

## **Annex 5**

### **AIJ DOCUMENTS - SOCIO-ECONOMIC IMPACT ASSESSMENT FOR THE SAN RAMON RURAL ELECTRIFICATION PROJECT**

The Netherlands  
Ministry of Foreign Affairs  
Environment and Development Cooperation  
Climate & Energy Division

Socioeconomic Impact Assessment  
The San Ramón Rural Electrification Joint Implementation Project  
(Las Misiones System)

**“Final Report”**



Av. Arce 2799 San Jorge  
Edif. Fortaleza 3th Floor Of. 302  
Telfax: (591-2) 2434512/2435014  
Email: [jceu@sasa-bolivia.com](mailto:jceu@sasa-bolivia.com)  
<http://www.sasa-bolivia.com>

September 2003

## TABLE OF CONTENTS

1.	RURAL ELECTRIFICATION PROJECT AND SUSTAINABLE DEVELOPMENT OF NORTH CHIQUITANIA	1
2.	DEMOGRAPHIC SOCIO-ECONOMIC CHARACTERISTICS OF THE COVERAGE AREA OF THE PROJECT	9
3.	ELECTRIC POWER IN THE REGION	12
4.	IMPACT OF THE PROJECT ON THE COVERAGE AREA	20
5.	ELECTRIC POWER SERVICE AND POVERTY	40
	BIBLIOGRAFÍA	43
	ANNEX 1	44

---

## 1. RURAL ELECTRIFICATION PROJECT AND SUSTAINABLE DEVELOPMENT OF NORTH CHIQUITANIA

---

### 1.1. San Ramón Rural Electrification Project

Cooperativa Rural de Credito (CRE) has supplied electric power in the region of the North Chiquitanía of the Department of Santa Cruz for more than 20 years. The generation and distribution of the electric power in this area took place by means of a system made up of six small isolated electric power generator plants, located in the largest localities of the region.

In the middle of the '90s, the CRE established that it was necessary to expand and improve this decentralized system to continue providing its clients with a reliable service at a reasonable rate. The feasibility study had indicated that the best solution would be to abandon the old diesel generators and its distribution system, replacing them with a one only generator plant and distribution network.

During the pre-feasibility study of the project, CRE found out that Compañía Minera del Sur (COMSUR) was going to build a gas pipeline from Mineros to San Ramon for its mine Puquio Norte, located 11 km away from the town of San Ramon. Taking advantage of this opportunity, the CRE entered a joint venture agreement with COMSUR to extend the diameter of the gas pipeline from 2 to 3 inches, in order to carry natural gas for the mine Puquio Norte and the thermo-electric plant that supplies electric power to the North Chiquitanía region. The joint venture agreement established that CRE was to finance the incremental cost of US\$ 800,000, required to extend the diameter of the gas pipeline, of the total cost of the pipeline<sup>1</sup> of US\$ 2,400,000.

The project was carried out based on the experience of a similar and successful project developed by the CRE in the region of the valleys in Santa Cruz several years ago. However, preliminary calculations indicated that the project San Ramon would not be financially viable. Should CRE have tried to recover the total investment through electric power rates, the high prices arisen from this procedure would have prevented many homes and small industrial establishments from connecting to the new CRE centralized system. On acknowledging the impact on the development of the project and all its additional environmental benefits, CRE decided to search for a co-financier.

The CRE, supported by the Bolivian government, searched for financial support from the government of Holland for their project of generation of electric power, which involved substituting diesel with natural gas. The contacts led to a financing agreement of US\$ 2,315,000 from the government of Holland within the framework of "*jointly implemented activities*" established in the UNFCCC. The financing was completed with a loan for the amount of US\$ 2,500,000 granted by the Prefecture of the Department of Santa Cruz and

---

<sup>1</sup> Large Mines and the Community, Socioeconomic and Environmental Effects in Latin America, Canada, and Spain, Edited by Gary McMahon and Felix Remy, Bolivia: Turning Gold Into Human Capital, Fernando Loayza, Ismael Franco, et al, The World Bank, Washington DC – USA, International Development Research Centre, Ottawa – Canada, 2001

the contribution of CRE for US\$ 5,308,765 (which included US\$ 800,000 invested in the gas pipeline).

The project was expected to provide electric power to the towns of San Ramon, San Javier, Concepción, Ascensión de Guarayos, San Julian, El Puente, Yotaú, Urubichá and Yaguarú, in addition to 19 small localities in the Chiquitanía. The project began on November 1, 1998 and the construction period was January 1999 to April 2000. On April 29, 2000 the thermoelectric plant located in San Ramon commenced operations through one of its three electric generators.

