

Analysis

Of the Energy Sector In Rural Areas of Paraguay



**MINISTERIO DE OBRAS PÚBLICAS
Y COMUNICACIONES**

VICEMINISTERIO DE MINAS Y ENERGÍA

Project: Rural Electrification

Date: November 2005



**Canadian International
Development Agency**

olade
Organización Latinoamericana de Energía



**UNIVERSITY OF
CALGARY**

The author of this document is Jean-Claude Pulfer, consultant.

The opinions expressed in the document are the responsibility of the author and do not bind the sponsoring organizations, "Latin American Energy Organization" (OLADE), "Canadian International Development Agency" (CIDA), "University of Calgary" or the "Ministerio de Obras Públicas y Comunicaciones (MOPC) – Viceministerio de Minas y Energía del Paraguay".

The use the information contained in this document is permitted if the source is cited.

The rights to this document are the property of the Rural Electrification Project of OLADE/University of Calgary/CIDA/Viceministerio de Minas y Energía del MOPC de Paraguay.

TABLE OF CONTENTS:

LIST OF TABLES AND ILLUSTRATIONS:	5
ABBREVIATIONS:	7
EXECUTIVE SUMMARY:	9
GENERAL CONTEXT OF THE COUNTRY AND ITS RURAL AREA	12
1.1. The Country and its Political Organization	12
1.2. Principal Demographic Data and Ethnic Composition	13
1.2.1. Total Population and Rural Population	13
1.2.2. Indigenous Population	14
1.3. Social and Economic Situation	15
1.4. Human Development Index and Unsatisfied Basic Needs	20
1.5. Productive Models in Rural Areas	21
1.6. Organizational Systems in Rural Areas	21
1.6.1. Introduction	21
1.6.2. Neighborhood Commissions	22
1.6.3. Production Committees	23
1.6.4. Peasant Organizations	23
1.7. Public Services in Rural Areas	24
1.7.1. Potable Water and Sanitation	24
1.7.2. Telephone Service	25
1.7.3. Electrical Energy	26
1.7.4. Highways	28
1.7.5. Education	28
1.7.6. Health and Social Welfare	30
1.8. Energy Matrix in Rural Areas	31
1.8.1. Energy Demand of Rural Families	31
1.8.2. Distribution of Improved Stoves	32
1.8.3. Energy Costs in Rural Areas	33
2. RURAL DEVELOPMENT ACTIONS	34
2.1. Introduction	34
2.2. Agrarian Reform	35
2.3. Rural Electrification	35
2.3.1. Historical Aspects	35
2.3.2. Electrification Plans	36

2.3.3.	Self-Help System.....	36
2.3.4.	Social Rate.....	38
2.3.5.	User Categories and Average Consumption.....	38
2.4.	Access to Financing.....	38
2.5.	Rural Industrialization.....	39
3.	REGULATORY AND INSTITUTIONAL FRAMEWORK FOR RURAL ENERGY	41
3.1.	Introduction	41
3.2.	Viceministerio de Minas y Energía	41
3.3.	Administración Nacional de Electricidad	42
3.4.	Entidad Binacional Itaipú.....	43
3.5.	Entidad Binacional Yacyretá.....	45
3.6.	Private Stakeholders in the Electrical Sector	45
3.7.	National Forest Service	46
3.8.	Secretaría del Ambiente	48
3.9.	Instituto Nacional de Tecnología y Normalización	50
3.10.	Public Contracts	53
4.	RURAL ELECTRIFICATION PROGRAMS.....	56
4.1.	Conventional Electrification	56
4.1.1.	Programs for Rehabilitating the Distribution Infrastructure of Self-Help Systems.....	56
4.1.2.	Short Term Electrification Plan.....	56
4.1.3.	Electrification of Indigenous Communities.....	57
4.2.	Decentralized Electrification of Isolated Communities.....	58
4.2.1.	Introduction	58
4.2.2.	Puerto 14 de Mayo, Indigenous Community of Karcha Bahlut.....	58
4.2.3.	Acaray Mi Indigenous Community	59
4.2.4.	Electrification of Rural Community Centers	60
4.2.5.	Sustainable Energy in Isolated Rural Communities for Productive Purposes	61
4.3.	Renewable Energy Project for Decentralized Rural Electrification	62
4.3.1.	Background	62
4.3.2.	Objetives	¡Error! Marcador no definido.
4.3.3.	Proposed Activities.....	62
4.3.4.	Work Method	63
4.3.5.	Institutional Analysis.....	64
4.3.6.	Barriers to the Dissemination of Renewable Energy.....	64
4.3.7.	Components of a Full Size Project	66
4.3.8.	Implications of the Rural Electrification Project.....	69

5. STRATEGIC PLAN OF THE ENERGY SECTOR OF THE REPUBLIC OF PARAGUAY 2004-2013.....	70
5.1. Introduction	70
5.2. Strategic Plan	70
5.2.1. Projected Scenarios	70
5.2.2. Energy Consumption	71
5.2.3. Energy Production	73
5.2.4. Weaknesses of the Energy Sector.....	76
5.2.5. Strengths of the Energy System	77
5.2.6. Strategic Plan.....	77
5.3. Regulatory Framework	81
5.3.1. Introduction	81
5.3.2. Weaknesses of the existing regulatory framework.....	81
5.3.3. Proposed Reforms in the Regulatory Framework	82
5.4. PESE viewed from the standpoint of rural electrification	83
6. RENEWABLE ENERGY RESOURCES.....	85
6.1. Solar Energy.....	85
6.2. Wind Energy	86
6.3. Hydraulic energy	87
6.4. Biomass.....	88
6.4.1. Introduction	88
6.4.2. Alcohol.....	88
6.4.3. Biodiesel.....	89
6.5. Summary of Renewable Energy Resources	89
BIBLIOGRAPHY.....	91

List of Tables and Illustrations:

Table 1: Departments of Paraguay showing their area and total and rural population.	13
Table 2: Ethnic groups of Paraguay	15
Table 3: Poverty levels by area %	16
Table 4: Family income by area and by decile 2000/2001	17
Table 5: Unsatisfied basic needs by department and type of NBI 2002	20
Table 6: Participation by citizens over 15 in 2002	¡Error! Marcador no definido.
Table 7: Percentage of homes by type of water supply and by area	24
Table 8: Homes and population without electricity by department (2002)	26
Table 9: Type of energy used principally for cooking	31
Table 10: Indigenous homes by department that will benefit from the project.....	57
Table 11: Cost of Project Components and Funding Sources.....	69
Table 12: Percentage variation in energy consumption between 2002 and 2013 by scenario	72
Table 13: Variation in per capita electricity consumption and energy intensity between 2002 and 2013 by scenario.....	72
Table 14: Percentages of energy sources in final consumption by scenario	73
Table 15: Projections of energy consumption (thousands of tep).....	73
Table 16: Electrical energy production forecasts by power plant 2003-2013	74
Table 17: Evolution of primary energy production (thousands of tep)	75
Table 18: Distribution of investments in renewable energy systems	80
Table 19: Average overall solar radiation in MJ/m ²	85
Figure 1: Political divisions of Paraguay	12
Figure 2: GINI coefficients of Latin American and Caribbean countries	18
Figure 3: Real per capita GDP in 1992 by district in the eastern region in 1992 US\$..	19
Figure 4: Population over 15 years that took a non-formal course, by years of schooling	29
Figure 5: Average years of schooling of the population over 25 years of age	29
Figure 6: Rate of illiteracy by sex.....	30
Figure 7: Annual average distribution of daily solar radiation (kWh/m ²)	85
Figure 8: Distribution of annual average wind energy in kWh/m ²	87
Figure 9: The most cost efficient renewable energy resources by zone.....	89

Abbreviations:

ANDE	Administración Nacional de Electricidad
IDB	Inter American Development Bank
BIOCAP	Cámara Paraguaya del Biodiesel
BNF	Banco Nacional de Fomento
CAH	Crédito Agrícola y de Rehabilitación
ECLAC	Economic Commission for Latin America and the Caribbean
CICAL	Centro Industrial de la Caña y del Alcohol
CIRD	Centro de Información y Recursos para el Desarrollo
CLYFSA	Compañía de Luz y Fuerza S.A.
COMIGAS	Comisión Mixta del Gas
CONAMURI	Coordinación Nacional de Mujeres Rurales e Indígenas
COPACO	Compañía Paraguaya de Telecomunicaciones S.A.
COPEP	Central de Organizaciones de Productores Ecológicos del Paraguay
DEAG	Dirección de Extensión Agraria
DGEEC	Dirección General de Estadísticas, Encuestas y Censos
DRE	Dirección de Recursos Energéticos
DRM	Dirección de Recursos Minerales
EIA	Environmental Impact Assessment
ENREL	Ente Regulador del Sector Eléctrico
EPH	Encuesta Permanente del Hogar
RE	Renewable Energy
ERD	Electrificación Rural Descentralizada
ERERD	Energía Renovable para la Electrificación Rural Descentralizada
ERSSAN	Ente Regulador del Sector Saneamiento
ESSAP	Empresa de Servicios Sanitarios del Paraguay S.A.
FDC	Fondo de Desarrollo Campesino
FMAM	Fondo para el Medio Ambiente Mundial
FNC	Federación Nacional Campesina
SWOT	Strengths, Weaknesses, Opportunities, Threats
RES	Renewable Energy Sources
FSP	Full Size Project
FUNDASDOL	Fundación para la Inversión Solidaria
FUNDECA	Fundación para el Desarrollo Campesino
GEF	Global Environmental Facility
LPG	Liquefied Petroleum Gas
GTZ	Gesellschaft für Technische Zusammenarbeit
IBR	Instituto de Bienestar Rural
HDI	Human Development Index
IFI	Instituciones de Financiación Intermediarias
IICA	Instituto Interamericano de Cooperación Agrícola
INCOOP	Instituto Nacional de Cooperativismo
INDERT	Instituto Nacional de Desarrollo Rural y de la Tierra
INDHP	Informe Nacional de Desarrollo Humano Paraguay
INDI	Instituto Paraguayo del Indígena
INTN	Instituto Nacional de Tecnología y Normalización
IPS	Instituto de Previsión Social
KfW	Kreditanstalt für Wiederaufbau
MAG	Ministerio de Agricultura y Ganadería
MCNOC	Mesa Coordinadora Nacional de Organizaciones Campesinas
MEC	Ministerio de Educación y Cultura

MERCOSUR	Mercado Común del Sur
MOPC	Ministerio de Obras Públicas y Comunicación
MSPBS	Ministerio de Salud Pública y Bienestar Social
NBI	Unsatisfied Basic Needs
UN	United Nations
OC	Peasant Organization
OAS	Organization of American States
OLADE	Latin American Energy Organization
ONAC	Organización Nacional Campesina
NGO	Non Governmental Organization
PDF	Project Document Form
PESE	Plan Estratégico del Sector Energético
PETROPAR	Petróleos Paraguayos
PI	Plan International
GDP	Gross Domestic Product
UNDP	United Nations Development Program
PRODECHACO	Proyecto para el Desarrollo Duradero del Chaco
SEAM	Secretaría del Ambiente
SEDI	Secretaría Ejecutiva para el Desarrollo Integral
SENASA	Servicio Nacional de Saneamiento
SFN	Servicio Forestal Nacional
SIN	Sistema Interconectado Nacional
STP	Secretaría Técnica de Planificación
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
VMME	Viceministerio de Minas y Energía

Executive Summary:

This document, "Analysis of the Energy Sector in the Rural Area of Paraguay," was prepared within the framework of a "Rural Energy Project" that was implemented in four countries of Latin America by the Latin American Energy Organization OLADE with the assistance of the University of Calgary, Canada. The report consists of 6 main chapters and is summarized below.

The first chapter discusses the general context of Paraguay and its rural area. There is a brief analysis of the geographic, demographic, and economic situation of the country that highlights the critical poverty that affects almost half the population of Paraguay. The second part of the chapter describes in more detail several specific aspects of the rural area, including existing methods of organization of the rural population and the status of the principal public services, including potable water and sanitation, telephones, electricity, roads, education and health and social welfare. Most of these public services are quite deficient in the rural area with the exception of electricity and basic education, where the level of coverage is relatively high in most of the country except for the Chaco region. The final part of chapter one analyzes the energy matrix of the rural area, focusing principally on the residential and commercial sectors. A high percentage use firewood as a fuel at the national level, and this constitutes more than 70% of all energy consumed; in rural areas, it is even higher. Despite the surplus of electricity that is produced in Paraguay, the penetration is very low in the domestic and industrial sectors. Rural homes that receive electrical energy from ANDE enjoy a social rate that is subsidized up to 75%.

The second chapter is an overview of rural development actions carried out in Paraguay by governmental and non-governmental organizations. Rural electrification, implemented almost exclusively by a state company, ANDE, is one of the actions that are analyzed in greater depth. There is a detailed description of the operation and scope of the electrification program begun in 1991 under the Self-Help System. The principal objective of that system was to reduce the investment cost of electrification in rural areas, where profitability is unattainable by conventional systems due to low consumption and low user density. Under the Self-Help System, costs are shared by ANDE, which provides the engineering and electrical materials, and the users, who contribute unskilled labor and materials for the posts.

The third chapter presents the current regulatory and institutional framework that is directly or indirectly involved with rural electrification. It first describes several pertinent state institutions and the legal framework that governs their functions and powers. The institutions are as follows: Viceministerio de Minas y Energía, Administración Nacional de Electricidad, Entidad Binacional Itaipú, Entidad Binacional Yacretá, Servicio Forestal Nacional, Secretaría del Ambiente and Instituto Nacional de Tecnología y Normalización. The subsection on the Secretaría del Ambiente mainly discusses the Law of Environmental Impact Assessment, which requires that a study be carried out for all types of projects and human activities of a certain magnitude that could directly or indirectly affect the environment. Another section discusses the principal private stakeholders in the electrical sector, and the final section summarizes the Law of Public Contracting.

The fourth chapter examines the different rural electrification programs in Paraguay. It first discusses ANDE programs, including the "Program for Maintaining Self-Help

Distribution Systems” and the “Short Term Electrification Plan” for the 2004-2008 period. Examples of decentralized rural electrification include two projects that were implemented by NGOs in recent years in two Indigenous communities, one involving photovoltaic solar energy and the other, biodiesel, as well as a project carried out by INTN in two communities with the assistance of the OAS.

The chapter ends with a detailed description of the “Renewable Energy Project for Decentralized Rural Electrification” that was carried out in 2001 and 2002 under the Viceministerio de Minas y Energía and the Paraguay office of UNDP, with the financial assistance of GEF. Its development objective was to establish and consolidate market conditions in order to remove barriers to the use of renewable energy for decentralized rural electrification. Its second phase is now complete, and involves the design of a full size project. This included an analysis of the institutional situation and the barriers to the dissemination of renewable energies. Several types of barriers were identified in the areas of legislation and regulations, institutions and training, information and technology transfer, as well as financing. The following actions are proposed for overcoming these barriers in a full size project: 1) modification of the legal, regulatory and institutional framework in order to promote alternative renewable technologies for decentralized rural electrification, 2) training program, 3) education and dissemination campaigns, 4) financial training program, 5) implementation of a pilot project, 6) program for the creation of certification standards and procedures, 7) guarantee fund for decentralized rural electrification projects that use renewable energy sources, and 8) a program for monitoring and disseminating the experience. The total cost of a full size project is estimated to be more than US\$ 10 million.

The entire fifth chapter is dedicated to the “Strategic Plan for the Energy Sector of the Republic of Paraguay 2004-2013,” a document that the Viceministerio de Minas y Energía entrusted to a Spanish consulting company, which was submitted at the beginning of this year. It is a very extensive analysis and is divided into two parts, the design of the strategic plan itself, and a proposal for reforming the current regulatory framework of the energy sector. The Strategic Plan involves three different scenarios that are based on three hypotheses about the evolution of the GDP and the total population of Paraguay over the first 10 years. The possible evolution of energy consumption under the three scenarios was studied first, then energy generation, including hydrocarbons (natural gas and petroleum from the Chaco), electrical energy and biomass, which plays an important role in the energy matrix of the country. The second part of the document analyzes the current strengths and weaknesses of the energy sector. The weaknesses include the obsolete regulatory framework and the dispersion of institutional jurisdiction; however, significant weaknesses were also found in each energy sector. The strengths include the specialization in hydroelectric power generation and the potential of hydrocarbons and renewable energies (micro hydroelectric plants, solar, biofuels), none of which have yet seen significant use.

The study defines 6 principal objectives, 1) institutional coordination, 2) a secure supply, 3) efficiency and energy savings, 4) extension of energy coverage, 5) development of a regulatory framework, and 6) integration with MERCOSUR. Seven lines of action are proposed for achieving these objectives, 1) integration of energy jurisdictions, autonomy, and institutional coordination, 2) monitoring of the proper functioning of the energy sector, 3) modernization/liberation of the petroleum sector, 4) development of natural gas, 5) modernization of the electrical sector, 6) introduction of renewable energies, and 7) improvement of the regulatory framework. In the next phase, one or more measures were identified for each line of action. Each of these 21 measures is analyzed in detail to define the justification, objectives, content, expected

results, weaknesses and strengths, and finally the cost and possible implementation schedule. Each line of action that involves the introduction of renewable energies includes as a first step the development of a “Renewable Energy Development Plan” (PDER) that will be the principal planning instrument for implementing decentralized and sustainable rural electrification projects.

The final part of the document suggests that the regulatory framework be modified, and includes aspects of institutional organization in general and concrete proposals for each energy sector. The liberalization of the market is the central theme of the proposals, especially for the electrical and hydrocarbon sectors. However, a special law has been proposed for the renewable energy sector that would specify a set of measures for promoting the use of renewable energy to improve the quality of service, protect the environment, and extend the supply to other areas of the transportation network at a reasonable cost.

Chapter six analyzes Paraguay’s renewable energy resources, including solar energy, wind energy, hydroelectric energy, and biofuels. Excellent radiation values for solar energy exist throughout the country, which means that it is suitable for use anywhere in the country. However, there are territorial limitations on the cost-effective use of other renewable sources, such as wind and hydroelectric energy. The areas with the highest wind energy resources are principally found in the northeast Chaco and in the northeastern part of the eastern region. The east of the country is the main area for the cost-effective use of small-scale hydroelectric energy. The potential for producing biofuels in Paraguay is high, based on alcohol that is mainly from sugar cane, and biodiesel that is produced from several different raw materials.

General Context of the Country and its Rural Area

1.1. The Country and its Political Organization

The Republic of Paraguay is a landlocked country with an area of 406,752 km² that is located in the heart of South America. It is bordered by Bolivia to the north, Argentina to the west, south, and southeast, and Brazil to the east. With the exception of the border with Bolivia, all are natural borders. The border with Argentina consists of the Pilcomayo, Paraguay and Parana Rivers, as well as the Amambay and Mbaracayu mountains. The Paraguay River divides the country into the Western or Chaco Region on its right bank and the Eastern Region on its left bank. The Chaco includes 61% of the territory and the eastern Region, 39%. In many aspects, including climate, vegetation, soil type, demography, and social and economic level, the two regions are quite different. Due to its relatively inhospitable nature and geographic isolation, the Chaco has, for a long time, been totally forgotten by the Paraguayan government. Only in recent decades has it gradually begun to have a presence in this region.

Figure 1: Political divisions of Paraguay



Source: Website of the Presidency of the Republic

The country is divided into 16 departments, of which 3 are in the Chaco and the rest are in the eastern region. Their administration is under a Governor, as the executive branch, and a Departmental Council that is the legislative body. Both are elected for 5 years by the people.

Asuncion, the capital of the country, is not part of a department, and only has municipal authorities. There are 225 districts, which are each governed by a mayor as the head of the executive branch and a Municipal Council as the legislative branch. Both authorities are elected by the people for 5 years. Most districts, especially the rural ones, have, in addition to their clearly demarcated municipal urban area, a certain number of localities; most of the names and boundaries are not official, but rather were defined historically by the inhabitants. Altogether, Paraguay has about 6000 localities.

Localities that have certain official characteristics are called "Colonias"; they were created by the national government during the land reform and are being administered by the "Instituto de Desarrollo Rural y del Tierra" (INDERT) until the present reform process has been completed. A similar case are the Indigenous settlements that are located on land owned by their inhabitants through community land titles granted by the "Instituto Paraguayo del Indígena" (INDI).

According to population data published by the "Dirección General de Estadísticas, Encuestas y Censos" (DGEEC), all land outside the municipal urban area of a district is considered rural, regardless of its number of inhabitants.

1.2. Principal Demographic Data and Ethnic Composition

1.2.1. Total Population and Rural Population

According to the most recent national census that was taken in 2002 by DGEEC, Paraguay has a total population of 5.1 million inhabitants, of which 57% live in urban areas and 43% in rural areas. Other sources (ECLAC, UN) and the DGEEC itself mention in the Integrated Home Survey carried out the following year, that the population was 5.7 million in 2003. The difference is due to incomplete coverage in the 2002 census. Ten years before, according to the 1992 census, the total population was only 4.2 million persons; this represents an average annual increase of 2.2%. The increase is mainly due to the high birth rate, one of the highest in the region, which is reflected in the high percentage of the population that is young (37% under 15, 64% under 30).

In 1992, the rural population of the nation was still 50%. The substantial decrease in that figure since then is mainly due to the migration from rural areas to the city that occurred during that time, which is observed in most developing countries. The departments that currently have the largest percentage of rural population are San Pedro (82.5%), Caazapá (81.8%), Paraguari (76.9%) and Canindeyú (74.6%).

Table 1: The departments of Paraguay showing their area and total and rural population

Department	Area km ²	Total Population	Density Inhab./km ²	Rural Population	% Rural Population
------------	-------------------------	---------------------	-----------------------------------	---------------------	-----------------------

Concepción	18,051	178,371	9.88	108,944	61.1
San Pedro	20,002	318,455	15.92	262,615	82.5
Cordillera	4,948	232,139	46.92	154,290	66.5
Guairá	3,846	177,097	46.05	116,467	65.8
Caaguazú	11,474	440,704	38.41	301,648	68.4
Caazapá	9,496	138,763	14.61	113,473	81.8
Itapúa	16,525	457,327	27.67	317,427	69.4
Misiones	9,556	101,344	10.61	51,167	50.5
Paraguarí	8,705	224,094	25.74	172,326	76.9
Alto Paraná	14,895	557,263	37.41	188,316	33.8
Central	2,465	1,356,753	550.4	188,156	13.9
Asunción	17	496,457	29,203	0	0.0
Ñeembucú	12,147	76,298	6.28	37,357	49.0
Amambay	12,933	114,731	8.87	36,874	32.1
Canindeyú	14,667	139,129	9.49	103,840	74.6
Eastern Region	159,827	5,008,915	31.34	2,152,903	43.0
Presidente Hayes	72,907	80,549	1.10	49,911	62.0
Boquerón	91,669	41,979	0.46	24,218	57.7
Alto Paraguay	82,349	12,895	0.16	6,076	47.1
Western Region	246,925	135,423	0.55	80,205	59.2
Country	406,752	5,144,338	12.65	2,233,108	43.4

Source: DGEEC 2002 census and its own compilation

The population of Paraguay is distributed very unequally throughout the country. There is a large concentration in and around the Capital, Asunción, of some 1.5 million persons. Other important cities are Ciudad del Este, the capital of the department of Alto Paraná, which has about 250,000 inhabitants, and Encarnación, the capital of the department of Itapúa, with about 100,000 inhabitants.

The least populated area of the country is mainly the Chaco region with only 135,000 inhabitants, although it constitutes more than 60% of the country. Its population density is only 0.55 inhab./km². In the eastern region, the average density is 31.34 inhab./km² and there is a large concentration around Asunción and in the Central department, with 745 inhabitants/km².

Except for the Indigenous population, no statistics are available on the racial composition of the population of Paraguay. According to several sources, about 95% of the population of Paraguay is "mestizo," the result of a mixing process that began with the Spanish colonization, principally European immigrants with the autochthonous Guaraní population. Most of the remaining 5% of the population of Paraguay are descendants of Europeans of different origins, and Indigenous peoples, which are less than 2% of the total population (see the next paragraph). It should be mentioned that Paraguay is one of the few countries colonized by Spain where the autochthonous language (Guaraní) is widely spoken as a colloquial language, and is recognized as an official language.

1.2.2. Indigenous Population

The Indigenous population is a small minority in Paraguay. According to the last Indigenous census carried out by DGEEC in 2002, it is only 1.7% of the total population. 87,099 individuals who live in 600 communities were counted. The

distribution of the Indigenous population varies considerably from one region to another. They are most numerous in the Chaco, where they are 31.7% of the total population. In the central-south region (departments of Paraguari, Cordillera, Misiones and Ñeembucú), on the other hand, they are almost completely absent. In all, there are 20 ethnic groups that pertain to 5 linguistic families. In the eastern region, Guaraní ethnic groups predominate. The other ethnic groups are mainly found in the Chaco.

