Bolivia

Final Report on Operational Activities

Rural Energy and Energy Efficiency

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ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)

PURPOSE

The Joint UNDP/World Bank Energy Sector Management Assistance Programme (ESMAP) is a special global technical assistance program run as part of the World Bank's Energy, Mining and Telecommunications Department. ESMAP provides advice to governments on sustainable energy development. Established with the support of UNDP and bilateral official donors in 1983, it focuses on the role of energy in the development process with the objective of contributing to poverty alleviation, improving living conditions and preserving the environment in developing countries and transition economies. ESMAP centers its interventions on three priority areas: sector reform and restructuring; access to modern energy for the poorest; and promotion of sustainable energy practices.

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ESMAP is governed by a Consultative Group (ESMAP CG) composed of representatives of the UNDP and World Bank, other donors, and development experts from regions benefiting from ESMAP's assistance. The ESMAP CG is chaired by a World Bank Vice President, and advised by a Technical Advisory Group (TAG) of four independent energy experts that reviews the Programme's strategic agenda, its work plan, and its achievements. ESMAP relies on a cadre of engineers, energy planners, and economists from the World Bank to conduct its activities under the guidance of the Manager of ESMAP, responsible for administering the Programme.

FUNDING

ESMAP is a cooperative effort supported over the years by the World Bank, the UNDP and other United Nations agencies, the European Union, the Organization of American States (OAS), the Latin American Energy Organization (OLADE), and public and private donors from countries including Australia, Belgium, Canada, Denmark, Germany, Finland, France, Iceland, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Sweden, Switzerland, the United Kingdom, and the United States of America.

FURTHER INFORMATION

An up-to-date listing of completed ESMAP projects is appended to this report. For further information, a copy of the ESMAP Annual Report, or copies of project reports, contact:

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Preface and Acknowledgments

This report was written by Enrique Birhuett García, Juan Carlos Guzmán Salinas, and Antonio Ruiz Michel who are the local managers of the rural energy, biomass and energy efficiency project components, respectively. It summarizes the first phase of the project for which Willem Floor and Anke Sofia Meyer were the World Bank task managers.

This technical assistance project was part of the overall Bolivia ESMAP Country Program, funded by the Dutch Ministry of Foreign Affairs (DGIS), which assisted the Bolivian Government in the restructuring of the energy sector. Salvador Rivera was the World Bank Task Manager for the overall country program.

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For all three project components a second phase is currently implemented, again with funding from the Dutch Ministry of Foreign Affairs.

Abbreviations and Acronyms

ALURE	European Union Program for the Rational Use of Energy in Latin America
CPEE	Centro de Promoción de Eficiencia Energética (Center for Promotion of Energy Efficiency)
EE	Energy efficiency
EP3	Environmental Pollution Prevention Program
ESCO	Energy Service Company
FFP	Fondos Financieros Privados (Private Finance Funds)
FIS	Fondo de Inversion Social (Social Investment Fund)
FONAMA	Fondo Nacinoal de Medio Ambiente (National Environment Fund)
GDP	Gross Domestic Product
INE	Instituto Nacional de Estadistica (National Statistical Institute)
INRA	Instituto Nacional de Reforma Agraria (National Institute of Agrarian Reform)
LPG	Liquid Petroleum Gas
PROPER/GTZ	Programa para la Difusion de Energias Renovables/Gesellschaft fuer technische Zusammenarbeit
RE	Rural energy
SIN	Sistema interconnectado nacional (National Interconnected System)
SNE	Secretaria Nacional de Energia (National Energy Department)
VMEH	Vice Ministerio de Energia e Hydrocarburos (Office of the Deputy Minister of Energy and Hydrocarbons)
YPFB	Yacimientos Petroliferos Fiscales Bolivianos

Units of Measure

BOE	Barrel of oil equivalent
Kg	Kilogram
Koe	kilo of oil equivalent
KWh	Kilowatt hour
Lt	Liter
MW	Megawatt (= 1000 kilowatt (kW) = 1 million watt (W))

Currency Equivalents

November 1999: US$1 = BOL 5.94

Executive Summary

During the middle of the 1990s, the infrastructure sector in general and the energy sector in particular in Bolivia underwent dramatic changes: The Government withdrew from ownership of most companies in the sector and concentrated on the roles of facilitator and regulator. Energy companies were broken up into generation, transmission and distribution units and capitalized, with strategic investors taking over partial ownership and management of the companies. A regulatory framework was set up with independent regulators supervising the sector. At the same time, political and fiscal decentralization was initiated.

Against this backdrop, several activities were initiated in 1994 to bring rural energy and energy efficiency issues to the attention of policy makers and other stakeholders after a long period of neglect. When the energy sector reforms were essentially completed in 1996, technical assistance initiatives in rural energy and energy efficiency picked up steam.

Rural Energy Component

Most of the rural population in Bolivia does not have access to modern energy. Less than 2% of the rural population have access to electricity, only about 15% use LPG and kerosene. Rural households rely on traditional energy such as fuelwood and dung for most of their energy needs.

Consequently, the objective of the project was to provide assistance to the government to develop a sustainable market for rural energy. The following principles guided the development of the rural energy component:

- The Government's role was defined as that of a regulator and facilitator; i.e., it should receive support in formulating a regulatory framework that would overcome the major obstacles facing rural energy.
- Priority demand should be met at municipal level, and consumers themselves should decide whether a given rural energy project should be implemented.
- The private sector should be encouraged to diversify energy supply in rural areas and to adopt the most sustainable and least costly combination of technologies (power grids, renewable energy, and decentralized generation).

During project implementation, several areas were analyzed to identify problems and lessons learned:

- Institutional framework: The constant participation of both the private sector and users must be secured, and technical assistance provided to both the government

(central Government as well as prefectures) and private bodies, appropriate to their needs.

- Regulatory framework: Specific regulations for the rural energy sector are required. They should be designed to facilitate procedures, not to impose obstacles, striking a careful balance between standardization and flexibility.
- Financial mechanisms: Government co-financing is indispensable for rural energy projects since these projects are usually not commercially viable.
- Technology diversification: Locally available and renewable energy sources, particularly solar energy, can play an important role in providing rural energy services. New technologies need to be feasible, safe, and reliable, should be deployed on the basis of cost-effectiveness, and require little maintenance. Consumers need to be provided with information about those new technologies and the services they can provide, and with training in their use and maintenance.
- Structuring of demand: Municipalities need to be provided with simple energy planning methods. This will facilitate participation by local consumers.
- Business development: The private sector needs help in capturing the potential energy market in rural areas, such as information, market analysis, feasibility studies.

The intent of the project was to equip the Government with tools it can use to design national programs for providing access to energy. Accordingly, the component helped in the formulation of the Rural Energy Strategy; the Indicative Plan for Rural Electrification; the Rural Electrification Investment Program, the purpose of which is to plan, promote, and provide support for the supply of energy to local communities; the Rural Electrification Regulations; the National Program for Rural Electrification; and the Training Program for technicians, decisions-makers and planners involved in rural energy.

Biomass Component

Halfway into the implementation of the rural energy component it was realized that the use of biomass in rural areas needed special attention. During the last year of project implementation, this area was analyzed in more detail, and an action plan was formulated which would provide guides towards the sustainable use of biomass for energy services in rural areas and mitigate the impacts of supplying and consuming biomass as an energy source.

Biomass accounts for one third of national energy consumption in Bolivia, and its use is concentrated in rural areas. The efficiency with which biomass is transformed into energy is very low. Consequently, the price of thermal energy obtained from commercial biomass is very high. The current supply of biomass as a fuel in many regions of Bolivia, particularly in the Altiplano and Valle, is unsustainable.

While previous household surveys have provided some information on the use of energy by rural households, very little is known about energy consumption of rural industries. Under the biomass component several case studies were carried out which show that biomass provides the thermal energy needs of more than 90% of the establishments surveyed. The technological development of rural industry is in its infancy and the market for biomass for industrial use is as informal as that devoted to domestic fuel. Future activities should focus on promoting the rational use of energy.

One of the major obstacles to the efficient and sustainable management of biomass for energy uses lies in the shortcomings of the Government's energy policy. What is needed is a policy that recognizes biomass as one of the most important energy sources in the national energy matrix, while focusing on the rational use of energy and adopting a comprehensive approach to the problem. Biomass management requires a specific regulatory framework that will govern the use of these resources for energy and supplement the existing regulations applicable to other aspects of rural production.

Another major obstacle to efficient management is to be found in the poverty afflicting rural areas. Communities have failed to develop – or at some point have stopped enforcing – social rules governing access to, and the use and exploitation of natural resources.

To eliminate those obstacles, an action plan has been developed, known as the National Biomass Program. It sets out energy policy options for creating regulatory and incentive mechanisms to promote the sustainable management of biomass. This approach, which integrates the various social, political, and economic variables by applying appropriate policies, will allow the biomass energy market to be integrated into the national energy market, balancing supply and demand, and establishing defined value/price standards.

The program will focus its activities on the following areas:

- The rational and efficient use of biomass, by reducing energy consumption and the specific cost of energy in the rural household and industrial sectors.
- The replacement of biomass with other commercial energy sources, by expanding the markets for LPG and natural gas, while ensuring that such expansion is technically and economically feasible.
- The provision of a sustainable supply of biomass for use as fuel, through the establishment of rural biomass markets.

The following types of activities will be carried out under the program:

- Institutional strengthening of government at central, regional, and local levels, through the development and transfer of policies and regulations for the efficient management of biomass, technical assistance for energy planning, the development of technical, organizational, and institutional capacities among local stakeholders, and the introduction of an information system.

- Development of support mechanisms for the efficient management of biomass as an energy source. This entails the design of methods for providing grants, recovering capital investment costs, and establishing channels for providing financing for projects to promote efficient biomass management, in line with the overall financial policies applicable to the energy sector, and the design of technical assistance and training mechanisms for local stakeholders.
- Development of pilot plans for the household and industrial sectors in rural areas which will serve as a mechanism for taking direct action, as well as for testing alternative technologies and providing a source of input and/or feedback on the policies and regulations to be developed under the program.

Energy Efficiency Component

The activity has contributed significantly in putting energy efficiency on the map in Bolivia and consolidating the energy sector reform process. The restructuring of the energy sector provides a competitive environment in which consumers of energy potentially will have much more choice. On the other hand, the government has been concerned primarily with the energy supply side, focussing on enabling a more efficient generation and production of energy. It has become obvious that many consumers of energy have now a heightened incentive to reduce their energy cost, only to find out that there is no infrastructure in place which can help them to realize more efficient ways to use energy. This is where the project has come in, developing pilot plans to show success stories which may prompt other energy consumers to consider investing in EE measures, and identifying needs for an EE infrastructure and developing proposals to set up this infrastructure in a sustainable way.

Assistance was provided to the Government to evaluate energy consumption patterns, identify the most important barriers to efficient use of energy and evaluate the potential for energy savings. Regarding the consumption of energy, the most striking developments during the 1990s was the large increase in the consumption of natural gas and the large increase of energy use in the industrial and transportation sectors.

On the basis of a diagnostic analysis, an energy efficiency strategy was designed. It is based on the following principles:

- Striking a balance between energy potential and rational use. At this stage of its development, Bolivia must meet the challenges of economic growth, at the same time taking into account the particular characteristics of its energy potential, the limitations arising from the use of nonrenewable energy resources, and the need to use them rationally.
- Minimizing the environmental impact. Attention must be paid to the pollution levels that development entails, and, as a consequence, the impact of energy production and consumption on the environment.

- Ensuring transparency and neutrality. The efficient use of energy resources must be part of an overall policy to promote efficiency. It is essential to ensure transparency in the establishment of financial and tax policies. This means that clear "rules of the game" must be established, that real-cost pricing must be used, and that consequently proper economic criteria must be applied to each of the various energy sources.
- Making productive sectors more competitive.

As a first step towards the implementation of the strategy, several pilot projects were implemented in the industrial and hotel sector and local energy experts were trained in energy management techniques, and in the technical and economic evaluation of energy efficiency projects.

The industrial sector was identified as the most promising for the demonstration of energy efficient practices. Consequently, energy audits were carried out in 14 facilities. They resulted in the identification of a large energy saving potential which would be very viable. In a second phase, an energy management scheme and low-cost energy efficiency measures will be implemented. Energy audits in the hotel sector showed similarly positive results.

Lack of technical and financial intermediation mechanisms had been identified as major barriers for the successful uptake of energy efficiency initiatives. The National Chamber of Industry has agreed to cooperate in the establishment of technical assistance mechanisms in the area of environment and energy efficiency. Specifically, this institution has expressed interest in helping set up the "Center for the Promotion of Energy Efficiency". A financial mechanism, the "Fund for Investment in New Energy Sources" has been developed which would provide cofinancing for energy efficiency projects and renewable energy projects. It would be established in and managed by the private sector.

1

Project Background

1.1 The various components of the Rural Energy and Energy Efficiency program were implemented against a background of sweeping changes in Bolivia's political structure. Between 1994 and 1997, the State moved away from being a producer of goods and services, and instead assumed the role of regulating and facilitating economic activities.

1.2 At the same time, legal and institutional measures were adopted to encourage the private sector to participate, in a transparent and competitive manner, in the production of goods and services. Thus, new laws were enacted, and the energy sector was given its own regulatory system, which is independent of the Government.

1.3 These reforms strengthened the economy, enabling it to attract investment from the private sector, which increased its supply of goods and services to include many that had previously been provided by the State.

1.4 At the same time, reforms in the system of government have resulted in administrative decentralization, so that the regions (nine in all) now play a more active role in their own development. This has meant that certain functions and responsibilities have been delegated to the Prefectures and the various Departmental Councils, so that regional development can be coordinated.

1.5 Representative participation has also been increased at grassroots level ("Populación Popular") by giving the municipalities new responsibilities within their boundaries, together with new financial resources. This has ensured that the various demands presented can be prioritized and satisfied in a coordinated manner.

1.6 Underlying both administrative decentralization and popular participation is the principle of equity, and this principle is reflected in the redistribution of wealth that these two processes are bringing about.

1.7 These reforms – which offer much greater scope for meeting demands – are also intended to consolidate the country's economic and political stability, and thence to promote economic growth.

Overview of the energy sector: 1996

1.8 Table 1 shows the main features of the energy sector in 1996, when project implementation began. The macroeconomic variables have not changed significantly since then, especially with respect to domestic demand.

1.9 One of the major problems facing Bolivia is its low rate of annual GDP growth, which reflects the country's foreign debt burden. The domestic energy market is small compared with those of neighboring countries (i.e. Peru, Chile, and Argentina), and it excludes the 43% of the population living in rural areas and without access to any source of commercial energy.

Table 1.1: Overview of the Energy Sector – 1996

Total population	*7.1 Million*
Population growth rate	2.33 %
Rural population as % of total	43 %
GDP per capita	US$700
GDP growth rate	4.50 %
External debt/GDP	80 %
Domestic energy demand:	
Electricity	800 MW
Liquid hydrocarbons	20,000 BOE/Year
Growth of energy demand (90-95)	4.50 %
Rural commercial energy coverage:	12 %

1.10 However, Bolivia possesses substantial petroleum reserves and hydroelectric potential. Consequently, the main strategy adopted under the new economic model is to create conditions favorable for energy development and production and for the export of energy to neighboring countries. Bolivia intends to become the energy hub of the Southern Cone, with connections to each of its neighbors through an integrated energy transmission and transportation system.