## **1.2. The project's climate change mitigation component**

The San Ramon Rural Electrification Project was developed as a *"jointly implemented activity"* within the pilot scheme of climate change mitigation projects established in UNFCCC. The parties involved in the activity are the Ministry of Development and Cooperation of the Dutch Government – on behalf of Holland – and Cooperativa Rural de Credito Ltd. (CRE) of Santa Cruz – on behalf of Bolivia.

As a jointly implemented activity, the San Ramon Rural Electrification Project is under the guarantee of the memo of understanding between the Ministry of Development and Cooperation of the Dutch Government and the Ministry of Sustainable Development and Planning, signed in Bolivia on September 23, 1998. According to this memo, the governments of Holland and Bolivia acknowledge San Ramon as a jointly implemented activity, accepting the rules established by UNFCCC.

After this date, the parties expressed a common interest in turning the project from a jointly implemented activity into a clean development project, which are also climate change mitigation projects between industrialized countries and development countries under the framework of the Kyoto Protocol. To this end, some base line studies and the monitoring and verification protocols have been conducted in accordance with the most demanding standards that clean development mechanism projects are to comply with. The purpose of the change of this component of the project is to make actual reductions of greenhouse effect gas emissions tradable in the market and therefore, creditable against the obligations to reduce emissions agreed by the Netherlands. This would also entail a financial flow for CRE and the prefecture of Santa Cruz, which also owns a part of the rights on the reductions of emissions, as detailed in the base line study of the project.

If the San Ramon Rural Electrification Project becomes a clean development project, then it would be subject to point 2 of article 12 of the Kyoto Protocol that textually reads, "The purpose of the clean development mechanism shall be to assist parties not included in Annex I<sup>2</sup> in achieving **sustainable development** and in contributing to the ultimate objective of the Convention, and to assist parties included in Annex I<sup>3</sup> in achieving compliance with their quantified emission limitation and reduction commitments under article 3." In other words, a main objective of the clean development mechanism is to make climate change mitigation projects executed in development countries into a means for these to reach sustainable development.

---

<sup>2</sup> This is in developing countries such as Bolivia.

<sup>3</sup> This is in industrialized countries such as Holland.

Despite this purpose, practically the totality of efforts undertaken by the parties of CMUNCC has aimed to develop methodologies and establish the principles and norms that allow the determination and verification of a clean development project indeed reducing greenhouse effect gas emissions. In regards to determining and verifying the contribution of a clean development project to the sustainable development, there are no standardized methodologies of determination and verification. It would seem as if the evaluation of the impact on the sustainable development was limited to the project formulation stage and not the monitoring and verification stages. Perhaps, the parties of the Kyoto Protocol, once the procedures and methodologies applicable to monitoring and verification of the reductions of the emissions of clean development projects are agreed, will turn their attention to those that would correspond to the monitoring and verification of the impact on the sustainable development. The aim of this report is to contribute to this process with a case and evaluate the impact of the project on the sustainable development of the North Chiquitanía of Santa Cruz.

### **1.3. Objective and methodological approach of the evaluation**

The objective of the present study has been the evaluation of the impact of the San Ramon Rural Electrification Project on the sustainable development of the communities of its coverage area.

In order to evaluate this impact three socio-economic agents have been considered: the companies, as producers of goods and services, the public sector, as a supplier of health, education and potable water services and the homes, as suppliers of productive factors and consumers of goods and public services. With the evaluation of the impact of the project on these three types of factors, a systematic estimate has been searched of the impact of the project on the *economic growth* through the enterprise sector; and in the *social development* through the quality and amount of public services and the quality of life of families. It is assumed that the economic growth and the social development are enabling factors of the political-institutional development and a harmonious relationship of the society with the environment<sup>4</sup>.

### **1.4. Impact on sustainable development**

The San Ramon Rural Electrification Project has allowed the cheapest, non-stop throughout-the-day provision of electric power, without great voltage variations and with enough power to take care of the energy needs of the area. The project replaced a fragmented system of low voltage small plants, enabling the existence in the North Chiquitanía of Santa Cruz of a cheaper, highly reliable power source, with the right amount of power to take care of its industrial requirements. Since this area is among the poorest of Santa Cruz and Bolivia, the project has created a significant potential for the economic growth and the social development of the Chiquitanía. On the other hand, as discussed throughout the report, the prevailing poverty in the region is likely to be the main obstacle which prevents the referred potential from being fully achieved.

