remove the barriers that it *will* address. Such barriers will need to come down to help insure the success of larger projects in the future that can more effectively address the higher-than-necessary-cost issue.
- 3. ¶46 provides a good discussion of lessons from previous projects. The proposal seems to be designed with some of these lessons clearly in view.

**BOLIVIAN RURAL ELECTRIFICATION PROGRAM
GEF BUDGET
(US\$)**

Activity	Task	Personnel	Sub-Contracts	Equipment	Travel	Other	Total
1 Evaluation of Institutional Options	1.1						0
	1.2						0
	1.3						0
Subtotal		0	0	0	0	0	0
2 Removal of Barriers in Financing Mechanism	2.1	46,000				2,000	48,000
	2.2	150,000	72,000	33,000		6,600	261,600
	2.3			1,000,000		0	1,000,000
	2.4		25,000				25,000
	2.5	14,400	115,200	8,000		40,000	177,600
Subtotal		210,400	212,200	1,041,000	0	48,600	1,512,200
3 Strengthening Local Utility Companies	3.1		44,600				44,600
	3.2		30,000				30,000
	3.3		275,000				275,000
	3.4		300,000				300,000
Subtotal		0	649,600	0	0	0	649,600
4 Development and Installation of Pilot Renewable Energy Facilities	4.1		220,000				220,000
	4.2		60,000				60,000
	4.3		60,000				60,000
	4.4		692,248				692,248
	4.5		30,000				30,000
Subtotal		0	1,052,248	0	0	0	1,052,248
5 Development of Standards and Certification Procedures	5.1		25,000				25,000
	5.2	10,000	25,000	25,000			60,000
Subtotal		10,000	50,000	25,000	0	0	85,000
6 Program Management, Supervision and Monitoring	6.1	200,000		50,000	100,000	50,000	400,000
	6.2	100,000		100,000	105,000	75,000	380,000
Subtotal		300,000	0	150,000	205,000	125,000	780,000
SUBTOTAL							4,089,048
EXECUTING AGENCY SUPPORT COSTS (3%)							122,671
TOTAL							4,211,719

BOLIVIAN RURAL ELECTRIFICATION PROGRAM
GLOBAL BUDGET
(US\$)

Activity	Task	Popular Participation Law	User Contribution	UNDP Contribution	GEF Contribution	Other Contribution	Total
1 Evaluation of Institutional Options	1.1			25,000			25,000
	1.2			25,000			25,000
	1.3			50,000			50,000
Subtotal Activity 1		0	0	100,000	0	0	100,000
2 Removal of Barriers in Financing Mechanism	2.1				48,000	36,650	84,650
	2.2				261,600	469,500	731,100
	2.3				1,000,000	1,000,000	2,000,000
	2.4				25,000		25,000
	2.5				177,600	97,600	275,200
Subtotal Activity 2		0	0	0	1,512,200	1,603,750	3,115,950
3 Strengthening Local Utility Companies	3.1				44,600		44,600
	3.2				30,000		30,000
	3.3				275,000		275,000
	3.4				300,000		300,000
Subtotal Activity 3		0	0	0	649,600	0	649,600
4 Development and Installation of Pilot Renewable Energy Facilities	4.1				220,000		220,000
	4.2				60,000		60,000
	4.3				60,000		60,000
	4.4	1,390,600	711,700		692,248		2,794,748
	4.5				30,000		30,000
Subtotal Activity 4		1,390,600	711,700	0	1,062,248	0	3,164,748
5 Development of Standards and Certification Procedures	5.1				25,000		25,000
	5.2				60,000		60,000
Subtotal Activity 5		0	0	0	85,000	0	85,000
6 Program Management, Supervision and Monitoring	6.1				400,000	250,000	650,000
	6.2				380,000		380,000
Subtotal Activity 6		0	0	0	780,000	250,000	1,030,000
SUBTOTAL FOR PROGRAM ACTIVITIES		1,390,600	711,700	100,000	4,089,048	1,853,750	8,145,298
EXECUTING AGENCY SUPPORT COSTS (3%)					122,671		122,671
TOTAL PROGRAM COSTS		1,390,600	711,700	100,000	4,211,719	1,853,750	8,267,969

Other Financial Sector Contribution
Other Financial Sector Cont
Other Donor or Commercial-Sector Contribution
Other Financial Sector Contribution

Other Govt in-kind contribution

Ministerio de Desarrollo Sostenible y Medio Ambiente

Secretaría Nacional de Recursos Naturales y Medio Ambiente

La Paz, febrero 28 de 1997
MDSMA - SNRNMA - N° 217/97

FAX: 223/97

Señora
Sirka Korpela
REPRESENTANTE RESIDENTE
PROGRAMA DE LAS NACIONES UNIDAS
PARA EL DESARROLLO
Presente

Ref: Solicitud de presentación del "Proyecto de Electrificación Rural con energías Renovables en el proceso de la Participación Popular" al comité de Aprobación del Proyectos del Global Environment Facility.

Distinguida Señora:

Me permito presentar el documento de referencia que ha sido elaborado por la Secretaría nacional de Energía.

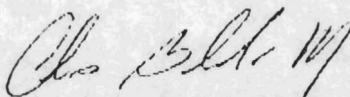
La concepción del proyecto se orienta a dos objetivos principales; incrementar la cobertura del servicio eléctrico para los hogares del área rural y utilizar tecnologías con energías renovables para mitigar los efectos ambientales evitando emisiones de gases de efecto invernadero.

Por otra parte, el proyecto ha sido diseñado ajustándose al nuevo marco resultante de las reformas tanto en el sector eléctrico como el sector social (Ley de Participación Popular y Ley de Descentralización). al mismo tiempo el Proyecto considera acciones orientadas a superar las principales barreras que impiden una difusión masiva de las fuentes de energías renovables.

En función de los objetivos propuestos, este proyecto está considerado de alta prioridad, ya que contribuye de manera efectiva al desarrollo sostenible de las áreas rurales.

Por lo anteriormente expuesto, agradeceré que por su intermedio, el mismo sea considerado en el comité de Aprobación de Proyectos del GEF en su próxima reunión.

Sin otro particular, reciba mis mejores saludos. Atentamente,



Lic. Carlos Balderrama M.

SECRETARIO NACIONAL DE RECURSOS NATURALES
Y MEDIO AMBIENTE a.i.



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PROGRAMA DE LAS NACIONES UNIDAS PARA EL DESARROLLO

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