2

Rural Energy Component (RE)

OBJECTIVE	Support the Government to overcome the main obstacles hindering the development of energy markets in rural areas; ensure that rural energy issues are taken into account in the various reforms.
START-UP	February 1994
BUDGET	$350,000
DURATION	45 months

2.1 The objectives of the rural energy component are described below.

2.2 Regulatory, political, and financial conditions are favorable for developing sustainable new energy markets in rural areas.

2.3 One of the main features characterizing rural areas is the small extent to which commercial energy services have penetrated this market. This is due to the following factors:

- There is no regulatory framework to encourage investment in the supply of energy to rural areas.
- There are no clear policies, particularly as regards the sort of government incentives and price liberalization that would enable commercial energy suppliers to penetrate this market.
- There is a lack of financing mechanisms, especially of the concessional kind, and such incentives would be necessary for developing the potential market that rural areas would offer.

2.4 The RE component was launched on February 2, 1994, with a small, one-man office in what was once the National Department of Energy and is now the Office of the Deputy Minister for Energy and Hydrocarbons. The activities relating to this component were completed on November 30, 1997.

2.5 Financing for the RE component totaled $350,000, and this includes ESMAP operations in Bolivia and the financing of the La Paz office.

2.6 From the outset, the component was intended to help the Government overcome the main obstacles hindering the development of energy markets in rural areas, and to ensure that rural energy issues were taken properly into account in the various reforms applied to the system of government (i.e. the Electric Power Law, the Decentralization Law, and the Rural Electrification Regulations). Consequently, the component provided for technical assistance, information dissemination, and specific studies.

2.7 The intent has been to equip the Government with tools it can use in designing national programs for providing access to energy, and so the component helped in the formulation of the Rural Energy Strategy, the Indicative Plan for Rural Electrification, and the Investment Program, the purpose of which was to plan, promote, and provide support for the supply of energy to local communities.

Rural energy prior to 1994

2.8 Until 1994, the Government and utilities focused their rural-energy activities exclusively on electrification. Other types of demand – especially for thermal energy – were neglected, whether they came from the household sector or the industrial sector.

2.9 Moreover, only one technological approach was adopted to rural electrification; namely, the use of an electric power grid and diesel generation. This meant, therefore, that only the inhabitants of population centers benefited, and these constitute only 16% of the total rural population.

2.10 Many diesel-generation projects failed to achieve financial equilibrium, and therefore proved to be unsustainable. One of the major reasons for their failure was their need for close supervision by qualified personnel. This requirement was not taken into account at the planning stage, and very soon led to inefficiencies, losses, etc.

2.11 Paradoxical as it may seem, the introduction of permanent subsidies – especially for fuels such as diesel oil – did not improve the financial position of rural operators; instead, it led to inefficiencies in the management of resources and energy. The subsidies did not encourage business efficiency, and so many of these utilities (most of which were cooperatives) went bankrupt.

2.12 At the same time, these rural electrification projects emphasized the supply of energy (while focusing solely on electric power and on one single technology),

rather than its efficient and productive use. In many cases, local people found themselves heavily in debt as a result of rural electrification loans, and there is no mechanism for recovering these debts.

2.13 Finally, many rural areas were electrified for political reasons (in response to pressure, to obtain votes, etc.) with no consideration for real needs or priorities. Generally speaking, the Central Government made its project decisions with very little input from consumers or their representative organizations.

2.14 The results of these projects have been far from encouraging:

- More than $40 million were invested between 1972 and 1992, but only 16% of rural areas received power supplies. Only 40,000 rural households out of a total of 480,000 were serviced in those twenty years.
- The rate of increase in newly electrified households over that period was 0.25%.
- In many cases the local utilities, especially those operating off-grid systems, went bankrupt, leaving their areas once again without any power supply.
- No financial or institutional mechanism has been established to promote rural electrification on a sustainable basis.

2.15 Moreover, no attempt has been made to address such issues as the supply and consumption of fuelwood and the environmental impact of its use, energy requirements for post-harvest processes (grinding and crushing, drying, storage, refrigeration, etc.), the use of local energy sources such as hydro potential, or the application of energy efficiency to rural industry.

2.16 In fact, the Government had little capacity to address these issues in depth. In addition, there was little real input from the people most closely involved.

Table 2.1: Rural/Urban Consumption Differences - 1995

Source/Sector	*Urban*	*Rural*
Biomass	0.1 ton/year	2.0 tons/year
Kerosene	25 lt/year	60 lt/year
LPG	200 kg/year	70 kg/year
Electric Power	185 kWh/month	20 kWh/month*

* Households with electric power supply.

Spheres of activity

2.17 In order to address these problems in a systematic manner, the following six areas were identified for priority attention:

- Institutional framework: central Government and prefectures.
- Regulatory framework: rural energy regulations.
- Financial mechanisms: public funding.
- Technology diversification: renewable energy.
- Structuring of demand: municipalities.
- Business development: electricity companies.

Institutional framework

2.18 Before undertaking activities in this area, the institutional framework consisting of the Office of the Deputy Minister of Energy and Hydrocarbons, the prefectures, the municipalities, and the utility companies was evaluated, from the standpoint of energy.

2.19 It is important to note that the RE component was implemented at a time when the functions of the State were undergoing radical changes. The initial evaluations produced a number of findings, some of which favored the RE component, while others pointed to problems that had to be overcome. These findings are summarized below:

- Reform of the government system had led to a better definition of institutional roles and functions, especially in the public sector, thanks to the application of the principle of administrative responsibility, which produced a better distribution of tasks, especially in the preparation and enforcement of regulations and in the promotion of investment in rural areas.
- The strengthening of the municipalities and the prefectures encouraged greater local and regional participation, a factor that enormously facilitated planning and priority setting.
- The private sector became involved in fields that were previously the exclusive domain of the Government, and took over responsibility for mobilizing resources of all kinds (i.e. human, financial, technological, etc.).

2.20 At the same time, however, it was noted that:

- While there were many new actors operating in the government agencies, there was very little coordination, too much overlapping of responsibilities, wide divergences in the criteria applied, and insufficient linkages between national policies and local initiatives.

Institutional framework: lessons learned

2.21 The RE component concentrated its efforts on overcoming institutional problems, while at the same time attempting to address the issue of rural energy. The

following lessons may be drawn from the efforts to strengthen the institutional framework:

2.22 From the outset, the constant participation of both the private sector and users must be secured, since this is will make proposals and projects viable right from the design stage. In this way, energy demands can be prioritized, and, from a technological standpoint, supply can be made more efficient.

- Technical assistance should be provided for both government agencies and private bodies to enable them to develop their individual ideas for rural energy. Both the municipalities and the prefectures have come up with plans for rural energy development, but they do not have the technical support needed to address the issue in more practical terms. In many cases, it has been necessary to provide training and technical assistance to these institutions before they could make rural energy a part of their planning.
- Assistance should be tailored to the needs of each institution, rather than provided according to some preconceived plan. This means that technical assistance must be appropriate to each institution's responsibilities, which in many cases must be clarified.
- Long-term agreements between institutions should be facilitated. Long-term agreements are particularly important, since they send a clear signal that long-term policies are being applied and that there is a clear division of responsibilities. This will also promote stability in the process of developing rural energy projects.

Table 2.2: Effect of Structural Reforms on Rural Electrification

Increase in Electric Power Service in Rural Areas			
Period	*1976-92*	*1992-97*	*1997-2002*
Average annual increase in rural coverage	0.25%	2.2 %	3.4% (With program) 1.4% (Without program)

Between 1976 and 1992, rural electric coverage grew at an annual average rate of 0.25%. In the wake of the Popular Participation and Decentralization Acts, this rate rose to 2.2%. Yet even at this rate, in 25 years 40% of the rural population will still be left without access to electricity. There are two possible scenarios for the 1997-2002 period: annual growth could rise to 3.4%, so that in 25 years more than 90% of the rural population would have coverage, assuming that there is a sustained program of rural electrification. Without such a program, the annual rate of increase could well decline to 1.4%.

Regulation

2.23 The new laws governing electric power, popular participation, decentralization, and hydrocarbons established a broad and favorable framework for addressing rural energy issues generally; however, there was still a lack of any clear

definition on certain aspects of rural energy, such as the roles played by the various stakeholders, information systems, project appraisal, financing, the use of public funds, etc.

2.24 The general objective of energy policy has been to promote energy exports by attracting domestic and foreign private capital, but developing commercial energy markets in rural areas (i.e. the domestic market) was not an explicit aim. Since the beginning of sector reforms, this shortcoming has been apparent in the lack of any regulations to govern the State's rural energy activities.

2.25 The existing regulatory framework was designed to govern those portions of the market that had already been developed (especially in urban areas) and export activities, while neglecting the potential of rural energy markets.

2.26 The following principles were taken as a guide when the regulations governing the development of rural markets were formulated under the RE component:

- The Government's role was defined as that of a regulator and facilitator; i.e. it was to be helped in formulating a regulatory framework that would overcome the major obstacles facing rural energy.
- Priority demand should be met at municipal level; that is, the consumers themselves should decide whether a given rural energy project should be implemented.
- The private sector should be encouraged to diversify energy supply and to adopt the most sustainable and least costly combination of technologies (power grids, renewable energy, and decentralized generation).

Regulation: lessons learned

2.27 The following recommendations emerged from the process of helping the Government prepare its regulatory framework:

- Areas where specific regulations will be required over the short, medium, and long term should be systematically identified. This has enabled the Government to increase its capacity to prepare regulations and plans, so that regulations are formulated and enforced in a timely manner, and are able to prevent problems from arising.
- Regulations should be designed to facilitate procedures, not to impose obstacles. Experience has shown that standardized procedures go a long way toward facilitating the processing and approval of projects, as well as reducing their costs.
- Care should be taken to prevent regulations from turning into obstacles because they contain excessively rigid conditions. Experience throughout the world has shown that developing rural markets calls for a variety of technologies and energy sources, as well as a broad range of approaches to

management and financing; in other words, there is no one single solution. This means that regulation must aim at diversifying solutions while ensuring that all of them are consistent with the prevailing legal framework.

- Rigidity must be avoided in the prospective relationships between consumers and service providers. As sources of energy become more diversified, it will be necessary for power tariffs in rural areas to be decided through negotiation between consumers and suppliers, in cases when supply does not exceed 300 kW. The reference point for suppliers is the ability to pay of rural consumers, and therefore they cannot overprice their services.
- Support should be provided for any initiatives devised by the operators themselves, provided that they are not in breach of the regulations. In many cases, such initiatives will represent the most appropriate solutions to local energy problems. To be acceptable, however, these solutions must not violate market principles or introduce price distortions, and they must allow for the expansion of services.

Financial mechanisms

2.28 Currently, a wide variety of financial mechanisms exists, and methods of financing depend on the particular financial institution involved. There are several sources of financing in the public sector; namely, Investment and Development Funds (of which there are four), prefectures, and municipalities.

2.29 Nongovernmental organizations have also been quite successful in experimenting with rural financing (particularly credit).

2.30 Nevertheless, none of these sources of financing has so far had any concrete experience of rural energy projects or programs. This lack of experience can be attributed to several factors: there are no technical advisory services with the necessary expertise in rural energy, and applications for financing exceed the capacity of the existing institutions.

2.31 The private sector could become a major source of financing, but the conditions normally applied would render most rural energy projects unviable. Generally speaking, interest rates are between 15% and 24%, and the loan period is four years at the most. In addition, loan guarantees are generally at a ratio of 2:1.

2.32 In these circumstances, rural consumers have little prospect of having access to private-sector financing. In rural areas, ability to pay is very low, and this makes the private sector very cautious.

Financing: lessons learned

2.33 The following lessons have been learned with regard to financing:

- Government financing is indispensable for rural energy projects.
- Project financing can be facilitated if the public and private sectors adopt the same appraisal criteria.
- Rural-energy consultants are needed as advisers to the financial institutions.

Technological diversification

2.34 A number of technical systems were evaluated with a view to taking better advantage of the energy sources available in rural areas. The following conclusions emerged:

- The potential for locally available and renewable energy sources such as solar and hydroelectric power is quite large, especially in the Andean area. Sources such as biomass (wood) are also significant, especially in the *llanos* (plains).
- Over the past six years, a number of technologies, particularly those involving renewable energy, have been successfully tested, indicating that solar, hydro, and wind energy are feasible on a small scale; however, the same is not true of biodigestion.
- The most highly developed source is solar power, and there are already high-quality suppliers on the market, providing both for thermal applications and for electricity generation.
- The use of energy in post-harvest processing was also explored, and a number of successful applications were found, including solar drying techniques.
- Another positive aspect is the reduction in the use of diesel generation for rural electrification. Such systems have produced unfortunate experiences in the past, and have an adverse effect on the environment.

2.35 Despite this progress, however, it was found that there are still barriers to the mass dissemination of new and renewable energy technologies. For example:

- The initial cost of new technologies still puts them out of reach for most rural consumers, given the lack of mechanisms for financing them.
- In addition, consumers have no information on the advantages and limitations of these technologies, and hence they have no grounds on which to base their decisions.
- While there are some local suppliers, their numbers are limited by import tariff restrictions on the import of energy technology, the lack of

incentives, the absence of technical standards, and unfair competition resulting from the diesel fuel subsidy.

Technology: lessons learned

2.36 The following lessons may be drawn from efforts to encourage the application of new technologies:

- Technologies must be demonstrably feasible, safe, and reliable. This means that they should be certified as to their quality and their ability to meet national technical standards. The existence of technology certification centers is a precondition for ensuring the quality and reliability of energy technologies.
- Linkages need to be established, using the principles of market relationships, between suppliers of energy technologies, financial intermediaries, and final consumers. This will demonstrate that particular technologies are sufficiently mature, and have found niches for their application in the country.
- With off-grid systems, it is a good idea to select technologies that require little maintenance and that can make use of locally available natural resources. The lack of serviceable roads, the shortage of trained local human resources, and a failure to adapt to local conditions have led to the failure of many attempts to introduce innovative technologies.
- The users of new technologies require full information about them. This is very important, being an aspect of energy management. In the case of renewable energy systems, potential consumers are often located in isolated areas, and they themselves have to undertake overall management of the energy system. Thus it is important that such consumers should have the necessary information to understand how the system functions.
- It is essential to consider training needs when implementing new technology projects. The success of any technology depends on the consumers being sufficiently trained to deal with any simple problems of a practical nature that may arise during its use.
- Technologies should be selected for both their cost-effectiveness and their sustainability.

Structuring of demand

2.37 The following questions were addressed: how does a demand arise, how does it come to be prioritized, and to what extent can it solve the major problems facing consumers?

2.38 To answer these questions, the institutional frameworks governing the demand for energy services (and indeed all consumer demands, particularly in rural areas) were examined. This analysis has led to the following conclusions:

- The Popular Participation Act has marked a turning point in the channeling of public demand in general. To determine demand priorities, a consensus must be reached, since there are not sufficient resources to provide for all of them at once. This has made it necessary to establish participatory planning mechanisms, so that agreement can be reached on the various needs of consumers. Local planning can then be integrated into regional and national plans.
- Energy services are not always accorded top priority, although in many cases it is impossible to develop other types of project without taking energy into account.