The economic growth has been fundamentally favored on account of the energy generated by the project, which has brought along productivity improvements mostly in

---

<sup>4</sup> Sustainable development, according to the Bolivian government materializes in economic growth, social development, citizenship participation and the conservation and preservation of the environment (Institutional Strategic Plan 1999, Ministry of Sustainable Development and Planning.)

family micro-companies. By having continuous electric power, several homes of the region have optimized the use of the work force during the day and night and between productive and commercial activities in and outside the house. Basically, they have more time on a daily basis to produce and generate income. Also, thanks to the availability of electric power supplied by the project, among other factors, productive establishments have been constituted aimed towards the export of wood and the development of the market of communication technologies, through the provision of "internet cafes", especially. This has resulted in an expansion of the direct and indirect employment in the region as well as the increase of income.

Convergent evidence was found in the sense that for most of the traditionally settled productive establishments in the region, the project has allowed a decrease in costs by enabling the acquisition of higher performance machinery and equipment as well as through the reduction of the cost of electric power<sup>5</sup>. However, it did not result in an expansion of employment and production due mainly to the limitations of the size of the market, the little population density in the localities of the region and the poverty of large segments of the population, which limits significantly their purchase capability<sup>6</sup>.

The San Ramon Rural Electrification Project has favored social development, facilitating an improvement in education, health and potable water services as well as the administrative attention provided by the municipalities. For instance, the attention of childbirths during the night presents fewer risks for the mother and the child; the pumping of potable water has improved considerably; there is a greater degree of automation in the administrative services of municipalities and the children have more available time at nights to take better care of their studies. Altogether, the project has contributed to the improvement of the human resources in the area.

This positive effect, however, has not been uniform. Its magnitude has been conditioned to the investment capability of the administrations or local governments and the degree of poverty prevailing in the communities. Those communities with greater investment capability and less poverty have been able to reap the greater benefits and vice versa. The investment capability depends directly on the number of inhabitants of the community. In general, it could be said that those smaller populations and with high levels of poverty like Yotaú, for instance, improved marginally on a social level thanks to the project; in these cases the potential is there but not the conditions to take advantage of it. On the other hand, the communities with greater population concentration and higher levels of income such as San Julian experienced greater relative progresses in their social development.

The greatest direct benefit of the project in the quality of life in the homes of the region is due to the lighting of the houses and the corresponding potential for the inhabitants to engage in different activities at nights, from the production of goods for domestic

---

<sup>5</sup> The exception would be the wood-related activities, where there still is a favorable cost-benefit relation to the use of own diesel-fueled generators, due to the current level of electric tariffs.

<sup>6</sup> This is a conservative affirmation given the fact that that company electricity consumption in traditional establishments may have increased as a whole in the region, hence the production of goods and services would have increased as well. This conservative position was adopted since there is no data to reliably differentiate between an effective increase in the consumption of electricity from a mere substitution of the electricity generated by own sources, from that generated by the project.

consumption to increasing the available study time for the children. In addition, it was possible to verify that the density of household electric appliances increased in the region. Articles such as ventilators, blenders and irons are more used in the area thanks to the project. To a great extent, however, their diffusion and benefits are restricted by the spending capabilities of the homes that in many cases, as referred to above, is seriously limited by the poverty prevailing in the North Chiquitanía of Santa Cruz.

The extension of positive the socioeconomic impact of the San Ramon Rural Electrification Project depends, to a great extent, on the poorest segment of the population of the coverage area being able to access the benefit of having electric power. That would require, among other things, the electric power consumption rates to decrease or converge towards the levels prevailing in the great cities or the national interconnected system. According to the study, the government has recently adopted a rate policy with crossed subsidies from the urban area to the rural area whose implementation is under the charge of the Regulator of Electric power and that will be applied within the next three years. This policy would allow an significant reduction in the electric power consumption rates of the San Ramon Rural Electrification Project.

In the following sections of the present report, the summary of results presented in this section is complemented with a detailed analysis of the impact of the project on the development of the North Chiquitanía.



---

## 2. DEMOGRAPHIC SOCIO-ECONOMIC CHARACTERISTICS OF THE COVERAGE AREA OF THE PROJECT

---

### 2.1. Coverage area of the project

The coverage area of the San Ramon Rural Electrification Project is the north region of the Department of Santa Cruz, made up by 7 greater localities, San Javier, San Ramon and San Julian in the Province Ñuflo de Chávez and Ascensión de Guarayos, El Puente and Yotaú in the Province Guarayos, and 13 smaller localities, 12 in the Province Ñuflo de Chávez and one in the Province Guarayos. The project, however, has not reached the localities of Urubichá and Yaguarú and six smaller localities, that were initially part of the scope of the project.