Prior to having contact with the European civilization, the Indigenous population of both regions of Paraguay lived in the jungle, often as nomads, and had a Neolithic level of development. Due to the expansion of the agricultural frontier and indiscriminate deforestation that occurred especially in the second half of the 20th century, the Indigenous peoples lost most of their ancestral habitat. In the Chaco, until very recently, there were forest groups that had never had contact with non-Indigenous people. Thanks to the national constitution of 1992 that granted Indigenous peoples the right to self-determination and self-administration, most of the Indigenous communities now possess legally recognized community lands in their respective places of origin.

Table 2: Ethnic groups of Paraguay:

Linguistic Family	Ethnic Group	Pop.	Regions where present
Guaraní	Aché	1,210	Canindeyú, Alto Paraná, Caazapá
	Ava Guaraní	13,315	San Pedro, Alto Paraná, Canindeyú
	Mbyá	14,858	Caaguazú, Guairá, Caazapá, Itapúa, San Pedro, Concepción
	Pa'i Tavyterã	12,964	Canindeyú, Alto Paraná
	Guaraní Nandeva	1,943	Concepción, Amambay
	Guaraní Occident.	2,255	Boquerón
Maskoy	Toba-Maskoy	952	Alto Paraguay
	Enlhet Norte	6,221	Pres. Hayes
	Enxet Sur	5,747	Pres. Hayes
	Sanapaná	1,942	Pres. Hayes
	Toba	1,085	Pres. Hayes
	Angaité	3,763	Pres. Hayes
	Guaná	72	Concepción
Mataco Mataguayo	Nivacle	13,965	Pres. Hayes, Boquerón
	Maká	1,316	Pres. Hayes, Central
	Manjui	290	Boquerón
Zamuco	Ayoreo	2,054	Alto Paraguay, Boquerón
	Ybytosó	1,479	Alto Paraguay
	Tomaráho	108	Alto Paraguay
Guaicurú	Toba-Qom	1,560	Pres. Hayes, San Pedro
Total	20	87,099	

Source: DGEEC, 2002 Indigenous census and its own compilation

1.3. Social and Economic Situation

The most important sector of the Paraguayan economy is the service sector, including business, gastronomy, hotels, finance and insurance, social services, real estate, and basic services (energy, water, transportation, and communication), which provided 48% of the Gross Domestic Product (GDP) in 2003. The production of goods is mainly

primary production, that is, agriculture, fishing and forestry, which in 2003, were 27% of the GDP. A large percentage of the agricultural products are for export, and 80% of Paraguay's exports come from this sector. Soybeans and their derivatives are by far the most important export products and make up more than 50% of the total. Other important products are beef, cotton fibers, timber, leather and organic sugar. The industrial sector is relatively unimportant to the economy of the country. In 2003, it was only 16% of the GDP. The majority of the few existing industries are directly involved in the transformation of primary products for export, such as cotton gins, sugar factories, slaughterhouses, oil factories, tanners, sawmills, etc.

Paraguay is a full member of the "Mercado Común del Sur" (MERCOSUR) with Argentina, Brazil and Uruguay. Bolivia, Chile and Venezuela are associate members. This international institution of the South Cone of the Americas was created in 1992; however, it has not had the expected effect on the economy of Paraguay, which is the weakest of all the MERCOSUR countries. From the beginning, MERCOSUR has served mainly as a customs union, but it has not operated satisfactorily for many Paraguayan export products.

Only since 2004, has the asymmetry among the different member countries of MERCOSUR been recognized, and during the latest summit of heads of state of the member countries held in June 2005 in Asuncion, it was resolved to create a contingency fund to benefit countries with less economic development, that is, Paraguay and Uruguay. Paraguay will benefit from 48% of the available funds, US\$ 100 million per year, to which will only have to contribute 1%. The funds are mainly for infrastructure projects for regional integration, such as highways, gas pipelines, electric transmission lines, etc.

In recent years the Gross Domestic Product of Paraguay (2003: US\$ 5,625 million) has not grown significantly; this, together with a large increase in population, resulted in a 9% drop in the per capita GDP between 1992 and 2002; among the surrounding countries this was only experienced by Paraguay. The last strong impulse received by the Paraguayan economy was the construction of the Itaipu dam during the second half of the 1970's and the 1980's, and to a lesser degree, the construction of the Yacreta dam. The principal causes of the stagnation of the national economy are, on one hand, the economic crisis suffered in recent years by the neighboring countries, Brazil and Argentina, with which Paraguay has strong commercial ties, and on the other, the lack of private investment in the productive sector during the past 10 to 15 years. The main reasons for this are the lack of legal security that still exists and weakness in the financial sector, which culminated in the second half of the 1990's with the failure of a large number of banks and financial institutions, and the loss of large amounts of money in deposits and shares.

As a result, rates of unemployment and underemployment are relatively high (the national average was 11% and 24%, respectively in 2004); in urban areas they are even higher than in rural areas. This situation, together with the inadequacy of state social assistance, causes several social problems, especially increased poverty and crime. Another phenomenon, the informalization of the economy, is also taking place, with an increase in the number of street sellers and garbage recyclers on the streets of the cities trying to earn their daily subsistence.

Table 3: Poverty levels by area%

	1997	2002	% Change
--	------	------	----------

Area	Total	Extreme	Total	Extreme	Total	Extreme
Country total	32.1	17.3	46.4	21.7	44.5	25.4
Rural	42.5	28.9	50.5	31.1	18.8	7.6
Urban	23.1	7.3	43.2	14.6	87.0	100.0

Source: DGEEC, UNDP and its own compilation

In 2002, the percentage of the population living in poverty rose to 46.4% (rural area 50.5%) and 21.7% live in extreme poverty (rural area 31.1%), which means that their income is not sufficient to satisfy their basic food needs. In only 5 years, the percentage of the population that is poor has increased by almost 45%, and the population in extreme poverty, by 25%. However, this increase was much more pronounced in urban areas than in rural areas (see Table 4). The total number of poor people increased by 87% in urban areas, while in rural areas the change was only 18.8%. The extreme poor increased by 100% in urban areas, but only 7.6% in rural areas.

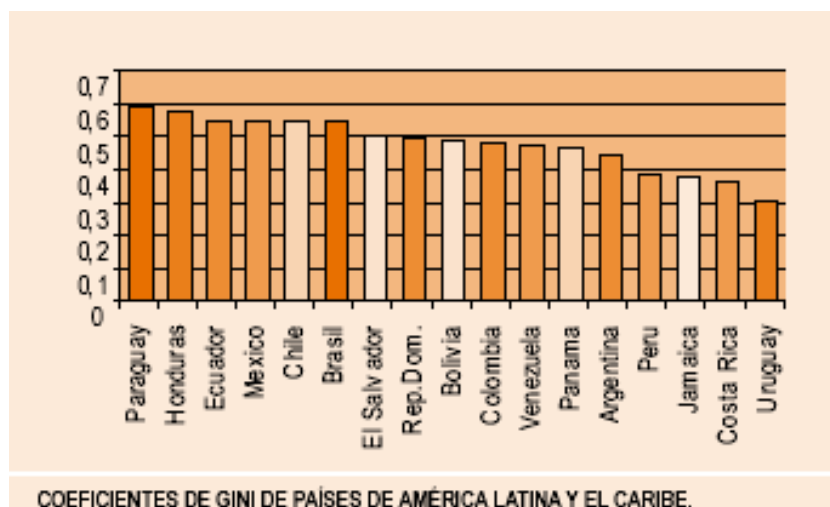
Table 4: Family income by area and by decile 2000/2001

Familias	Ingreso promedio de los hogares (guaraníes por mes)			Participación relativa dentro del ingreso nacional		
	Total	Urbana	Rural	Total	Urbana	Rural
Todas las familias	1.820.173	2.428.518	1.024.379	100,0%	100,0%	100,0%
I decil	182.680	314.608	129.144	1,0%	1,3%	1,3%
II decil	392.759	635.763	267.207	2,1%	2,6%	2,6%
III decil	563.839	888.843	381.320	3,1%	3,7%	3,7%
IV decil	769.029	1.135.969	489.379	4,2%	4,7%	4,6%
V decil	986.634	1.409.223	605.348	5,4%	5,8%	6,1%
VI decil	1.231.242	1.730.368	782.685	6,8%	7,1%	7,7%
VII decil	1.562.573	2.169.773	965.848	8,6%	8,9%	9,4%
VIII decil	2.048.878	2.809.481	1.193.300	11,3%	11,6%	11,5%
IX decil	2.958.202	3.958.968	1.574.657	16,3%	16,3%	15,5%
X decil	7.497.543	9.219.159	3.843.961	41,2%	38,0%	37,5%

Source: UNDP, INDHP 2003

Per capita income in rural areas is somewhat less than half what it is in urban areas. The inequality in the distribution of family income has also increased. Paraguay has one of the highest Gini coefficients in Latin America, which is an indicator that expresses inequality.

Figure 2: GINI coefficients of Latin American and Caribbean countries



Source: UNDP, INDHP 2003

This problem, which affects a large proportion of the population of Paraguay, is even more pronounced among the Indigenous population; due to their marginalization, they are much more vulnerable than the peasant population.

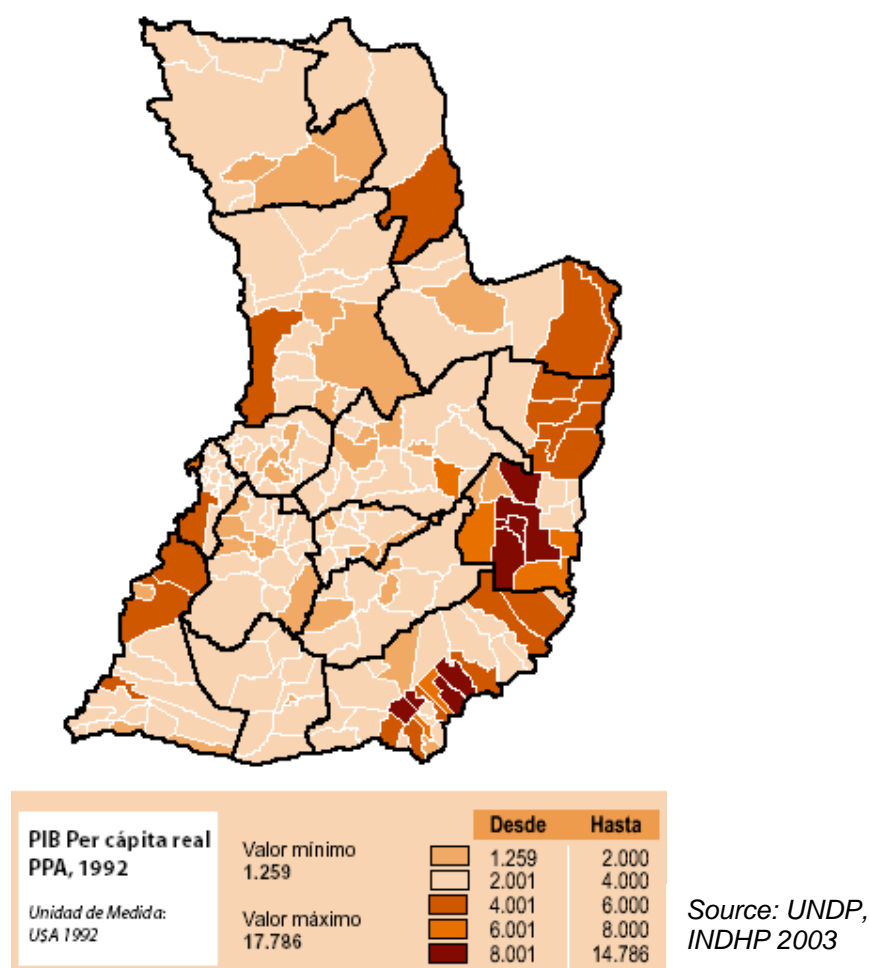
Figure 3 shows the significant differences that existed in the actual per capita GDP in US\$ in 1992 for the various districts of the eastern region. The districts with the highest values, other than the city of Asuncion, are in the east and southeast of the country, where mechanized agriculture is concentrated, and in a few cities that are located on the border with Argentina and Brazil, where intense border trading occurs. The people in the southern, central and northern districts that have a low per capita GDP are mainly peasants. The districts with the highest per capita GDP in the western region are in the central Chaco, where there are 3 Mennonite colonies, Menno, Fernheim, and Neuland, and in the extreme south near the capital, Asuncion.

In the past, the most important safety valve for this situation was emigration, mainly to Argentina. It is estimated that the Paraguayan population in the Buenos Aires region is over one million. The recent grave crisis in that country closed the valve, and many Paraguayans who lost their jobs had to return to their native country. This phenomenon obviously aggravated Paraguay's social problems even more. However, in recent months, the Argentine economy, and that of Brazil, the other neighboring country of great importance for trade, have been recovering slowly, and this has had a positive effect on the social and economic situation in Paraguay. Recently Spain has become an attractive emigration destination for many Paraguayans in search of work.

The current Government of President Nicanor Duarte Frutos that took office in August 2003, is trying to reverse the critical situation of the country, mainly through a series of social and economic measures. Two of the five strategic objectives that were delineated at the beginning of his mandate, clearly reflect this:

- *"To reactivate the economy and create jobs according to a new model of sustainable development."*
- *"To fight poverty, corruption and insecurity."*

Figure 3: Real per capita GDP in 1992 by district in the eastern region in 1992 US\$



In the latest administrative report for July of this year, he presented the principal achievements made by his government during its first two years in office. These include a substantial 34% increase in Social Expenditure that is planned in the general budget for the current year compared to 2003. Social Expenditure includes expenses for education, health, basic sanitation, and poverty reduction. This substantial increase will be financed by the significant increase in tax collection that the government has achieved thanks to a substantial reform of the taxation system and more efficient management of the Customs Department, as well as projects financed through the Social Fund of the Itaipu Binational Agency, which has US\$ 15 million available each year. Another significant achievement that should be mentioned is Law N° 2501/2004, which increased the number of beneficiaries of the social electricity rate from 18,000 users in November 2004, to more than 285,000 users currently (see par. 2.3.4).

1.4. Human Development Index and Unsatisfied Basic Needs

According to figures published by the UN for 2002, Paraguay is among the countries with an medium level of human development, at position No. 89 with an index of 0.751. The maximum is 1 and the minimum is 0. According to that same report, the country with the highest level of human development in the world is Norway, at 0.956, and the lowest is Sierra Leon at 0.273. The Human Development Index (HDI) is based on the following indicators of human development: life expectancy at birth in years, the adult literacy rate, the school enrolment rate, and the per capita GDP based on purchasing power parity. In South America only Argentina, Chile and Uruguay have a high index (above 0.8). It should be noted, however, that in Paraguay, unlike other surrounding countries, the index has not increased significantly during the past 20 years. In 1980, it was 0.701 and in 1990, it was 0.719. In the capital, Asuncion, however, the HDI is almost 0.9, the highest in the country. The District of Itanara in the department of Canindeyu has the lowest index in Paraguay, 0.51, which is considered to be the line between medium and low human development.

A home survey in 2002 (see Table 5) showed that in departments of the eastern region that have a predominantly peasant population, that is Concepción, San Pedro, Caaguazú and Caazapá, 50 to 60% of the population has at least one unsatisfied basic need (NBI). In the western region these percentages are much higher, that is, 70% to 95% of the population. These high figures are mainly the result of poor quality housing and the lack of sanitary facilities. In the eastern region, on the other hand, the housing quality NBI is predominant.

Table 5: Unsatisfied basic needs by department and type of NBI 2002

	Población Total	NBI en Acceso a Educación	NBI en Calidad de la Vivienda	NBI en Infraestructura Sanitaria	NBI en Capacidad de Subsistencia	Al menos una NBI
Paraguay Total	5.144.338					
Asunción	496.457	3,6	17,0	6,3	6,2	24,1
Concepción	178.370	9,2	44,4	27,5	18,8	61,3
San Pedro	318.454	10,2	47,1	14,6	19,3	58,6
Cordillera	232.140	6,9	36,8	12,1	13,9	47,0
Guaira	177.095	10,6	37,0	19,2	15,1	52,8
Caaguazú	440.705	8,6	42,1	20,7	15,7	56,4
Caazapá	138.763	12,3	45,1	17,4	19,8	58,0
Itapúa	457.326	10,5	32,6	17,7	17,0	47,8
Misiones	101.343	11,6	19,5	19,2	19,5	48,1
Paraguarí	224.092	8,1	34,5	14,8	18,4	47,0
Alto Paraná	557.263	9,3	26,8	24,7	14,2	47,0
Central	1.356.750	4,6	27,8	11,7	9,4	37,8
Ñeembucú	76.297	9,2	32,0	24,7	14,0	49,5
Amambay	114.731	11,1	33,4	34,3	16,6	56,5
Canindeyu	139.129	11,7	43,8	22,3	20,1	60,2
Presidente Hayes	80.549	15,3	48,6	57,2	17,9	75,7
Boquerón	41.979	19,4	49,9	66,7	24,1	87,5
Alto Paraguay	12.894	13,2	66,1	66,1	23,2	95,5

Fuente: DGEEC - Censo Nacional de Población y Viviendas 2002. (Muestra del 10%).

1.5. Productive Models in Rural Areas

The social and economic situation in rural areas is characterized by a combination of three very different productive models that are primarily related to landholding:

- The **traditional peasant model** in which small parcels are cultivated on family farms of 1 to 20 hectares with very little technology and a great deal of family labor, so productivity is very low. The products are principally for subsistence, except for cotton, which is the most important source of income for peasants. Due to the lack of effective answers to the needs of the peasant population, most people on some 300,000 family farms live below the poverty line.
- The **modern mechanized export agriculture model**, in which several hundred hectares are normally farmed with very little labor, and the extensive use of technology and agricultural chemicals. This model has expanded enormously in the last 50 years in areas with the best soils, especially in the eastern, southern and east-central departments of the country; most of the forest cover they formerly had has been destroyed. Most of this mechanized agricultural production is in the hands of Brazilian, Mennonite, and European immigrants. The principal products are soybeans and wheat.
- The **extensive cattle raising model** also involves enormous areas of land called "estancias" (ranches), many of which include thousands of hectares. This economic activity has existed in Paraguay since colonial times and traditionally pertained to a few wealthy families. The model uses very little labor. The ranches are found principally in areas less suitable for agriculture in the departments of Chaco in the northern, west central and southern areas of the eastern region.

In many areas, peasant smallholdings, large farms, and ranches coexist in the same region. These huge social contrasts are obviously a source of conflicts between peasants and landowners that include frequent occupations of lands that are considered unproductive by the landless peasants.

1.6. Organizational Systems in Rural Areas

1.6.1. Introduction

During the dictatorship of General Stroessner, who governed Paraguay from 1954 to 1989, social organizations were persecuted, especially in rural areas; the so-called Christian Agricultural Brigades operated there and were considered subversive by the authorities. The organizational disruption that occurred due to this persecution has effects even today. People became very suspicious and even apathetic about attempts by the government and by non-governmental organizations to promote the establishment of new structures of social organization. In 2002, only 25.3% of the population over 15 years of age participated in any kind of group or association. Most of these people, that is, 32.1%, were involved in a religious group. Cooperatives and neighborhood commissions are in second and third place with 14.3% each (see Table 6).

Membership in a group	%
Participate	25.3
Do not participate	67.9
Not available	6.8

Type of group	%
Religious group	32.1
Cooperative	14.3
Neighborhood commission	14.3
Producers' committee	5.8
Sports group	5.5
Youth group	4.3
Employees' association	4.0
Parents' group in schools	3.3
other	16.3

Table 6: Participation by citizens 15 and older in 2002

However, in recent years with the arrival of a new generation of rural leaders, the situation is improving. The political strength of peasant organizations is increasing. They participate actively in extra-parliamentary debate, often through public protests in the Capital and in the interior of the country, and not only in matters that are directly linked to peasants, but also political and social matters of national interest.

Source: DGEEC, 2002 Census, its own compilation

1.6.2. Neighborhood Commissions

Neighborhood Commissions are grassroots social organizations that are normally formed among neighbors from the same neighborhood. They exist in urban as well as rural areas, generally for the purpose of improving living conditions in their respective neighborhood through infrastructure projects, and social, cultural, sports and other activities. Neighborhood Commissions are generally an instrument for direct cooperation and interaction between the population of a neighborhood and the municipal authorities. In order to achieve recognition, Neighborhood Commissions must be registered with the Municipality. This requires at least bylaws, an executive committee that is democratically elected by the members, and a minute book. Districts that are more populous often have a municipal employee who is exclusively in charge of matters involving Neighborhood Commissions. Sanitation Boards are special types of Neighborhood Commissions whose purpose is to distribute potable water to the population of the neighborhood. Their liaison for this purpose is the "Servicio Nacional de Saneamiento" (SENASA) (see par. 1.7.1).

In recent years, some very successful examples of citizens' participation have taken place in several districts of Paraguay in order to participate in the preparation of the municipal budget through public hearings and citizens' monitoring of the public administration, among others. Many of these initiatives are encouraged and supported by the "Centro de Información y Recursos para el Desarrollo" (CIRD) Foundation within the framework of its "Program of Support for Citizens' Initiatives" that began in 2001, and is financed with USAID funds. The objectives of the program include the promotion of permanent citizens' mechanisms for participation in the decision-making process of central, departmental, and municipal governments, and the achievement of greater transparency in public administration through monitoring by citizens.

1.6.3. Production Committees

Production Committees are grassroots social organizations that are formed by 5 to 20 peasants who live in the same neighborhood. There are several types of production committees, according to their gender and age group. There are committees only for men, only for women and only for youth, while other committees are mixed. Their purpose is to join together in a productive project for the community and must be carried out on land belonging to one of the members, or it can be partly individual and partly community. An example of this system is when a certain product is produced individually, but marketed collectively.

Normally rural development projects involving agricultural production that are promoted by governmental and non-governmental organizations require that the beneficiaries be organized in this way so that they can act as a legal counterpart. They are organized like neighborhood committees, and depending on the type of projects they carry out, they require the recognition of the Municipality, Governor's Office, or Ministry of Agriculture and Ranching (MAG). In many cases, over time they become production or multipurpose pre-cooperatives, and then cooperatives. Their legal recognition and supervision is the responsibility of the "Instituto Nacional de Cooperativismo" (INCOOP). The "Federación de Cooperativas de Producción" (FECOPROD) includes a large number of production cooperatives throughout the country.

1.6.4. Peasant Organizations

Peasant organizations (OC) are generally second and third tier organizations. Second tier OC's include production committees for a relatively small area that could be a locality or even a district. Many second tier OC's were formed around productive projects financed with funds received through Government institutions, especially MAG, or NGO's.

Third tier OC's are federations or offices that generally include second tier OC's. Some have members from the entire country, while others are only for a specific region. Most third tier OC's are political, that is, they were established to defend peasant rights, for instance, the struggle for land, state agricultural subsidies, or forgiveness of debts. The most important of these are the "Federación Nacional Campesina" (FNC) and the "Mesa Coordinadora Nacional de Organizaciones Campesinas" (MCNOC). The "Organización Nacional Campesina" (ONAC) and the "Central de Organizaciones de Productores Ecológicos del Paraguay" (COPEP), on the other hand, are oriented towards production.

A specific organization that should be mentioned here is the "Coordinación Nacional de Mujeres Rurales e Indígenas" (CONAMURI), which includes about 5000 women from 14 departments of the country. According to Maggi Balbuena, one of its leaders, the *"organization is a tool in the struggle against discrimination and exploitation that women have historically suffered. It is an autochthonous organization that supports the people's struggle. Together with organized sectors, we struggle for a just society and equitable distribution of wealth."* It has been able to overcome many challenges over the years, and has gained the respect of public and private institutions as an organization that represents the rights of rural and Indigenous female workers. In mid October 2002, during its national congress in Asuncion, more than one thousand activists marched through the streets of the capital to the national parliament building to demand greater attention for productive projects and the education and health needs of

their communities. It showed strength and organization, and a commitment to struggle for their rights.

The situation of Indigenous women is even worse, according to Beatriz Rivarola, a leader of the Organización de Aborígenes Independientes. *"We suffer marginalization as Indigenous People and as women. Our people have many needs. That is why we believe it is essential to organize in order to struggle for our rights,"* she said. *"This can help us defend our culture as well as our survival. People used to tell us to preserve our culture, and to do that they wanted to keep us in a state of dependence and marginalization. Indigenous People have the right to development with our identity and culture. So Indigenous women are organizing and trying to improve the situation of our communities and our children. We want to escape marginalization. We don't want paternalism. That is not development. We want to preserve our culture and produce on our own community land in order to escape poverty."* Beatriz reflected. She feels that her Indigenous community *"understands the importance of the contribution of women for achieving this purpose."*

1.7. Public Services in Rural Areas

1.7.1. Potable Water and Sanitation

The Ongoing Home Survey of 2003 that was carried out by DGEEC found that only 32.9% of rural homes have potable water from a public or private distribution network. 61.1% obtain potable water from a well with or without a pump, and 5.5% from a pond, spring, stream, or river (see Table 7).