2.39 Despite the Popular Participation Act, it was found that:

- Often for purely political reasons, the political authorities frequently respond to demands that are not the outcome of advanced planning, and this discourages others from engaging in planning.
- Consumers are allowed little input in the design of projects, and no account is taken of their contributions and points of view.
- Local initiatives are still disregarded, and more attention is paid to proposals from experts and politicians at central government level.
- Local planners are given little information about the major processes and trends in national energy policy.

Demand: lessons learned

2.40 The following are the main lessons learned:

- It is essential to provide municipalities with simple energy planning methods. This will facilitate participation by local consumers, and make it easier to reach agreement and consensus.
- Methods of channeling information to planners in municipalities and prefectures need to be devised, so as to provide a free flow of information on developments in the main energy policies, and so that decision-making can be speeded up.
- Local participation also makes it easier to assign priorities to competing demands. Consumer participation in legitimate local organizations is a clear sign that there are new markets ripe for development.
- It is wise to avoid creation of unrealistic expectations when responding to demand. In many cases, projects have been presented as solutions to problems, but without being quantified. Generally speaking, they are then

abandoned because of a lack of funds and proper planning, having created false expectations and disappointed the consumers.

- The prefectures and the central Government need to respect local planning decisions. Once a municipality has formulated and prioritized its demands, the authorities at central level, as well as the prefectures, must incorporate these demands into their regional and national plans; otherwise, local participation will be meaningless.
- Demand should be channeled toward feasible proposals. This will inspire consumer confidence in the process of Popular Participation and in all the various mechanisms for prioritizing demands.

Developing entrepreneurship in the private sector

2.41 The reforms in the public sector have considerably increased the private sector's participation in the economy, and made its role more important. The aim is to ensure that this sector will make its contribution by mobilizing resources of all kinds – financial, human, technological, etc. – in an efficient and sustainable manner.

2.42 Nevertheless, there are still a number of restrictions, and these particularly affect local enterprises:

- There is very little capacity for identifying, developing, and implementing rural energy projects. This is because the private sector is still in its infancy, and has not yet come to recognize "the potential market for energy in rural areas." There is still a prejudice that stigmatizes such issues as poverty.
- At local level, the traditional private sector is not familiar with rural consumers, and has little confidence in their ability to pay. There is still a need to build bonds of mutual trust.
- Only a few technologies are supplied by the private sector, and even these are unfeasible. The private sector needs to increase its knowledge and adopt more aggressive strategies, while diversifying the range of technologies it offers.
- The private sector in local areas has failed to establish the sort of dialogue with government authorities that would enable it to take advantage of the incentives currently available to consumer-oriented projects.

Developing entrepreneurship: Lessons learned

2.43 Efforts to strengthen the private sector's capacity to invest in rural energy have yielded the following lessons:

- The private sector needs to be encouraged to adopt a long-term approach. The current conditions imposed by banks (high interest rates and short

repayment periods) have forced the private sector to adopt a short-term view, concentrating on high-risk financial activities (agricultural exports, for example), at the expense of others that would be more financially secure, such as supplying energy to local communities.

- The private sector should be helped to capture the potential energy market in rural areas. This means providing it with information, market analyses, and feasibility studies that will balance short- and medium-term considerations. Above all, entrepreneurs should be shown how to gain access to the incentives offered to those who undertake rural energy projects.
- A regulatory structure is needed that will facilitate private-sector operations. Among other things, import duties should be lowered, the tax system should be amended, prices per unit of energy should be freely negotiable in rural areas, and the conditions imposed on private-sector participation should be kept to a minimum.
- The regulatory framework should be one that attracts investment to rural areas. This will call for direct incentives to the productive use of energy, measures for achieving energy efficiency, and the promotion of diversification, so that a single rural utility will provide water supply, communications, energy, etc.

Principal outputs of the rural energy component

2.44 The following results were achieved during the implementation of the RE component of the program:

- Institutionalizing the central Government's concern with rural energy: Through the Office of the Deputy Minister of Energy and Hydrocarbons, the Government has adopted a rural energy policy that is to be implemented and monitored through the new Energy Development Unit in the Office of the Director General of Energy. This is a sign that the authorities have now been made fully aware of this issue, and that there is still some way to go in reforming the energy sector, since the new rural market for energy must also be taken into account.
- The main obstacles to rural energy development have now been identified and analyzed, thanks to an energy consumer survey of the rural household sector. The purpose of the survey was to identify obstacles to the sustainable development of the energy sector in rural areas. Those obstacles have been taken as the basis for designing the Rural Energy Strategy, the Rural Electrification Regulations, and other regulatory instruments.
- The Rural Energy Strategy: The Government has established an energy policy framework for rural areas, with principles, rules, and approaches that will facilitate investment and energy supply in those areas. This

strategy is the result of consultations and workshops in which all the various parties concerned participated, particularly during the preliminary phases.

- Sources of financing for rural energy: Bolivia has four public investment funds for promoting development. Since 1994, each of these has made some kind of investment in rural energy. The Social Investment Fund (FIS) is equipping all rural schools and health posts with decentralized energy systems such as solar panels, both for heating water and for generating electricity. The National Environmental Fund has provided financing to enable small-scale industries to switch from burning wood to natural gas, or to make more efficient use of wood. The National Fund for Regional Development has provided cofinancing for a wood-fired thermal plant in an isolated village of the Amazon region. For its part, the Rural Development Fund (*Fondo de Desarrollo Campesino*) is financing a program of hydroelectric stations to provide power for productive uses. In addition, both the municipalities and the prefectures have undertaken experiments in financing rural energy, and specifically rural electrification.
- Other sectors also have incorporated rural energy into their development plans. For example, the Ministry of Sustainable Development has identified rural energy as an area calling for direct action under the Economic and Social Development Plan. In addition, a number of municipalities and prefectures have included rural energy issues in their planning.

Other outputs of the rural energy component: rural electrification

2.45 Five major milestones were achieved which will advance rural electrification:

- The Indicative Plan for Rural Electrification: This is a database with information on the energy situation in the various regions, showing potential markets and quantifying demand. It was produced and published in 1995.
- The Rural Electrification Investment Program: This is a pipeline of projects prioritized according to their commercial attractiveness and – consequently – their lower need for incentives. It was produced and published in 1996.
- The Rural Electrification Regulations: These establish a regulatory framework for generating information on existing rural electrification systems, on operating agents, and on future projects. It was approved by Supreme Decree in 1997.
- The National Program for Rural Electrification: This provides a frame of reference for the implementation of projects forming part of the

Investment Program. The final version was prepared in 1997 and is expected to come into effect in 1998.

- The Training Program: This is intended to provide training for technicians, decision-makers, and planners involved in rural energy. It was developed during 1996 and 1997, and has provided training for more than 1,200 people.

3

Biomass Component

OBJECTIVE	To formulate an action plan for solving problems and mitigating the impact of supplying and consuming biomass as an energy source
START-UP	June 1996
METHODOLOGY	Field studies and bibliographic research
BUDGET	$30,000
DURATION	15 months

3.1 The biomass component has been undertaken as part of the National Strategy for Rural Energy. This Strategy complements the reforms in the energy sector, and is intended to bring about substantial changes in the patterns of energy consumption and supply in rural areas.

3.2 The rural market is typified by persistent poverty, a highly dispersed population, low levels of commercial energy consumption, and the use of noncommercial and nontraded traditional energy sources.

3.3 Government intervention is indispensable to satisfying energy demand in rural areas, for the following reasons: (1) energy distribution projects require large amounts of capital investment; (2) energy issues – and, in particular, biomass consumption – are closely interrelated with poverty issues; and (3) inefficient biomass management has considerable local and global environmental consequences.

Tasks performed

3.4 In pursuing the objective set in 1996, activities were undertaken in the following areas: (1) gathering information; (2) defining the obstacles to efficient management; and (3) conducting case studies for identifying pilot projects. On the basis of this work, an action plan was prepared so that the issues arising from the use of biomass as a source of energy could be addressed.

Information gathering

The energy sectors and uses selected:

3.5 Work to date has focused on energy consumption by rural households and microindustries, because of the following factors: (1) the information available; (2) information resources and access; (3) the share of total national consumption accounted for by these sectors; (4) the numbers of consumers involved; (5) the relationship of this consumption to poverty; and (6) local environmental problems.

3.6 With respect to rural households, information has been gathered from such sources as the National Energy Balance, the Survey of Energy Consumption in the Rural Domestic Sector, the National Energy Plan, and other studies.

3.7 In the case of rural microindustry enterprises, a number of case studies had to be undertaken as a means of estimating overall consumption and identifying energy consumption patterns for the sector. Short-term consultants were hired to carry out these studies.

3.8 The work of compiling information focused on analyzing two aspects of the issue, one relating to institutional variables and the other to economic variables.

Results

a) Economic variables

3.9 Second only to petroleum products, biomass accounts for one third of national energy consumption, and its use is concentrated in rural areas of the country.

3.10 In the household sector, more than 70% of the rural population relies on this source of energy, which covers up to 80% of their energy needs, being used primarily for cooking.

3.11 As a result of rural household energy demand for cooking, 965,000 metric tons of fuelwood and 263,000 metric tons of animal dung are consumed every year. Commercial transactions are involved in only 15% of consumption in the case of fuelwood, and 2% in the case of dung. As regards the number of households using a specific fuel, more than 70% rely on biomass, while 38% of the rural population has access to LPG; see Table 3.2. Generally speaking, rural families rely on more than one source of energy for cooking.

3.12 Average energy consumption for rural households amounts to 770 koe per household per year. Most of this demand is for cooking (89%), and it is met primarily with biomass (80%) and LPG (13%). Domestic lighting and the use of electric power account for only 5% and 2%, respectively, of rural household consumption; see Tab. 3.1.

3.13 Rural energy consumption is clearly very low, and thermal and biomass sources predominate.

Table 3.1: Structure of Rural Household Energy Consumption

By use		*By source*	
Cooking	89%	Fuelwood	63%
Lighting	5%	Dung	15%
Heating water	4%	LPG	13%
Other	2%	Kerosene	3%
		Electric power	2%
		Other	4%
	100%		100%

3.14 The efficiency with which biomass is transformed into energy is very low. Each unit of thermal energy obtained (koe) requires the consumption of 25 physical units (kg) of fuelwood, 33 of dung, but only 1.41 of LPG. If these levels of efficiency are factored into household expenditure on fuels, it will be found that families using fuelwood and dung are paying, respectively, two and three times as much per unit of thermal energy as those that burn LPG; in other words, the price of the thermal energy obtained from commercial biomass is very high.

3.15 There are also problems affecting the supply of biomass as a fuel. Indeed, the current situation in the Altiplano and Valle regions is unsustainable, given the natural productivity of wood resources. The exploitation of forest resources for energy purposes is not governed by leases, the removal of wood from communal lands and farming properties is not taxable, etc., meaning that the price of biomass is based almost exclusively on the cost of harvesting, transporting, and marketing it.

3.16 Whether biomass is intended for commercial use or simply for household consumption, in most cases the economic return from farming is so low that this work is left to women and children, because in their case the opportunity costs are lower. Thus it can be seen that the gathering of biomass for own-use is unrelated to normal considerations of value and cost.

3.17 Finally, from available information on the volume of labor required to collect biomass for domestic energy use, it has been calculated that the country's rural population devotes the equivalent of about 7 million working days to this task every year.

Table 3.2: Biomass Consumption in the Rural Household Sector *

Description	*LPG*	*Fuelwood*	*Dung*
Use by population in rural areas (%)	38	73	22
Total consumption (1000tons/year)	49	998	265
Family consumption (kg/month)	15	161	145
Combustion efficiency (%)	60	12	11
Self-supply (%)	- -	85	98
Family expenditures (US$/month)	5.64	6.19	6.23
Price per useful energy (US$/koe)	0.50	1.00	1.56
Collection time (millions of days/year)	0	4.2	2.7
Family labor (days/household-month)	- -	1	1.6

* These calculations are based on the Rural Domestic Energy Consumption Survey (INE-ESMAP, 1991).

3.18 In the case of rural industry, biomass provides the thermal energy needs of more than 90% of the establishments surveyed.

3.19 In order to gather information on microindustry enterprises, case studies were conducted – as far as the available resources permitted – in the departments of Santa Cruz, Cochabamba, and La Paz.

Table 3.3: Biomass Consumption in the Rural Industrial Sector *

Activity	*Total Biomass Consumption (1000tons/year)*	*Specific Consumption (Kcal/Kg)*	*Energy costs in relation to revenue (%)*
Sugar production	2.6	5,747	23.80
Rice milling	18.2	395	6.18
Bakeries	5.6	1,662	1.98
Brick production	177.0	629	32.06
Gypsum/Plaster products	48.0	495	20.00

* Results of case studies; not countrywide.

3.20 A number of biomass-consuming industrial activities were identified, studied, and considered for possible future action on the basis of the following criteria:

- Their specific energy consumption.
- The impact of energy costs on the financial position of the industry.
- The importance of the activity to the local economy.
- The degree of development of a rural biomass market.

3.21 On the basis of the case studies, it can be concluded that the technological development of rural industry is in its infancy, that the market for biomass for industrial use is as informal as that devoted to domestic fuel, and that future activities should focus on promoting the rational use of energy.

3.22 For both domestic and industrial uses, the prices of marketed biomass products were found to bear no relationship to their production costs.

b) Institutional variables

3.23 The following conclusions can be drawn from an analysis of institutional variables relating to the management of biomass as an energy source:

- Although overall energy policies are in place (based on considerations of marginal costs, private-sector participation, and the efficient exploitation of energy resources), no measures have yet been formulated to govern the use of biomass as a fuel. An appropriate energy policy should be devised to address the following questions:
    - Under what circumstances can biomass compete with other energy sources?
    - Should biomass be replaced entirely as a fuel, or should ways be sought to use it more efficiently?
    - What measures are needed to mitigate the local impacts from the nonsustainable exploitation of biomass?
    - What roles should the various stakeholders (the users, the suppliers, the Government, etc.) play in managing biomass efficiently?

3.24 Generally speaking, policymakers are poorly informed about the magnitude and importance of the issue, while regional and local authorities are unaware of procedures and methods for undertaking the planned exploitation of biomass resources. Moreover, the financial and organizational conditions for private-sector participation in dealing with this problem have not been defined.

3.25 The Government of Bolivia has issued a number of laws relating directly or indirectly to the exploitation of biomass as a fuel (the Forestry Law, the Environment Law, the INRA[1] Law, the Popular Participation Law, the Administrative Decentralization Law, the Organizational Law Governing Municipalities, etc.).

3.26 Nevertheless, the regulatory framework contains no provisions dealing specifically with the exploitation of biomass resources for energy purposes. Although the

[1] INRA = National Institute of Agrarian Reform.

Forestry and Environment Laws include some basic concepts governing the exploitation of forest resources, these are concerned almost exclusively with the use of forest resources for logging, with particular emphasis on tropical forest areas. This lack of provisions is particularly serious in the case of forests in the Chaco and Andean region.

3.27 Although population growth and the rate of deforestation in the country's river valleys are closely interrelated, the latter phenomenon cannot be attributed solely to growing numbers of people. To a large extent, the rural population meets its daily food and energy needs from the natural resources at hand. Many of these benefits are not measured in monetary terms; moreover, the growing penetration of the monetary economy has made social and cultural relations among the rural population more complex. A frequent result of this increasing complexity has been a decline in the importance of traditional systems of control and supervision over community resources.

3.28 However, the decline of traditional systems of control has not been offset by any new systems for supervising resources, whether they belong to the community, the State, or private individuals.