### 2.2. Demographic characteristics

The above mentioned coverage area has, as seen in Table 1, around 40,000 inhabitants and an average growth rate of 7.6%, much higher than its equivalents of the department of Santa Cruz and Bolivia, 4.5% and 2.9%, respectively. It is, therefore, one of the regions with the greatest population growth rate in the department and the country.

**Table 1**

Coverage area of the San Ramon Rural Electrification Project: Population and population growth rate

Localities	Population (2001)	Annual growth rate
San Ramón	4,746	8.7%
San Javier	5,538	6.5%
Concepción	5,611	6.8%
San Julián	6,585	22.3%
Ascensión de Guarayos	12,284	4.5%
El Puente	2,142	7.6%
Yotaú	1,267	5.1%
Other localities	ND	ND
Total	38,173	7.6%

Source: Own preparation based on information from the National Institute of Statistics, Population and Housing National 2001, Database, Santa Cruz, Beyond 20/20, 2002.

### 2.3. Socio-economic characteristics

The coverage area of the project (see table 2) is in the department with the greatest income per capita in Bolivia and the lowest poverty rate: 38% of poor population against the national average 58.6%.

The localities of the coverage area of the project, however, are located in the poorest municipalities of the department of Santa Cruz and Bolivia. Among 50 municipalities, the municipality of El Puente is the third poorest one of the department with 92.3% of poor

population; Ascensión de Guarayos is the seventh poorest one with 87.5%, Concepción is the eleventh with 84.6%, San Javier is fourteenth with 82.9%, San Julian is sixteenth with 81.6% and San Ramon is eighteenth with 79.5% of poor population.

**Table 2**

Coverage area of the San Ramon Rural Electrification Project: Gross Domestic Product and poor population, according to municipalities

	<b>GDP per capita (\$us.)</b>	<b>Poor population (%)</b>
Bolivia (2001)	962	58.6
Santa Cruz (2001)	1,030	38.0
El Puente	n.a.	92.3
Yotaú	n.a.	92.3
Ascensión	n.a.	87.5
Concepción	n.a.	84.6
San Javier	n.a.	82.9
San Julián	n.a.	81.6
San Ramón	n.a.	79.5
Note: n.a.: Not available.		
Source: Own preparation based on the information of the National Institute of Statistics, Statistics Yearbook 2001, Population and Housing National Census 2001, Bolivia: Map of poverty 2001, 2002.		

The main economic activities in the localities of the coverage area of the project are bovine cattle raising, wood extraction, dairy products, agriculture, restaurants and hotels, tourism, handicrafts, rustic auriferous mining and retail commerce.

**Table 3**

Coverage area of the San Ramon Rural Electrification Project: Amount of employees by entrepreneurial unit

<b>Activities</b>	<b>Employment</b>
Milk and dairy factories	5 – 15
Lumbering and wooden products (sawmills and wood shops)	5 – 10
Ranches	5 – 10
Restaurants and hotels	2 – 5
Others	1 – 5
Source: Own preparation based on the information gathered from the survey of companies.	

The development of entrepreneurial activities is incipient and confined to micro and small sawmills, ranches, milk and dairy factories, lumber companies, hotels and restaurants, tourist complexes and commercial shops. Most of the companies of the region were established in order to create employment for the home members and they are administered following domestic economy logic or reasoning: to provide its members with the means to subsist before maximizing profits or accumulating assets.

The activity that absorbs the largest amount of companies and employment is retail commerce, which enables the trade of a great variety of products, from livestock food products to goods for different activities, and uses, on average, between 1 to 5 employees. In the last years, possibly influenced by the accelerated population growth and the introduction of electric power in 2000, some commercial companies dedicated to wholesale trade settled down in different localities, specially San Julian, which is the closest locality to the capital of the department.

Most companies established in the region employ on average between 1 to 5 people. Restaurant and hotels are among these, as seen in Table 3. Cattle raising, one of the most traditional activities in the area, employs an average of 5 to 10 people. The milk and dairy factories, also a traditional activity in the region of San Javier, employ between 10 and 15 people. Lumber companies: sawmills, wood shops and other companies that work with wood, one of the activities with greatest development in the Chiquitanía, also employ on average between 5 to 10 people.