Table 6: Percentage of homes by type of water supply and by area

COBERTURA DE SERVICIOS	ÁREA DE RESIDENCIA		
	TOTAL	Urbana	Rural
TOTAL PAÍS	1.247.957	737.081	510.876
FUENTE DE AGUA			
essap/SENASA	46,4	61,5	24,7
Pozo sin bomba	22,2	8,6	41,9
Pozo con bomba	14,3	10,9	19,2
Red privada	14,4	18,8	8,2
Tajamar - río	2,3	0,1	5,5
Aljibe	0,3	0,1	0,6
Otro(*)	0,0	0,0	0,0

(*) Incluye Agua de lluvia

Source: DGEEC,
EPH 2003

Rainfall in the Chaco is much scarcer than in the eastern region. This combined with high temperatures, means that shallow underground water is often very salty, which precludes digging the shallow wells that are common in the eastern region as a water supply. Other than deep wells that are drilled at only a few sites, there are two principal ways of obtaining water. Higher income homes have cisterns for collecting rainwater from the roof using eave gutters. The other source of water that is used mainly by the poor, is rivers, streams and lakes, or artificial ponds for collecting rainwater. Obviously, the water from these sources is normally not fit for human consumption without prior treatment.

In cities with more than 10,000 inhabitants, it is the "Empresa de Servicios Sanitarios del Paraguay S.A." (ESSAP), a 100% state-owned company that is responsible for water distribution and sewer lines. However, ESSAP currently operates in only 22 of 37 cities with those characteristics. In other localities with fewer than 10,000 inhabitants, it is the "Servicio Nacional de Saneamiento" (SENASA), a state agency under the "Ministerio de Salud Pública y Bienestar Social" (MSPBS) that is in charge of distributing potable water. It operates in cooperation with sanitation boards, which are users' organizations that are established for this purpose in a particular locality. SENASA invests the necessary public funds and transfers the management of potable water systems to the boards. The investment must be partially reimbursed by the board during a period that is specified in each case. There are 900 of these boards supplying potable water to 180,000 users in Paraguay.

SENASA is unable to satisfy all of the enormous needs in these areas. For that reason, other agencies become involved in the construction of rural potable water systems, for example, Governors of departments, the Ministry of Agriculture, the First Lady's Foundation, UNDP, UNICEF and international NGO's, including Plan International. In these cases, investments are generally non-reimbursable. In the Chaco, the PRODECHACO Project was carried out by the Ministry of Agriculture with European Union funds, and mainly installed water collection and distribution systems in Indigenous communities using reservoirs, natural lakes, and the Paraguay River.

There are also some 400 private companies called "aguaterías" that operate in suburban areas; they distribute water to some 900,000 inhabitants, especially around Asunción and Ciudad del Este. They require a license from the corresponding municipal authorities in order to do so. Most aguaterías take water from an artesian well, disinfect it, and then distribute it through a network. SENASA is in charge of carrying out laboratory tests to control water quality.

In 2000, the "Ente Regulador del Sector Saneamiento" (ERSSAN), was established. It is the state agency that is responsible for regulating the entire potable water and sanitation sector of the country. Its principal functions are:

- a) To regulate rates and supervise potable water and sanitation services,
- b) To function as a central water resources development agency for granting concessions to Governors' Offices and Municipalities.

1.7.2. Telephone Service

The coverage of fixed telephone service is very low in Paraguay with 180,000 lines (2002 census), and only 16.7% of homes in the country have this service. In rural areas, the coverage is even lower with some 9000 lines that cover only 2.0%, which varies according by department between 1.0 and 3.2%. In urban areas, on the other hand, average coverage is 27.0%, and in Asunción, 39.7%. The state company, "Compañía Paraguaya de Telecomunicaciones S.A." (COPACO), was created in 2001 from a state agency, ANTELCO, and has the exclusive right to offer fixed telephone service throughout the country. There are now some 330,000 active lines, which represent only 58 lines per 1000 inhabitants. However, people who do not have their own telephone can use one of the numerous phone booths that offer personalized service and are found throughout the country. This service was opened up to the private sector when COPACO was created, and constitutes an increasingly important sector of the fixed telephone market.

Due to the significant shortage of landlines, cellular telephones, which entered Paraguay about 10 years ago, are rapidly achieving wide distribution. Four private companies are competing for the market (Telecel, Personal, Vox, and Porthable) and there are presently 1,550,000 lines. In 2004, 36.0% of the homes in Paraguay had at least one cellular telephone (EPH 2004). In 2002, the figure was 32.3% (2002 census). In the rural area, the figures are 18.7% and 16.5%, respectively. Coverage is mainly limited to areas along major highways where the population density is higher. The departments with the lowest coverage, that is, less than 5%, are, in ascending order, Alto Paraguay, Amambay, Concepción and Canindeyú. In some departments, the coverage in rural areas is more than 20% (Central, Alto Paraná, Itapúa, Misiones, and Paraguari).

1.7.3. Electrical Energy

Although the level of development in Paraguay is relatively low, the coverage of electrical energy is quite high through the National Interconnected System (SIN) of the "Administración Nacional de Electricidad" (ANDE). The SIN does not only cover urban areas, but also most rural areas except for most of the western region and a few peripheral areas of the eastern region, mainly due to the low population density in both cases.

A census of 1,098,020 homes was taken in the entire country in 2002. Only 10.8% (119,090) did not have electricity, involving 570,000 people. In rural areas, the census counted 453,940 homes, 22.9% (103,808) of which did not have electricity, affecting 540,000 persons. Based on these figures, it can be concluded that 87.2% of the homes without electricity are in rural areas.

There is a considerable variation in electrification coverage in the different parts of the country (see Table 8). It can be seen that there is an enormous difference between the eastern region and the Chaco. The rate of non-electrified homes in the former is 21.6%, or 94,548 homes, and the latter it is 54.2%, or 9260 homes. In the eastern region the departments with the fewest electrified homes are, in descending order, Amambay, Canindeyú, Ñeembucú, Concepción and Caazapá; all have population densities lower than 15 inhab./km² and are located in geographically isolated areas. These 5 departments contain 40% of the homes without electricity in the entire eastern region, but only represent 19% of its rural population.

There are also significant differences among the different departments of the Chaco with regard to rural electrification coverage. In the department of Presidente Hayes, which is closest to the Capital, Asuncion and has the highest population density, 48.6% of rural dwellings do not have electricity, whereas in 2 departments of northern Chaco, Boquerón and Alta Paraguay, the figures are 62.9% and 71.4%, respectively. The average population density of the entire western region is only 0.55 inhab./km², and varies from 0.16 to 1.1 inhab./km² depending on the department, which explains the very low rural electrification coverage figures.

Table 7: Homes and population without electricity by department (2002)

Department Region	% rural homes without	Rural homes without electricity	Inhabitants without electricity
----------------------	-----------------------------	---------------------------------------	---------------------------------------

	electricity		
Concepción	32.3	6,644	35,174
San Pedro	21.5	5,952	56,729
Cordillera	14.3	4,757	22,310
Guairá	13.2	3,151	15,831
Caaguazú	21.9	12,466	66,539
Caazapá	28.0	6,349	32,154
Itapúa	18.9	11,974	60,600
Misiones	20.6	2,291	10,494
Paraguarí	17.8	6,610	31,526
Alto Paraná	17.6	6,946	33,545
Central	6.9	2,766	12,953
Ñeembucú	38.1	11,289	50,803
Amambay	56.7	4,489	20,815
Canindeyú	42.0	8,863	44,039
Eastern Region	21.6	94,548	493,512
Presidente Hayes	48.6	5,370	25,825
Boquerón	62.9	3,090	15,486
Alto Paraguay	71.4	800	4,295
Western Region	54.2	9,260	45,607
Country	22.2	103,808	539,118

Source: DGEEC, 2002 census and its own compilation

1.7.4. Highways

Paraguay has a very few paved all-weather roads, a total of about 3000 km. National routes that link the principal urban centers are paved. Outside the metropolitan area and major urban centers, most secondary roads and local tracks are strips of earth, and in some cases, gravel has been applied. During periods of intense rainfall, these roads become impassible and are closed to vehicle traffic. This situation hampers considerably the transportation of primary products to urban centers for sale.

In recent years, however, a large number of roads to the interior have been cobbled by the MOPC, Governors' Offices, and Municipalities. This type of paving has a big advantage in that the investment cost is relatively low and a large amount of labor can be used during construction. The useful life is relatively short, especially if the roads receive frequent heavy vehicle traffic.

1.7.5. Education

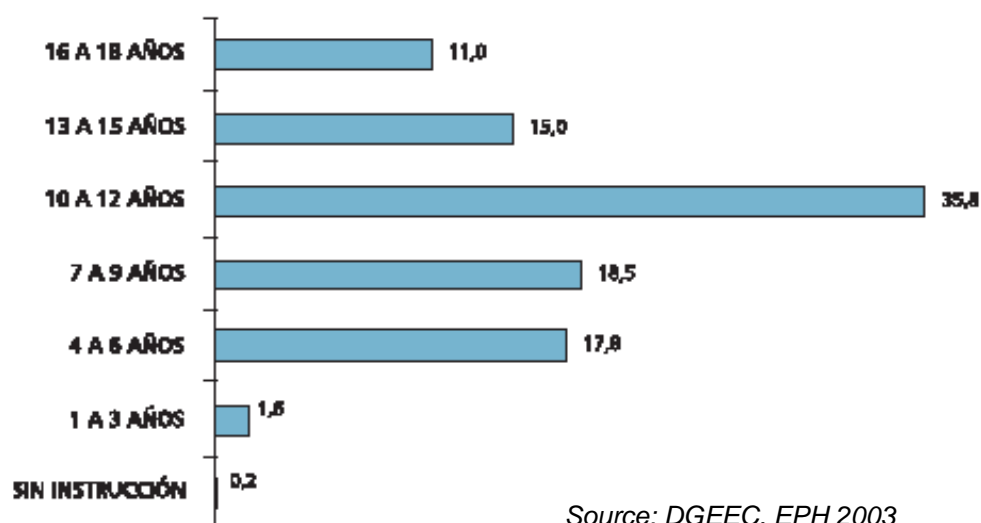
The education system in Paraguay is completely centralized and under the "Ministry of Education and Culture " (MEC). According to the EPH of 2003, an average of 96.1% of the children of the country between the ages of 6 and 14 attend school. This age range attends the first level of education, which is also obligatory. In rural areas, the corresponding rate is somewhat lower (88.9%). Differences due to sex are very small (country: boys 92.4% vs. girls 92.8%, rural areas: boys 89.1% vs. girls 88.7%). Throughout the 1990's and early 2000's, the rate of attendance in the first level of education was about 91% to 92% (ECLAC).

In recent years, the government has made a great effort to reduce the number of children who do not attend any school, which is a double challenge given the high demographic growth of Paraguay. According to the Minister of Education and Culture on July 8 of this year, 99% of primary school age children are presently enrolled in a institution for formal education. The number of children that remain outside the education system is less than 10,000.

For secondary education, that is, between the ages of 15 and 18 years, the rates of school attendance are much lower than in the first level, that is, 62.5% on the average for the country, and 52.5% in rural areas (EPH 2003). The trends by sex are similar. Between 1990 and 2001, there was a significant increase in secondary school attendance throughout the country, from about 25% to 50% (ECLAC).

The percentage of persons over 15 years of age that have received a non-formal training course depends to a large extent on the number of years of formal schooling that have already been received (see Figure 4). For example, 35.5% of those over 15 that have 10 to 12 years of education received non-formal training, while it was only 1.6% for those with 1 to 3 years of education.

Figure 4: Population over 15 years that took a non-formal course, by years of schooling



The illiteracy rate in Paraguay among the population over 15 years of age (see Figure 6) is 6.6% (EPH 2003). In rural areas, the rate is 10.2%. It should be noted that there are significant differences in illiteracy between men and women (country 5.6% vs. 7.5%, rural areas: 8.2% vs. 12.5%). The average number of years of schooling for the population over 25 years of age (see Figure 5) is 7.0 years, but in rural areas, this figure is only 4.9 years (EPH 2003). The differences between men and women, on the other hand, are relatively small (country: 7.1 vs. 6.8, rural areas: 5.1 vs. 4.6).

Figure 5: Average years of schooling of the population over 25 years of age

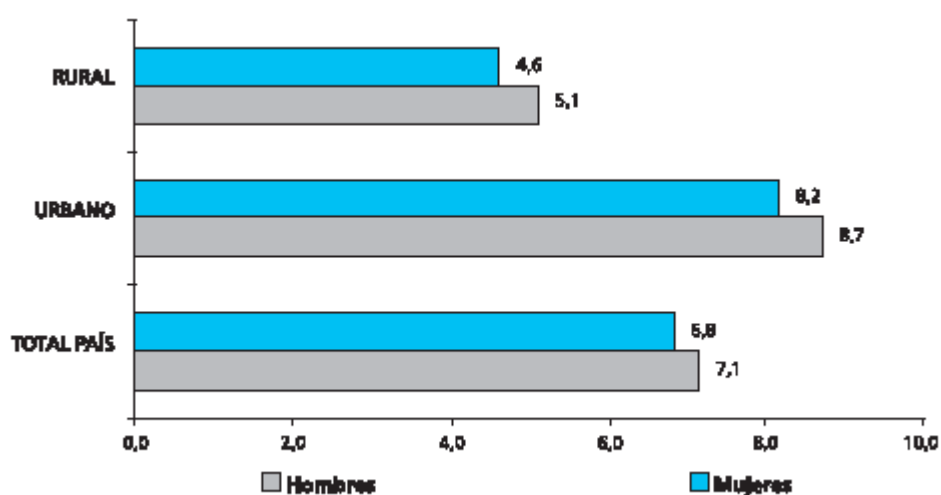
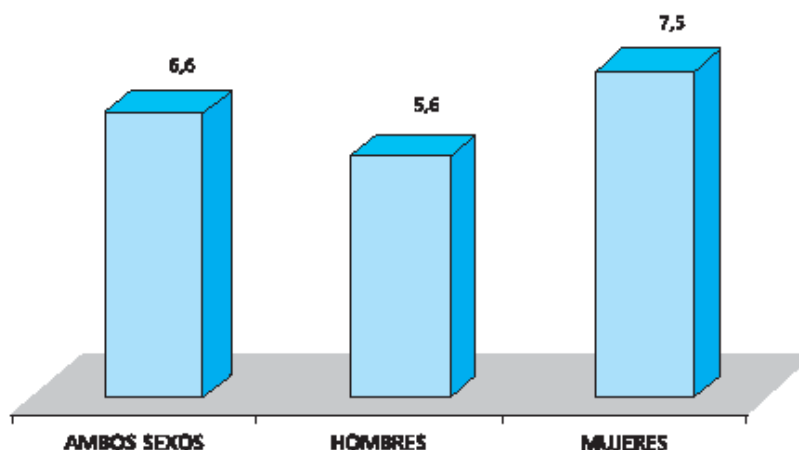


Figure 6: Rate of illiteracy by sex



Source: DGEEC, EPH 2003

1.7.6. Health and Social Welfare

Paraguay has a state system of social welfare and health insurance. The institution responsible is the "Instituto de Previsión Social" (IPS). Only persons with formal employment in the private sector and their families have access to these services. The services include health insurance with ample coverage for doctors' appointments, hospital care and medicines, as well as a retirement system. The proportion of the population of the country that can benefit from this system is about 10.3%, and in rural areas, only 5.3% (EPH 2003).

There are also a large number of companies that offer prepaid medicine, many of which are linked to a private clinic; due to their relatively high fees, they are accessible only to the sector of the population that has an above average income. In Paraguay 8.9% of the population are affiliated to that health insurance system, or have insurance for police officers and the armed forces. In rural areas, the percentage is only 3.1%. 80.7% of the population of the country and 91.6% of the rural population have no health insurance (EPH 2003).

When necessary, people without health insurance can go to hospitals and health posts throughout the country that operate under the "Ministerio de Salud Pública y Bienestar Social" (MSPBS). However, in rural areas, the coverage of these health posts is very limited and in many places where they do exist, they lack supplies and qualified personnel.

The infant mortality rate (deaths of children under 1 year of age) is 37 per 1000 live births, which is higher than the average for Latin America (31.5). Only Haiti, Bolivia, and Guatemala have higher figures. However, in the last 10 years a considerable reduction has been achieved. During the first quinquennium of the 1990's, the infant mortality rate was still 43.3 per 1000 live births. However, Paraguay's maternal mortality rate of 170 per 100,000 live births (2000), is slightly lower than the average for Latin America and the Caribbean, which is 190. During the decade of the 1990's, public expenditure on health increased considerably from 0.3% of GDP in 1990 to 3.3% in 2000 (ECLAC).

The life expectancy at birth in Paraguay is presently 70.8 years (males: 68.6, females: 73.1), while the average for Latin America is 71.9 years (males: 68.8, females: 75.2). The respective figures for Paraguay ten years ago were 68.5 years (males: 66.3, females: 70.8) and for Latin America 69.0 years (males: 65.8, females: 72.4) (ECLAC).

1.8. Energy Matrix in Rural Areas

1.8.1. Energy Demand of Rural Families

According to the 2003 energy balance prepared by VMME, the residential and commercial sector consumes 37% of the country's total energy, the transportation sector consumes 30% and industry, 31%. In the residential and commercial sector, which also includes small craft industries such as bakeries, candy factories, etc., 72% of the energy consumed comes from firewood, 16% from electricity, 6% from charcoal, and another 5% from LPG. Firewood, charcoal and LPG, which provide 84% of the energy needs of the residential and commercial sector, are used principally for cooking food, while businesses and small industries use them for various thermal processes, often involving the production or transformation of food. A much lower proportion of these fuels is used for heating homes and lighting. Paraguay has a hot climate practically all year round. There are only a few cold days during the period of June to August.

In rural areas, the proportion of firewood in the energy matrix of the residential and commercial sector is even greater than the national average. The latest Ongoing Home Survey (EPH) in 2004 that was carried out by DGEEC (see Table 9) found that on the average, rural homes use the following energy sources for cooking food: firewood, 75.1%, LPG 17.1%, charcoal 6.4% and electricity 0.1%. By comparison, the situation in the Capital, Asuncion, is quite different, and the figures are as follows: firewood 3.3%, LPG 79.5%, charcoal 14.7%, and electricity 0.7%. The data on LPG agree quite well with figures from in the 2002 Census, which revealed that 16.6% of rural homes had a gas stove, while in Asuncion the proportion was 81.9%.

Table 8: Type of energy used principally for cooking

SERVICIOS	TOTAL PAÍS				
	TOTAL	URBANA	RURAL	ASUNCIÓN	CENTRAL
LEÑA	38,6	13,6	75,1	3,3	12,6
GAS	46,5	66,6	17,1	79,5	60,5
CARBÓN	12,8	17,2	6,4	14,7	24,7
ELECTRICIDAD	0,3	0,5	0,1	0,7	0,5
OTRO (*)	0,1	0,2	0,0	-	0,2
NO COCINA	1,7	1,9	1,3	1,7	1,5

(*) Incluye: Aserrín, Kerosene, Alcohol

Source: DGEEC, EPH 2004

It is surprising that in a country that produces a surplus of electricity, so few homes use this clean energy for cooking, even in the urban area. The main reason is the relatively high cost of electrical energy compared to LPG or charcoal. Presently the price differential per unit of energy, based on ANDE's low-tension residential rate for electrical energy, is about 35% in favor of LPG purchased in 13 kg. cylinders.

Charcoal is mainly used by low-income families in suburban areas because it is easy to buy in small quantities. On the other hand, LPG is currently sold almost exclusively in 10 and 13 kg. cylinders by several retail companies; this requires that a sizeable amount of money be available for the purchase, presently equivalent to at least one minimum daily wage (approx. \$US 8 for 13 kg). In recent months, due to repeated increases in the price of hydrocarbons in general and LPG in particular, many families from that social sector have stopped using it and have begun to use charcoal, though its monthly cost is similar to that of LPG. Another important home use of charcoal is for barbecues, a tradition in most families from all social sectors on Sundays and holidays. A law was recently passed to permit gas cylinders to be refilled at service stations. Consumers will have the opportunity to receive less than their full capacity. For this law to take effect, it will still be necessary to prepare regulations and install technical facilities at points of sale, especially with regard to safety procedures.

In rural areas, firewood is the energy source that people generally find in their surroundings. In most places, it is still easily available, and this explains the high rate of use. However, in some rural areas in Paraguay where there has been excessive deforestation, firewood has become a scarce resource.

In 2003, Plan International (PI) carried out a home survey in the communities where it operates, which are located in rural areas of five departments, San Pedro, Caaguazú, Guairá, Paraguari and Cordillera. The survey revealed that an average of 92.5% of homes use firewood to cook, 3.9% use LPG, 3.6% use charcoal, 0.1% use electricity, and 0.1%, dried leaves. For lighting, 92.2% use electrical energy, 4.6% use candles, 3.0% use kerosene lanterns and 0.3% use some other source of energy, or nothing.

A comparison of these figures with those of EPH 2004, shows that figures for the use of firewood for cooking are significantly higher in PI data, that is, by almost 17%, and the use of LPG is 13% lower. One possible explanation could be that PI works with communities that are poorer and further from urban centers than the national average.

1.8.2. Distribution of Improved Stoves

Statistical data on the way in which firewood is used for cooking in Paraguay are not very specific. EPH 2003 discovered that 55% of rural homes have some type of stove, but does not specify the type of energy they use. Since all homes that cook with gas, 17% of the total according to EPH 2004, have a stove, it can be estimated that on the average, 35% to 40% of rural homes that cook mainly with firewood, have a stove. Most rural homes generally cook over an open fire on the floor in a room that is built for that purpose; it does not have a chimney, but rather permeable walls to allow air circulation to remove the smoke. In addition to the problem of energy inefficiency, there are significant risks for the people. The smoke that they have to breathe continuously during cooking causes serious respiratory problems and small children that accompany their mothers can easily be burned.

Since the 1970's, the Agrarian Extension Department (DEAG) of the Ministry of Agriculture and Ranching (MAG) has distributed improved stoves to improve conditions in homes and the health of rural families. The model that is used for this purpose has a masonry wall covered by a cast iron plate with different sized holes and lids for pots, and a galvanized sheet metal chimney. It also has a small oven that is heated by the stove. This model permits the use of large, thick pieces of firewood. As part of the

same program, DEAG also distributes fixed, elevated sinks for washing cooking utensils, simple kitchen furniture, and hard floors for homes and latrines.

The method is as follows: groups of rural people that are organized in committees ask the nearest DEAG agency (there are 144 in the country) for the necessary assistance. After the request is accepted, specialized technicians from DEAG first carry out a participatory rural diagnosis in the community in order to identify unsatisfied needs in the homes and define priorities for correcting the situation. Based on the diagnosis, they prepare a project and seek funds to finance it. To finance the program DEAG currently makes alliances with different rural development projects that are being carried out in Paraguay and generally operate with external funds (see Chapter 2).

A written agreement is signed with the beneficiaries, who agree to provide locally available materials (bricks or earth, sugar syrup) and the labor for building the stoves. As the counterpart, DEAG provides the other materials (a metal oven, a cast iron plate, a grate, a chimney, and Portland cement), a trainer, and her transportation to the community. A seminar-workshop is then held in the community where specialized technicians from DEAG provide theoretical and practical training in stove manufacture to promoters from the community.

After a prototype stove has been built in the community, the local promoters take charge of directing the construction of stoves for the other members of the committee. DEAG does not presently have data on the number of stoves that have been built during the approximately 30 years since it began, nor has an impact study been carried out on the families that use the stoves. Programs similar to this DEAG program have been carried out by international NGO's such as Plan International, Peace Corps, Partners of the Americas, and others.

1.8.3. Energy Costs in Rural Areas

As was already mentioned, most of the energy consumed by a rural family is for cooking food, but the energy generally does not represent a direct monetary cost for the family. However, other energy needs in the home, that is, lighting, communication (radio, television, telephone), ventilation on hot days, and perhaps a refrigerator, represent a direct cost for the rural family. According to EPH 2004, 61.7% of the rural homes in Paraguay have a television set and 54.1% have a refrigerator.

Several surveys have been carried out in the past to study the implications of energy costs for families that do not receive electricity from ANDE; the objective has been to study their capacity to pay for minimum electrical services. The results from the different studies are similar, and show that the average monthly cost for lighting and communication, principally for kerosene, candles, diesel fuel and batteries, is US\$ 10 (APPLIMAR Project).

The amount that a rural family presently spends for electricity from ANDE, on the other hand, is a social rate and most pay only US\$ 1.50/month (see par. 2.3.4.).