3.29 It is also difficult to determine whether communities facing acute problems of biomass supply have lost their traditional forms of social control over access to, and use of, forest resources, or whether they have simply failed to develop them, as in the case of cattle raising and water management. The latter hypothesis is suggested by an analysis of the legal framework governing the communities' rights of access, use, and exploitation with respect to government-owned and communal forest lands. The following conclusions can be drawn from this analysis:

- Local capacity for controlling access, use, and exploitation of government-owned or communal forest lands is very limited.
- There are no meaningful incentives that would promote the sustainable exploitation of resources, or that would motivate communities to develop social-control mechanisms to govern their access, use, and exploitation.
- Gaps in the legislation relating to the exploitation of biomass resources reinforce the communities' perceptions about the forest and its ownership, control, and exploitation.
- A number of institutional stakeholders were contacted in the process of gathering information for this project. In general, it was found that:
    - There are institutional weaknesses in terms of enforcing the law and formulating regulations.
    - There is confusion as to the roles and responsibilities of the Government, private individuals, and communities in controlling and exploiting resources.
    - Stakeholders' activities are characterized by "informality".
    - Stakeholders have no access to financing from the formal sector.

Major obstacles identified

3.30 One of the major obstacles to the efficient and sustainable management of the biomass for energy uses lies in the shortcomings of the Government's energy policy. What is needed is a policy that recognizes biomass as one of the most important energy sources in the national energy matrix, while focusing on the rational use of energy and adopting a comprehensive approach to the problem, the purpose being to provide biomass management with a specific regulatory framework that will govern the use of these resources for energy and supplement the existing regulations applicable to other aspects of rural production.

3.31 The lack of such a policy has the following consequences:

- Gaps in the regulations governing the exploitation of biomass resources.
- The lack of energy-related information and planning systems at central-government, regional, and local levels.
- The lack of incentives for sustainable exploitation.
- Excessive subsidies for hydrocarbon substitutes (natural gas and LPG).

3.32 Another major obstacle to efficient management is to be found in the poverty afflicting rural areas. The crisis in rural production systems (population growth, together with overgrazing and excessive wood consumption, leading to a scarcity of fertilizers and forage, soil degradation, and unsustainable production systems) has meant that communities have failed to develop – or at some point have stopped enforcing – social rules governing access to, and the use and exploitation of, resources. This combination of poverty and regulatory weakness has the following results:

- A low capacity for the efficient local management of biomass on private, government-owned, and/or communal lands.
- An approach to biomass management that disregards local or global environmental externalities.
- A price for biomass that does not reflect its production costs.

Action Plan (National Biomass Program)

Conceptual framework

3.33 In order to achieve the objectives of this component, an action plan has been developed, known as the PNB, or National Biomass Program. This sets out energy policy options for creating regulatory and incentive mechanisms to promote the sustainable management of biomass, for the purpose of not only preventing further resource losses through unsustainable energy use, but also restoring those resources.

3.34 The plan places its emphasis on correcting processes in which a loss of control over resources is related to inappropriate policies and institutional weaknesses on the part of the Government, combined with population pressure on resources.

3.35 In short, this approach, which integrates the various social, political, and economic variables by applying appropriate policies, will allow the biomass energy market to be integrated into the national energy market, balancing supply and demand, and establishing defined value/price standards.

Principles

a) Land management

3.36 Since the exploitation of biomass involves management of a variety of resources in specific areas, the action plan will be based essentially on the mechanisms established by the Popular Participation and Administrative Decentralization Laws, thus bringing local stakeholders (both private individuals and communities) into the discussions and related activities.

b) Management consistent with national energy policy

3.37 Implementation of the National Biomass Program entails the application of the National Rural Energy and Energy Efficiency Strategies, in line with the new sectoral structure created by the reforms and the new responsibilities and institutional structure assigned to the Office of the Deputy Minister of Energy.

c) Cross-sectoral application of policies and regulations

3.38 Not only do natural resources require a comprehensive management approach, in light of their interrelationships and interdependency; it is also necessary to take account of the role of society at large in administering and supervising these resources, because of the crisis in rural production systems, the environmental externalities generated by such management, and the role of women in environmental and energy management.

3.39 As a matter of principle, therefore, an integrated, cross-sectoral approach will be applied to the preparation of all regulations, policies, and specific actions.

Objectives of the National Biomass Program

3.40 The national biomass program aims to:

- Reduce the environmental impact of the inefficient and unsustainable use of biomass, and

- Enhance the economic and social benefits derived from the use of biomass energy.

Areas of work

3.41 The program will focus its activities on the following areas:

- The rational and efficient use of biomass, by reducing energy consumption and the specific cost of energy in the rural household and industrial sectors.
- The replacement of biomass with other commercial energy sources, by expanding the markets for LPG and natural gas, while ensuring that such expansion is technically and economically feasible.
- The provision of a sustainable supply of biomass for use as fuel, through the establishment of rural biomass markets.

Activities

3.42 The following types of activities will be carried out under the program:

- Institutional strengthening of government at central, regional, and local levels, through:
  - The development and transfer of policies and regulations for the efficient management of biomass.
  - Technical assistance for energy planning.
  - The development of technical, organizational, and institutional capacities among local stakeholders.
  - The introduction of an information system that will define the sources from which data is to be gathered, the data-processing mechanisms to be used, and the ways in which information is to be disseminated to users in a timely, reliable, and accessible manner.
- Development of support mechanisms for the efficient management of biomass as an energy source:
  - The design of methods for providing grants, recovering capital investment costs, and establishing channels for providing financing for projects to promote efficient biomass management, in line with the overall financial policies applicable to the energy sector.
  - The design of technical assistance and training mechanisms for local stake-holders (i.e. municipal governments, entrepreneurs, and communities).

- Development of pilot plans:

  - As a mechanism for taking direct action, as well as for testing alternative technologies and providing a source of input and/or feedback on the policies and regulations to be developed under the program, pilot plans will be designed for the household and industrial sectors in rural areas. These plans will be concerned with the efficient use of fuel and the substitution and sustainable supply of biomass as a fuel.
  - The mechanisms and methodologies for these plans will be developed as part of the rural energy component and will promote competition among the various stakeholders. The principal challenge here is to create mechanisms that will ensure that the activities undertaken are sustainable with regard to economic and technical feasibility, relevance, and local ownership, and – in particular – that they will be replicable.

Achievements

3.43 The following results were achieved during the period covered by this report:

- Basic information was compiled on the patterns of biomass consumption for energy use in the household and industrial sectors in rural areas.
- Case studies were conducted at regional level in the rural industrial sector, with a view to identifying classes of biomass consumers, estimating patterns of energy consumption and overall biomass consumption, and making a preliminary assessment of future action to be taken as part of the National Biomass Program.
- A financing plan was prepared for the implementation of the action plan, and financial support was secured.
- Stakeholders were identified for each of the sectors involved and each of the selected areas of activity, and relationships were established with them.
- Pilot projects were identified in the rural industrial sector.

4

Energy Efficiency Component

START-UP DATE	January 1995
CLOSING DATE	November 1997
BUDGET	US$ 388,205

Introduction

4.1 Against the background of the broader reforms introduced into the energy sector, work began in January 1995 on the Energy Efficiency component (EE), as part of the activities constituting the Energy Sector Management Assistance Program for Bolivia (ESMAP COUNTRY PROGRAM BOLIVIA).

4.2 Because the concept of energy efficiency is new to the sector in Bolivia, activities under this component have been directed toward raising the consciousness of the Government, the productive sectors, and other entities with regard to the importance and advantages of actively supporting the efficient use of energy. To this end, technical assistance was provided, pilot projects were launched in the industrial and hotel sector, and information was disseminated through a series of seminars and meetings organized for the sector.

4.3 The duration of the energy efficiency component was three years, and the budget was US$ 388,205.

Objectives

4.4 The objectives of the program were:

- To provide technical assistance for the National Energy Department (SNE: *Secretaría Nacional de Energía*), to enable it to assess energy consumption patterns, identify the major obstacles for efficient use of energy, and evaluate the potential for energy conservation.
- To evaluate the environmental impact of the production, transformation, and use of energy, and to identify legal and institutional requirements for reducing this impact.[2]
- To design an energy efficiency strategy.

4.5 The intention was, by pursuing these objectives, to familiarize the Government and the various economic sectors with the basic concepts of rational energy use.

Diagnostic study of the energy sector

4.6 The first task under the EE component was to prepare a general diagnostic study of the sector, including energy output and consumption data for the country as a whole, and an analysis of the sector's legal and institutional framework. This work provided reference points for guiding further actions under the EE component.

4.7 Annex 2 of this report contains a summary of this diagnostic study.

Barriers

4.8 The following are the principal obstacles and disincentives that were identified in the diagnostic study as having a direct impact on efforts to improve energy efficiency:

- **Lack of political will**: If energy conservation efforts are to be successful, the Government must be committed to improving energy efficiency, i.e. the political will is required. Over the last three years, the Government has been preoccupied with such tasks as capitalizing YPBF and ENDE, and arranging for the sale of natural gas to Brazil.
- **Distorted energy prices**: The fact that energy prices are now set without reference to any economic criteria is a serious obstacle to increasing energy efficiency. Energy price subsidies are a disincentive to companies to invest in energy conservation. Currently, various forms of subsidy are applied to the prices of natural gas, electric power, and LPG.

[2] While the analysis of the environmental impacts was an important objective at the outset of the ESMAP Country Program, the diagnostic analysis (see Annex 2) showed that environmental impacts of the commercial energy subsectors are relatively minor, and were taken care of through separate environmental assessments of power sector and oil and gas sector operations, respectively.

- **Lack of planning and information**: There is no system of indicative planning for identifying trends in the sector and hence fostering the rational use of energy resources and encouraging investment in this area. Similarly, there no system for carrying out reliable and timely studies on energy output and consumption by sector or (at a more disaggregated level) by economic activity.
- **Gaps in legislation and regulations:** Bolivia lacks the necessary legislation to encourage the rational use of energy. The new Electricity Law has introduced some important new provisions with regard to certain efficiency factors that must be taken into account in the generation and distribution of power, and yet the legislation is deficient when it comes to offering incentives for the efficient use of power on the part of consumers, cogeneration, and the substitution of environmentally friendly energy sources for those currently in use.
- **Lack of energy-efficiency standards**: Achieving substantial increases in energy savings will depend on developing standards specifically designed to govern the production, import, and marketing of domestic appliances, internal combustion engines, electric motors, etc. Bolivia currently has no energy-efficiency regulations or standards to govern industrial or domestic appliances and equipment.
- **Lack of awareness and technical skills**: There is a widespread lack of awareness about the importance of improving the country's energy efficiency levels, in both the public and private sectors. Moreover, the skills necessary for undertaking energy conservation activities are lacking, and there are no agencies with sufficient experience to offer technical assistance in the area of energy efficiency.
- **Conflicting investment priorities**: It is common for industrial companies to give priority to investments that will expand their production, rather than those that will improve their productivity and efficiency. Thus, little priority is given to investment that will improve energy efficiency. To overcome this obstacle, incentives will be needed that will encourage investment in energy efficiency.

4.9 It is hoped that the reforms that have been made in the sector, together with the capitalization of state enterprises, will help to overcome price and tariff distortions over the medium term. At the same time, once these major reforms are completed, the issue of energy efficiency will become a focus of attention for the Government, as well as for electricity distribution companies and industrial firms.

Energy efficiency strategy

Basic principles of the strategy

4.10 The Energy Efficiency Strategy is based on the following principles:

- Striking a balance between energy potential and rational use. At this stage of its development, Bolivia must **meet the challenges of economic growth, at the same time taking into account the particular characteristics of its energy potential, the limitations arising from the use of nonrenewable energy resources, and the need to use them rationally**.
- Minimizing the environmental impact. **Attention must be paid to the pollution levels that development entails, and, as a consequence, the impact of energy production and consumption on the environment.**
- Ensuring transparency and neutrality. The efficient use of energy resources must be part of an overall policy to promote efficiency. In this respect, **it is essential to ensure transparency in the establishment of financial and tax policies**. This means that clear "rules of the game" must be established, that real-cost pricing must be used, and that consequently proper economic criteria must be applied to each of the various energy sources.
- Making productive sectors more competitive. This means that the productive sectors must be brought into the globalized economy.

General objective of the strategy:

- To develop the mechanisms and tools needed to introduce energy-efficiency practices.

Short-term objectives:

- To institutionalize energy-efficiency activities as part of government practice.
- To provide the private sector with an institutional basis for taking action on energy efficiency.

Medium-term objectives:

- To implement an energy efficiency policy consistent with the needs of the sectors concerned.
- To establish the necessary regulatory framework.

Activities performed

4.11 Activities in this EE component have focused on the following key areas:

- Technical assistance for VMEH (the Office of the Deputy Minister of Energy and Hydrocarbons).
- Raising the consciousness of the various stakeholders regarding the need for energy efficiency measures.
- Implementing demonstration experiments.
- Designing support mechanisms.

4.12 These activities have been carried out as part of the Energy Efficiency Strategy.

Technical assistance for VMEH

4.13 As part of the technical assistance provided for VMEH, the National Energy Efficiency Strategy was designed to serve as a tool of public policy for guiding EE activities over the short and medium terms. This tool was submitted to, and discussed with, various institutions in the public and private sectors, and was publicized through a national seminar that was held in June 1996. It has also been presented in regional and sectoral seminars and other events.

Consciousness-raising

4.14 As part of the effort to publicize and stimulate awareness of EE issues, stakeholders have been identified in each area of activities. These include:

Private enterprises:

4.15 In addition to the industries and hotels involved in the demonstration experiments, links were established with the National Chamber of Industry, the umbrella organization for large and medium-scale industries; the Chambers of Industry in the Departments of Cochabamba, Chuquisaca, and Santa Cruz; the Chamber of Mining of Potosí; the Bolivian Federation of Small-Scale Industries; and the Bolivian Chamber of Hotels and Catering.

4.16 In addition, contact was established with electric power distribution utilities, including: CRE (the Santa Cruz Rural Electrification Cooperative); ELFEC (the Light and Power Company of Cochabamba); CESSA (the Electric Power Company of Sucre), and ELECTROPAZ (in the City of La Paz).

Government agencies:

4.17 Cooperative relationships were established with the Office of the Deputy Minister of Sustainable Development and Environment, through the National Program on Climate Change. As part of this program, work is under way to design an Action Plan on Climate Change, which will include EE-oriented activities.

4.18 Discussions have begun with FONAMA (the National Environment Fund) on undertaking joint EE projects. The Fund has expressed an interest in participating in the establishment of the Center for the Promotion of Energy Efficiency (see 4.26).

International cooperation agencies:

4.19 Links were established with the Environmental Pollution Prevention Program (EP-3), with a view to coordinating activities affecting the National Chamber of Industry and a number of industrial enterprises. Work is in progress with that institution to establish the Center for the Promotion of Energy Efficiency (see 4.26).

4.20 In addition, cooperation has been established with other institutions, including PROPER/GTZ; JUNAC (the Board of the Cartagena Agreement), through the PAIE (the Andean Program for Energy Integration); OLADE (the Latin American Energy Organization); ALURE (the European Union's Programme for the Rational Use of Energy in Latin America); ICAEN (the Catalan Energy Institute); and UNDP (the United Nations Development Programme).