---

### 3. ELECTRIC POWER IN THE REGION

#### 3.1. Electric power before the San Ramon Rural Electrification Project

Before the start up of operations of the San Ramon Rural Electrification Project, the localities of the coverage area were provided with electric power through an isolated system, composed of five isolated electric power generation plants established in the localities of San Ramon, San Javier, Concepción, Ascensión de Guarayos and El Puente. The main characteristics of these plants were the following: (i) limited capacity, (ii) discontinuous provision of the service, between 4 and 18 hours per day, (iii) frequent and prolonged outages and (IV) strong voltage fluctuations.

**Table 4**

Isolated System: Power, schedules and amount of service hours per day

Localities	Installed Capacity (kW)	Service schedule	Service hours per day
San Javier	420	7:00 – 1:00	18
Concepción	249	7:00 – 24.30	17.5
Ascensión	300	7.00 – 13:00 and 15:00 – 24:30	15.5
San Ramón	164	18:00 – 24:00	6.0
El Puente	100	18.00 – 22.00	4
Source: Own preparation based on information provided by CRE.			

**Limited capacity.** The isolated electric power generation plants, of 420 kW in Ascensión de Guarayos, 300 kW in San Javier, 249 kW in Concepción, 160 kW in San Ramon and 100 kW in El Puente, as seen in table 4, provided electric power to homes and companies with a demand for low power, excluding companies that used high power machinery and equipment, such as 5 hp (3.7 kW) and 10 hp (7.5 kW) or more.

Consequently, the isolated system did not satisfy the needs of companies like mechanic repair shops, rice peelers (mill products and bakery), milk and dairy factories (dairy products) and sawmills and wood shops (lumber and wooden products), due to its low capacity. For instance, a large sawmill that uses machinery and equipment of 100 hp (74,6 kW) of power, would require around 45%, 18%, 25%, 30% and 75% of the installed capacity of the plants of San Ramon, San Javier, Ascensión de Guarayos and El Puente, respectively.

**Discontinuous provision of the service.** The isolated electric power generation plants of San Javier, Concepción and Ascensión operated during the day except for Ascensión de Guarayos, that interrupted its services between 13:00 and 15:00, and at nights (see Table 4). In the localities of San Ramon and El Puente the provision of the service was limited to some hours at night, between 18:00 and 24:00 and between 18:00 and 22:00, respectively, thus restricting the use of electric power to these intervals at night.

Due to the discontinuous provision of the service, which became worse due to the outages, the isolated system could not satisfy the needs of the companies that use high power equipment and require devices that require a permanent supply of energy such as refrigerators in restaurants, hotels and slaughter houses.

**Frequent and prolonged outages** that occurred due to a lack of maintenance of the generators, a lack of diesel, the fuel used by these engines; a lack of spare parts; and electric discharges, very usual in the region. The outages used to last from a few hours to 15 days. Even so, the outages increased the discontinuity of the above mentioned service.

**Voltage fluctuations.** Voltage fluctuations increased the risk of burned electrical appliances, hindering the use of expensive devices, such as televisions and computer equipment. Due to these limitations the isolated system was used basically for lighting purposes and rarely for electrical appliances.

### 3.2. San Ramon Rural Electrification Project

The start of operations of the San Ramon Rural Electrification Project took place in late April 2000, providing electric power to the localities of San Ramon, San Javier, San Julian, Ascensión de Guarayos and 11 smaller localities, Concepción and a smaller locality as from May 2000, and El Puente, Yotau and another smaller locality as from February 2001. In December 2002, the Project provided electric power to 7 urban localities, two of them province capitals, four municipality capitals, one canton capital and 13 smaller localities.

The San Ramon Rural Electrification Project provides electric power 24 hours a day and has enough installed capacity to satisfy the demand for electric power in homes, companies and the public sector, in education, health, potable water, public lighting system and town halls as seen in table 5. In addition, by virtue of the technology used by the Project, the fluctuations and outages are controlled in permissible margins. Therefore, the San Ramon Rural Electrification Project provides a high quality service that exceeds the limitations of the isolated system.

**Table 5**

The San Ramon Rural Electrification Project: Installed capacity and amount of electric power service hours per day

Localities	Installed capacity (kW)	Service hours per day
San Ramón, San Javier, Concepción, Ascensión de Guarayos, San Julián, El Puente, Yotaú and other localities	2,868	24 continuous hours
Source: Own preparation based on information from CRE.		