2. Rural Development Actions

2.1. Introduction

Rural development actions in Paraguay are carried out by several governmental agencies and a large number of NGO's, some are international with offices in Paraguay, and others are domestic. The national government that took office in August 2003 developed an "Agrarian and Rural Development Plan 2004-2008", whose principal objective is to organize *"the actions of the different stakeholders in the public, private, and international sectors to carry out specific missions that are consistent with the achievement of major pre-established goals."* The fourth of its five strategic objectives that is more closely related to the social situation of the peasant population calls for *"the integration of public and private multisectorial rural development efforts and the strengthening of the economy and wellbeing of peasant families."*

This plan focuses principally on productive aspects of the agricultural sector in order to achieve the following overall goals, of which the last 3 are the most relevant for poor peasants:

1. *"To increase the Agricultural GDP by 3% per year during the first three years and by 5% in subsequent years."*
2. *To increase agricultural exports by 3-5% per year during the quinquennium."*
3. *Food security for all the population by increasing food production at a rate at least equal to the rate of growth of the population."*
4. *To reduce rural poverty by means of essentially productive undertakings and the creation of jobs. During the quinquennium it is hoped to reduce extreme poverty by 30% and benefit 53,700 families (270,000 persons)."*
5. *To reorganize land use through a cadastre, improve land distribution by providing 8000 deeds per year, and legalize deeds to land where 153 old communities are established on an area of 748,308 hectares."*

Several national government agencies are involved in rural development, of which the most important are:

- "Ministerio de Agricultura y Ganadería" (MAG), mainly through the "Dirección de Extensión Agraria" (DEAG), which has 144 local agencies located throughout the country;
- "Instituto Nacional de Desarrollo Rural y de la Tierra" (INDERT), which is responsible for distributing land to small producers and providing basic infrastructure for new rural settlements (see next chapter);
- "Oficinas Regionales del Ministerio de Industria y Comercio" (ORMIC), which implement government policies in the sectors of industry and commerce in the interior of the country.
- "Instituto Nacional del Indígena" (INDI), which deals with Indigenous affairs, principally their constitutional rights to land ownership and providing material assistance to needy Indigenous people.

Projects that are carried out under MAG are coordinated by the Dirección Nacional de Dirección y Coordinación de Proyectos (DINCAP).

A large number of NGO's are active in rural development. They are involved in a variety of ways in several rural sectors (agricultural production, education, environmental protection, civil organization, health, basic infrastructure, human rights, etc.). Traditionally, NGO's have their own projects that are generally financed by international agencies, and there is little coordination with state authorities. In recent years, a new means of participation by NGO's has developed and involves the outsourcing of government activities, especially regarding technical assistance to peasants and non-formal training. An example of this was the "Proyecto de Apoyo a Pequeñas Fincas Algodoneras" (PRODESAL) by MAG through which some 20 Technical Intervention Units in several parts of the country were awarded to NGO's and consulting companies by means of a bidding competition. The intervention essentially consists of providing technical assistance to small cotton producers to improve their production.

Many large and small domestic NGO's have joined the following second tier organizations: Red Rural, "Federación Nacional de ONGs para el Desarrollo Rural Campesino TEKOKATU" or Red Ambiental. The "Asociación de Organizaciones No Gubernamentales del Paraguay POJOAJU," on the other hand, is a third tier organization, and joins together the principal NGO networks.

2.2. Agrarian Reform

Rural development currently takes place under the Agrarian Law of 2002 (Law 1863) that gives the responsibility for applying that law to the "Instituto Nacional de Desarrollo Rural y de la Tierra" (INDERT); before 2004, it was known as the "Instituto de Bienestar Rural" (IBR). It is mainly involved in Agrarian Reform, the principal objective of which is to provide landless peasants with access to land. The necessary land is obtained by expropriating large unproductive estates or through the voluntary sale of large pieces of land by their owners. INDERT also has the power to implement a rural development policies that should provide a better life for peasants.

Through the agrarian reform process, INDERT has created agricultural and cattle-raising settlements where a group of peasant families carry out a colonization process through which each is granted a parcel of land as a family production unit, and in some cases, there are also community fields. Through the colonization process, general support is provided to peasant families to help them become established; this includes the construction of basic infrastructure such as roads, schools, potable water systems, etc.; a sustainable production system is implemented, support is provided for the community organization, settlers are trained, and land ownership is regularized.

2.3. Rural Electrification

2.3.1. Historical Aspects

The electrification of rural areas of the country, that is the exclusive responsibility of ANDE, was begun in the 1970's. However, efforts at that time were directed towards electrifying urban areas, and most electricity was generated by thermal plants that burned imported petroleum fuels. During that phase, the number of users expanded at a rate of 9% per year; by 1990, there were 406,419 users, whereas in 1975 there were only 107,563. With regard to the rate of coverage of electricity service, this expansion

resulted in an increase from about 16% in the early 70's to approximately 50% in the late 80's and early 90's.

The construction of the Acaray, Itaipú and later Yacyretá hydroelectric power plants, and a transmission network to large urban centers during the 1980's and 1990's provided the infrastructure and quantities of energy necessary for promoting rural electrification. For that reason, the predominantly rural electrification phase began in the early 1990's and involved the expansion of mostly medium tension lines. Electrical energy consumption over the more than twenty-five year period increased by 1000%, from 500 GWh in 1970 to 5,000 GWh in 1997.

2.3.2. Electrification Plans

In April 1993, ANDE presented a document called "Plan Nacional de Electrificación: Ningún Paraguayo a Oscuras en el Año 2000". Due principally to financial and structural problems, it was not fulfilled completely, and 5 years after it ended there was still a coverage deficit of 7%. One of the basic assumptions of the plan was that most electrical energy consumption would be met by ANDE through the "National Interconnected System" (SIN), since *"the necessary measures will be implemented to allow energy to be supplied to areas that are very remote from power plants using unconventional resources."* Although the document expressed the intention to use these "unconventional" resources, meaning the possible use of decentralized systems, principally diesel-powered generating plants, the electrification plan was finally implemented almost exclusively through an expansion of the SIN.

ANDE uses plans with different time horizons that are subdivided into quinquenniums, for the implementation of its electrification projects. The short-term plan is for five years, and the current one is for the 2004-2008 period. The medium term plan is for the following quinquennium (2009-2013), and the long-term plan is for the subsequent five years (2014-2018). The short and medium term plans are revised each year, but the long-term plan is not.

The construction system ANDE uses for implementing its electrification plan is called the conventional job method, which follows international quality standards. The investment necessary for carrying out the projects is provided mainly from the company's own funds, but part also comes from external funds. The priorities in this electrification system are set according to a cost-benefit analysis that predicts the return on investment over a certain period. ANDE's Projects and Jobs Division is responsible for developing and monitoring electrification projects. Electrification projects are carried out by contracting companies, and ANDE awards the contracts through a public bidding process.

2.3.3. Self-Help System

In areas with low population density, where the cost-benefit study for electrification shows very low profitability, ANDE applies an alternative electrification system called the Self-Help System that was initiated in 1991. This is a program by which electrification takes place where the people of a certain rural area are interested in having electricity, organize a neighborhood commission, and ask ANDE for electrification. ANDE mainly provides the engineering and electrical materials, including cables, insulators, transformers, etc., and as a counterpart contribution, the people

agree to provide labor and materials for posts, which are generally wooden and are available in the area. In this way, public electrical service is made available to a substantial sector of the population by reducing the size of the investment necessary for implementing the projects. According to ANDE figures, the Self-Help System reduces the investment cost by 40% compared to the conventional system.

The detailed process for carrying out an electrification project using the Self-Help System is described below:

- **Establishment of the neighborhood self-help commission:**

The first step is the formation of a neighborhood commission by the residents that will undertake the “electrification of the community.” This requires the participation of the majority of the future users. ANDE suggests the use of notices and home visits by community leaders.

- **Appointment of a responsible person:**

Once the neighborhood commission has been organized, the community appoints a responsible person who will be in charge of preparing the list of interested persons (future users). Later, a request to “extend the line for the self-help system” is submitted to ANDE, together with the list of interested persons and a map of the area that is to be electrified.

- **Assistance of ANDE project staff:**

When an application is received, according to its plan ANDE sends appropriate employees to the requesting community to collect information in the field and prepare the corresponding implementation project. ANDE provides technical assistance services in the initial phase and during the implementation of the project. All services are provided at no cost to the requesting community.

- **Preparation of the Economic Feasibility Project:**

After the pertinent information has been collected in the field, the economic feasibility project is prepared, which consists basically of a 13.2 kV single phase system with a return to ground, and a 220 V. secondary that uses low cost materials (3 mm² galvanized steel wire or bare aluminum alloy conductors; wooden posts, etc.). In a few cases, a three-phase electrification system is installed. The Cost/Benefit analysis generally provides a result equal to or greater than 1. This analysis helps to determine the contribution that will be required from the community. The optimum breakeven point that it tries to achieve is for the contributions of ANDE and the community to be 50% each.

Between the beginning of the program in May 1991, and October 1997, 107,520 users were connected to the system, which is equivalent to an annual average of 16,500 users. In recent years, however, the number of new users that have been connected through the self-help program has dropped considerably. Between January 2001 and May of this year only 7,277 new users were added, which is equivalent to 1,500 new users per year; they are located mainly in the departments of Itapúa, Canindeyú, Caazapá, San Pedro and Amambay (in descending order). This drop in the number of new users that are connected each year compared to the first years of the program can be explained by the already fairly high rate of coverage achieved in the meantime during the rural electrification of the eastern region of Paraguay, as well as the increasing cost of electrifying the remaining areas with their very low population

density. It is estimated that 70,000 rural homes in Paraguay currently do not have electricity, which affects about 350,000 people.

Most electrical systems that were installed under the self-help program are now experiencing problems with service quality due to the use of materials of doubtful quality and the short-term sizing of the systems that did not consider future growth in electrical demand. For that reason, ANDE is presently being forced to invest large amounts of money to salvage those systems (see par. 4.1.1.).

2.3.4. Social Rate

Part of the program to combat poverty of the current national government, which took office in August 2003, is a new social rate that was introduced for ANDE users with a monthly consumption of less than 150 kWh and maximum power of 2,200 W (1 single-phase MT 10A tap). Up to 100 kWh/month, the rate is 25% of the normal rate for homes that have low tension and consumption greater than 150 kWh per month (presently 402 Gs/kWh tax included, equivalent to US \$0.066). In other words, the subsidy is 75%, and for 101 to 150 kWh per month, the subsidy is 50%. This discount is granted automatically without any need to submit a request.

Thus, a family that consumes 100 kWh/month pays only 10,050 Gs. (presently equivalent to US \$1.66), rather than 40,200 Gs, and a family that consumes 150 kWh per month pays 30,150 Gs. (currently equivalent to US \$4.98) rather than 60,300 Gs. About 300,000 users, which is practically one third of all ANDE users, can benefit from the new social rate. Most of the beneficiaries of the social rate live in rural areas where families use electricity mainly for lighting the home, and for a few low consumption electrical appliances, such as a fan, a television set, or a radio.

2.3.5. User Categories and Average Consumption

86.0% of the present 1,042,000 ANDE users (June 2005) are residential, 10.4% are commercial, 1.3% are industrial, and 2.4% are others (state agencies, etc.). Residential users consume 42.7% of the total, and have a monthly average consumption of 170 kWh, commercial users consume 19.1% at 632 kWh/month, industrial users consume 23.0% at 6,099 kWh/month, and others consume 15.2% at 2,229 kWh/month. The current number of ANDE users that are located in rural areas is greater (53.4%) than in urban areas (46.6%).

According to its own estimates based on ANDE billing details, the average annual consumption per rural home in 2004 was 1,030 KWh or 86 kWh/month, which is about half the overall average for the residential sector, and is somewhat lower than the maximum level of consumption, 100 kWh/month, that is required for the social rate with a 75% subsidy.

2.4. *Access to Financing*

For all practical purposes, there are only two national financial institutions in Paraguay that operate in rural areas and serve small and medium agricultural producers. One is "Banco Nacional de Fomento" (BNF) and the other is "Crédito Agrícola y de Habilitación" (CAH). Both are decentralized state agencies under MAG. They have a

developmental mission and a very dense network of branches in the interior of the country. The main difficulty encountered by the poorest producers when trying to obtain credit from these agencies is that they often do not have the necessary guarantees. One cause this problem is the delay in granting deeds to settlements that are administered directly by INDERT. Historically there has been a long delay between providing land to landless peasants and providing the corresponding deed. The current administration of INDERT is trying to correct this situation by promoting the provision of deeds for land that was provided by previous administrations.

Many credit unions and multipurpose cooperatives are also established locally through the initiative of the people themselves, and these generally offer loans under more favorable conditions than banks.

Also worth mentioning is the "Fondo de Desarrollo Campesino" (FDC), a second tier financial institution that is also under MAG. It provides low interest loans exclusively to so-called "Instituciones de Financiación Intermediarias" (IFI), which can be peasant organizations or cooperatives. These, in turn, offer loans to their members for investment in the productive sector.

A specific example of a financial institution that benefits the rural sector is "Fundación para la Inversión Solidaria" (FUNDASOL) that was established recently. The NGO is part of the "Federación Nacional de ONGs para el Desarrollo Rural Campesino - Tekokatú," that includes 20 Paraguayan NGO's, and the "Central de Organizaciones de Productores Ecológicos del Paraguay" (COPEP), by which 10,000 peasant families from 9 departments of the country have organized. FUNDASOL offers loans under very favorable conditions to small producers' committees that are members of COPEP, which is possible because it is a non-profit institution. Federación Tekokatú has another service institution that is very important to the peasant sector. It is "Fundación para el Desarrollo Campesino" (FUNDECA), which acts as a supportive marketer of agricultural products from all producers in the Tekokatú system.

2.5. Rural Industrialization

In Paraguay, agricultural production in general and peasant production in particular are characterized by a very low level of industrialization. Most cash crops that are produced by peasants, that is, mainly cotton fibers, sesame seed, cassava, corn, tobacco, and fruit (bananas, pineapples, citrus, guava, etc.) are marketed in a primary manner that provides very little income to the farmer. Peasants often depend on specific intermediaries in the region who operate as middlemen and in some cases as manufacturers. Most exploit the small producers through high interest loans and low prices for their products. Often peasants have no access to other sources of financing for their production, and with no means of transportation, they cannot market their products directly

The traditional cash crop of Paraguayan peasants is cotton, but in recent years low yields and low international prices for fibers have meant that this crop is no longer profitable, so on several occasions the government has provided a subsidy, given away seed and pesticides, and paid a higher price than the market price. The government has also tried to introduce other cash crops, such as sesame seeds, castor beans, tobacco, sugar cane, etc., to reduce their dependence on cotton and improve income for peasants.

Another product that small rural producers are using increasingly to augment their income with the encouragement of unscrupulous traffickers, is marihuana, especially in the departments of Concepción, San Pedro, Canindeyú, Caaguazú, etc. Due to its high quality, compressed marihuana from Paraguay is very popular in the major urban centers of Brazil and Argentina. Since it is an illegal crop, the judicial authorities and the "Secretaría Nacional Antidrogas" (SENAD) are trying to combat it, but up to now, the results have been rather unsatisfactory. However, in recent months, this and other drugs that only pass through Paraguay, especially cocaine from Bolivia, have been increasingly confiscated.

For several years the government and many NGO's that support rural development in Paraguay, have been promoting the creation of small individual or community industries in rural areas; this is very difficult because peasants in Paraguay are very conservative and individualistic. The most popular peasant industries are petitgrain distilleries, and factories for making sugar cane syrup, cassava starch and sausages. The construction of small silos for grain has reduced the dependence of peasants on middlemen. Another strategy that has been applied increasingly is the formation of small producers' organizations to market together and produce according to a business plan that is developed at the beginning of the crop year, agreed to by the group, and negotiated with the buyers of the products.

3. Regulatory and Institutional Framework for Rural Energy

3.1. Introduction

In Paraguay, the government plays a major role in the energy sector as a regulator and as a participant in the market, and has a monopoly in the most important sectors. However, the regulatory and institutional system lack systematization. The present legal and administrative structures are organized according to the energy sector. The electrical sector is under a state company, "Administración Nacional de Electricidad" (ANDE), and the two Binational Agencies of Itaipú and Yacyretá, in which ANDE also has a share. The only state agency with jurisdiction over all the energy sectors is the "Viceministerio de Minas y Energía."

3.2. Viceministerio de Minas y Energía

In the National Government, the energy sector is under the "Viceministerio de Minas y Energía" (VMME) that was established in 1990 as part of the "Ministerio de Obras Públicas y Comunicaciones" (MOPC). It is currently headed by the Vice Minister, Mr. Hector Ruiz Diaz. The VMME has two departments, the "Dirección de Recursos Minerales" (DRM) and the "Dirección de Recursos Energéticos" (DRE). The latter includes the Department of Conventional Energy and the Department of non Conventional Energy. VMME's mission is to promote, serve, facilitate and guarantee the mutual interests, investments, projects and undertakings of the energy, hydrocarbon, hydroelectric and mining sectors of the country.

Law No. 167/93 gave VMME a governing role in the national energy sector and specified the following principal functions:

- *"To study, identify, and propose energy alternatives according to current and potential consumption needs of the country;*
- *To consider all aspects of national and international energy developments that are available, be they conventional or non conventional; and*
- *To propose policies, regulations and applications for national development to ensure the proper use of available resources."*

VMME also represents the National Government in international agencies and forums involving the energy sector, including the "Latin American Energy Organization" (OLADE) and Subgroup No. 9, "Mining and Energy" of MERCOSUR.

Article 3 of Law N° 966/64 states that *"Official relations between ANDE and the Executive Branch will take place through the Ministry of Public Works and Communications; it will have a direct relationship with the Branches and administrative departments of the Government ."*

Article 29 of Law N° 167/93 ratifies and correlates both laws, and states, *"Relations between the Administración Nacional de Electricidad, as a Decentralized Agency, and the Ministry of Public Works and Communications will take place through the Cabinet of the Vice Minister of Mines and Energy, without prejudice to its powers and functions as stated in its Organic Law".*

With regard to "Petróleos Paraguayos" (PETROPAR), the state agency in charge of the hydrocarbon sector, its relationship with the Executive Branch is governed by Article 3 of its Organic Charter, Law No. 1182/85, which states: *"Relations between PETROPAR and the Executive Branch will take place through the Ministry of Industry and Trade. It can establish direct links for industrial, commercial and functional operations with other government departments and with the private sector."*

There will be direct contact between the Executive Branch and the two autarchic agencies, ANDE and PETROPAR, as well as with the two Binational Agencies of Itaipú and Yacyretá under the direction of the President of the Republic. The latter has the power to appoint the Presidents of ANDE and PETROPAR, and the Paraguayan Director of Itaipú and Yacyretá, as well as the Paraguayan representatives that are on their respective Boards of Directors. The Executive Branch is also in charge of coordinating the execution of their respective plans and programs, and budgets with those agencies.

There is thus an obvious dispersion of jurisdiction over legal matters in the energy sector. VMME also has very little influence over the management of the energy sector (see also par. 5.3.2.). To correct these significant weaknesses in the present regulatory framework of the energy sector, several Draft Laws have been prepared in recent years to propose the corresponding reforms, but none have been successful. The Strategic Plan of the Energy Sector that was presented in January of this year contains the most recent reform proposal that VMME wants to implement, which will begin with changes in its own internal organization (see par. 5.3.3.).

3.3. Administración Nacional de Electricidad

The electrical sector in Paraguay is under the "Administración Nacional de Electricidad" (ANDE) that was established in 1949 by means of Decree No. 3161 of the Executive Branch; it was organized by Decree Law No. 2340 of 1950, approved by Law No. 274 of 1955, and is presently governed by Law No. 966 of 1964. This organic law was modified and expanded by Laws No. 976 of 1982 and No. 2199 of 2003, respectively. ANDE is an autarchic, decentralized agency of the Public Administration with legal status and its own capital, and is responsible for meeting the electrical energy needs of the entire country. The agency is controlled directly by the Executive Branch through MOPC.

ANDE is involved in the entire electrical process, that is, generation, transmission, distribution, and marketing of electrical energy. Article 5 of Law 966/64 states that ANDE will have the following functions:

- a) *"to prepare electrical development plans and programs, and propose, for the approval of the Executive Branch, a National Electrification Plan that will be updated at least every five years;*
- b) *to project, provide, and purchase electrical generation, transmission and distribution equipment, and other facilities and goods that are necessary for the proper operation of electrical services;*
- c) *to utilize its own electrical supply systems and those of third parties under its responsibility, supply consumers, and provide public lighting service, with rates that are approved according to the provisions of this Law;*

- d) *to purchase and sell electrical energy inside and outside the country to other companies or public or private service systems, and exchange energy with them;*
- e) *to regulate all matters that involve the electrical energy it generates, transforms, transmits, distributes and/or supplies;*
- f) *to coordinate and guide electrical development in the country and promote energy consumption;*
- g) *in general, to carry out all other acts and functions required for the fulfillment of these objectives."*

ANDE currently has a practical monopoly in the electrical sector. Article 64 of its organic law states that *"ANDE will enjoy exclusivity in the public supply of electrical energy and lighting throughout the Republic. As such, it will have the preferential right to utilize the necessary hydroelectric resources."*

However, its organic law also foresees certain exceptions to this exclusivity. Art. 65 states that *"Existing production concessions for electrical energy service enjoyed by private or other types of organizations will be respected until their legal termination. In order to renew them or make any changes in the concession contract, a favorable report will be required from ANDE. ANDE's approval will also be required for projects that expand or modify existing infrastructure. The provisions of this Law will be followed when the current rates are modified."* Art. 66 states that *"With the affirmative vote of at least four members of the Board of Directors, ANDE can delegate its exclusive rights to other companies for the supply of electrical energy and public lighting service in towns that are not served by ANDE. This delegation will be by contract and considered by the Legislative Branch."*

The President of ANDE has the authority to approve electricity rates (Article 16 of Law 2199/03). According to Art. 85 of its organic law: *"Rates will be determined such that the income from their application will allow ANDE to cover all production costs and obtain a reasonable profit on investments made in electrical supply activities to ensure that the company has the necessary resources to cover its debts and the normal expansion of its services."* According to Art. 91 of Law 966/64, *"different rates will be established for different groups of consumers, such as residential or domestic, commercial, industrial and rural."* ANDE's list of rates includes a large number of different rates, such as the differentiation between the types of tension (low, medium, high, very high tension), type of consumer (social, residential, commercial, industrial, general, governmental, public lighting), amount of energy consumed, and declared power.

ANDE supplies electrical energy principally from 3 hydroelectric plants that feed the Sistema Interconectado Nacional (SIN). The first is the Acaray hydroelectric plant with 190 MW of installed power, which is owned exclusively by ANDE. The other two hydroelectric plants are Itaipu and Yacyreta. Both are binational entities that Paraguay shares with its neighbors, Brazil and Argentina, respectively. In both cases, ANDE owns the 50% equity that pertains to Paraguay.

3.4. Entidad Binacional Itaipú

"Entidad Binacional Itaipú" was established in 1973 by means of a treaty between the Federative Republic of Brazil and the Republic of Paraguay, in order to *"utilize the*

hydroelectric potential of the hydroelectric resources of the Parana River that are jointly owned by the two countries, from and including the Guaira Falls or Sete Quedas Falls to the mouth of the Yguazu River” to be shared equally by the two signatory countries. The treaty has been modified and adapted several times since it was signed through an exchange of notes between the Governments of the two countries.

Itaipú is a binational agency, which means that it shares the nationality of Paraguay and Brazil. It has legal status and its own capital, which consists of equal contributions by the partners, ANDE for Paraguay, and ELECTROBRAS (Centrais Elétricas Brasileiras, S.A.) for Brazil. Unfortunately, the partners do not participate as parties to the treaty, and do not have the power to appoint the members of the Board of Directors, or the members of the Executive Board of Itaipu, which are appointed partitively by both countries.

The Itaipú hydroelectric dam has 12,600 MW of installed power and is the largest in the world; it was built between 1975 and 1991. It has 18 turbines with 700 MW of power each, and half pertain to Paraguay. However, only a small part of the energy produced on the Paraguayan side is consumed in the country. The amount of energy distributed by ANDE in the year 2000 was approximately 4450 GWh; half of the energy generated in Itaipu that same year, however, was 46,700 GWh, that is, 10 times more, and is not even the amount of energy generated by one of the turbines.

The 1973 treaty states that Paraguay can only sell its surplus electrical energy to Brazil, and at a price that is significantly lower than current prices on the electrical market of the region; this constitutes a major loss for the national economy. Two additional turbines of 700 MW each are presently being installed, and will increase the total installed power to 14,000 MW.

3.5. *Entidad Binacional Yacyretá*

"Entidad Binacional Yacyretá" was also created in 1973 by means of a treaty between the Republic of Argentina and the Republic of Paraguay. Like the case of Itaipu, the treaty has been modified and expanded through the exchange of notes between the two governments.