EE service companies

4.21 Support was provided for training in local institutions that are potential providers of EE technical-assistance services. These include Energética and P&A Partners in Cochabamba, and Ecología y Empresa and Sistemática in the city of La Paz. These institutions participated in the demonstration projects in the industrial and hotel sectors.

Pilot plans

4.22 As part of the Energy Efficiency Strategy, pilot plans were undertaken in the industrial and hotel sectors. In both cases, energy audits were performed, making it possible to assess both the major difficulties facing these sectors in their use of energy, and their potential energy savings.

4.23 Energy audits were performed in 14 industrial concerns in the Departments of Santa Cruz (6), Chuquisaca (3), Cochabamba (3), and La Paz (2). Companies were selected in various branches of industry, including cement and ceramics, beverages, food, and textiles. A work program for a second phase of the pilot plan in industry has been developed. It includes the implementation of low-cost EE measures and the identification of medium-cost measures A summary of the EE Pilot Plan is presented in Annex 3 of this report.

4.24 Similar activities were conducted in the hotel sector. Energy audits were performed in six hotels in the Departments of Santa Cruz (3), La Paz (2), and Cochabamba (1). As an additional element in the analysis of this sector, the possible use of solar energy for water heating (instead of fuels) was examined. A summary of the Pilot Plan for the hotel sector is presented in Annex 4.

4.25 As part of these activities, a project for a "Demand Management Study of the City of Sucre" was also designed and submitted to the European Union (ALURE). The project was not approved by ALURE, but will be resubmitted with appropriate amendments.

Designing support mechanisms

4.26 In order to overcome the obstacles affecting technological and financial intermediation, two mechanisms were established: the New Energies Investment Fund and the Center for the Promotion of Energy Efficiency. Efforts are under way to secure financing for both of these. Annexes 5 and 6 contain summaries of the relevant documentation.

Lessons learned

4.27 The key lessons learned after three years of activity in the Energy Efficiency Component are summarized below. These will serve as a guide for subsequent action, and should be disseminated, together with an account of the experience gained under the program.

Functions of the Government

4.28 Introducing a concern for energy efficiency into the various economic sectors is certainly a complex task, both because of the innovations it entails, and because of the many obstacles identified. Consequently, the issue presents a formidable challenge, so that launching these activities will demand a high degree of commitment and political will on the part of the Government.

4.29 Although the promotion of energy efficiency must ultimately be based on market principles, initially the Government will have to play a proactive role, especially when it comes to defining policies and regulations for encouraging and fostering the rational use of energy.

Consultation

4.30 The success of EE measures will depend to a large extent on the degree of consultation and joint action that can be established among the various stakeholders, i.e. the Government, the private sector, sectoral regulatory bodies, providers of technical and financial services, and international cooperation agencies. The Government will also

need to create or develop mechanisms for facilitating consultation among the various actors concerned with energy efficiency.

Demonstration activities

4.31 Experience has shown that presenting concrete results from demonstration experiments, even if these are still in their initial stages, as in Bolivia, is the most successful means of promoting these methods and involving the potential beneficiaries in EE activities. Moreover, the Government itself responds very positively to action of this kind.

Information

4.32 Systems that can provide timely, reliable, and accessible information are an invaluable instrument for helping enterprises, and the Government itself, make decisions on EE measures.

Energy efficiency and the environment

4.33 Typically, entrepreneurs have viewed environmental issues as representing an additional cost burden, and this has made them reluctant to take measures to prevent or correct emissions and effluents. For this reason, EE activities need to emphasize both the economic and the environmental advantages.

Appropriate responses

4.34 Entrepreneurs, and the public in general, are not prepared to take risks in matters over which they have less than full control. Because energy efficiency is at odds with this attitude, the responses made to entrepreneurs must be concrete and appropriate. When considering such measures, business people will want to know, specifically, how much they will cost, how long they will take, and what the benefits will be.

Achievements

4.35 A summary of achievements to date under the EE component is presented below. They should be viewed as having so far partially solved the obstacles identified at the outset.

In Government

4.36 The EE component, through the Energy Development Unit, has been made part of the structure of the Office of the Deputy Minister of Energy and Hydrocarbons. This shows that the Government has a real interest in taking action on energy efficiency.

4.37 Similarly, the Government has demonstrated its willingness to deregulate the energy market, a process that is to be undertaken over the next few years. Concrete steps in this regard are now being taken in the electricity sector, where a new rate

structure is being prepared. The Energy Information System is also in process of implementation, as part of the institutional strengthening measures.

In the private sector

4.38 The National Chamber of Industry has agreed to cooperate in the establishment of technical assistance mechanisms in the area of environment and energy efficiency. Specifically, this institution has expressed interest in helping set up the Center for the Promotion of Energy Efficiency (CPEE). Joint efforts are currently being made to establish the Center.

4.39 The experiments carried out in the industrial and hotel sectors, together with the new trends toward market integration, have awakened the interest of entrepreneurs in moving ahead with energy efficiency and pollution prevention measures.

Within the program

4.40 The pilot plans carried out in the industrial and hotel sectors have demonstrated the potential for energy savings. At the same time, the principal stakeholders have been identified, and relationships have been established with them.

4.41 Basic information is now available on the consumption characteristics of the various sectors, and links have been established with international agencies that can supply data and experience in the field of energy efficiency.

4.42 As a result of the experiments carried out in the industrial and hotel sectors, initial training has been provided for a group of local energy analysis specialists. This may be regarded as a first step in providing specialized technical-assistance services.

Annex 1

Publications/Seminars and Workshops Conducted

Publications:

- *Rural Energy Strategy*, Ministry of Economic Development, National Energy Department, Bolivia, 1994.
- *Rural Electrification Investment Program: Bolivia, 1996-2001*, Ministry of Economic Development, National Energy Department, Bolivia, 1996.
- *Indicative Plan for Rural Electrification in Bolivia*, Ministry of Economic Development, National Energy Department, Bolivia, 1996.
- *Proceedings of the Workshop-Seminar on Energy for Rural Development*, National Senate, Bolivia, 1995.
- *Proceedings of the Departmental Seminar on Rural Electrification for Chuquisaca*, PROPER, 1996.
- *Proceedings of the Departmental Seminar on Rural Electrification for Potosí*, PROPER, 1996.
- *Proceedings of the Departmental Seminar on Rural Electrification for Tarija*, PROPER, 1996.
- *Proceedings of the Departmental Seminar on Rural Electrification for Cochabamba*, PROPER, 1996.
- *Manual of Guidelines for the Preparation of Rural Electrification Projects with Municipalities*, PROPER, Ministry of Economic Development, National Energy Department, Bolivia.
- *Rural Electrification Regulations*, Official Gazette, Bolivia, 1997.

- *Assessment of Solar-Energy Potential in the Andean Region of Bolivia*, PROPER-ESMAP, 1997.

Seminars And Workshops Conducted:

- Rural Energy Strategy – September 1 and 2, 1994.
- Business roundtable with European entrepreneurs for developing renewable-energy projects – April 24, 1995.
- Rural Electrification in the Context of Popular Participation – June 28 and 29, 1995.
- Hydro Projects in Rural Areas – October 24, 1995.
- Rural Electrification in Cochabamba – July 10, 1996.
- Rural Electrification in Tarija – September 20, 1996.
- Rural Electrification in Potosí – November 28, 1996.
- Rural Electrification in Chuquisaca – November 29, 1996.
- Joint Implementations and Rural Energy – February 15, 1997.
- Renewable Energy and Rural Electrification – June 10, 1997.
- International Experiences in Energy Efficiency and Strategy for Bolivia – June 5, 1996.
- Presentation of the Results of the Energy Efficiency Pilot Plan in the Industrial Sector – February 2, 1997.
- Energy Efficiency Seminar, National Chamber of Industries, , La Paz – April 17, 1997.
- Energy Efficiency Seminar, Departmental Chamber of Commerce of Cochabamba –May 8, 1997
- Energy Efficiency Seminar, Prefectura of Chuquisaca – June 17, 1997
- Energy Efficiency Seminar, Association of Mines of Potosí , June 16,1997

Annex 2

Diagnostic Study of the Energy Sector

(Summary)

Output And Consumption

1. In the decade from 1986 to 1995, the output of **primary energy** rose from 48,238,000 BOE to 57,848,000 BOE, for an average annual growth rate of 1.8%. Output of crude petroleum showed the greatest increase (from 6,713,000 to 10,930,000 BOE, with an annual growth rate of 5%), while bioenergy output fell from 7,099,000 to 6,332,000 BOE, an annual decline of about -1.1%. Available data show a rising trend in primary output, except for bioenergy. Table No. 1 provides detailed information and shows the percentage share of total output for each source of energy over the years 1986-95.

TABLE No. 1: OUTPUT OF PRIMARY ENERGY (1986-95)

ENERGY SOURCE	*1986 (in thousands of BOE)*	*%*	*1995 (in thousands of BOE)*	*%*	*Annual Growth 1986-95*
Bioenergy	7,099.00	14.70	6,332.00	10.90	(1.1)
Natural Gas	31,759.00	65.80	37,288.00	64.50	1.6
Crude Oil	6,713.00	13.90	10,930.00	18.90	4.9
Hydropower	2,667.00	5.50	3,299.00	5.70	2.10
Total	48,238.00	100.00	57,849.00	100.00	1.8

Source: Based on the Energy Balance 1983-95, National Energy Department.

Final consumption of energy products

2. Table No. 2 provides data on final energy consumption for the years 1986 and 1995, and the percentages for each of these years.

TABLE No. 2: FINAL ENERGY CONSUMPTION (1986-95)

ENERGY SOURCE	*1986 (in thousands of BOE)*	*%*	*1995 (in thousands of BOE)*	*%*	*Annual Growth 1986-95*
Bioenergy	6,947.0	44.6	5,965.0	30.0	(1.5)
Natural Gas	638.0	4.1	2,183.0	10.9	12.3
Petroleum Products	7,071.0	45.4	10,178.0	51.0	3.6
Electric Power	929.0	6.0	1,633.0	8.2	5.6
Total	15,585.0	100.0	19,959.0	100.0	2.5

Source: Based on the Energy Balance 1983-95, National Energy Department.

3. Over the decade, total energy consumption increased moderately, at an average annual rate of 2.5%; however, the increase in natural gas consumption was particularly significant (12.3%), and this reflected its use as a substitute for other energy sources in the industrial sector. Electric power consumption also showed substantial growth, at 5.6%. On the other hand, the consumption of biomass for energy uses declined, as new substitutes were introduced for fuelwood and dung, and as rural-urban migration continued.

4. As can be seen from the table above, there have been significant shifts in the shares of the various energy sources in final consumption. The share of bioenergy declined from 44% to 30%, while that of natural gas rose from 4% in 1986 to 11% in 1995. In the case of electric power, there was an increase from 6% to 8%. Petroleum products, as a share of total consumption, remained virtually constant, and they continue to be the most widely consumed source of energy in the country.

5. Although natural gas consumption has increased in recent years, it is clear that Bolivia is using only a small portion of its main product (only 11% of total consumption in 1995). The main item of consumption is liquid hydrocarbons (51%), followed by bioenergy (30%). This latter item is mostly consumed in rural areas, and mainly for domestic purposes.

Consumption by sector

6. Between 1986 and 1995, final **household and commercial** consumption declined at an average rate of 1.4% per year. This decrease was due exclusively to the replacement of biomass by other energy sources. Over the same period, household and commercial consumption of LPG and electric power grew by 3.4% and 6.8% respectively.

TABLE No. 3: FINAL ENERGY CONSUMPTION BY SECTOR (1986-95)

SECTOR	*1986 (in thousands of BOE)*	*%*	*1995 (in thousands of BOE)*	*%*	*Annual Change 1986-95*
Household and Commercial	8,394.0	53.9	7,263.0	36.4	(1.4)
Transportation	4,289.0	27.5	7,449.0	37.3	5.5
Agriculture/ Stock Raising	165.0	1.1	41.0	0.20	(13.9)
Industry	2,553.0	16.4	4,969.0	25.0	6.7
Other	185.0	1.2	237.0	1.2	2.5
Total	15,585.0	100	19,959.0	100.0	2.5

Source: Based on Energy Balance 1983-95, National Energy Department.

7. The largest increase in energy consumption was in the industrial sector. Consumption of natural gas rose at an annual rate of 14%, reflecting industrial growth and the substitution of natural gas for fuel oil and diesel fuel. Electric power consumption in the industrial sector rose by 4.2% per year.

8. In the transportation sector, consumption rose by 5.5% annually. Diesel fuel consumption grew by an average of 11.6% per year, while gasoline consumption increased by only 1.8%. This primarily reflects the lower market price for diesel fuel. As a result, the country has had to import this fuel.

9. Energy consumption in the agricultural sector declined significantly over the period; however, no specific data are available for the sector. Rising agricultural production in the Oriente region suggests that consumption in this sector has in fact been much larger than the available data suggest.

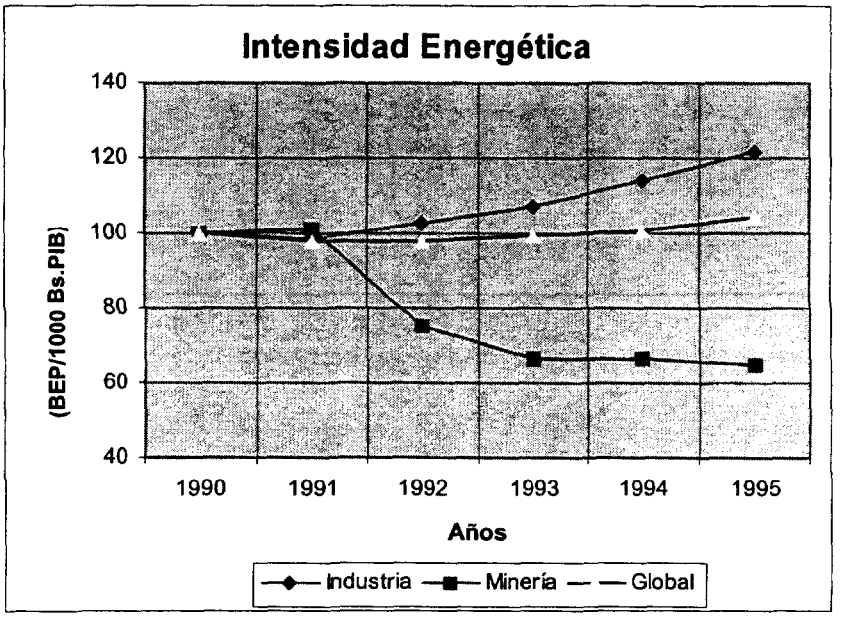
Principal indicators for the sector

Energy intensity

10. Figure No. 1 shows that Bolivia's overall energy intensity has remained constant, with a rising trend over the last two years. In the industrial sector, there has been a rapid increase since 1992; in contrast, energy intensity in the mining sector has declined dramatically, due (among other factors) to the increase in gold mining, and the advanced technology involved.

11. Bolivia's overall energy intensity, and in particular that of the industrial sector, is higher than that of the developed countries or of other countries in the region. This reflects the low profitability of final energy consumption.

Figure No. 1: Energy Intensity in Bolivia, 1990-1995



The electric power sector

12. In 1995, Bolivia's electric power sector had an installed capacity of 802 MW, of which hydroelectric generation accounted for 38.1%, and thermal electric generation the remaining 61.9%. In the same year, total output reached 3,004 GWh, of which 42.7% was from hydro sources and 57.3% was from thermal generation.