The initial installed capacity of 2,868 kW would allow the project to satisfy the increase of demand for electric power until 2008. From then on, the Project would have to incorporate additional generators to satisfy the increased demand.

### 3.3. Strategies to face the limitations of the Isolated System

Companies, public institutions and homes adopted different strategies to satisfy their electric power requirements, according to their needs and the availability of alternative means of energy.

## Companies

In order to exceed the limitations of the isolated system, companies resorted to (i) own diesel generators<sup>7</sup> to provide high power machinery and equipment such as machines and equipment for sawmills, wood shops, factories and fuel pumps with electric power; (ii) LPG for appliances that require continuous consumption of electric power, such as refrigerators in restaurants and hotels; and (iii) solar panels for lighting.

Chart 1 schematically includes an approach to the different sources of energy used by the companies to somehow counteract the limitations of the isolated system. Handicrafts workshops (diverse manufactured products), savings and credit cooperatives (financial services) and telephone companies (communications), despite the limitations of the isolated system, did not resort to other electric power generation systems and they adapted to the characteristics of the available electric power. Handicrafts workshops where manual work was done only used electric power for illumination purposes. The savings and credit cooperatives in the localities of San Javier, Ascensión and Concepción used electric power for electric devices, such as computer equipment and refrigerators, in office hours. Finally, the telephone companies (communications) used the electric power to light the offices and client attention stands.

The commerce in general uses the electric power for lighting. However, gas stations resorted to diesel generators for the fuel pumps. Likewise, television and radio stations (recreational services) resorted to diesel generators to have electric power when the available electric power service in the locality was cut off. Restaurants, hotels and slaughter houses (fresh and prepared meats) resorted to diesel generators for water pumps and LPG for refrigerators<sup>8</sup>.

Ranches (livestock related products) did not have electric power for being located in distant places from the urban localities. These companies, in order to satisfy their needs, resorted to diesel generators for water pumps and some household appliances and to solar panels for lighting.

---

<sup>7</sup> The consumption of diesel generated electricity is determined by the power of the generators and not the power of the machines using it. Thus, the companies using generators very frequently were unable to use all the energy they generated. Anyhow, it was necessary for the engine to be on, independently of whether the generated electricity turned on a 60 W light bulb or a 10 hp (7.5 kW) circular power saw.

<sup>8</sup> Restaurants and hotels also used GLP to cook. However, this energy is used independently of the type of electricity provision system.

### Chart 1

Electric power provision strategy used by the companies before the Project

Activities	Strategies
Diverse manufactured products	Isolated Electric power Generation Plants
Financial services	
Communications	
Commerce	Isolated Electric power Generation Plants
Recreational services	Own diesel generators
Restaurants and hotels	Isolated Electric power Generation Plants
Fresh and prepared meats	Own diesel generators LPG
Livestock related products	Own diesel generators Solar panels
Repair services	Own diesel generators
Mill products and bakery	
Dairy products	
Lumber and wooden products	
Source: Own preparation based on the information gathered from the survey of companies.	

Electric repair shops (repair services), rice peelers (mill products and bakery), milk and dairy factories (diary products) and sawmills and wood shops (lumber and wooden products), all of which use high power electric machinery, resorted to diesel generators.

#### Public sector

The sectors of education, health, potable water and municipal town halls resorted to own diesel generators, solar panels and LPG to deal with the limitations of the electric power provided by the isolated system. Chart 2 includes a schematic approach to the different strategies used by the public sector in doing so.

Educational units, hospitals, health posts and municipal town halls adapted to the characteristics of the available electric power service in their corresponding localities and did not resort to other sources of provision. The main limitations of the isolated system for the educational units and municipal town halls were the lack of continuous provision of the service or the non-existence of the service in some localities, the unexpected interruptions and the voltage fluctuations. The limited installed capacity was not a problem because the machines and electric equipment used in these sectors demand little power. Some medical equipment, for instance, can work with solar panels. Hospitals and health centers were forced to resort to diesel generators, solar panels, gas lamps and even candles to deal with childbirths, due to lack of electric power in the morning.

## Chart 2

Electric power provision strategy used by the public sector before the Project

Sectors	Strategies
Educational services	Isolated system
Municipal town halls	
Municipal administration (public lighting)	
Health service	Diesel generators Isolated system Solar panels
Potable water service	Diesel generators
Source: Own preparation based on information gathered in interviews with public sector institutions.	

The main limitation of the isolated system for the potable water service was the limited installed capacity, that prevented the provision of electric power to the pumping systems of the potable water cooperatives, forcing these to resort to diesel generators.