Yacyretá, like Itaipú, is a binational entity between Paraguay and Argentina that has joint and equal representation by both countries. It has legal status and its own capital that is provided by the contributions of the partners, which are, by equal parts, ANDE for Paraguay and the Ministry of Foreign Affairs, International Trade and Culture for the Republic of Argentina (replacing AEE, Agua y Energía Eléctrica de la Argentina, State Company). Its object is to provide hydroelectric energy and improve the navigation conditions of the Parana River near Yacyreta Island and eventually attenuate the damage caused by flooding during extraordinary floods. The entity is managed by a Board of Directors and an Executive Committee.

Construction work only began in 1983 and lasted until 1998, when the 20 turbines were completed. However, as yet the reservoir has only been filled up to level 76 (76 meters above sea level) because several complementary projects are lacking; these will allow the reservoir to reach its nominal level, which is 83. These works are presently in their initial phase. Meanwhile, the 20 turbines are operating at reduced power, that is 58% of their nominal value, that is, 160 MW each, or 3200 MW in total. Paraguay currently uses only 1% of the energy generated by Yacyreta, although it has the right to 50%. According to the Yacyreta treaty, it is obligated to export the rest to Argentina.

3.6. *Private Stakeholders in the Electrical Sector*

Only two private companies currently participate in the electrical energy market. The oldest is "Compañía de Luz y Fuerza S.A." (CLYFSA) of Villarrica that distributes electrical energy in the city of Villarrica, the capital of the department of Guairá, which it purchases in bulk from ANDE. Another private initiative is the "Asociación de Colonias Menonitas" (ACM) that includes three Mennonite colonies in central Chaco, Fernheim, Menno and Neuland; they previously had their own production units and distribution facilities, and supplied energy to their communities. In the year 2000, the region was connected to the SIN, and for that reason, their own generating units were taken out of service. Since that time, ACM purchases electrical energy in bulk from ANDE and distributes it in the area.

Most ranches (extensive cattle raising establishments) that do not receive electrical energy from ANDE and are located in the western region, and have diesel-powered generators that produce electricity to cover their needs. Some also have photovoltaic solar systems and/or small wind systems.

There are practically no legal regulations yet in Paraguay for the non-conventional renewable energy sector, especially solar energy, wind energy, and biofuels, and the number of specialized stakeholders is very small. At the state level, VMME and INTN handle this matter (see par. 3.8). In addition to these public institutions, there are also several private organizations that should be mentioned here. These include several commercial companies that sell photovoltaic solar panels and the corresponding

accessories; however, the most do not have specialized personnel to provide competent assistance to customers. The largest of these companies is Rieder & Cia., which is the Siemens representative in Paraguay.

There are also a few manufacturers of solar and wind devices. These include CEDESOL Ingenieria, with which the author of this article is involved. It is the only company in Paraguay in this category, and it develops, manufactures and installs several types of solar devices, including water heaters, driers and solar ovens, but also high efficiency wood stoves. The company also prepares and implements autonomous rural electrification projects that use photovoltaic solar panels and small wind generators (see par. 4.2.2.). Several companies also manufacture and install wind driven pumps that are popular in the Chaco region, where wind resources are more abundant than in the eastern region. In addition to these companies, mention should be made of an NGO, whose activities include the dissemination of solar energy in Paraguay. It is the "Fundación Celestina Pérez de Almada," and works closely in this field with CEDESOL Ingenieria.

3.7. National Forest Service

The legal basis for the forestry sector in Paraguay is Law No. 422 of 1973, called the "Forestry Law," which was replaced in 1995 by Law No. 542, known as the "Forestry Resources Law." The state agency in charge of the forestry sector is the "National Forest Service" (SFN) that is directly under the "Cabinet of the Ministry of Agriculture and Ranching." It controls and monitors natural or planted forest resources for production, and lands which, though not forested, are classified as forestlands. The powers of SFN are described in Article 13 of Law No. 542/95, and include:

- *"To formulate and propose Forestry Policy in coordination with State organizations that are involved in the field of economic development and environmental protection in the country;*
- *To administer the forestry development fund and the ordinary and extraordinary funds of its budget and capital;*
- *To adopt appropriate actions to prevent and repress illegal trafficking of logs and lumber;*
- *To perform inventories and monitor forests used for production and the forest lands of the country;*
- *To monitor activities involving the harvesting and clearing of the forest resources of the country;*
- *To produce technical and technological studies and regulations for forest products in cooperation with knowledgeable official and private organizations;*
- *To administer the production, recovery or protection of the forest heritage of the State;*
- *To designate forest reserves, and ensure and verify their total protection;*

- *To apply the penalties specified in this Law, and establish the amount of the fines;*
- *To take the necessary measures for preventing and controlling forest fires, pests, and diseases;*
- *To administer and promote the creation of centers for forestry research, education, extension, and production;*
- *To create and maintain organic control and vigilance mechanisms to ensure the proper fulfillment of this Law;*
- *To foster and develop forestry education and extension activities with knowledgeable official and private agencies."*

All forests and forestlands in the country will be subject to this Law. They can be declared common public interest and thus forests and forestlands that are required for the following purposes can be subject to expropriation:

- Controlling soil erosion;
- Regulating and protecting watersheds and springs;
- Protecting crops;
- Protecting and beautifying roads;
- Public health, tourism and scientific research;
- Wild areas and Indigenous community areas;
- Settlements of small agro forestry producers.

The destruction of forests and forestlands and the irrational use of forest products are prohibited. Forests can be utilized only with the authorization of the National Forest Service, and for this, the owner must submit the necessary application and forest management plan. When it is approved, the corresponding forest products transportation permit will be issued and a mark that is obligatory for these products will be used. Wood and other forest products cannot be transported or sold without permits that specify the quantity, species, weight or volume, origin, and destination of the product that is being shipped. Chapter VIII of that Law establishes and regulates the Forest Fund for financing SFN programs.

Because of the loss of most of the native forests over the past 50 years, especially in the eastern region of Paraguay, and to ensure a supply of forest products for various purposes, Law No. 536 "De Fomento a la Forestación y Reforestación," was passed in 1994 giving the State the power to promote reforestation. For this purpose, the State reimburses 75% of the direct implementation costs on a single time basis for each area that is planted or replanted, and 75% of the direct costs of maintaining the forest or plantation during the first three years. The Banco Nacional de Fomento provides preferential long term, low interest loans for financing the corresponding projects.

Due to their legal documentation requirements, especially the management plan, both laws are difficult to apply to small forestland owners, that is, to peasants; in most cases, their farms vary from 5 to 20 hectares. Their forests are often only used for their own wood needs for construction, or cooking, or perhaps for a small industry that requires firewood as fuel. Many also sell their wood resources on a small scale, especially as firewood and charcoal, to provide additional income for their families. Most firewood and charcoal that is sold in the cities comes from small producers who sell forest products to part-time middlemen who have the necessary means of

transportation. This activity is actually illegal, through of great social importance, and is difficult to control and regulate.

For several years, the Department of Forestry Education, Extension and Research has been implementing a program of technical assistance to small rural producers to help counteract this problem and achieve greater sustainability in forest use by peasants. However, the resources that are available for this program are insufficient to cover the large needs of this important task. Under MAG, the "Proyecto Manejo Sostenible de Recursos Naturales" is currently being implemented in several parts of the eastern Paraguay with the assistance of the German Aid Agency (GTZ) with funds from the German Restoration Bank (KfW) and local Government funds. Its principal objectives are:

- To contribute to the conservation and rehabilitation of natural resources and biodiversity and thus help to stabilize the income of the rural population of Paraguay in the long term.
- To introduce sustainable agriculture and forest management systems on small and medium sized private farms in selected areas.
- The Project includes the financing of financial incentives, supplies and technical assistance, soil conservation measures, and the establishment of agro forestry, reforestation, and forest management systems. It also seeks to promote the implementation of the management plan of the Ybycui National Park.

In order to ensure the high quality of its implementation and the efficient use of the existing resources, the project is linked to other rural development projects that are being implemented by MAG, the most important of which is PRODESAL.

Despite the fact that the Ley de Fomento a la Forestación y Reforestación has been in effect for more than 10 years, and the incentive it offers to owners of forestlands, the area reforested during that time has been small. Other laws that control and protect forest resources have also been unable to slow significantly the reduction of the forested area of Paraguay. The World Wide Fund for Nature, WWF, estimates that the Atlantic Forest of Alto Parana that originally covered half of the eastern region of Paraguay could disappear completely within only 5 years if current deforestation trends are not reversed. For that reason, this international organization is presently carrying out a significant awareness campaign that includes the establishment of social pacts among the different stakeholders from the sector to try to protect the remaining remnants of that forest; its biological value, according to WWF scientists, places it among the 200 most biologically important sites on earth.

3.8. Secretaría del Ambiente

The "Secretaría del Ambiente" (SEAM) was established in the year 2000 by Law 1561, which modified its position in the organization chart of the national government. Previously it functioned as the "Undersecretariat of Natural Resources and Environment" in MAG. It is currently an agency of the Executive Branch of the national government and is directly under the President of the Republic. In its own words, its functions or purposes are as follows:

- *The formulation of policies, the coordination, supervision and implementation of environmental actions, and the plans, programs, and projects that are specified in*

the National Development Plan for the preservation, conservation, rehabilitation, and management of natural resources;

- *Ecological and environmental zoning, in general, to continually improve the living conditions of the various sectors of Paraguayan society and ensure the conditions for economic growth, social justice and ecological sustainability in the long term.*

Under the "Dirección General de Control de la Calidad Ambiental y de los Recursos Naturales" SEAM is the administrative authority for Law No. 294/93 on "Environmental Impact Assessment" (EIA). That law states that it is obligatory to carry out an EIA for all types of jobs and human activities of a certain magnitude that could directly or indirectly affect the environment. Only professionals that have registered with the corresponding register are authorized to carry out those studies. In Art. 3 it states:

"All Environmental Impact Assessments must contain at least:

- a) A description of the type of job or the nature of the projected activity, including the owners or responsible persons; its location and magnitude; its installation, operation and maintenance process; types of raw materials and supplies that are to be used; its stages and schedule of execution; the number and description of the labor force to be used;*
- b) An estimate of the social and economic significance of the project, its link to government, municipal and departmental policies and its suitability for a policy of sustainable development, as well as territorial, urban and technical regulations;*
- c) The boundaries of the geographic area that is to be affected, including a detailed quantitative and qualitative physical, biological, socioeconomic and cultural description of the area of direct influence of the work or activity, and an environmental inventory of the area to characterize its state prior to the planned transformations, giving special attention to the determination of watersheds;*
- d) The essential analyses for determining the possible impacts and risks of the work or activities during each stage of their execution, and after they have been completed; their positive and negative, direct and indirect, permanent or temporary, reversible or irreversible, continuous or discontinuous, regular or irregular, cumulative or synergic, short, medium or long term effects;*
- e) An Environmental Management Plan that will contain a description of the protective, corrective or mitigative measures for negative impacts that are foreseen in the project; planned compensations and indemnifications; inspection, monitoring and control methods and instruments that will be used, as well as other precautions that are included in the regulations;*
- f) A list of technical alternatives to the project and its location, as well as an estimate of the circumstances that could arise if it is not carried out; and,*
- g) A summary of the detailed information contained in the Environmental Impact Assessment and its conclusions. The summary must be written in easily understandable terms using visual communication media and other didactic techniques, and not exceed one fifth of the Environmental Impact Assessment."*

Art. 7 states: *"An Environmental Impact Assessment will be required for the following projects or public or private activities:*

- a) Human settlements, colonization, housing developments, and their guidelines and regulations;*

- b) Agriculture, ranching, and forestry production and farming;*
- c) Industrial complexes and units of any kind;*
- d) Extraction of solid surface or underground minerals and their processing;*
- e) Extraction of fossil fuels and their processing;*
- f) Construction and operation of pipelines for water, oil, gas, minerals, sewage and industrial effluents in general;*
- g) Hydraulic projects in general;*
- h) Power plants and electrical transmission lines;*
- i) Production of charcoal and other sources of energy as well as the activities that utilize them;*
- j) Collection, treatment and disposal of urban and industrial waste;*
- k) Road projects in general;*
- l) Port projects in general and their operating systems;*
- m) Landing strips and their operating systems;*
- n) Storage depots and their operating systems;*
- o) ñ) Mechanic workshops, foundries and others that could cause external impacts;*
- p) Construction, clearing and excavation projects;*
- q) Archeological and speleological activities and prospecting in general;*
- r) Production, marketing and transportation of hazardous substances;*
- s) Introduction of exotic species, exploitation of native forests, wild flora and fauna, commercial fishing; and,*
- t) Any other job or activity, which, due to its size or intensity, is likely to cause environmental impacts."*

Each EIA has to be presented at a public hearing in the locality where the project is to be carried out. This is to allow the affected population to become thoroughly informed about the project and its environmental impact, and be able to express their concerns in this regard. However, the objections raised in the public hearing are not binding, but to the extent possible, they should be taken into account to improve the project.

3.9. Instituto Nacional de Tecnología y Normalización

"Instituto Nacional de Tecnología y Normalización" (INTN) is an autarchic agency that was created by Law 862, passed and promulgated on June 26, 1963, and has been in existence since April 1965. By means of Law 937 of September 13, 1982, and its corresponding Regulations 1988 of February 16, 1999, INTN was made responsible for the implementation and operation of the National Metrological Laboratory. Through Decree 15,552 of the Executive Branch of the Nation on November 26, 1996, INTN was made the National Certification Agency, permitting it to act directly in the certification of products, systems, and services. Relations between INTN and the Executive Branch take place through the "Ministerio de Industria y Comercio" (MIC).

INTN is a member of the following international agencies that are involved in energy and technology matters:

- International Organization for Standardization (better known as ISO)
- International Electrotechnical Commission (IEC)
- Comisión Panamericana de Normas Técnicas (COPANT)
- Comité MERCOSUR de Normalización (CMN)
- Programa Iberoamericano de Ciencia y Tecnología para el Desarrollo (CYTED)

Its mission is to assist consumers, industry, business and services by providing assistance in applied research, development, innovation, and technological services, standards, certification and metrology. Its principal activities are:

- To develop national technical standards at the request of interested sectors with the participation of all the parties, and to help foster the Paraguayan contribution to the homologation of standards in the Mercosur and international region.
- To certify products, processes, services, and personnel, and Quality Management Systems of companies in order to add competitive differential value that will help promote international trade and cooperation.
- To ensure uniformity in all measurement processes that are carried out in public and private laboratories, and in diverse productive activities.
- To establish metrological control by the State over measurement instruments in order to guarantee consumer protection, and the health and safety of citizens.

In recent years, INTN has carried out several technological research projects on the application of renewable energy in Paraguay and has developed prototypes of solar devices such as driers, ovens, and distillation equipment. It has also published two studies on renewable energy resources in Paraguay; one was "El Recurso Eólico en Paraguay", that was carried out in 1997 with the "Fondo Argentino de Cooperación Horizontal" and the "Dirección Nacional de Aeronáutica Civil" of Paraguay, and the other was "Estimación de la Distribución de la Radiación Solar Global en la República del Paraguay" that was published in 1994 with the "Comisión Nacional de Investigaciones Especiales" of Argentina.

From 2001 to 2003, INTN participated in a Multilateral Project with the OAS, SEDI/AICD/AE N° 071/01; it is known as "Energización de Centros Comunitarios Rurales" and was implemented simultaneously in several countries of the region. Since 2004, INTN has been working with the same multilateral institution on another Project, SEDI/AICD/AE N° 204/03; it is known as "Energización Sustentable en Comunidades Rurales Aisladas con Fines Productivos" (see par. 4.2.4. and 4.2.5.), and was designed as a continuation of the previous Project. Its duration will be until 2006.

As Paraguay's representative in CYTED, INTN participates in activities within the framework of "Subprogram VI: Nuevas Fuentes y Conservación de la Energía" that includes the following Thematic Networks:

- Thematic Network VI.B "Red Iberoamericana para la Electrificación Rural con Energías Renovables".
- Thematic Network VI.D "Red Iberoamericana de Cocción Solar de los Alimentos."

- Thematic Network VI.E "Red Iberoamericana de Solarimetría".
- Thematic Network VI.G "Red Iberoamericana de Generación Eólica."

Research Project VI.7 is also participating in the same Subprogram "Aprovechamiento de Nuevas Tecnologías Destinadas al Tratamiento de Aguas para Consumo Humano."

3.10. Public Contracts

Law N° 2051 “De Contrataciones Públicas” that was promulgated on January 21, 2003, created and regulated the contracting system for all agencies of the Central Administration of the State; departmental government; national universities; autonomous, autarchic, regulatory and supervisory agencies; public social security agencies; public companies and mixed companies; corporations in which the state is a majority shareholder; official financial institutions; the Central Bank of the State, and agencies of the Decentralized Public Administration; and municipalities.

Decree No. 21,909 of 2003, provided detailed regulations for that law. Its executive body is Unidad Central Normativa y Técnica (UCNT), which is known as "Dirección General de Contrataciones Públicas" and is under the Ministry of Finance.

Each convoker, that is, state agencies that use public contracting, must have a department that performs the functions of the corresponding Operative Contracting Unit (OCC). According to Art. 10 of the Decree, it has the following powers:

- *"To prepare the Annual Contracting Program for each fiscal year and submit it for the consideration and approval of the Convoker's maximum authority.*
- *To prepare specific Bidding Conditions for each public bidding competition, manage the invitation and sale of bidding conditions, respond to questions and send out modifications, receive and safeguard bids that are received, submit them to the Evaluation Committee, review the evaluation reports, and ratify the award recommendation of the Evaluation Committee, and send it to the highest Authority of the Convoker, as appropriate.*
- *To define the technical specifications and other conditions for direct contracting, process the invitations, respond to questions and send out modifications, receive and safeguard bids that are received, evaluate the bids and recommend the award if an Evaluation Committee is not established, and make the recommendation to the highest Administrative Authority, as appropriate.*
- *To manage the formalization of contracts and receive the corresponding bonds."*

Art. 16 of the Law specifies the different types of procedures that are to be applied according to the expected amount of the contract, which are as follows:

- a) **Public Bidding Competition:** for contracts that exceed the equivalent of ten thousand minimum daily wages;
- b) **Competitive Bidding Process:** for contracts whose value is between two thousand and ten thousand minimum daily wages;
- c) **Direct Contracting:** for contracts that are less than the equivalent of two thousand minimum daily wages, except as specified in Article 34; and,
- d) **With a Fixed Fund:** for the minor purchases specified in Article 35.

The minimum daily wage is established and adjusted periodically by the Executive Branch according to the inflation during the previous months. Currently the minimum daily wage is equivalent to about US\$ 7.50.

Public bidding competitions can be **national**, where only individuals and companies that are domiciled in the country may participate, or **international**, where individuals

and companies that are domiciled in the country, as well as those that are not, may participate.

A **prequalification** stage may be utilized as the first stage of a public bidding competition or a competitive bidding process in order to make a prior selection of the possible participants depending on their particular conditions. Prequalification must be based only on the minimum capacity of the possible bidders to execute satisfactorily the contract that is involved.

Invitations or calls for tenders are published by the "Sistema de Información de Contrataciones Públicas" (SICS) in at least one national daily newspaper for at least three days, and in the official gazette. SICS also has a website specifically used for public contracting (www.contratacionesparaguay.gov.py) that provides access to all the corresponding information, where all the documents of each bidding competition can be downloaded.

Technical and economic bids plus all the documents and bonds required in the Bidding Conditions according to the Law and its Regulations will be submitted at one time in a closed envelope with the appropriate security features to prevent its contents from being known and to preserve its inviolability, at the place, date and time set for the ceremony for submitting and opening the bids.

The **opening of the bids** will take place in a formal, public ceremony at which the Convokers verify fulfillment of the requirements of laws and the bidding conditions using checklists.

The **evaluation of the bids** is carried out by evaluation committees using the methods and parameters specified in the bidding conditions, and in this law and its regulations. The method is principally as follows:

1. Verification of the compliance of each bid with regard to the provision of basic substantial documentation, and the elimination of any that do not provide the documentation, or if it is unsatisfactory.
2. Provisional selection of the lowest priced bid, which is analyzed in detail to verify its compliance with the other requirements of the bidding competition, such as technical specification, delivery times, financial and technical capacity to fulfill the contract, etc. If that bid substantially fulfills all these requirements, it is declared the lowest bid evaluated, and is proposed for the award.

A **bidding competition** is declared **annulled** through a resolution of the maximum authority of the Convoker if:

- a) no bids are submitted;
- b) none of the bids meet the conditions required in the bidding conditions or deviate substantially therefrom; or
- c) the prices of the bids are unacceptable because they vary substantially from the contract estimate, or they exceed the budgetary provisions determined by the Convoker.

In **Competitive Bidding Processes**, no less than five participants are invited directly and notice of the process must be simultaneously provided through the Public Contracting Information System (SICP), so that any potential bidder that is interested

and can meet the requirements of the bidding conditions, can submit its bid under the same conditions as those that were invited. Art. 33 indicates under what conditions and in which cases public bidding competitions are not necessary.

Direct Contracting is carried out by means of an invitation in writing and through the Public Contracting Information System (SICP) to potential bidders asking them to submit their technical and economic bids in a closed envelope or by virtual means to the Operative Contracting Unit (UOC).

Contracting with Fixed Funds for the purchase of goods or the contracting of services can be used by organizations, entities and municipalities if, due to the amount and nature of the expenditures involved, they do not need to abide by the procedures specified in the law, charging to the respective fixed funds if the total amount of each operation does not exceed twenty minimum daily salaries.

The Law foresees several cases for **special contracts**, which are as follows:

- Public Works Contracts
- Purchase of Real Estate
- Location of Real Estate
- Location of Chattels
- Contracting the Services of Third Parties
- Contracting the Services of Consultants

One of the last chapters of the Law and the corresponding Regulations deals with **Infractions and Penalties** that can be applied in contractual relationships between private and public parties.

4. Rural Electrification Programs

4.1. *Conventional Electrification*

4.1.1. Programs for Rehabilitating the Distribution Infrastructure of Self-Help Systems

Since 2004, ANDE has been carrying out a Program for Rehabilitating the Distribution Infrastructure of Self-Help Systems, which involves the standardization of all medium and low-tension distribution networks. The program has a horizon of 10 years and is based on priorities according to the condition of the networks that were built under this system. In this program, all facilities (posts, cable, transformers, etc.) that do not meet current ANDE standards will be replaced. Due to the poor quality of the materials used during the early years of the program, that is, wooden posts and galvanized steel cable, the systems are very prone to technical problems and have a very short useful life (5 years); this has forced ANDE to carry out this rehabilitation program and make enormous investments.

4.1.2. Short Term Electrification Plan

The current short-term distribution work plan of ANDE began in 2004 and will continue until 2008. It involves the incorporation of 19,500 new users through the self-help system and the construction of about 1600 km of low-tension lines. The plan will connect 14,500 new users by means of the conventional system and construct 600 km of low-tension lines. The plan varies according to the 6 distribution systems of ANDE:

- Western System: includes the department of Presidente Hayes and the Central Chaco
- Northern System: includes the entire departments of Concepción and Amambay, the Chaco side of the Paraguay River as far as Fuerte Olimpo and the extreme northern part of the department of San Pedro
- Eastern System: includes the entire departments of Alto Paraná and Canindeyú, the eastern part of the department of Caaguazú and the extreme northern part of the department of Itapúa
- Southern System: includes the entire departments of Misiones and Ñeembucú and most of the department of Itapúa
- Central System: includes the entire departments of Guairá and Caazapá and the central and western part of the department of Caaguazú
- Metropolitan System: includes the Capital and the entire departments of Central, Cordillera and Paraguari.

The priority of these distribution systems are, in descending order according to the number of new users: Central, Metropolitan, South, and East. In the Northern and Western Systems where the current coverage is lower, only a small number of new users, about 2300, is planned.

Thus coverage in the country should reach 93% in 2004 (EPH 2004), and 96% by 2008. However, if the 2004 plan is compared with what was actually done this year, the

difference is significant. Only 1,703 new users, rather than the projected 3,189 new users have been connected using the self-help system, that is, only 53.4% of the goal.

4.1.3. Electrification of Indigenous Communities

ANDE is currently carrying out a feasibility study for electrifying Indigenous communities by extending existing lines by means of the self-help system. The study covers 64 communities, all located in the eastern region of Paraguay, where 4,418 home will be benefited. According to the Indigenous census of 2002, 98 homes in the communities that will benefit from this Project have electrical energy service, meaning that 4,320 homes will effectively be benefited. The project is expected to last 5 years (2006-2010).

The departments with the largest number of homes that will be benefited are Amambay (1,551), Caaguazú (744), Canindeyú (715) and Alto Paraná (568) (see Table 10). Other departments with a smaller number of homes are Caazapá (259), San Pedro (230), Concepción (158) and Itapúa (95). Under this electrification Project, 8,204 non-electrified homes in Indigenous communities in those departments (Indigenous census 2002) will be reduced to 3,884, which is somewhat less than half. The greatest reduction in non-electrified Indigenous homes will take place in the department of Amambay, where 85% of Indigenous homes that do not yet have electricity will benefit from this public service. The Project is presently based exclusively on the technical feasibility of extending existing lines. The financing has not yet been finalized.