13. The Interconnected System (SIN) services the capital cities, and adjacent areas, of the Departments of La Paz, Cochabamba, Santa Cruz, Chuquisaca, and Potosí. Cities of medium size, such as Tarija, Trinidad, and Cobija, are serviced by systems that are not connected with the SIN. The so-called "smaller off-grid systems" are used in smaller centers, such as provincial capitals.

14. Certain indicators point to problems in the overall management of the power system, particularly in distribution, and especially in the off-grid and smaller systems.

15. The extent of these problems can be gauged objectively from certain of the performance indicators. On average, the SIN has a load factor of 54%; in the case of the smaller distribution utilities within the SIN, this factor is only 29%, reflecting the concentration of consumption at peak hours. Distribution losses (i.e. technical plus nontechnical losses) average 11%.

16. In the off-grid and smaller systems, peak-hour concentration is accentuated by the lack of any industrial users; consequently, the load factors average 47% and 41% respectively, while losses are about 21%.

Table N° 4: National Electric Power System (1995)

System	*Installed Capacity in MW*		*Total*	*%*	*Generation GWh*		*Total*	*%*
Type	Hydro	Therm.			Hydro	Therm.		
Interconnected System	268.2	352.9	621.1	77.4	1,207	1,425	2,632	87.6
Off-Grid Systems	8.2	37.7	45.9	5.7	24	109	133	4.4
Smaller Off-Grid Systems	5.2	22.1	27.3	3.4	11	39	50	1.7
Total Public Utilities	**281.6**	**412.7**	**694.3**		**1,242**	**1,573**	**2,815**	
Self-generation	24.0	83.9	107.9	13.5	42	147	186	6.3
Total Country	**305.6**	**496.6**	**802.2**	**100**	**1,284**	**1,720**	**3,004**	**100**
Share %	38.1	61.9	100.0		42.7	57.3	100	

Source: Statistical Yearbook for the Electric Power Sector, 1995. VMEH.

Energy sector reforms

17. Significant reforms have been under way in the energy sector since 1994, aimed at opening up the sector to market forces and providing incentives for private-sector participation. Under these reforms, the Government has taken on a new role, focusing its attention on defining policies and regulations. At the same time, its supervisory functions have been transferred to autonomous entities such as the Regulatory Agencies of Hydrocarbons and Electricity.

18. As part of these reforms, new legal instruments have been designed to govern activities in the sector, through a series of laws replacing the former Electricity and Hydrocarbon Codes. This new legal framework will facilitate to cover future domestic demand for energy, and to increase exports by private producers.

19. One important aspect of these reforms was to capitalize the major enterprises engaged in the generation, transmission, and distribution of electricity. A similar approach has been adopted in the hydrocarbons sector.

Annex 3

First Phase of the Pilot Plan for Energy Efficiency in Bolivia's Industrial Sector

Summary of Activities

1. The first phase of this pilot plan has consisted essentially of conducting energy audits in 14 industries, with a view to assessing the potential for energy savings in industry and preparing the investment phase.

2. The energy audits in the various industries were performed by Cenergía (Peru), P.A. & Partners and Energética (Bolivia), under the supervision of the March Consulting Group (UK), and Energy Consulting (Brazil).

Participating enterprises

3. The following are the enterprises in which the energy audits were performed:

Santa Cruz:

- MARGLA (ceramics)
- Cervecería Santa Cruz - Ducal (brewery)
- Sociedad Aceitera del Oriente - SAO (sunflower and soybean oil and flour)
- Mendocina (soft drinks)
- EMBOL (soft drinks)
- Molinera del Oriente (wheat flour)

Sucre:

- Sociedad Industrial del Sur - SUREÑA (beer, malt, balanced foods)
- FANCESA (cement)
- TMT (sombrero manufacturer)

Cochabamba:

- VASCAL Avícola (poultry processing)
- DURALIT (fibrous cement tiles and tanks)
- QUIMBOL-LEVER (detergents, soaps, shampoos, and waxes)

La Paz:

- Universaltex (Textiles)
- TUSEQUIS (Sausages)

Dissemination of results

4. The diagnostic studies in these enterprises were conducted from October to December 1996, and the results were presented at a series of seminars held in the cities of Santa Cruz, La Paz, Cochabamba, Sucre, and Potosí.

Seminars on Energy Audits in Industry

City	*Date*	*Place*
Santa Cruz	Feb. 5, 1997	National Seminary
La Paz	April 17, 1997	National Chamber of Industry
Cochabamba	May 8, 1997	Departmental Chamber of Industry
Potosí	June 16, 1997	Mining Association
Sucre	June 17, 1997	Prefecture (Sucre)

Overall results

5. Annual expenditure on energy in the 14 enterprises totals about US$7 million. Overall, there was a significant potential for energy savings, amounting to some US$800,000 per year (59% in electric power, 36% in thermal energy, and 5% in water). The capital investment would be recovered in about one year.

6. The enterprises that took part in this first phase of the pilot plan have also shown considerable interest in participating in the second phase, which will consist of implementing an energy management scheme ("Monitoring and Targeting"), and in taking specific action to improve certain processes through energy savings projects.

7. The case study on Universaltex (see box) shows the favorable results of investments which were implemented as a result of the diagnostic studies.

BOX: Case Study – UNIVERSALTEX

Energy Efficiency Pilot Plan activities in the industrial sector included a December 1996 energy audit of textile manufacturer UNIVERSALTEX, La Paz. At the same time, an environmental audit was conducted with assistance from the Environmental Pollution Prevention Program (EP-3).

This plant has two production lines: (a) cotton and polyester, and (b) wool and acrylic. In both cases, the production process follows the same steps: preparation, spinning, dyeing, weaving, finishing, and shipping.

The environmental audit revealed the following energy loss problems:

- leakages of air, water, and steam
- defective layout of steam pipes and electricity network
- defective production processes
- failure to capitalize on water and thermal energy recovery potential
- shortcomings in boiler management
- less than full insulation of steam pipes
- failure to control maximum demand and reactive power
- defective equipment maintenance.

As a result, the enterprise shows high specific consumption figures for electricity, natural gas, and water: 2.9 kWh, 0.05 Mcf, and 0.19 m^3 per kilogram of product, respectively.

On learning the results of the environmental audit, the enterprise introduced a plan to rectify its energy situation. The key issues requiring priority attention were the heavy consumption of water, the excess of reactive power, and optimization of boiler combustion. Accordingly, it was decided to:

- buy and install water meters
- buy and install gas meters
- upgrade boiler combustion
- buy and install series capacitors.

Also incorporated in this first phase were steps to sensitize factory personnel.

The initial results of these measures indicated significant improvements:

- specific consumption of natural gas declined appreciably, to a sustained level of less than 0.04 Mcf/kg;
- specific consumption of water fell drastically and quickly to levels of 0.12 m^3/kg;
- specific consumption of electric power remained unchanged, but reactive power losses declined.

In view of these results, plant management has decided to expand its energy saving campaign and has committed to the necessary investments. ESMAP technical assistance with the implementation phase will be available to UNIVERSALTEX (as well as to seven other industrial enterprises with similar plans).

Annex 4

Energy Efficiency Plan in the Hotel Sector

(Summary)

Pilot Plan objectives

1. The following objectives were pursued with the pilot plan:

- To determine the potential for energy savings in the hotel sector, on the basis of specific technical evaluations.
- To define a set of low-cost energy savings measures that could be applied to hotels.
- To examine the technical and financial feasibility of using substitute sources of energy to achieve savings.
- To disseminate technical and financial information on the feasibility of the various measures for enhancing the sector's energy efficiency.

Advantages of energy efficiency measures

2. Similar experiments in other countries have shown that the introduction of energy efficiency measures in the hotel sector can produce major benefits, including:

- Reduced specific energy consumption, resulting in lower operating costs.
- Significant savings in specific water consumption, resulting in lower operating costs.
- The side effects of energy efficiency measures on overall facility management, making it more efficient.
- An improved image for the hotel. The overall trend in the sector is toward what is called "ecotourism." It therefore considerably increases the hotel's attractiveness and prestige if it be seen to be using clean energy sources and using energy rationally, thus helping reduce the environmental impact of its operations.

- In addition, measures applied to improve the efficiency of energy use can also be extended to other hotel activities, including garbage collection, waste treatment, cleaning, and organization in general.

Development of the Plan

3. With support from the Program for the Dissemination of Renewable Energies (PROPER-Bolivia), energy audits were carried out in six hotels in different cities. The work was done by P.A. & Partners in the following hotels:

- In the Department of Santa Cruz: Hotel Los Tajibos, Hotel Cortez, Hotel Santa Cruz
- In the Department of La Paz: Hotel Gloria, Hotel Copacabana
- In the Department of Cochabamba: Hotel Cochabamba

Overall results

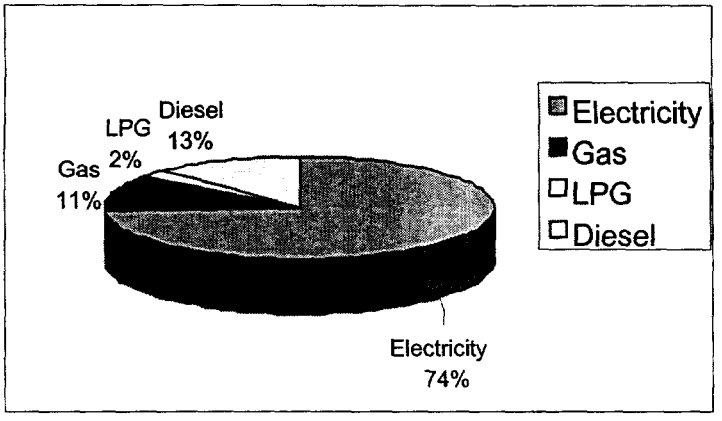
4. The results of these energy audits show that the hotels spend about US$420,000 per year on energy. Figure 1 below shows the distribution of these costs among electricity, natural gas, LPG, and diesel fuel.

5. The audits indicated that, if energy efficiency measures were to be applied, the potential savings for these hotels would total about US$40,000 per year. The capital investment needed to implement these measures would be recovered over about 18 months.

Possible use of solar energy

6. In all three of Bolivia's climatic zones, significant potential was found for the use of active solar energy, primarily for preheating water. If all the potential areas could be involved (184 hotels: 38 in the city of La Paz, 22 in the rural area of La Paz, 24 in the city of Cochabamba, 9 in the rural area of Cochabamba, 47 in the city of Santa Cruz, 26 in the rural area of Santa Cruz, 18 in the city of Sucre), a total surface area of approximately 4800 square meters of solar panels could be installed.

Figure 1: Distribution of Energy Costs in Hotels



7. From a technical viewpoint, the practicable surface area that could be installed would depend on a number of factors: surfaces available for installation, the solar access of sites, orientation, existing heating systems, etc. It would also depend on the interest and willingness of the managers or owners of the hotels.

Annex 5

Center for the Promotion of Energy Efficiency

(Summary)

Justification

1. In the context of the structural reforms now under way in Bolivia, and in the energy sector in particular, promoting the rational use of energy and encouraging care for the environment are issues of special interest. Their importance relates to the need to improve standards of efficiency and productivity, on both the supply side and the demand side, and to create a sustainable economic base.

2. This will require efforts to make rational use of energy resources, expand the range of available technologies based on nonpolluting energy sources (such as solar, hydro, and wind power), and prevent environmental degradation by applying environmentally responsible practices that are consistent with the processes for producing goods and providing services.

Sponsors

3. The sponsoring entities helping establish the Center for the Promotion of Energy Efficiency (CPEE) are the Bolivian Confederation of Private Entrepreneurs and the National Chamber of Industry and Commerce.

Institutional support

4. The proposal is supported by the following institutions:

- Energy Efficiency Project – ESMAP/World Bank
- The Office of the Deputy Minister of Energy and Hydrocarbons -- Ministry of Economic Development

Objectives of CPEE

5. The overall objective of the CPEE is to contribute to the introduction, dissemination, and adoption of measures to promote energy savings and the rational use of energy, and practices for preventing pollution in the various sectors of economic activity, thereby helping to establish a market-based relationship between the suppliers and consumers of energy efficiency services.

Principal activities of the Center

6. The following will be the principal activities of the CPEE:

- Strengthening and promoting the supply of, and demand for, technical assistance services in the field of energy efficiency and pollution prevention.
- Coordinating efforts among the entities involved.
- Establishing links between suppliers and consumers of energy efficiency and pollution control services.
- Strengthening, encouraging, and assisting the providers of energy efficiency and pollution control services.
- Promoting the establishment of energy services companies (ESCOs).
- Certifying the quality of energy efficiency and pollution control services.
- Developing information services for the productive and service sectors.
- Disseminating the results of successful experiments undertaken within the country and abroad.
- Developing mechanisms for the exchange of technological information.
- Proposing institutional policies that the Government can implement to help the manufacturing and services sectors consolidate the benefits provided by technical assistance and international cooperation.
- Helping the Government establish regulations for the rational use of the country's natural resources and environment.

Project cost: US$ 2 million for three years

ANNEX 6

Fund for Investment in New Energy Sources

(Summary)

Background

1. The following barriers for investment in renewable energy and energy efficiency projects have been identified:

- Economic obstacles.
- Lack of financial mechanisms for supporting energy efficiency measures.
- The financial system lacks the criteria and experience needed for evaluating projects of this type.
- This is not an area of priority interest of either public or private sector.
- Lack of information.
- Lack of specialized technical assistance.
- High financial costs.
- Repayment periods.
- Guarantee mechanisms.

Description and objectives

2. A financial mechanism has been devised which is intended to support energy efficiency and renewable energy projects. Its objectives is to

- Encourage the rational and competitive use of energy.
- Improve the market competitiveness of the country's economic sectors.
- Minimize their environmental impact.

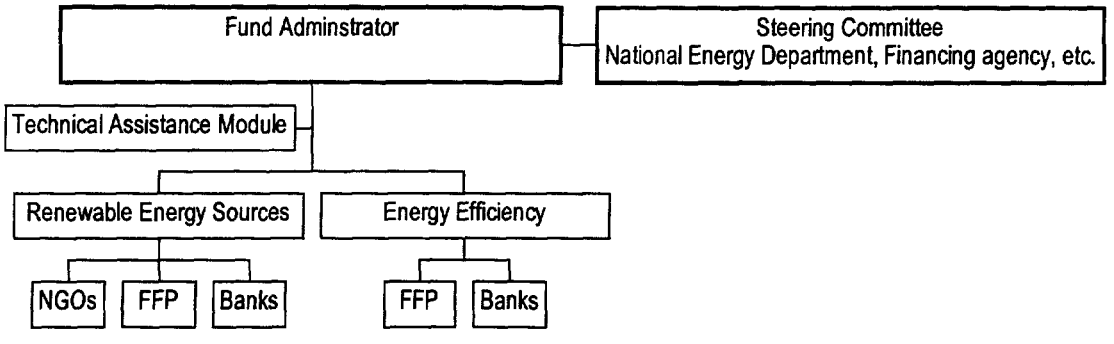
Features

3. The most important features of the financial mechanism are the following:

- An incentive mechanism for energy efficiency, sponsored by the Government.
- Aimed at the private-sector producers.
- Established in, and managed by, the private sector.
- Receiving guidance from international cooperation agencies, the Government, and the private sector.