### Homes

The homes used the electric power provided by the isolated system generation plants for illumination purposes, as a main function, and household-appliances, such as refrigerators, televisions, radios and sound equipment. Most of these units could not access diesel generators, for economic reasons. In addition, the electric power provided by the electric power generation plants, despite its limitations, performed satisfactorily its function of lighting homes. Complementarily, however, the homes also used other types of energy for illumination, such as gas lamps, kerosene and candles to deal with electric power outages.

## 3.4. San Ramon Rural Electrification Project

### Companies

The start of operations of the San Ramon Rural Electrification Project, providing electric power to 7 large localities and 13 smaller localities, found a favorable reception from the main companies in the consumer region. These companies ceased to use of diesel generators, solar panels and the LPG, with the exception of some companies in two identified lines of business of the 12 identified as the main ones of the region, see Chart 3.



### Chart 3

Provision of electric power to the companies within the Project

Activities	Strategies
Diverse manufactured products	San Ramon Rural Electrification Project
Financial services	
Commerce	
Restaurants and hotels	
Recreational services	
Fresh and prepared meats	
Communications	
Repair services	
Mill products and bakery	
Dairy products	
Livestock products	San Ramon Rural Electrification Project or diesel generators and solar panels
Lumber and wooden products	San Ramon Rural Electrification Project or diesel generators
Source: Own preparation based on the information gathered from the survey of companies.	

Regarding the economic activity of livestock products, ranches are outside the urban localities. However, some of these ranches are near electric power carrier lines from the generator plant to the different localities which are part of the project. Consequently, they represent potential consumers of this project electric power service. Some of these ranches have already been connected to the project's electric power network. However, most of them have not yet done it and continue using own generators and solar panels. Apparently, for these ranches the cost-benefit relation of replacing the electric power provided by the project for that generated at home by means of own generators and solar panels is not favorable to them due to the connection costs, made up of the cost of the cable, poles and a transformer.

Regarding lumber and wooden products, most sawmills continue to use diesel generators, apparently due to the high costs of the connection to the network. According to the analysis of some sawmills entrepreneurs, the cost-benefit relation of maintaining the use of diesel generators instead of using electric power from the San Ramon Rural Electrification Project would be slightly unfavorable for the sawmills located a few meters away from the electric power main and favorable for those located far from it. Complementarily, according to the levels of the current electric power rates, it would be ideal to use diesel generators for the main machines and electric power generated by the project for lighting and for equipment and tools that consume little electric power, an emery for instance. This would help avoid the disadvantage of turning on the diesel engines for any use, including smaller uses<sup>9</sup>.

---

<sup>9</sup> In most cases the ranches and sawmills are located several hundred meters, even kilometers, away from the Project's electricity network. The connection cost to said electricity network varies in direct proportion to the distance from the network to the connection point. The greater the distance, the greater length of cable and the more poles required. In these cases, the total cost of

To sum up, the availability of electric power provided by the San Ramon Rural Electrification Project, given its quality and cost, led to consuming this service and leaving other power sources, with the exception of an important part of ranches and sawmills.

### **Public sector**

Since San Ramon Electrification Project began providing electric power, educational services, health services, potable water services and municipal town halls have been using this energy, and seized to use electric power generation alternative means such as diesel generators and solar panels, as seen in Chart 4.

### **Chart 4**

Provision of electric power to the public sector within the Project

<b>Sectors</b>	<b>Strategies</b>
Educational services	San Ramon Rural Electrification Project
Municipal administration	
Public lighting	
Health service	
Potable water service	