Table 9: Number of Indigenous homes by department that will benefit from the project

Department	benef. comun.	possib. benef. homes			Indigenous homes			% homes elec.	
		total	elec.	to be elec.	total	elec.	not elec.	before	after
Caaguazú	14	744	0	744	1462	49	1413	3.35	54.24
Caazapá	6	259	0	259	503	39	464	7.75	59.24
San Pedro	4	235	5	230	562	35	527	6.23	47.15
Alto Paraná	5	612	44	568	974	31	943	3.18	61.50
Canindeyú	9	750	35	715	2008	173	1835	8.62	44.22
Amambay	18	1554	3	1551	2090	6	2084	0.29	74.50
Concepción	5	169	11	158	511	29	482	5.68	36.59
Itapúa	3	95	0	95	469	13	456	2.77	23.03
Total	64	4418	98	4320	8579	375	8204	4.37	54.73

Legend: benef. comun: number of beneficiary communities
 possib. benef. homes: number of possible beneficiary homes
 elec.: number electrified
 to be elec.: number to be electrified
 not elec.: number not electrified

Source: ANDE, DGEEC, its own compilation

4.2. Decentralized Electrification of Isolated Communities

4.2.1. Introduction

Very few decentralized electrification projects have been carried out in isolated communities of Paraguay up to this time. This is mainly due to an ANDE policy on rural electrification that gives priority to the extension of the SIN. One of the few exceptions made by ANDE itself is the town of Puerto Bahía Negra, located in the department of Alto Paraguay on the banks of the Paraguay River. This locality together with the neighboring Indigenous community of Puerto Diana have a decentralized electrical energy distribution network fed by a 280 kVA diesel-powered generator that produces electricity mainly during the evening hours.

Due to an increasing awareness by national government planning authorities that the conventional electrification system will be unable to reach all the communities of the country, especially in the Chaco, several studies have been carried out recently on decentralized electrification. Some of these projects and studies are presented below.

4.2.2. Puerto 14 de Mayo, Indigenous Community of Karcha Bahlut

Karcha Bahlut is an Indigenous community of the Ybytoso ethnic group, a subgroup of the Chamacoco, also known as Yshyr, located in the department of Alto Paraguay on the banks of the Paraguay River; it is 133 km north of Fuerte Olimpo, the capital of the District where the community is located, and about 30 km south of the locality of Puerto Bahía Negra. It is a community of 68 persons who live in 17 homes (Indigenous census 2002). They mainly hunt, fish, gather and make handicrafts from palm leaves and wood.

A Paraguayan NGO, "Patio de Luz," carried out the project in 2002, and has been supporting the community for some time in its sustainable community development process. The project relates to the need of the people to improve the quality of lighting in their homes, in particular, and to have electricity for several uses in their community center, and includes a school and a local museum. At first, the idea was to seek non-reimbursable funds to purchase a diesel-powered generator. The community of Karcha Bahlut went to the British Embassy in Asuncion with this in mind, but the request was rejected due to sustainability problems with this electrification system (supply of fuel, maintenance, etc.). In its rejection note, the Embassy suggested that the community submit a new, more sustainable project based on a solution involving solar panels, a technology that was not completely new to them, since their radio already had a solar panel. The "Patio de Luz" leaders then contacted "CEDESOL Ingenieria," practically the only company in Paraguay that specializes in solar energy. The company prepared a technical proposal that was suitable for the stated needs of the community, and the budget of the British Embassy. The proposal included the following points:

- Installation of a portable lantern in each home with a fluorescent tube and a built-in rechargeable battery, as well as a small independent amorphous silicon solar panel on the wall of the house or on a post in the yard to charge the lantern during the day;

- Installation of a fixed photovoltaic system in the community center with 16 solar panels of 85 Wp each to power fluorescent tubes, fans and a 250 l community freezer to conserve fish for later sale;
- Installation of a semi-industrial drier for drying medicinal plants and wild meat, and a parabolic solar oven at the school, both designed and built by CEDESOL Ingenieria;

All the photovoltaic components with the exception of the batteries were purchased from a specialized supplier in Switzerland. At the insistence of the British Embassy, British manufactured solar panels had to be purchased. The Indigenous community imported the materials directly, taking advantage of their exoneration from customs taxes and duties that benefits Indigenous communities with legal status. The batteries were purchased from a specialized Paraguayan company that manufactures stationary batteries.

Due to the absence of access roads, all materials and the technical personnel for the installation had to travel by river on a public boat that makes the round trip from Concepcion to Bahia Negra once a week. The trip up river takes three and a half days, and down river, two and a half days.

In general, the results of the project were very positive. Lighting in the community center allows adult literacy classes to be held at night. The improved illumination in homes permits the families to work on their palm leaf handicrafts at night, among other things, when the temperature is more suitable for this activity. The freezer has become an important source of income for the community through the sale of frozen fish.

4.2.3. Acaray Mi Indigenous Community

Acaray Mi is an Indigenous community of about 700 persons from the Ava-Guaraní ethnic group that is located in the District of Hernandarias, also the site of the Itaipu dam. A French NGO, "Electricians Without Borders," implemented a very innovative decentralized electrification project in the community in 2004. This included the installation of a community diesel-powered generator that operates on biodiesel, which the community itself is producing from the sunflowers they grow at a small oil processing plant. Some of the sunflower oil is used for food in the community and some is sold to surrounding areas, which generates income for the community.

4.2.4. Electrification of Rural Community Centers

A Multilateral OAS Project, "Electrification of Rural Community Centers," SEDI/AICD/AE N° 071/01, was carried out between 2001 and 2003 in 3 countries, Argentina, Paraguay and Uruguay, with funds from the Organization of American States OAS. The National Institute for Technology and Standardization INTN was the executing institution for Paraguay, which was the coordinating country during the final year of the Project.

The general objective of the Project was to improve the availability of electricity and the quality of life of the inhabitants of isolated rural communities through the implementation of community demonstration systems in small settlements located in the different regions, using solar and wind technologies and promoting their multiplication. The specific objectives were to develop electrical energy generating systems in six centers (2 in each participating country) based on solar or wind resources, and water heating and treatment, and to carry out a technical analysis of the results obtained, the level of satisfaction of the persons served, and the regional dissemination of the systems installed. The 2 isolated rural communities chosen in Paraguay were Yacac Vash, an Indigenous community located in the department of Boqueron, and Punta Diamante, a peasant community located in the department of Ñeembucu. The conditions of the two communities were very different, especially with regard to their geography, climate, ethnology and everything that those conditions signify for the daily lives of the people.

The following activities were carried out in the 2 communities within the framework of the Project:

- A survey to evaluate the energy and water needs of the selected community centers.
- An evaluation of solar and wind resources available in the region
- Installation of basic solar and wind generating systems
- Characterization of water heating and treatment systems
- Training of local leaders in the preventive maintenance of the installed systems.

The following equipment was installed in Yacac Vash:

- Photovoltaic panels in the community center, school, health post, and church.
- Wind generator for community lighting and the teacher's house.
- Water distillation in the health center using pan distillers.
- Automatic solar radiation and wind speed and direction indicators.

The following equipment was installed in Punta Diamante:

- Photovoltaic panels in the church, school, and recreation center, and a battery charger for community use.
- Natural convection hot water system in the school with collectors and an insulated tank.
- Water distillation using pan distillers.
- Chemical treatment system for potable water at the school (with solar pump)
- VHF communication system (solar powered).
- Automatic solar radiation and wind speed-direction indicators.

Regarding the evaluation of sun and wind resources, studies were carried out to update solar and wind data for the country based on work published by INTN in 1994 and 1997 respectively (see par. 6.1. y 6.2.).

4.2.5. Sustainable Energy in Isolated Rural Communities for Productive Purposes

A multilateral OAS project, "Sustainable Energy in Isolated Rural Communities for Productive Purposes," SEDI/AICD/AE N° 204/03, began in 2004 and will continue until 2006. Five countries are participating, Argentina, Chile, Paraguay, Peru, and Uruguay. The Project was designed as a continuation of the project described in the previous chapter. As in the previous case, INTN is the executing institution for Paraguay; it was again chosen to be the coordinating country due to its excellent implementation of the previous project.

The general objective is to promote productive activities in rural areas by means of the sustainable transfer of renewable energy technologies and improve the living conditions of the population. The specific objective of the Project is to provide the people of selected communities with opportunities for production, employment and income using sustainable energy for new productive activities and/or improving existing ones, in order to improve their quality of life.

The Project has the following components:

- Studies and diagnoses to select the communities and define the lines of production that will be developed or strengthened, which involve the use of renewable energy, in particular solar and/or wind energy.
- Evaluation of sun and wind resources that are available in the region in order to size properly the production systems.
- Implementation of the necessary infrastructure to operate at least two productive systems in each community that are based on renewable energy technologies.
- Training of people from the communities involved as well as extension workers in the use of the transferred technologies, and wide dissemination of the project.
- Evaluation of the project.

The same two beneficiary communities from the previous project will also benefit from this project, that is, Yacac Vash, department of Boqueron, and Punta Diamante, department of Ñeembucu. The following activities were carried out during the first year of execution:

- Methodologies were developed for dealing with socioeconomic and productive matters.
- Community organization was strengthened.
- Participatory workshops, censuses, interviews, and observations, were held to implement the action plan for defining the lines of production.
- Productive lines were identified for implementation:
 - Punta Diamante: apiculture and aromatic herbs
 - Yacac Vash: apiculture, improvements in sesame seed production, and a community garden.

- Development of educational materials (information guides, booklets, pamphlets).
- Training of the people in matters relating to the lines of production of each community.
- Evaluation of the solar and wind resources in each community.

4.3. Renewable Energy Project for Decentralized Rural Electrification

4.3.1. Background

The "Renewable Energy Project for Decentralized Rural Electrification" (ERERD) originated with a request for Preparatory Assistance that was submitted by the National Government to the "Global Environment Facility" (GEF) through UNDP, and an agreement was signed in the year 2000. The Project consisted of a large-scale project design stage to be financed partly by GEF and partly by the Paraguayan Government, and the Vice Minister of Mines and Energy acted as the executing unit. The project was part of Operational Program 6 of GEF, known as "Promotion of the Adoption of Renewable Energy by Eliminating Barriers and Reducing Implementation Costs".

4.3.2. Objectives

The general objective was to *"assist Paraguay to reduce the long term growth of greenhouse gases (GHG) that could result from increased use of fossil fuels for electrification and the continued use of kerosene and LPG for lighting in unelectrified rural areas."* The solution that was proposed to achieve this general objective was the utilization of renewable non-carbon emitting energies to satisfy the energy needs of rural areas efficiently, principally for lighting and communication, and some productive sectors.

The Development Objective of the Project was the establishment and consolidation of market conditions to eliminate the barriers to the use of renewable energy for decentralized rural electrification by:

- Creating a suitable institutional framework to facilitate market conditions for small renewable energy companies,
- Strengthening rural development programs by prioritizing principally the productive use of renewable energy, and
- Mobilizing conventional financial resources for the development of renewable energy micro enterprises.

4.3.3. Proposed Activities

Activities proposed in the framework of this project were:

1. Evaluation in legislation, regulations, policies, and institutions of barriers to decentralized rural electrification based on renewable energy and the development of an appropriate institutional framework.

2. Evaluation of training and institutional strengthening needs, planning of training programs in decentralized rural electrification based on renewable energies.
3. Design of a demonstration project program to test administrative/operational models and the technical and financial feasibility of renewable technologies in the Paraguayan context.
4. Evaluation of barriers to financing renewable energy projects and the design of financial mechanisms for project implementation.
5. Planning of a promotional campaign on the use of renewable energy by the rural population.
6. Development of a framework for standardizing and certifying renewable energy technologies.
7. Coordination of activities and formulation of a project document.

The basis for the project that was carried out in late 2001 and throughout most of 2002 was the Country Analysis that was prepared for the APPLIMAR Project in 1998, the Renewable Energy Study prepared by VMME in 1995, and the National Energy Plan developed by STP with the support of UNDP in 1992.

4.3.4. Work Method

The innovative aspect of the work methods used in the Project was the fact that it was carried out with the close cooperation of diverse groups of stakeholders that can in some way influence the dissemination of renewable energy for decentralized rural electrification in Paraguay. A SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis was carried out for that purpose.

Eight well-defined groups of stakeholders were identified, together with their respective roles:

1. **Public Authorities** (national, departmental and municipal levels): Formulation of Policies, Planning, Monitoring, Legislation, Concessions
2. **Funding Agencies**: Availability of financial resources for projects
3. **Energy Companies**: Production, Transportation, Distribution, Marketing
4. **Private Stakeholders and Professionals**: Production and Sale of Equipment and Services
5. **NGO's**: Administration, Training, R&D, Implementation
6. **R&D Centers**: Research and Development
7. **Training Centers**: Formal Education and Training
8. **Customers**: Final beneficiaries

The administration of the Project was shared institutionally by governmental and non-governmental stakeholders, including the international agency that negotiated the project, that is, UNDP, in order to take into account the rich diversity of the stakeholders.

4.3.5. Institutional Analysis

This project dates from the year 2001/2002. Many of the aspects to which it refers still exist in the current context, while others may have totally or partially changed positively or negatively. However, we feel it is important to include the conclusions of the project as a reference. The principal conclusions drawn from the analysis of the institutional situation were:

- *"The work method selected for the project and the involvement of groups of stakeholders are relevant and permit the development of synergies that help to achieve the objectives of the project. Progress has been made in the methodology and mechanisms used in the past to achieve the same goal of supplying electrical energy to rural people.*
- *The Formation of Human Capital and Education, in the opinion of the participants in the SWOT exercise, was the most active element of the system, and also one of the most critical. This underscores one of the most interesting characteristics of the study because it demonstrates the importance stakeholders place on human resources training activities and general education strategies. It is thus evident that there is practically a consensus that reinforces the initial proposal of the PAR/00/G41 project, one of the principal components of which was Training. It should be noted that this element of the SWOT matrix has two aspects, the first being a Training Program to generate national capacities and competencies to implement a renewable energy project sustainably (either through elemental training within the framework of formal education, or specialized training activities), and the second being educational campaigns in affected communities to overcome one of the principal obstacles, which is the people's lack of information and cultural resistance to changes in behavior (users expect to be "connected" first to the ANDE system; a radical change in this expectation is proposed since isolated systems will be developed).*
- *The other four elements that are considered to be critical by the stakeholders are Public Policies, the Legal Framework, International Cooperation, and Financing. The persons consulted thus see a need for the State (generally the "manager" of these four elements, though not exclusively) to take a decisive position as the promoter and architect of the legal structure, as manager, and for financial mechanisms to help to facilitate the project. This means that state agencies have an unavoidable responsibility for providing technical and financial assistance if projects are to be successful. The other element, institutional strengthening, that was considered in this consultancy is also fully justified and has a more precise orientation."*

4.3.6. Barriers to the Dissemination of Renewable Energy

The clarification in the previous item regarding the date of the study and the possibility that during the past 5 years some of the elements identified could have changed is also valid here. The principal barriers to the dissemination of renewable energies in the four areas studied in Paraguay that were identified are as follows:

1. Most Significant Legislative and Regulatory Barriers:

- a. *The lack of a Regulatory Framework for the electrical sector that decentralizes and demonopolizes the generation, transmission, and distribution of electricity, and provides the same opportunities to renewable energies.*
- b. *The need to obtain concessions from ANDE, as the sole alternative, in order to exploit electrical power generation and marketing opportunities, by virtue of Law 966 of August 12, 1964.*
- c. *The lack of an institution to coordinate and direct efforts and plans in the electrical sector, including generation by alternative sources.*
- d. *ANDE's monopoly in fact and in law by virtue of Law 966.*
- e. *The lack of Regulations for Concessions to provide procedures for ANDE concessions.*
- f. *Contradictory laws, such as Law 966, that contradict the law that decentralizes the administration to local or departmental governments.*

2. Barriers that involve Institutions and Training:

- a. *The lack of training programs in renewable technologies at all levels of education and professional training, i.e. formal and informal.*
- b. *The lack of training programs in financial risk evaluation and sensitivity variables in the financial analysis of renewable energy projects.*
- c. *The structures of educational institutions for promoting and developing renewable energies are weak.*
- d. *The lack of trainers of trainers, or molders of opinion about the sector.*
- e. *The lack of an institutional structure that is specifically for small scale renewable energy, that has the strength to lead and promote access to electricity in isolated areas that are not included in the SIN.*
- f. *The links between stakeholders are very diffuse, and institutions for small-scale renewable energy lack definition.*

3. Barriers to the Transfer of Information and Technology:

- a. *The lack of awareness at all levels about the existence of alternative options that are based on renewable sources of energy and the related technologies.*
- b. *The almost total absence of experience with the use of alternative renewable energies for small-scale electrical power generation or decentralized uses, and with the administration and negotiation of projects.*
- c. *Very limited relevant information that relates principally to hydraulic (small scale), biomass and wind resources.*
- d. *The lack of coordination among the isolated efforts of environmental and educational organizations involved in the development and promotion of renewable energy use.*
- e. *Structural weakness in institutions involved in the dissemination and transfer of this type of technology.*
- f. *The lack of regulations and procedures for standardizing and certifying renewable technology equipment.*

- g. *The absence of general promotion and education campaigns regarding these technologies.*

4. Barriers Related to Financing:

- a. *The total lack of mechanisms and tools for financing small-scale renewable energy projects.*
- b. *The perception of high risk in operations involving these technologies.*
- c. *Two factors in combination have a negative effect; the high initial investment cost, and the beneficiaries' limited capacity to pay in rural communities.*
- d. *The lack of tax and customs incentives that would place renewable technologies on an equal footing to compete with traditional options.*
- e. *Families that have no access to the SIN are not creditworthy according to traditional commercial banking standards, principally because they do not own private property (or it is mortgaged under Agrarian Reform), and do not have sufficient income.*
- f. *The lack of perception that makes it difficult to demonstrate the business opportunities underlying these technologies to the financial sector and entrepreneurs."*

4.3.7. Components of a Full Size Project

The following components and subcomponents have been identified for a full size Project, including their respective objectives and expected outcomes:

Component 1: Adaptation of the Legal, Regulatory, and Institutional Framework for the promotion of alternative renewable technologies for decentralized rural electrification

Subcomponent 1.1. Implementation in the Legal Framework of the electrical sector of PDF recommendations that relate to renewable energy sources for Decentralized Rural Electrification

Objective: To ensure competitive market conditions for alternative renewable technologies for decentralized rural electrification.

Expected outcome: A set of laws and sectorial regulations that promote competitive markets for renewable energy sources used in electrifying scattered rural areas that are isolated from the SIN.

Subcomponent 1.2. Modification of current procedures

Objective: To modify current legislation (Law 966/64) to promote private investment in renewable energy.

Expected outcome: The negotiation of production permits, as processed and decided by ANDE, will be appropriate for the needs of the potential market in decentralized rural electrification.

Subcomponent 1.3. Institutional Strengthening Program

Objective: The creation of an appropriate institutional framework for regulating and monitoring the decentralized rural electrification market.

Expected outcome 1: The Vice Ministry of Mines and Energy will be restructured and strengthened as the agency that coordinates institutional regulations for the promotion and development of decentralized rural electrification in Paraguay.

Expected outcome 2: Adjustments to current legislation will promote decentralized electrification using Renewable Energy Sources (FRE) and existing institutional capacity.

Expected outcome 3: Regulation of Concessions for the operation of decentralized renewable energy systems for rural electrification.

Subcomponent 1.4. Framework of tax and customs incentives

Objective: To compensate for the failure to consider economic and environmental externalities in electrical generation alternatives that use fossil fuels.

Expected outcome: A legal framework of tax and customs incentives to promote investment in small scale renewable energy sources.

Component 2: Training Program

Objective: To develop the capacity to design, implement and manage decentralized rural electrification projects that use renewable energy sources.

Expected outcome: The creation of entrepreneurial capacity for the development of rural electrification energy companies that use renewable energy sources.

Component 3: Education and Dissemination Campaigns

Objective: To implement dissemination campaigns that focus on the final user and other stakeholders in the decentralized rural electrification market.

Expected outcome: The “democratization” of information and knowledge on alternative renewable energies and their potential use.

Component 4: Financial Training Program

Objective: To compensate for the complete lack of knowledge, information and training in order to channel the resources of commercial banks and financial intermediaries toward decentralized rural electrification projects.

Expected outcome: The commitment of financial resources of commercial banks to this new market niche.

Component 5: Program for the Implementation of Pilot Projects

Objective: To begin developing an alternative market for decentralized rural electrification services using the most feasible renewable energy sources: small-scale solar, wind and hydro.

Expected outcome 1: The creation of a decentralized electrification services market for rural communities that are isolated from the network.

Expected outcome 2: The implementation of rural electrification projects within the framework of a Full Size Project to complement the integrated rural development projects of IBR (Instituto de Bienestar Rural).

Expected outcome 3: The implementation of pilot projects will complement the results of Training and Promotion Programs.

Component Number 6: Program for the Development of Certification Standards and Procedures

Objective: To ensure the useful life of renewable energy equipment for decentralized rural electrification.

Expected outcome: A set of certification standards and procedures for equipment that will ensure a level of quality appropriate for its useful life.

Component Number 7: Guarantee fund for decentralized rural electrification projects that use renewable energy sources

Objective: To channel the financial resources of local commercial banks toward decentralized rural electrification projects that use renewable energy sources.

Expected outcome: Investments of local commercial banks will be channeled toward this new market niche.

Component 8: Program for Monitoring and Disseminating the Experience

Objective: To ensure that the results obtained from the full size project are monitored efficiently and disseminated to stakeholders in order to encourage replication.

Expected outcome 1: Continuous monitoring and evaluation of the results obtained from the full size project.

Expected outcome 2: The dissemination of the results and lessons learned throughout the region.

Componentes	GEF	Co-financiamiento	TOTAL
Componente 1	832.200	103.800	936.000
Componente 2	251.872	38.968	290.840
Componente 3	400.000	82.500	482.500
Componente 4	46.000	0	46.000
Componente 5	276.000	1.052.498	1.328.498
Componente 6	135.000	13.000	148.000
Componente 7	144.000	6.242.542	6.386.542
Componente 8	501.000	81.000	582.000
TOTALES	2.586.072	7.614.308	10.200.380

Table 10: Cost of Project Components and Funding Sources

Source: UNDP, ERERD-GEF Project

The scheme for financing project costs is basically as follows: the incremental costs associated with the consolidation of the structural framework (legal, financial, training) for promoting renewable technologies in the decentralized rural electrification market will receive most of the GEF funding, while the incremental costs associated with the creation of infrastructure (renewable generating systems in demonstration projects) will receive most of the counterpart funding.

The goal of the demonstration project component of the GEF activity is a minimum of 7500 homes (5% of the decentralized rural electrification market) to be achieved over a 5 year period. These activities in a diverse area will produce a multiplying effect and will lead to the creation and development of a decentralized rural electrification market that will be able to complete the task without assistance.

4.3.8. Implications of the Rural Electrification Project

The “Renewable Energy for Decentralized Rural Electrification” Project is of great importance for resolving the rural electrification problem in Paraguay. The project has several thrusts for overcoming various current weaknesses. The project phase for the development and design of the PDF-B was successfully completed. The results of that phase as well as the actions proposed were utilized in the development of the Strategic Plan of the Energy Sector 2005-2013 (PESE, see Chapter 5) to design the strategic focuses of the renewable energy sector.

After they are suitably adapted to the present situation, the concrete actions of the ERERD project will be partially or completely incorporated into the “Renewable Energy Development Program” (PDER) that PESE expects to use as a planning instrument for concrete actions in Renewable Energy. The implementation of those actions will be subject to the availability of the necessary funds, which could come from several sources, including the GEF.

5. STRATEGIC PLAN OF THE ENERGY SECTOR OF THE REPUBLIC OF PARAGUAY 2004-2013

5.1. *Introduction*

The "Strategic Plan of the Energy Sector of the Republic of Paraguay 2004-2013" (PESE) is a project that was prepared during 2004 at the request of the Government of Paraguay through the "Secretaría Técnica de Planificación del Desarrollo Económico y Social de la Presidencia de la República del Paraguay" and the "Viceministerio de Minas y Energía" by a Spanish consulting company, "Ingeniería, Estudios y Proyectos, NIP, S.A." (NIPSA) with the support of a Spanish law firm, "Masons Buxeda Menchén" and financing from the Government of Spain.

The study has two main parts, the design of a Strategic Plan for the Energy Sector, and a draft of the Regulatory Framework for the sector that supports it.

Existing statistical and documentary information was analyzed to diagnose and identify the problems that limit the development and operation of the energy sector in Paraguay. That analysis was complemented by the opinions of agents and experts that are involved in the economy and in particular in the energy sector of the country.