Institutional framework

4. The graph shows the basic relationships which will govern the financial mechanism.



Joint UNDP/World Bank

ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)

LIST OF REPORTS ON COMPLETED ACTIVITIES

Region/Country	*Activity/Report Title*	*Date*	*Number*
	SUB-SAHARAN AFRICA (AFR)		
Africa Regional	Anglophone Africa Household Energy Workshop (English)	07/88	085/88
	Regional Power Seminar on Reducing Electric Power System Losses in Africa (English)	08/88	087/88
	Institutional Evaluation of EGL (English)	02/89	098/89
	Biomass Mapping Regional Workshops (English)	05/89	--
	Francophone Household Energy Workshop (French)	08/89	--
	Interafrican Electrical Engineering College: Proposals for Short- and Long-Term Development (English)	03/90	112/90
	Biomass Assessment and Mapping (English)	03/90	--
	Symposium on Power Sector Reform and Efficiency Improvement in Sub-Saharan Africa (English)	06/96	182/96
	Commercialization of Marginal Gas Fields (English)	12/97	201/97
	Commercilizing Natural Gas: Lessons from the Seminar in Nairobi for Sub-Saharan Africa and Beyond	01/00	225/00
Angola	Energy Assessment (English and Portuguese)	05/89	4708-ANG
	Power Rehabilitation and Technical Assistance (English)	10/91	142/91
Benin	Energy Assessment (English and French)	06/85	5222-BEN
Botswana	Energy Assessment (English)	09/84	4998-BT
	Pump Electrification Prefeasibility Study (English)	01/86	047/86
	Review of Electricity Service Connection Policy (English)	07/87	071/87
	Tuli Block Farms Electrification Study (English)	07/87	072/87
	Household Energy Issues Study (English)	02/88	--
	Urban Household Energy Strategy Study (English)	05/91	132/91
Burkina Faso	Energy Assessment (English and French)	01/86	5730-BUR
	Technical Assistance Program (English)	03/86	052/86
	Urban Household Energy Strategy Study (English and French)	06/91	134/91
Burundi	Energy Assessment (English)	06/82	3778-BU
	Petroleum Supply Management (English)	01/84	012/84
	Status Report (English and French)	02/84	011/84
	Presentation of Energy Projects for the Fourth Five-Year Plan (1983-1987) (English and French)	05/85	036/85
	Improved Charcoal Cookstove Strategy (English and French)	09/85	042/85
	Peat Utilization Project (English)	11/85	046/85
	Energy Assessment (English and French)	01/92	9215-BU
Cape Verde	Energy Assessment (English and Portuguese)	08/84	5073-CV
	Household Energy Strategy Study (English)	02/90	110/90
Central African Republic	Energy Assessement (French)	08/92	9898-CAR
Chad	Elements of Strategy for Urban Household Energy The Case of N'djamena (French)	12/93	160/94
Comoros	Energy Assessment (English and French)	01/88	7104-COM
	In Search of Better Ways to Develop Solar Markets: The Case of Comoros	05/00	230/00
Congo	Energy Assessment (English)	01/88	6420-COB
	Power Development Plan (English and French)	03/90	106/90
Côte d'Ivoire	Energy Assessment (English and French)	04/85	5250-IVC
	Improved Biomass Utilization (English and French)	04/87	069/87

Region/Country	*Activity/Report Title*	*Date*	*Number*
Côte d'Ivoire	Power System Efficiency Study (English)	12/87	--
	Power Sector Efficiency Study (French)	02/92	140/91
	Project of Energy Efficiency in Buildings (English)	09/95	175/95
Ethiopia	Energy Assessment (English)	07/84	4741-ET
	Power System Efficiency Study (English)	10/85	045/85
	Agricultural Residue Briquetting Pilot Project (English)	12/86	062/86
	Bagasse Study (English)	12/86	063/86
	Cooking Efficiency Project (English)	12/87	--
	Energy Assessment (English)	02/96	179/96
Gabon	Energy Assessment (English)	07/88	6915-GA
The Gambia	Energy Assessment (English)	11/83	4743-GM
	Solar Water Heating Retrofit Project (English)	02/85	030/85
	Solar Photovoltaic Applications (English)	03/85	032/85
	Petroleum Supply Management Assistance (English)	04/85	035/85
Ghana	Energy Assessment (English)	11/86	6234-GH
	Energy Rationalization in the Industrial Sector (English)	06/88	084/88
	Sawmill Residues Utilization Study (English)	11/88	074/87
	Industrial Energy Efficiency (English)	11/92	148/92
Guinea	Energy Assessment (English)	11/86	6137-GUI
	Household Energy Strategy (English and French)	01/94	163/94
Guinea-Bissau	Energy Assessment (English and Portuguese)	08/84	5083-GUB
	Recommended Technical Assistance Projects (English & Portuguese)	04/85	033/85
	Management Options for the Electric Power and Water Supply Subsectors (English)	02/90	100/90
	Power and Water Institutional Restructuring (French)	04/91	118/91
Kenya	Energy Assessment (English)	05/82	3800-KE
	Power System Efficiency Study (English)	03/84	014/84
	Status Report (English)	05/84	016/84
	Coal Conversion Action Plan (English)	02/87	--
	Solar Water Heating Study (English)	02/87	066/87
	Peri-Urban Woodfuel Development (English)	10/87	076/87
	Power Master Plan (English)	11/87	--
	Power Loss Reduction Study (English)	09/96	186/96
	Implementation Manual: Financing Mechanisms for Solar Electric Equipment	07/00	231/00
Lesotho	Energy Assessment (English)	01/84	4676-LSO
Liberia	Energy Assessment (English)	12/84	5279-LBR
	Recommended Technical Assistance Projects (English)	06/85	038/85
	Power System Efficiency Study (English)	12/87	081/87
Madagascar	Energy Assessment (English)	01/87	5700-MAG
	Power System Efficiency Study (English and French)	12/87	075/87
	Environmental Impact of Woodfuels (French)	10/95	176/95
Malawi	Energy Assessment (English)	08/82	3903-MAL
	Technical Assistance to Improve the Efficiency of Fuelwood Use in the Tobacco Industry (English)	11/83	009/83
	Status Report (English)	01/84	013/84
Mali	Energy Assessment (English and French)	11/91	8423-MLI
	Household Energy Strategy (English and French)	03/92	147/92
Islamic Republic of Mauritania	Energy Assessment (English and French)	04/85	5224-MAU
	Household Energy Strategy Study (English and French)	07/90	123/90

Region/Country	*Activity/Report Title*	*Date*	*Number*
Mauritius	Energy Assessment (English)	12/81	3510-MAS
	Status Report (English)	10/83	008/83
	Power System Efficiency Audit (English)	05/87	070/87
	Bagasse Power Potential (English)	10/87	077/87
	Energy Sector Review (English)	12/94	3643-MAS
Mozambique	Energy Assessment (English)	01/87	6128-MOZ
	Household Electricity Utilization Study (English)	03/90	113/90
	Electricity Tariffs Study (English)	06/96	181/96
	Sample Survey of Low Voltage Electricity Customers	06/97	195/97
Namibia	Energy Assessment (English)	03/93	11320-NAM
Niger	Energy Assessment (French)	05/84	4642-NIR
	Status Report (English and French)	02/86	051/86
	Improved Stoves Project (English and French)	12/87	080/87
	Household Energy Conservation and Substitution (English and French)	01/88	082/88
Nigeria	Energy Assessment (English)	08/83	4440-UNI
	Energy Assessment (English)	07/93	11672-UNI
Rwanda	Energy Assessment (English)	06/82	3779-RW
	Status Report (English and French)	05/84	017/84
	Improved Charcoal Cookstove Strategy (English and French)	08/86	059/86
	Improved Charcoal Production Techniques (English and French)	02/87	065/87
	Energy Assessment (English and French)	07/91	8017-RW
	Commercialization of Improved Charcoal Stoves and Carbonization Techniques Mid-Term Progress Report (English and French)	12/91	141/91
SADC	SADC Regional Power Interconnection Study, Vols. I-IV (English)	12/93	--
SADCC	SADCC Regional Sector: Regional Capacity-Building Program for Energy Surveys and Policy Analysis (English)	11/91	--
Sao Tome and Principe	Energy Assessment (English)	10/85	5803-STP
Senegal	Energy Assessment (English)	07/83	4182-SE
	Status Report (English and French)	10/84	025/84
	Industrial Energy Conservation Study (English)	05/85	037/85
	Preparatory Assistance for Donor Meeting (English and French)	04/86	056/86
	Urban Household Energy Strategy (English)	02/89	096/89
	Industrial Energy Conservation Program (English)	05/94	165/94
Seychelles	Energy Assessment (English)	01/84	4693-SEY
	Electric Power System Efficiency Study (English)	08/84	021/84
Sierra Leone	Energy Assessment (English)	10/87	6597-SL
Somalia	Energy Assessment (English)	12/85	5796-SO
South Africa Republic of	Options for the Structure and Regulation of Natural Gas Industry (English)	05/95	172/95
Sudan	Management Assistance to the Ministry of Energy and Mining	05/83	003/83
	Energy Assessment (English)	07/83	4511-SU
	Power System Efficiency Study (English)	06/84	018/84
	Status Report (English)	11/84	026/84
	Wood Energy/Forestry Feasibility (English)	07/87	073/87
Swaziland	Energy Assessment (English)	02/87	6262-SW
	Household Energy Strategy Study	10/97	198/97
Tanzania	Energy Assessment (English)	11/84	4969-TA
	Peri-Urban Woodfuels Feasibility Study (English)	08/88	086/88
	Tobacco Curing Efficiency Study (English)	05/89	102/89
	Remote Sensing and Mapping of Woodlands (English)	06/90	--

Region/Country	*Activity/Report Title*	*Date*	*Number*
Tanzania	Industrial Energy Efficiency Technical Assistance (English)	08/90	122/90
	Power Loss Reduction Volume 1: Transmission and Distribution SystemTechnical Loss Reduction and Network Development (English)	06/98	204A/98
	Power Loss Reduction Volume 2: Reduction of Non-Technical Losses (English)	06/98	204B/98
Togo	Energy Assessment (English)	06/85	5221-TO
	Wood Recovery in the Nangbeto Lake (English and French)	04/86	055/86
	Power Efficiency Improvement (English and French)	12/87	078/87
Uganda	Energy Assessment (English)	07/83	4453-UG
	Status Report (English)	08/84	020/84
	Institutional Review of the Energy Sector (English)	01/85	029/85
	Energy Efficiency in Tobacco Curing Industry (English)	02/86	049/86
	Fuelwood/Forestry Feasibility Study (English)	03/86	053/86
	Power System Efficiency Study (English)	12/88	092/88
	Energy Efficiency Improvement in the Brick and Tile Industry (English)	02/89	097/89
	Tobacco Curing Pilot Project (English)	03/89	UNDP Terminal Report
	Energy Assessment (English)	12/96	193/96
	Rural Electrification Strategy Study	09/99	221/99
Zaire	Energy Assessment (English)	05/86	5837-ZR
Zambia	Energy Assessment (English)	01/83	4110-ZA
	Status Report (English)	08/85	039/85
	Energy Sector Institutional Review (English)	11/86	060/86
	Power Subsector Efficiency Study (English)	02/89	093/88
	Energy Strategy Study (English)	02/89	094/88
	Urban Household Energy Strategy Study (English)	08/90	121/90
Zimbabwe	Energy Assessment (English)	06/82	3765-ZIM
	Power System Efficiency Study (English)	06/83	005/83
	Status Report (English)	08/84	019/84
	Power Sector Management Assistance Project (English)	04/85	034/85
	Power Sector Management Institution Building (English)	09/89	--
	Petroleum Management Assistance (English)	12/89	109/89
	Charcoal Utilization Prefeasibility Study (English)	06/90	119/90
	Integrated Energy Strategy Evaluation (English)	01/92	8768-ZIM
	Energy Efficiency Technical Assistance Project: Strategic Framework for a National Energy Efficiency Improvement Program (English)	04/94	--
	Capacity Building for the National Energy Efficiency Improvement Programme (NEEIP) (English)	12/94	--
	Rural Electrification Study	03/00	228/00
	EAST ASIA AND PACIFIC (EAP)		
Asia Regional	Pacific Household and Rural Energy Seminar (English)	11/90	--
China	County-Level Rural Energy Assessments (English)	05/89	101/89
	Fuelwood Forestry Preinvestment Study (English)	12/89	105/89
	Strategic Options for Power Sector Reform in China (English)	07/93	156/93
	Energy Efficiency and Pollution Control in Township and Village Enterprises (TVE) Industry (English)	11/94	168/94

Region/Country	*Activity/Report Title*	*Date*	*Number*
China	Energy for Rural Development in China: An Assessment Based on a Joint Chinese/ESMAP Study in Six Counties (English)	06/96	183/96
	Improving the Technical Efficiency of Decentralized Power Companies	09/99	222/999
Fiji	Energy Assessment (English)	06/83	4462-FIJ
Indonesia	Energy Assessment (English)	11/81	3543-IND
	Status Report (English)	09/84	022/84
	Power Generation Efficiency Study (English)	02/86	050/86
	Energy Efficiency in the Brick, Tile and Lime Industries (English)	04/87	067/87
	Diesel Generating Plant Efficiency Study (English)	12/88	095/88
	Urban Household Energy Strategy Study (English)	02/90	107/90
	Biomass Gasifier Preinvestment Study Vols. I & II (English)	12/90	124/90
	Prospects for Biomass Power Generation with Emphasis on Palm Oil, Sugar, Rubberwood and Plywood Residues (English)	11/94	167/94
Lao PDR	Urban Electricity Demand Assessment Study (English)	03/93	154/93
	Institutional Development for Off-Grid Electrification	06/99	215/99
Malaysia	Sabah Power System Efficiency Study (English)	03/87	068/87
	Gas Utilization Study (English)	09/91	9645-MA
Myanmar	Energy Assessment (English)	06/85	5416-BA
Papua New Guinea	Energy Assessment (English)	06/82	3882-PNG
	Status Report (English)	07/83	006/83
	Energy Strategy Paper (English)	--	--
	Institutional Review in the Energy Sector (English)	10/84	023/84
	Power Tariff Study (English)	10/84	024/84
Philippines	Commercial Potential for Power Production from Agricultural Residues (English)	12/93	157/93
	Energy Conservation Study (English)	08/94	--
Solomon Islands	Energy Assessment (English)	06/83	4404-SOL
	Energy Assessment (English)	01/92	979-SOL
South Pacific	Petroleum Transport in the South Pacific (English)	05/86	--
Thailand	Energy Assessment (English)	09/85	5793-TH
	Rural Energy Issues and Options (English)	09/85	044/85
	Accelerated Dissemination of Improved Stoves and Charcoal Kilns (English)	09/87	079/87
	Northeast Region Village Forestry and Woodfuels Preinvestment Study (English)	02/88	083/88
	Impact of Lower Oil Prices (English)	08/88	--
	Coal Development and Utilization Study (English)	10/89	--
Tonga	Energy Assessment (English)	06/85	5498-TON
Vanuatu	Energy Assessment (English)	06/85	5577-VA
Vietnam	Rural and Household Energy-Issues and Options (English)	01/94	161/94
	Power Sector Reform and Restructuring in Vietnam: Final Report to the Steering Committee (English and Vietnamese)	09/95	174/95
	Household Energy Technical Assistance: Improved Coal Briquetting and Commercialized Dissemination of Higher Efficiency Biomass and Coal Stoves (English)	01/96	178/96
Western Samoa	Energy Assessment (English)	06/85	5497-WSO

Region/Country	*Activity/Report Title*	*Date*	*Number*
	SOUTH ASIA (SAS)		
Bangladesh	Energy Assessment (English)	10/82	3873-BD
	Priority Investment Program (English)	05/83	002/83
	Status Report (English)	04/84	015/84
Bangladesh	Power System Efficiency Study (English)	02/85	031/85
	Small Scale Uses of Gas Prefeasibility Study (English)	12/88	--
India	Opportunities for Commercialization of Nonconventional Energy Systems (English)	11/88	091/88
	Maharashtra Bagasse Energy Efficiency Project (English)	07/90	120/90
	Mini-Hydro Development on Irrigation Dams and Canal Drops Vols. I, II and III (English)	07/91	139/91
	WindFarm Pre-Investment Study (English)	12/92	150/92
	Power Sector Reform Seminar (English)	04/94	166/94
	Environmental Issues in the Power Sector (English)	06/98	205/98
	Environmental Issues in the Power Sector: Manual for Environmental Decision Making (English)	06/99	213/99
	Household Energy Strategies for Urban India: The Case of Hyderabad	06/99	214/99
Nepal	Energy Assessment (English)	08/83	4474-NEP
	Status Report (English)	01/85	028/84
	Energy Efficiency & Fuel Substitution in Industries (English)	06/93	158/93
Pakistan	Household Energy Assessment (English)	05/88	--
	Assessment of Photovoltaic Programs, Applications, and Markets (English)	10/89	103/89
	National Household Energy Survey and Strategy Formulation Study: Project Terminal Report (English)	03/94	--
	Managing the Energy Transition (English)	10/94	--
	Lighting Efficiency Improvement Program Phase 1: Commercial Buildings Five Year Plan (English)	10/94	--
Sri Lanka	Energy Assessment (English)	05/82	3792-CE
	Power System Loss Reduction Study (English)	07/83	007/83
	Status Report (English)	01/84	010/84
	Industrial Energy Conservation Study (English)	03/86	054/86
	EUROPE AND CENTRAL ASIA (ECA)		
Bulgaria	Natural Gas Policies and Issues (English)	10/96	188/96
Central and Eastern Europe	Power Sector Reform in Selected Countries	07/97	196/97
	Increasing the Efficiency of Heating Systems in Central and Eastern Europe and the Former Soviet Union	08/00	234/00
Eastern Europe	The Future of Natural Gas in Eastern Europe (English)	08/92	149/92
Kazakhstan	Natural Gas Investment Study, Volumes 1, 2 & 3	12/97	199/97
Kazakhstan & Kyrgyzstan	Opportunities for Renewable Energy Development	11/97	16855-KAZ
Poland	Energy Sector Restructuring Program Vols. I-V (English)	01/93	153/93
	Natural Gas Upstream Policy (English and Polish)	08/98	206/98
	Energy Sector Restructuring Program: Establishing the Energy Regulation Authority	10/98	208/98
Portugal	Energy Assessment (English)	04/84	4824-PO

Region/Country	*Activity/Report Title*	*Date*	*Number*
Romania	Natural Gas Development Strategy (English)	12/96	192/96
Slovenia	Workshop on Private Participation in the Power Sector (English)	02/99	211/99
Turkey	Energy Assessment (English)	03/83	3877-TU
	Energy and the Environment: Issues and Options Paper	04/00	229/00

MIDDLE EAST AND NORTH AFRICA (MNA)

Arab Republic of Egypt	Energy Assessment (English)	10/96	189/96
	Energy Assessment (English and French)	03/84	4157-MOR
	Status Report (English and French)	01/86	048/86
Morocco	Energy Sector Institutional Development Study (English and French)	07/95	173/95
	Natural Gas Pricing Study (French)	10/98	209/98
	Gas Development Plan Phase II (French)	02/99	210/99
Syria	Energy Assessment (English)	05/86	5822-SYR
	Electric Power Efficiency Study (English)	09/88	089/88
	Energy Efficiency Improvement in the Cement Sector (English)	04/89	099/89
	Energy Efficiency Improvement in the Fertilizer Sector (English)	06/90	115/90
Tunisia	Fuel Substitution (English and French)	03/90	--
	Power Efficiency Study (English and French)	02/92	136/91
	Energy Management Strategy in the Residential and Tertiary Sectors (English)	04/92	146/92
	Renewable Energy Strategy Study, Volume I (French)	11/96	190A/96
	Renewable Energy Strategy Study, Volume II (French)	11/96	190B/96
Yemen	Energy Assessment (English)	12/84	4892-YAR
	Energy Investment Priorities (English)	02/87	6376-YAR
	Household Energy Strategy Study Phase I (English)	03/91	126/91

LATIN AMERICA AND THE CARIBBEAN (LAC)

LAC Regional	Regional Seminar on Electric Power System Loss Reduction in the Caribbean (English)	07/89	--
	Elimination of Lead in Gasoline in Latin America and the Caribbean (English and Spanish)	04/97	194/97
	Elimination of Lead in Gasoline in Latin America and the Caribbean - Status Report (English and Spanish)	12/97	200/97
	Harmonization of Fuels Specifications in Latin America and the Caribbean (English and Spanish)	06/98	203/98
Bolivia	Energy Assessment (English)	04/83	4213-BO
	National Energy Plan (English)	12/87	--
	La Paz Private Power Technical Assistance (English)	11/90	111/90
	Prefeasibility Evaluation Rural Electrification and Demand Assessment (English and Spanish)	04/91	129/91
	National Energy Plan (Spanish)	08/91	131/91
	Private Power Generation and Transmission (English)	01/92	137/91
	Natural Gas Distribution: Economics and Regulation (English)	03/92	125/92
	Natural Gas Sector Policies and Issues (English and Spanish)	12/93	164/93
	Household Rural Energy Strategy (English and Spanish)	01/94	162/94
	Preparation of Capitalization of the Hydrocarbon Sector	12/96	191/96

Region/Country	*Activity/Report Title*	*Date*	*Number*
Bolivia	Introducing Competition into the Electricity Supply Industry in Developing Countries: Lessons from Bolivia	08/00	233/00
	Final Report on Operational Activities Rural Energy and Energy Efficiency	08/00	235/00
Brazil	Energy Efficiency & Conservation: Strategic Partnership for Energy Efficiency in Brazil (English)	01/95	170/95
	Hydro and Thermal Power Sector Study	09/97	197/97
	Rural Electrification with Renewable Energy Systems in the Northeast: A Preinvestment Study	07/00	232/00
Chile	Energy Sector Review (English)	08/88	7129-CH
Colombia	Energy Strategy Paper (English)	12/86	--
	Power Sector Restructuring (English)	11/94	169/94
	Energy Efficiency Report for the Commercial and Public Sector (English)	06/96	184/96
Costa Rica	Energy Assessment (English and Spanish)	01/84	4655-CR
	Recommended Technical Assistance Projects (English)	11/84	027/84
	Forest Residues Utilization Study (English and Spanish)	02/90	108/90
Dominican Republic	Energy Assessment (English)	05/91	8234-DO
Ecuador	Energy Assessment (Spanish)	12/85	5865-EC
	Energy Strategy Phase I (Spanish)	07/88	--
	Energy Strategy (English)	04/91	--
	Private Minihydropower Development Study (English)	11/92	--
	Energy Pricing Subsidies and Interfuel Substitution (English)	08/94	11798-EC
	Energy Pricing, Poverty and Social Mitigation (English)	08/94	12831-EC
Guatemala	Issues and Options in the Energy Sector (English)	09/93	12160-GU
Haiti	Energy Assessment (English and French)	06/82	3672-HA
	Status Report (English and French)	08/85	041/85
	Household Energy Strategy (English and French)	12/91	143/91
Honduras	Energy Assessment (English)	08/87	6476-HO
	Petroleum Supply Management (English)	03/91	128/91
Jamaica	Energy Assessment (English)	04/85	5466-JM
	Petroleum Procurement, Refining, and Distribution Study (English)	11/86	061/86
	Energy Efficiency Building Code Phase I (English)	03/88	--
	Energy Efficiency Standards and Labels Phase I (English)	03/88	--
	Management Information System Phase I (English)	03/88	--
	Charcoal Production Project (English)	09/88	090/88
	FIDCO Sawmill Residues Utilization Study (English)	09/88	088/88
	Energy Sector Strategy and Investment Planning Study (English)	07/92	135/92
Mexico	Improved Charcoal Production Within Forest Management for the State of Veracruz (English and Spanish)	08/91	138/91
	Energy Efficiency Management Technical Assistance to the Comision Nacional para el Ahorro de Energia (CONAE) (English)	04/96	180/96
Panama	Power System Efficiency Study (English)	06/83	004/83
Paraguay	Energy Assessment (English)	10/84	5145-PA
	Recommended Technical Assistance Projects (English)	09/85	--
	Status Report (English and Spanish)	09/85	043/85
Peru	Energy Assessment (English)	01/84	4677-PE
	Status Report (English)	08/85	040/85
	Proposal for a Stove Dissemination Program in the Sierra (English and Spanish)	02/87	064/87

Region/Country	*Activity/Report Title*	*Date*	*Number*
Peru	Energy Strategy (English and Spanish)	12/90	--
	Study of Energy Taxation and Liberalization of the Hydrocarbons Sector (English and Spanish)	120/93	159/93
	Reform and Privatization in the Hydrocarbon Sector (English and Spanish)	07/99	216/99
Saint Lucia	Energy Assessment (English)	09/84	5111-SLU
St. Vincent and the Grenadines	Energy Assessment (English)	09/84	5103-STV
Sub Andean	Environmental and Social Regulation of Oil and Gas Operations in Sensitive Areas of the Sub-Andean Basin (English and Spanish)	07/99	217/99
Trinidad and Tobago	Energy Assessment (English)	12/85	5930-TR
	GLOBAL		
	Energy End Use Efficiency: Research and Strategy (English)	11/89	--
	Women and Energy--A Resource Guide The International Network: Policies and Experience (English)	04/90	--
	Guidelines for Utility Customer Management and Metering (English and Spanish)	07/91	--
	Assessment of Personal Computer Models for Energy Planning in Developing Countries (English)	10/91	--
	Long-Term Gas Contracts Principles and Applications (English)	02/93	152/93
	Comparative Behavior of Firms Under Public and Private Ownership (English)	05/93	155/93
	Development of Regional Electric Power Networks (English)	10/94	--
	Roundtable on Energy Efficiency (English)	02/95	171/95
	Assessing Pollution Abatement Policies with a Case Study of Ankara (English)	11/95	177/95
	A Synopsis of the Third Annual Roundtable on Independent Power Projects: Rhetoric and Reality (English)	08/96	187/96
	Rural Energy and Development Roundtable (English)	05/98	202/98
	A Synopsis of the Second Roundtable on Energy Efficiency: Institutional and Financial Delivery Mechanisms (English)	09/98	207/98
	The Effect of a Shadow Price on Carbon Emission in the Energy Portfolio of the World Bank: A Carbon Backcasting Exercise (English)	02/99	212/99
	Increasing the Efficiency of Gas Distribution Phase 1: Case Studies and Thematic Data Sheets	07/99	218/99
	Global Energy Sector Reform in Developing Countries: A Scorecard	07/99	219/99
	Global Lighting Services for the Poor Phase II: Text Marketing of Small "Solar" Batteries for Rural Electrification Purposes	08/99	220/99
	A Review of the Renewable Energy Activities of the UNDP/ World Bank Energy Sector Management Assistance Programme 1993 to 1998	11/99	223/99
	Energy, Transportation and Environment: Policy Options for Environmental Improvement	12/99	224/99

Region/Country	*Activity/Report Title*	*Date*	*Number*
Global	Privatization, Competition and Regulation in the British Electricity Industry, With Implications for Developing Countries	02/00	226/00
	Reducing the Cost of Grid Extension for Rural Electrification	02/00	227/00

8/31/00

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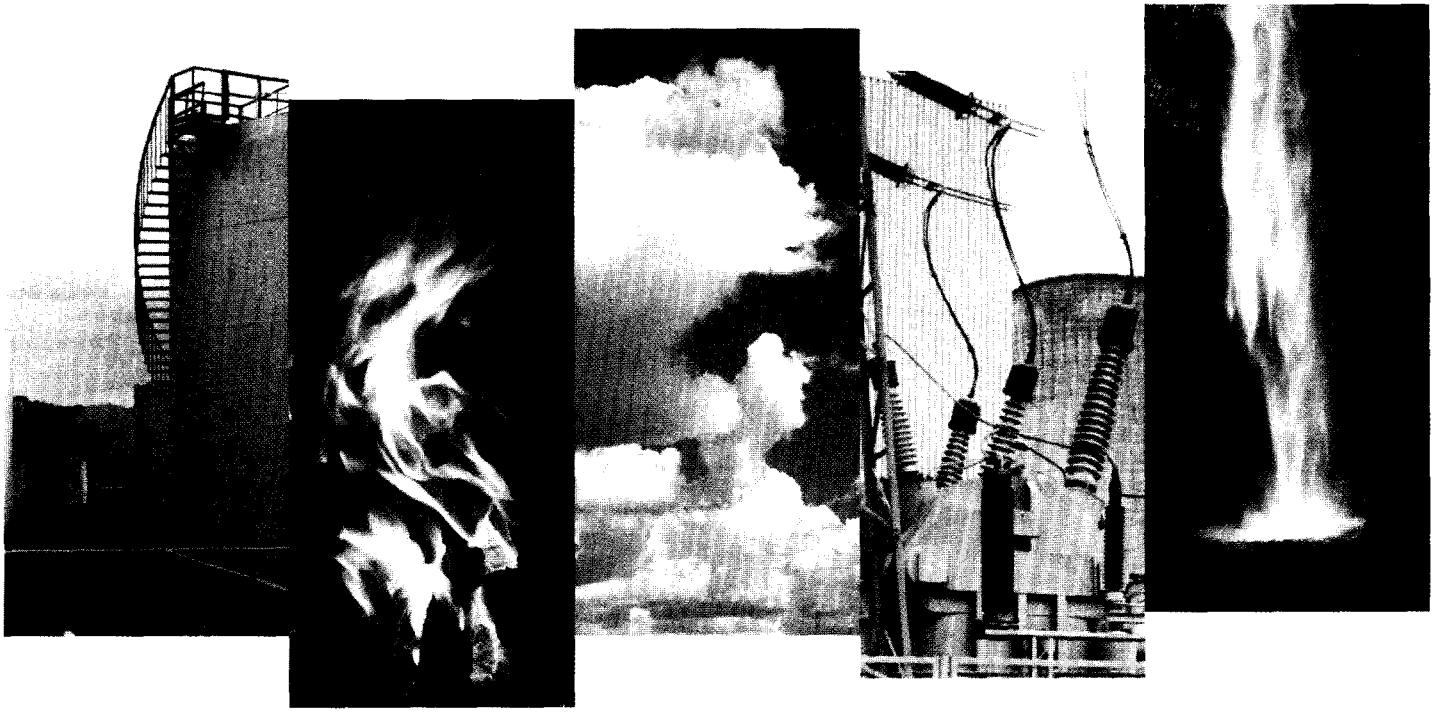

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