The authors of the Study hope that the Strategic Plan will be sufficiently realistic so that it can be adopted by all stakeholders in the Energy Sector, and that the proposed Regulatory Framework will not only support this Strategic Plan, but that the Energy Sector will be compatible with the operation of the energy systems of MERCOSUR, and that in the future Paraguay will be able to benefit from the potential synergies that a single energy market could generate in MERCOSUR. All the chapters analyzed the situation of Paraguay, and linked and compared it with the corresponding international situation, in particular, that of MERCOSUR.

5.2. *Strategic Plan*

5.2.1. Projected Scenarios

The Strategic Plan section is divided into eight chapters and the contents are as follows:

- Chapter I describes the socioeconomic system of Paraguay and the economic scenarios used in preparing the Strategic Plan.
- Chapters II and III deal with the international energy environment and the energy balances of Paraguay and MERCOSUR.
- Chapters IV to VII discuss the sectorial aspects of energy in Paraguay, that is, petroleum, natural gas, renewable energies and the environment.
- Chapter VIII is a prospective analysis of the energy sector of Paraguay, including world energy forecasts with specific reference to Latin America. Three different scenarios have been prepared for Paraguay, according to the evolution of the GDP.
- Chapter IX completes the analyses, diagnoses, and identification of problems with the presentation of a Strategic Plan for the Energy Sector (PESE).

The three scenarios that are analyzed in Chapter VIII are based on three hypotheses about the evolution of the GDP and the population, and uses the projected figures of BCP and ECLAC for the 2003-2004 period, that is, 2.5% in 2003 and 3.0% in 2004:

1. **Tendency Scenario (E1):** Annual growth rate of 1.7% for 2005-2013
2. **Desirable Scenario or Central Scenario (E2):** Annual growth rate of 3,5% for 2005-2009 and 3% for 2009-2013
3. **Optimum Desirable Scenario (E3):** Annual growth rate of 5,6% for 2005-2009 and 6,4% for the rest of the period

The final overall energy consumption and primary energy production were studied for the 3 scenarios and differentiate among the primary sources, that is, petroleum products (gasoline, diesel, fuel oil, LPG), electricity, biomass, and natural gas:

5.2.2. Energy Consumption

In the case of electricity, the study estimates that its consumption will accelerate in the coming years due to industrialization and modernization policies, and the substitution effects that affect biomass. There will also be a substitution effect for LPG, and probably natural gas by the end of the period examined by the strategic plan.

It is expected that biomass consumption will decline in both the industrial and residential sectors during the coming years due to substitution and modernization policies.

There are great expectations for natural gas in the coming years. Current exploration activities in the Chaco could lead to production by late 2006 or early 2007. There are presently several companies involved in the concession stage, which could become involved in the production of natural gas. This process will culminate in the construction of a gas pipeline to Asuncion and the start up of a 750 MW combined cycle power plant in 2013 in Asuncion. At that point, several industrial companies that use biomass extensively might begin to replace it with natural gas.

According to the three evolutionary scenarios, energy consumption will evolve in the following manner:

The **tendency scenario (E1)** forecasts an increase of 35.2% in energy consumption during the 2002-2013 period with important variations in the different sources of energy. The greatest increase would be 65.5% for electricity, while the smallest increase would be about 20% for biomass. This scenario follows the current trend, which is characterized by low economic activity, loss of per capita income, increased unemployment and reduced employment rates. This scenario is also strongly influenced by the lack of any type of energy policy that encourages energy substitution and/or improvement of energy efficiency. Low employment rates and economic activity will lead to a loss of energy productivity, and an increase of 10% in the energy intensity of the GDP.

In the **desirable or central scenario (E2)**, energy consumption would increase by 47.1%. In this scenario, policies with incentives would encourage energy substitution, mainly biomass by electricity, and real prices, especially for diesel fuel. As a result,

there would be a 141% increase in electrical consumption and a 2.6% reduction in the consumption of biomass. However, despite the projected increase in diesel fuel prices, consumption would increase by 116% between 2003 and 2013.

The **optimum desirable scenario (E3)** forecasts a 98.2% increase in energy consumption during the 2002-2013 period. The most significant increase, 269%, is for electricity. The principal reasons for the jump in electricity consumption, other than the large increase in the GDP, are the active modernization and industrial development policies and incentives promoting the use of electricity. These political measures would also cause a large increase in energy intensity. This scenario would also permit greater convergence with the energy levels MERCOSUR had in 2001.

Table 11: Percentage variation in energy consumption between 2002 and 2013 by scenario:

Energy Source	E1	E2	E3
Electricity	65.5	141	269
Petroleum Products	50.7	97.2	191
Biomass	19.6	-2.6	6.4
Total	35.2	47.2	98.3
Variation in GDP 2004-2013	22.8	40.4	79.0

Source: PESE and its own compilation

Table 12: Variation in per capita electricity consumption and energy intensity between 2002 and 2013 by scenario:

Parameter / Scenario	Year	2013			2001	Units
	2002	E1	E2	E3	Mercosur	
Per capita electricity consumption	772	1,007	1,463	2,242	1,828	kWh/inhab.
Per capita biomass consumption	0.350	0.329	0.268	0.293	0.224	tep/inhab.
Energy intensity	3.24	3.57	3.39	3.58	-	tep/mio Gs

Source: PESE and its own compilation

Table 13: Percentages of energy sources in final consumption by scenario:

Primary Source / Scenario	Year	2013		
	2002	E1	E2	E3
Electricity	10.4	12.7	17.0	19.3
Petroleum Products	35.0	39.0	46.8	51.4
Biomass	54.6	48.3	36.2	29.3

Source: PESE and its own compilation

Table 14: Projections of energy consumption (thousands of tep)

	2002(r)	E1		E2		E3	
		2008	2013	2008	2013	2008	2013
P. Petrolíferos	1.280	1.628	1.928	1.796	2.523	2.108	3.725
Gasolinas	209	252	277	255	290	281	378
Gasoil	861	1.118	1.351	1.251	1.861	1.493	2.816
Fuel-oil	78	110	131	119	151	140	224
GLP	81	105	120	123	161	140	224
Otros	51	43	49	48	60	54	83
Electricidad	380	515	629	639	914	770	1.402
Biomasa	2.000	2.333	2.392	2.093	1.948	2.149	2.127
TOTAL	3.660	4.476	4.949	4.528	5.385	5.027	7.254

(r): real.

E1: Escenario tendencial.

E2: Escenario deseable/central.

E3: Escenario óptimo deseable.

Source: PESE

5.2.3. Energy Production

The energy production scenarios can be summarized as follows; the total increase in production between 2004 and 2013 is 21.6%:

1. **Hydrocarbon Production:** The production of natural gas could begin in late 2006 or early 2007 and crude oil in 2008; the initial amount would be 50,000 tep/year for both sources of energy, and production will double every 2 years.
2. **Hydroelectric Production:** It is expected that the two additional 700 MW groups at Itaipu will commence operation by the end of this year, and the work for reaching level 86 will be completed at Yacyreta in 2008, allowing production to increase

progressively to its nominal value of 1540 MW. It is also expected that the future 250 MW complimentary plant at Brazo Aña Cua in Yacyreta complex, and the 200 MW Punta de Yguazu plant on the Yguazu River, will begin operation in 2008.

3. **Thermoelectric Production:** Two natural gas driven power plants will be added to the present insignificant thermoelectric generating capability. The first is 50 MW and will begin operation in 2007 in central Chaco, close to the gas fields. It will supply the Mennonite colonies in the area. A similar thermoelectric plant, but with 750 MW capacity, may be built near Asuncion; it would depend mainly on the confirmation of the production forecasts for the Chaco gas field, and the construction of a gas pipeline from the fields to the capital of Paraguay, a distance of about 500 km. The power plant could begin operation at the end of the period of the PESE.
4. **Production of Electricity using Renewable Energy:** The following production systems with their respective installed power are planned before 2013: thermal power plants using biomass, 20 MW, wind generators, 45 MW, micro hydroelectric plants, 15 MW, and photovoltaic solar systems, 40 kWp.

Table 15: Forecasts of electrical energy production by power plant 2003-2013

Año	Itaipú	Yacyretá	Aña Cuá	Acaray	Yguazú	Térmicas	Biomasa	Eólica	Solar fotovoltaica	Minihidráulica	Total
2003	44.575,5	6.016,0		1.049,4		0,5					51.641,4
2004	43.480,2	5.995,5		1.049,4		0,5					50.525,6
2005	47.500,0	6.468,5		1.049,4		0,5					55.018,4
2006	47.500,0	6.468,5		1.049,4		0,5					55.018,4
2007	47.500,0	7.589,5		1.049,4		325,5					56.464,4
2008	47.500,0	9.256,5	895,0	1.049,4	190,0	350,5	75,0	36,0	0,0	22,5	59.374,9
2009	47.500,0	9.841,0	957,0	1.049,4	240,0	350,5	75,0	36,0	0,0	22,5	60.071,4
2010	47.500,0	9.841,0	957,0	1.049,4	240,0	350,5	112,5	72,0	0,1	45,0	60.167,5
2011	47.500,0	9.841,0	957,0	1.049,4	240,0	350,5	112,5	72,0	0,1	45,0	60.167,5
2012	47.500,0	9.841,0	957,0	1.049,4	240,0	350,5	112,5	72,0	0,1	45,0	60.167,5
2013	47.500,0	9.841,0	957,0	1.049,4	240,0	1550,5	150,0	108,0	0,1	67,5	61.463,5

Source: PESE

Table 16: Evolution of primary energy production (thousands of tep)

	Petróleo	Gas natural	Hidráulica	O. Renovables	Biomasa			Total		
					E1	E2	E3	E1	E2	E3
2003	---	---	4.441	---	2.270	2.225	2.225	6.711	6.666	6.666
2004	---	---	4.345	---	2.289	2.197	2.197	6.634	6.542	6.542
2005	---	---	4.732	---	2.299	2.169	2.185	7.031	6.901	6.916
2006	---	---	4.732	---	2.310	2.144	2.172	7.042	6.875	6.904
2007	---	50	4.828	---	2.321	2.118	2.161	7.199	6.996	7.039
2008	50	50	5.065	5	2.427	2.187	2.244	7.597	7.357	7.413
2009	50	100	5.125	5	2.439	2.161	2.238	7.718	7.441	7.517
2010	100	100	5.125	10	2.498	2.179	2.280	7.832	7.514	7.615
2011	100	200	5.125	10	2.509	2.150	2.276	7.944	7.584	7.710
2012	200	200	5.125	10	2.521	2.120	2.272	8.056	7.654	7.807
2013	400	400	5.125	15	2.581	2.137	2.316	8.521	8.076	8.256

Source: PESE

The study also analyzes ANDE's increase in transmission and distribution capacity during the 2004-2013 period according to their current short term (2004-2008) and medium term (2009-2013) plans, which include the construction of new high-tension lines and substations, and the rehabilitation of existing systems. The number of transmission lines of varying voltages should increase by somewhat less than 10% by 2013, and most of the increase will take place in 2008.

There are differences between the electrical consumption forecasts made by ANDE and the figures the study calculated for the tendency scenario (E1), which is for the least growth. These differences could be due to the most recent updates of ANDE's short term and medium term plans, that have not yet been incorporated into the study.

Regarding the investments ANDE would need make during the 2004-2012 period, these would total US\$ 507 million according to its own data. 51% of this would involve distribution, 15%, transmission, and the remaining 27%, generation. The distribution part includes about 62 million for the Special Program for Rehabilitating Distribution Infrastructure. To finance the investments it has planned up to 2013, ANDE itself would provide 72% and the remainder would come from international banks and ANDE suppliers.

5.2.4. Weaknesses of the Energy Sector

The study detected the following main energy sector weaknesses in the analysis of the energy balance and the operation of the different energy sectors, as well as the world and regional energy situation:

a) "General and institutional in nature:

- The **regulatory framework** is obsolete, non-transparent, and incompatible with the frameworks that are in place in the other MERCOSUR countries.
- The high degree of **dispersion of institutional jurisdictions** in energy matters leads to a serious lack of coordination and coherence (even contradictions) in energy actions.

b) Sectorial in nature:

Hydrocarbons:

- Total external dependency and present lack of autochthonous resources.
- Up to early 2004, **exploration** activities were practically non-existent.
- Inappropriate **business organization**, and the privileged existence of the state company, Petropar.
- The public company (Petropar) is used by the Government as an instrument for a low price policy, below the purchase cost, which affects mainly diesel fuel, the principal petroleum product that is consumed in Paraguay.
- The public company (Petropar) has experienced continuous production losses as a result of the above; this has resulted in increasing decapitalization, as well as a certain abandonment of other company responsibilities, such as maintenance and improvement of refining, storage and transportation infrastructure and the promotion of exploration activity.
- For natural gas, the main weakness is the lack of consumption, which indicates a total lack of infrastructure.

Electricity:

- The business organization has a single public company (ANDE) with a **monopoly** over all the phases (generation, transportation and distribution)
- At times, the **pricing policy** is below the total cost of electrical service, which has resulted in ANDE experiencing production losses, and its capacity to generate adequate cash flows for undertaking investments in the improvement and expansion of electrical infrastructure has been reduced considerably.
- The foregoing explain the deficiencies that have been discovered in the transportation and distribution **infrastructure**, which have resulted in significant losses and insufficient geographic and demographic coverage.
- The inadequate coverage is explained not only by ANDE's economic and financial problems, but also by the high investment cost (probably unrecoverable) that was required to take electricity to some parts of Paraguay
- The low **penetration of electricity** in all sectors of the economy and all that that means.

- *Modernization of productive processes.*
- *Utilization of inefficient (low producers of energy) energies (biomass) and their negative environmental impact (deforestation). Underutilization of an energy resource that has clear comparative advantages for MERCOSUR countries.*
- ***Binational Companies*** *that have autonomous bylaws that lead them to operate like entities that are not necessarily committed to the energy policy of the country.*
- *The binational company, **Yacyretá**, is incomplete, and has huge financial problems (a debt of almost US\$ 10,000 million dollars) that make it unviable under current conditions. Only Argentina, spurred by its energy crisis, could provide an out, to finish the project (raise the level) and make it viable by finding a reasonable solution to the debt.*

Biomass:

- *The high penetration of this energy source in final consumption has a negative impact, as mentioned above, on energy productivity, modernization of industrial production processes, and the environment (deforestation).*

Renewable Energies:

- *Insufficient knowledge of the **potential** of renewable energy in Paraguay.*
- *No participation by these energies (not including hydroelectricity).*
- *Despite technological advances, **investments** in renewable energies are still **expensive**.*
- *The foregoing implies a need to seek **external financing** (given the limited financial resources of Paraguay) to make viable the installation of certain renewable energy systems (wind, photovoltaic, micro hydroelectric plants) in areas that currently have no electricity.*
- *The high **margin of coverage** of the country's electricity needs that allows it to be a net exporter of electricity, which is one of its principal sources of hard currency."*

5.2.5. Strengths of the Energy System

The study mentions the following strengths of the energy system of Paraguay:

- ***"Hydroelectric specialization*** *in Paraguay gives it comparative advantages over other MERCOSUR countries.*
- *The **hydrocarbon potential** (petroleum and natural gas) in the Chaco has awakened increasing interest by several foreign companies.*
- *The potential of **renewable energy**, especially micro hydroelectric plants, biofuels, and solar energy. This potential provides Paraguay with the opportunity to attract funds under the Kyoto Protocol (MDL) to finance a renewable energy plan."*

5.2.6. Strategic Plan

The study defined the following six principal strategic objectives for reforming the energy sector; these, in turn, lead to the identification of seven lines of action for achieving the respective objectives:

Objective	Line of Action
1. Institutional Coordination	1. Integration of energy jurisdictions, autonomy and institutional coordination 2. Monitoring of the proper functioning of the energy sector
2. Secure Supply	3. Modernization/liberation of the petroleum sector 4. Development of natural gas 5. Modernization of the electrical sector 6. Introduction of renewable energies
3. Energy Efficiency and Savings	The achievement of this objective involves the same activities as the objective of a secure supply.
4. Extension of Energy Coverage	This objective is achieved principally through lines of action 5 (modernization of the electrical sector) and 6 (renewable energies). The introduction of natural gas will also facilitate the extension of energy coverage.
5. Development of a Regulatory Framework	7. Development of the regulatory framework.
6. Integration in MERCOSUR	The implementation of institutional actions, the modernization, and development of petroleum, gas and electricity sectors, the introduction of renewable energy, and finally, the modification/improvement of the regulatory framework will facilitate and make possible the integration of the energy sector of Paraguay in MERCOSUR.

All these lines of action are complemented by the implementation of a line of technical assistance.

A subsequent phase identified one or more measures for each line of action. Measures with a global effect are differentiated from the other measures that have a sectorial effect, principally the reorientation of businesses and improvement of infrastructure, and finally, those that have an extended sectorial effect, and affect several energy sectors, especially those that cause changes in behavior and expand the range of energies.

Lines of Action	Planned Measures
1. Integration of energy jurisdictions, autonomy and institutional coordination	1. Creation of a Technical Ministry/Secretariat of Energy 2. Creation of an Inter-Ministerial Coordination Commission
2. Monitoring of the proper functioning of the energy sector	3. Creation of a single Regulatory Agency or one per energy sector
3. Modernization/liberation of the petroleum sector	4. Support for hydrocarbon exploration 5. Reorientation of Petropar and coordination with the Commission for Strengthening Petropar 6. Sale or modernization of the Villa Elisa Refinery 7. Infrastructure. Appraisal and design of an investment plan 8. Liberalization of diesel fuel imports. Action to organize the petroleum products market and pricing systems 9. Creation of awareness about the rational use of fuels
4. Development of natural gas	10. Gas plan. The role of COMIGAS 11. Plan for investing in gas infrastructure
5. Modernization of the electrical sector	12. Infrastructure plan. Generation, transportation and distribution. 13. Involvement of binational companies in energy policy 14. Pricing policy and management of demand
6. Introduction of renewable energies (ER)	15. Development Plan for Renewable Energies (PDER) 16. Pilot applications of renewable energy for producing electricity 17. Pilot applications for the production of biodiesel
	18. Technical assistance
7. Development of the regulatory framework.	19. Development in line with PESE objectives 20. Standardization with other legislation 21. Harmonization of standards with MERCOSUR

Each item on the list is analyzed in detail in the study, including its justification, objectives, content and expected results, weaknesses and strengths, and finally its cost and possible schedule of implementation.

The lines of action that will have the greatest effect on rural electrification are undoubtedly the “Modernization of the Electrical Sector” and the “Introduction of Renewable Energies.” However, the chapter that refers to the first of these lines of mention does not specifically mention the problem of rural electrification, but rather is worded in general terms, although one of its objectives is the expansion of geographic and economic coverage through increased penetration by electricity. The objectives mentioned for the introduction of renewable energies are:

- Greater diversification of autochthonous energy sources, implying a reduction in energy dependence and vulnerability.
- Increased geographical energy coverage of the population.

- Reducing the environmental impact of energy use and promoting the sustainable nature of the energy system of Paraguay.

Here the study suggests that a first activity should be the preparation of a “Development Plan for Renewable Energies” (PDER). The basis of that plan would first be to carry out a study to identify renewable energy potential in Paraguay, and differentiate the energies by type (biomass, wind, micro hydroelectric plants, solar photovoltaic, and biofuels) and by geographic area.

The second activity would be to implement pilot applications using non-conventional renewable energy to produce electricity. The objective would be to make operational a reasonable minimum number of renewable energy systems for producing electricity in accordance with the Strategic Plan, which estimates that 326 GWh of electricity will be generated in 2013. The measure can be summarized as follows:

- Utilization of biomass to produce electricity. Installed power 2008-2013: 20 MW. Estimated production in 2013: 150 GWh.
- Installation of 45 MW of wind energy in 2008-2013. Estimated production in 2013: 108 GWh.
- Installation of photovoltaic solar energy facilities to supply electricity in areas that are remote from the distribution network and have low consumption. Installation of 40 kW during 2008-2013. Estimated production in 2013: 60 MWh.
- Installation of 15 MW of micro hydroelectric plants during 2008-2013, with an estimated production of 68 GWh (2013).

The estimated cost of using these renewable energy systems to produce electricity during the period (2008-2013) is almost US\$ 81 million, which distributed as follows:

Table 17: Distribution of investments in renewable energy systems

	%
Biomasa	36,4
Eólica	42,4
Minihidráulica	20,5
Solar fotovoltaica	0,7
TOTAL	100,0

Source: PESE

These systems could be entirely financed by international organizations, advanced countries and foreign companies through the Clean Development Mechanism of the Kyoto Protocol.

5.3. **Regulatory Framework**

5.3.1. Introduction

The section on the Regulatory Framework is divided into four chapters with the following content:

- Chapter I is an analysis of energy sector legislation in the European Union and Spain.
- Chapter II reviews current legislation in the MERCOSUR countries.
- Chapter III analyzes current energy legislation in Paraguay.
- Chapter IV proposes a new regulatory framework for the energy sector in Paraguay.

The **principal objectives** of the new regulatory framework would be:

- To develop an integrated institutional structure;
- To establish a modern, complete, stable regulatory framework that provides juridical security;
- To continue with the configuration of a free, competitive market within the framework of MERCOSUR, although with different scope, depending on the characteristics of the sector;
- To provide the conditions for the establishment of a national entrepreneurial sector in the energy sector starting with the present stakeholders;
- To promote the extension and security of the supply with adjusted rates and respect for the environment.

5.3.2. Weaknesses of the existing regulatory framework

A study of the **current legal framework** of the Paraguayan energy sector revealed the following **weaknesses**:

- a) *"A lack of institutional integration between the different agencies in the Administration that have jurisdiction over the energy sector;*
- b) *The difficulty that has existed in practice in modifying current legislation;*
- c) *The lack of a general regulation of the electrical sector, the scarce utilization of CPP's (Public Private Cooperation) by agents in the sector, the rigid regulation of rates does not have a positive effect on costs and the assumptions are poorly differentiated;*
- d) *There is no general regulation of the gas sector and existing legislation is oriented toward developing a concrete business project that has already been abandoned;*
- e) *Excessive rigidity of the system for regulating rates in the hydrocarbon distribution and marketing sector, and*
- f) *The lack of development or modernization of regulations in the prospecting, exploration, and production sector, the limitations imposed on PETROPAR in particular with respect to its participation in consortiums or partnerships for carrying*

out its activities, and the lack of development and modernization of a contracting system for hydrocarbon prospecting, exploration and production."

5.3.3. Proposed Reforms in the Regulatory Framework

To overcome these weaknesses, the study proposes an **amended regulatory framework** based on the following main guidelines:

- **Institutional Organization:** The institutional framework would consist of three elements: a Ministry, General Secretariat or General Department of Energy that would have executive functions, a regulatory agency that will serve as the independent monitoring and control body of the sector, and an inter-ministerial commission that will be the coordinating body between the different agencies of the Administration with interests in the energy sector.
- **Electrical Sector:** It proposes the creation of a free electricity market with the participation of producers, sellers, and large consumers from the MERCOSUR countries through bilateral transactions. ANDE would participate as a producer and seller, if possible through different companies. The creation of a free market would allow Paraguayan electricity producers to export their electrical surpluses freely to markets in other MERCOSUR countries. There would also be a regulated market in which distributors would supply electricity to most of the consumers of the country at a rate that is approved by the executive agency with jurisdiction over the energy sector to ensure that general interests are safeguarded. Regarding the transmission and distribution network, ANDE should maintain its technical role, as well as the functions as regulator of technical matters, and the monitoring and control of the network. ANDE would own the transmission network, but to develop it, ANDE could, depending on the needs, temporarily transfer all or part of the financial, construction, operation, maintenance or production obligations to private initiatives. Distribution activity could be carried out by private or public operators, for example, municipalities, with ANDE authorization.
- **Gas Sector:** The regulatory framework would ensure that the producers, sellers and large consumers could carry out their activities and transactions in a free market system in harmony with MERCOSUR standards. Consumers could receive gas at reference rates under standard contracting conditions. The participation of companies from other countries in the market, especially from MERCOSUR, would depend on Paraguayan companies being granted the same rights in those countries. The construction and operation of gas pipelines for transportation and distribution would be done freely by private companies. In order to ensure that consumers are supplied and have the freedom to choose the supplier, the capacity of the gas pipelines should be linked to the consumer and not the supplier. The state could establish an autarchic agency to act as the promoter and operator of gas pipelines for transportation and distribution, grant concessions for its development, impose obligations on operators that are in the general interest, and act as a marketer to supply gas to consumers, large consumers or for export. Producers would be required to maintain strategic reserves to ensure the continuity of the supply in times of crisis.
- **Petroleum Sector:** The new regulatory framework foresees a free, competitive market for all stakeholders. The regulatory body of the energy sector should control the operation of the market, guarantee the interests of consumers, competition and transparency. PETROPAR is to be reformed, and would be one more agent in the market, competing freely with private agents. However, PETROPAR would

conserve a few public functions, in particular, the maintenance of a strategic reserve that would ensure Paraguay's supply in times of crisis and the assignment of certain jurisdictions for hydrocarbon prospecting, exploration, and production..

- **Hydrocarbon Prospecting, Exploration, and Production:** The regulatory framework would establish a system for obtaining authorizations, permits, and concessions for hydrocarbon prospecting, exploration and production. The State would intervene in prospecting, exploration and production activities through PETROPAR and the autarchic body that is proposed for the gas sector.
- **Renewable Energy:** It proposes a special legal regime for establishing a set of measures that encourage the use of renewable energy in order to improve the service quality, protect the environment and extend the supply at a reasonable cost to places that are remote from the transportation and distribution network. An autarchic body would be created for this purpose under the Ministry, Secretariat or General Department of Energy; its objective would be to provide technical assistance, and encourage, finance, promote and participate in renewable energy studies and projects. That body would be financed through a tax on energy sector activities and/or with income from its own activities.

5.4. PESE viewed from the standpoint of rural electrification

The 2004-2013 Strategic Plan and the Regulatory Framework that are proposed for the Energy Sector of Paraguay practically do not make specific mention of the subject of rural electrification. Calculations of energy demand for that period are essentially based on several hypotheses with projections of economic factors (GDP growth) and population growth. Electrical energy consumption does not explicitly include the unsatisfied demand in the areas of the country that have not yet been electrified. The situation of the Chaco, in particular, which has the lowest electrical electrification coverage, would merit a more profound analysis, especially from the standpoint of the necessary investment. The study mentions only the overall amount based on plans of ANDE itself, which is about US\$ 300 million for the necessary investments in the distribution network by 2013 for projects that both increase geographical coverage and satisfy normal growth in demand in areas that are already electrified; however, it does not differentiate between these two categories. There is no specific mention of areas where the investments would be made. It does mention, however, that part of the investments will be required for rehabilitating the distribution system that was built through self-help.

However, investments in generating systems that are based on unconventional renewable energies (biomass, solar photovoltaic, wind, micro hydroelectric plants) for a total of almost US\$ 81 million by 2013 appear to be the proposals of the authors of PESE themselves. The implementation of those investments has several objectives, including, *“increasing the geographic energy coverage of the population”* which directly implies rural areas. These are principally investments that are proposed for *“photovoltaic solar facilities”* that would *“supply electricity in areas that are remote from the distribution network and have small consumers.”* It expects that the total installed power of photoelectric system in 2013 would be 40 kW, and would electrify about 500 rural homes. The geographic areas where these installations could be made are also not mentioned. The other generating systems that are proposed, based on unconventional renewable energy, that is, biomass, wind, and micro hydroelectric plants having a total power value of 80 MW by 2013, would generate electricity to feed

the SIN in order to achieve *“diversification with autochthonous energy sources, that would signal a reduction in energy dependence and vulnerability”* and *“limit the environmental impact of energy use, and strengthen the sustainable nature of the Paraguayan energy system”*.

One of the objectives of the regulatory framework that is proposed by the authors of the PESE is *“to promote the extension and security of the supply, according to adjusted rates and respect for the environment,”* which should also imply rural electrification. Due to obstacles that presently exist to the implementation of renewable energy electrification projects, which are essentially economic and financial, and related to the dissemination of the pertinent technical knowledge in Paraguay, the regulatory framework that is proposed deals with the matter separately from the electrical sector by proposing a special legal regime with the specific objective of *“extending the supply at a reasonable cost to places that are remote from the transportation and distribution network.”*

PESE was presented in January of this year to the pertinent Paraguayan authorities without much publicity. It is presently being studied to incorporate elements that have high priority in the overall strategic and technical planning process of the National Government, in charge of the STP. A national debate is planned for September or October of this year, where the different stakeholders involved in energy, both government, as well as civil society, will be able to participate; it will undoubtedly facilitate the implementation of the necessary measures that are proposed by PESE for improving the situation of the energy sector.

6. Renewable Energy Resources

6.1. Solar Energy

Paraguay enjoys good solar radiation conditions throughout its territory, and there is relatively little variation from one region of the country to another. Data from land measurements taken over sufficiently long periods exist at several meteorological stations. INTN carried out a study in 1994 called "Estimation of the Distribution of Overall Solar Radiation in the Republic of Paraguay." Daily sunshine data (heliofania) from 14 stations were used; four of these are located in the Chaco and ten are in the Eastern Region, and they have records for at least 5 years. Data from several stations in the bordering countries of Argentina and Brazil were also used to determine the coefficients of the formula that gives the relationship between sunshine and overall solar radiation, as well as data from satellite measurements.

Yearly averages of the daily overall radiation on a horizontal surface that was obtained in this manner, varied from 16.2 to 18.2 MJ/m², depending on the site. For January, they varied from 20.5 to 22.9 MJ/m², and for July, from 9.9 to 13.3 MJ/m². In summer, the highest figures are recorded in the area of Asuncion and in the southeast of the country, while the lowest are found in the northern Chaco and the southeastern part of the eastern region. In winter, on the other hand, the country experiences a gradual decrease in overall radiation values from north to south.

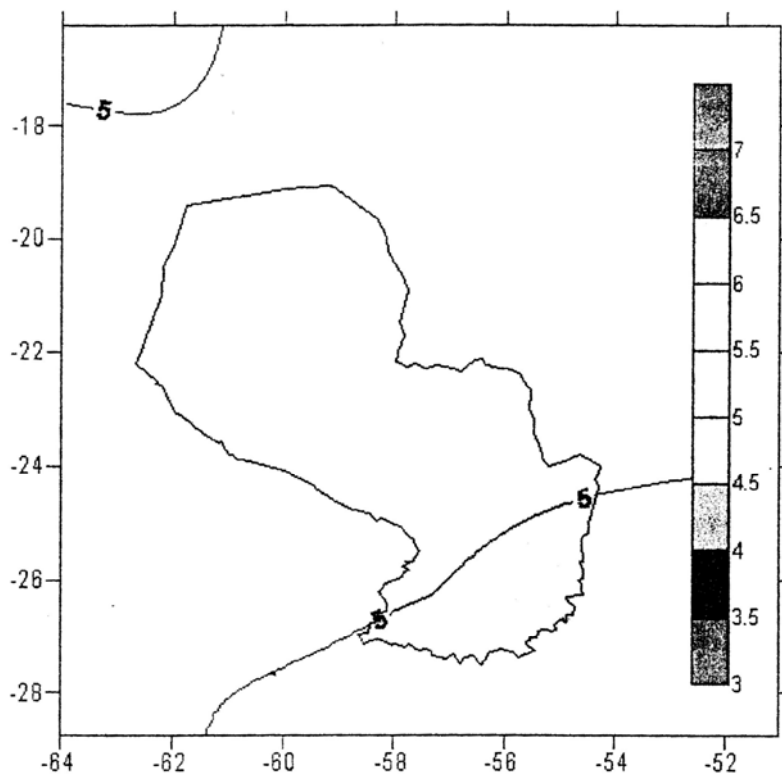
Table 18: Average overall solar radiation in MJ/m²

Station	Department	Jan	Feb	Mar	Apr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dec	Año
Bahía Negra	Alto Paraguay	21.8	20.5	18.1	15.0	12.3	10.7	13.1	13.9	15.2	18.8	21.3	19.6	16.7
Nueva Asunción	Boquerón	21.6	22.8	20.1	14.4	11.8	10.0	10.0	12.4	13.7	16.6	19.8	21.3	16.2
Mcal. Estigarribia	Boquerón	21.8	21.8	19.1	16.2	12.0	10.2	12.3	14.3	16.6	20.9	22.0	22.6	17.5
Pratts Gill	Boquerón	22.3	22.0	18.4	16.1	12.6	10.1	11.7	13.9	16.8	20.5	22.0	22.3	17.4
Paso Barreto	Concepción	22.7	23.2	19.1	17.2	13.5	12.3	13.3	14.0	16.6	20.8	23.4	22.7	18.2
Concepción	Concepción	20.6	20.9	18.3	15.4	12.3	10.2	11.9	12.5	15.3	18.6	21.5	20.5	16.5
Salto del Guairá	Canindeyú	20.5	21.2	18.2	14.9	11.7	10.5	11.3	12.6	14.1	18.3	20.5	20.3	16.2
San Lorenzo	Central	24.2	22.7	18.9	15.9	12.7	10.7	11.6	13.6	16.0	20.4	23.3	24.6	17.9
Asunción	Central	23.9	23.2	19.4	16.2	12.9	11.0	11.6	14.2	16.6	20.3	23.2	24.5	18.1
Ciudad del Este	Alta Paraná	22.4	22.4	18.9	16.4	12.3	10.3	11.4	12.9	15.5	19.0	22.8	22.8	17.3
Villarrica	Guairá	22.7	21.9	18.6	16.4	12.6	10.4	11.5	13.7	15.9	19.4	23.3	23.0	17.4
Carapeguá	Paraguarí	21.9	21.9	18.0	16.5	11.7	9.9	9.9	11.5	14.7	18.9	22.9	22.2	16.7
San Juan Bautista	Misiones	22.9	21.6	18.2	15.7	11.8	10.1	9.9	12.3	16.3	19.5	23.1	22.8	17.0
Encarnación	Itapúa	22.3	22.2	17.2	15.5	11.5	10.0	10.4	12.2	15.3	18.6	21.2	23.0	16.6

Source: INTN and its own compilation

In 2003, INTN published a study by a consultant, Jaime Moragues, which was carried out under a Multilateral Project, "Electrification of Rural Community Centers," OAS SEDI/AICD/AE N° 071/01, and entitled "Updating and Improving Solar Energy Data for the Republic of Paraguay ." It represents a substantial advance in the accuracy of the data compared to a study published in 1994, since it is based on real data from satellite radiation measurements (GEOS-1), and not only estimates based on sunshine data. The report includes distribution maps for the 3 countries, Paraguay, Brazil and Argentina, prepared by R. Righini that show the average daily solar radiation for each month of the year, and for the entire year. The last map shows a very even distribution over the whole country of about 5 kWh/m², which is equivalent to 18 MJ/m² (see Figure 7).

Figure 7: Annual average distribution of daily solar radiation (kWh/m²)



Source: Moragues, .J. : *Electrification of Community Centers Project OEA SEDI/AICD/AE N° 071/01, Updating and Improving Solar Energy Data for the Republic of Paraguay*

6.2. Wind Energy

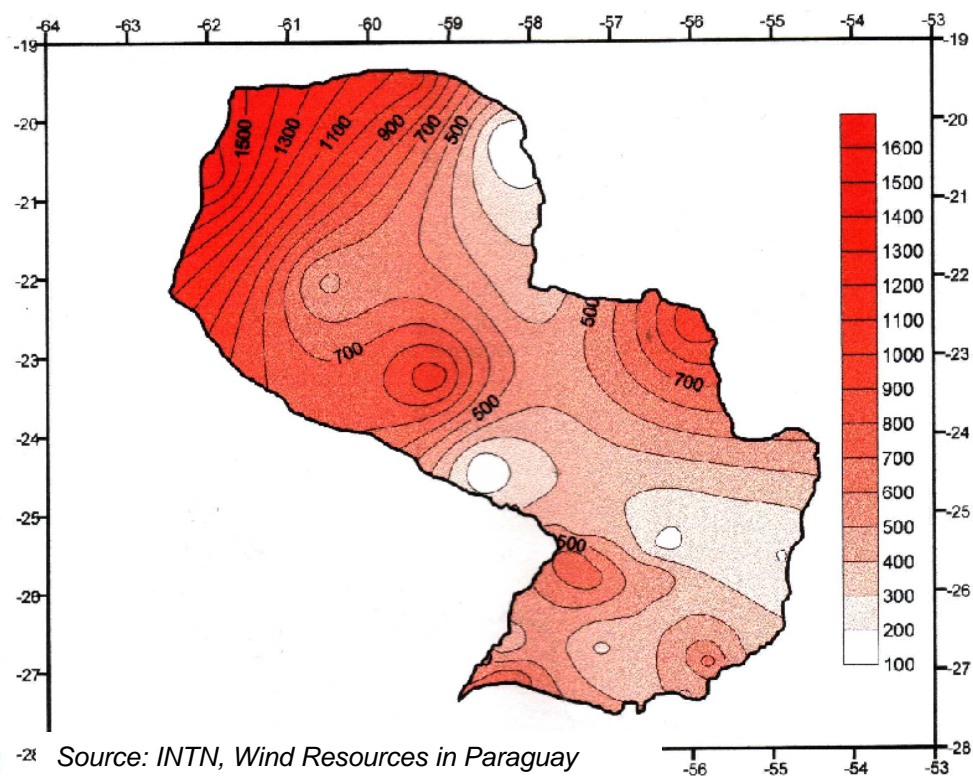
Except for a few regions, wind resources in Paraguay are not abundant. Data on the measurement of wind speed and direction are available for extended periods at 29 meteorological stations distributed throughout the country. To evaluate wind resources for energy use, INTN carried out and published a detailed study of the matter in 1997, entitled "Wind Resources in Paraguay," where data from nearby stations in the neighboring countries of Argentina, Bolivia and Brazil were also taken into account. The results of that study could be summarized as follows:

The following areas have the best wind resources: in the northeast of the country, annual energy values that are available at a height of 15 meters are 500 to 1,500 kWh/m², increasing toward the northeast. The northeastern part of the eastern region also has values above 500 kWh/m², that is, principally the department of Amambay, and several islands to the south of Asuncion in southern Ñeembucú and in Itapúa. The following map shows the distribution of the average annual energy. The situation does not change significantly if it is analyzed on a monthly basis. The distribution for January to July is very similar to the annual average. However, absolute values show significant variations throughout the year. The months with the most wind are June to October. The months with the least wind are December to March. Another point to be considered when evaluating the possibility of utilizing the wind for energy purposes is the frequency of calms and low wind speed, that is, less than 2 m/s. The frequency varies from 25% to 85% according to the season, and the average is 45% to 50%. The frequency of wind speeds of 2 to 4 m/s, which are also not very attractive for energy production, are 10% to 40%, and the average is 25% to 30%. These figures

demonstrate that events that affect the annual average energy are relatively infrequent, and this hampers the utilization of the wind as a source of energy.

In 2003, INTN published a study carried out by Hector Mattio, a consultant to the Multilateral Project, "Electrification of Rural Community Centers," OEA SEDI/AICD/AE N° 071/01, that is entitled "Updated Evaluation of Available Resources: Evaluation of Wind Resource Possibilities of the Region for Contributing to a Hybrid System for Paraguay, Uruguay and Northeastern Argentina." The study complemented and updated the figures from the above-mentioned study that was published in 1997, which mostly involved measurements by plate anemometers installed at meteorological stations throughout the country; these are subject to errors due to parallax and increased inclination of the devices. For that reason, the most recent study uses data from satellite measurements (GEOS-1) and correlated them to earth measurements. The report contains only concrete wind energy and solar radiation data at the sites where the "Electrification of Rural Community Centers" Project will be implemented; there are two for each of the countries mentioned in the title of the study, and the data were used to size the electricity generating facilities.

Figure 8 8: Distribution of annual average wind energy in kWh/m²



6.3. Hydraulic energy

Paraguay has abundant hydroelectric resources; however, up to now, they have principally been harnessed on a large and very large scale, that is, the Acaray, Itaipú and Yacyretá dams; the second two utilize the energy of the abundant Parana River. There are plans to build another dam named Corpus between the two existing dams on that same river, but its location has not yet been defined precisely.

There are, however, practically no small-scale facilities that utilize hydroelectric energy, despite the significant potential that exists on the tributaries of the Parana River, in particular. Due to the uneven topography of the area, not only is the flow continuous, but also, in many cases, there are significant differences in height. The numerous tributaries of the Paraguay River, whose watershed includes much of the eastern region and eastern Chaco, also has interesting potential for harnessing energy through the installation of micro turbines. Quantitative data on hydroelectric potential, other than for the large rivers, are not available at this time, but the matter is slated for study within the framework of the “Decentralized Rural Electrification using Renewable Energies” Project that was submitted to GEF.

6.4. Biomass

6.4.1. Introduction

As was mentioned in paragraph 1.8, biomass plays an important role in the energy matrix of Paraguay, and mainly consists of firewood, charcoal and harvest residues (sugar cane bagasse, cereal grain husks, etc.). This chapter discusses only unconventional types of biomass, that is, biofuels such as biogas, biodiesel, and alcohol. It can generally be said that except for alcohol that is produced from sugar cane, for which there is a certain tradition in Paraguay, the use of biofuels is still incipient and limited to specific experiments carried out by individuals interested in the matter. However, the continuous increases in oil prices in recent months have created an increasing awareness by the population as well as the authorities of the need to promote biofuel production in Paraguay.

In this area, Law N° 2748/05 “Promoting Biofuels” recently came into effect. The most important aspects of that law are the possibility of carrying out projects under the Clean Development Mechanism (CDM) of the Kyoto Protocol, tax stability during 15 years that was approved by the government in Law N° 1447/99, similar to the case of Brazil, Colombian and Europe, and the requirement that diesel fuel be mixed with biofuel according to a percentage that will be set by MIC according to the availability of biofuel in the local market.

6.4.2. Alcohol

There are several plants in Paraguay that produce absolute alcohol from sugar cane. The largest is located in Mauricio José Troche in the department of Guairá. It is owned by PETROPAR and uses the alcohol that is produced as an additive in certain types of gasoline that it sells. Other important alcohol manufacturers are Azucarera Paraguaya in Tebicuary in the department of Guairá, and OTISA in Arroyos y Esteros in the department of Cordillera. According to figures from CICAL, Centro Industrial de la Caña y del Alcohol, that includes 25 companies from the sector, the annual production of alcohol in Paraguay is currently about 50 million liters. This also includes alcohol for industrial purposes, for beverages and for medicinal use. According to the 2003 energy balance, only about 1 million liters were used for energy purposes. The companies in this sector have the goal of promoting alcohol production for use as a fuel in motor

vehicles, which would not only help to reduce gasoline imports, but would also relieve rural poverty by expanding the cultivation of sugar cane. Currently almost 1 million hectares are cultivated for this purpose in Paraguay.

6.4.3. Biodiesel

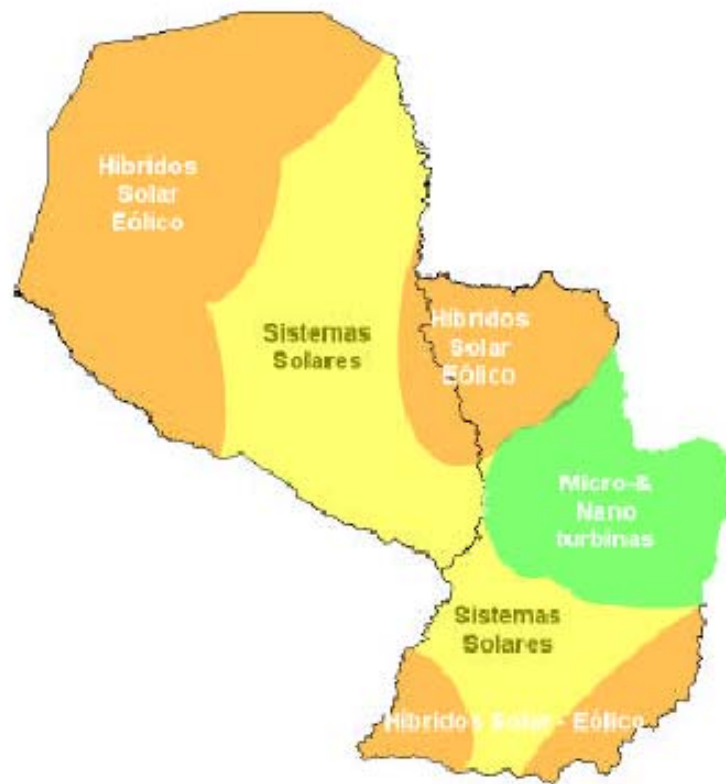
There have been very few experiences with or facilities in operation for producing biogas or biodiesel in Paraguay. Biodiesel is produced only on a small scale and in small quantities by enthusiasts. However, the Cámara Paraguaya del Biodiesel BIOCAP was formed a few months ago, and includes persons and companies that are interested in the matter. To promote the production of biodiesel in Paraguay, the organization prepared a National Biodiesel Plan that it submitted to authorities of the Government and National Congress. Sharp increases in oil prices in recent months have given this Plan a significant boost.

Lipids with the greatest potential as a raw material for biodiesel production include coconut oil (mbocaya), spurge oil and soybean oil, as well as animal fat, especially from cattle, which has a lower value on the market than vegetable oils. To obtain financial assistance for promoting the production of biodiesel in Paraguay, representatives from Congress and the National Government held negotiations a few months ago with entrepreneurs and the German Government, and the results were very promising.

6.5. ***Summary of Renewable Energy Resources***

The following map was prepared by VMME and summarizes the potential of the above-mentioned renewable energy resources (solar, wind and hydroelectric); it divides the country into zones that have a high potential for one or more of these sources, and also considers the cost-efficiency factor. Solar resources are considered uniform and there are excellent solar radiation values throughout country, which means that it is suitable for use in the whole country. Yellow areas represent regions where solar energy has the greatest potential to be the most cost efficient resource. Orange areas are zones with good annual wind speed averages (4 to 6 m/s); however, due to the high frequency of calms and low velocity winds, it is recommended that these regions choose hybrid solar-wind solutions. Green areas represent regions with the highest concentration of different sized watercourses in the country, where the topography indicates that micro hydroelectric plants would have the potential to be the most cost efficient. There are no data for biomass that would permit the value and distribution of this resource to be quantified.

Figure 9: The most cost efficient renewable energy resources by zone



Source: VMME for the ERERD UNDP-GEF Project

BIBLIOGRAPHY

- 1 ANDE: Historial de Facturación por Distritos y Sectores de Consumo, 2004
- 2 ANDE: Obras Ejecutadas de Electrificación Convencional, Crecimiento Vegetativo 2001, 2002
- 3 ANDE: Obras Ejecutadas de Electrificación por Autoayuda, 2001, 2002, 2003, 2004, 2005
- 4 ANDE: Plan de Obras de Distribución, Planificación Corto Plazo 2004/2008
- 5 ANDE: Web page
- 6 Bakalian A.: Private Concessions for Small Town Water Supply, 2001
- 7 Banco Central del Paraguay: Informe Económico Preliminar 2004
- 8 ECLAC: Statistical Yearbook for Latin America and the Caribbean, 2004
- 9 DGEEC: Atlas de las Comunidades Indígenas, 2002
- 10 DGEEC: Condiciones de Vida de la Población Paraguaya, 2002
- 11 DGEEC: Indicators by District, 2002 Census (10% Sample)
- 12 DGEEC: Principales Resultados EPH/2003
- 13 DGEEC: Resultados Finales del II. Censo Nacional Indígena, 2002
- 14 DGEEC: Tríptico con los Principales Resultados, EPH/2004
- 15 Duarte Frutos N.: Informe Presidencial al Congreso de la Nación, 2005
- 16 INDERT: Web page
- 17 INTN: El Recurso Eólico en Paraguay, 1997
- 18 INTN: Estimación de la Distribución de la Radiación Solar global en la República del Paraguay, 1994
- 19 INTN: Web page
- 20 Itaipú Binacional: Web page
- 21 MAG: Web page
- 22 MOPC: Web page
- 23 Mattio, Héctor Fernando: Proyecto Energización de Centros Comunitarios Rurales OAS SEDI/AICD/AE N° 071/01, Evaluación actualizada del Recurso disponible, Evaluación de las Posibilidades del Recurso eólico en la Región para aportar a un Sistema híbrido, 2003
- 24 Moragues, Jaime: Proyecto Energización de Centros Comunitarios Rurales OAS SEDI/AICD/AE N° 071/01, Actualización y Mejoramiento de Información del Recurso Solar en la República del Paraguay, 2003
- 25 MSPBS: Web page
- 26 PETROPAR: Web page
- 27 UNDP: National Human Development Report, Paraguay, 2003
- 28 UNDP: Human Development Report, 2004
- 29 Presidencia de la República: Web page
- 30 Project PAR/00/G41, Project Document, final version, 2002
- 31 Project PAR/00/G41, Institutional Strengthening and Training, final report, 2002
- 32 S. Von Horoch Consultants: Country Study Paraguay, Country Report - Evaluation "APPLIMAR", final report, 1998
- 33 SEAM: Web page
- 34 STP: Web page
- 35 VMME/ UNDP, R. Jahns: Renewable Energy for Decentralized Rural Electrification,
- 36 VMME/ UNDP, V. Oxilia: Renewable Energy for Decentralized Rural Electrification,
- 37 VMME: Balance Energético de la República del Paraguay (preliminary version), 2003
- 38 VMME: Plan Estratégico del Sector Energético, 2005
- 39 VMME: Web page
- 40 WWF Paraguay: Web page
- 41 Yacyretá Binacional: Web page