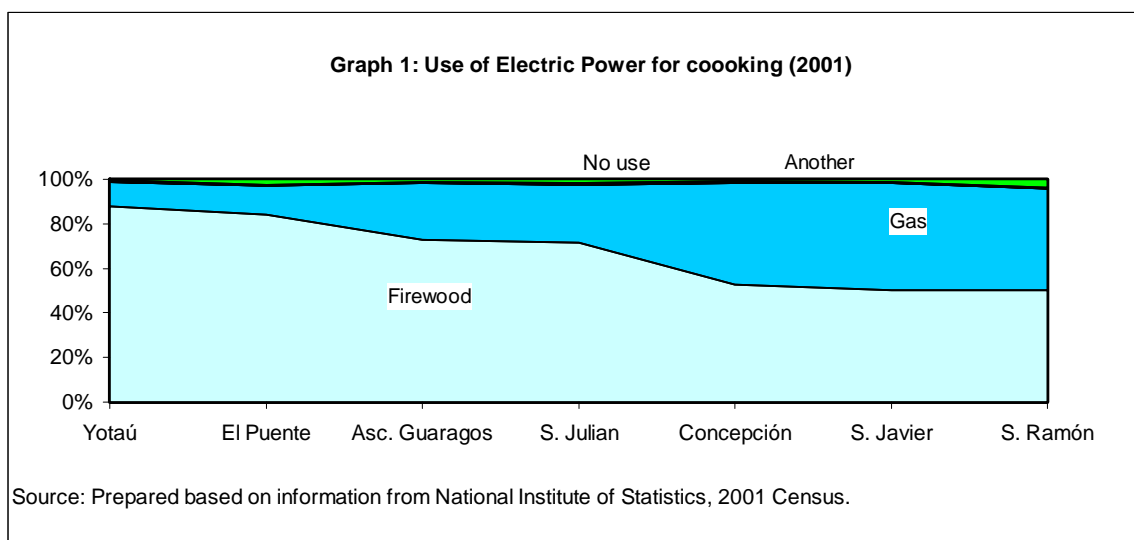
Educational units, health centers, municipal town halls and potable water cooperatives, consequently, cover their electric power requirements with electric power generated by the project. These units state that the electric power provided by the project, given its quality and cost, is the best available option in the region, better than the old diesel generators and solar panels.

### **Homes**

The San Ramon Rural Electrification Project facilitated homes the use of electric power for lighting and use of electric appliances. The use of other forms of energy used in the past such as gas and kerosene lamps and candles were discarded, with the only restriction of consumption cost.

---

the electricity produced by own generators is cheaper than the total cost (connection and service) of the electricity of Proyecto de Electrificación Rural San Ramón.



Homes in the past used and continue to use at present two types of energy to cook: firewood and LPG, with a tendency to substitute firewood with LPG. There is no tendency in the area to replace electric power with firewood or LPG as fuel for cooking (see graph 1 and Annex 1).

#### 4. IMPACT OF THE PROJECT ON THE COVERAGE AREA

Electric power is a necessary good in the production of other goods and services by the companies; public services, by the public administration; and comfort in homes. However, electric power is one among several concurrent factors to these aims. Consequently, it is particularly difficult to attribute a given amount of impact exclusively to the provision of energy to a region. The evaluation of the impact of the project pays as much attention as possible to the above mentioned concurrent factors, such as the existence of a market to improve and extend the production of the companies.

##### 4.1. Impact on electric power rates

The residential electric power rate in the localities of San Ramon, San Javier and Ascensión de Guarayos in 2002, the third year of operations of the San Ramon Rural Electrification Project, was lower in 34%, 16% and 33%, respectively, with respect to the residential electric power rate in 1999, the year before the start up of operations of the project (see Table 6). Likewise, the electric power rate of the lighting system in the localities of San Ramon, San Javier and Ascensión de Guarayos in 2002 was lower in 32%, 15% and 32%, respectively, with respect to the residential electric power rate in 1999.

**Table 6**

The San Ramon Rural Electrification Project: Electric power rates (\$us./kWh)

	1999		2002		Variation	
	Residential	Public Lighting	Residential	Public Lighting	Residential	Public Lighting
San Ramón	25.50	24.69	16.95	16.89	-34%	-32%
San Javier	20.21	19.95	16.95	16.89	-16%	-15%
Ascensión de Guarayos	25.23	24.96	16.95	16.89	-33%	-32%
City of Santa Cruz			6.08	7.37		
Relation of rates of the Project and in Santa Cruz			2.79	2.29		

Source: Own preparation based on information of the Regulator of Electric power.

The San Ramon Rural Electrification Project established a unique electric power rate for residences and companies in all the localities of its coverage area. Consequently, the differences in the variation rates from one locality to another are originated in the differences of the rates in 1999. This justifies the lower decrease of the electric power rate in the locality of San Javier, which was the lowest in the region in 1999. The electric power rate in 2002 in the localities in the project's coverage area, despite the decrease with respect to 1999, was 2,8 times the rate in the city of Santa Cruz de la Sierra in the same year. In other words, the rate still remains comparatively high.

The homes, companies and the public sector of the coverage area of the San Ramon Rural Electrification Project value the decrease of the electric power rates due to the

execution of the project. However, they consider the rates to be still very high. According to the perceptions of the above mentioned economic and social agents, the differential of the electric power rate would create comparative disadvantages for the region in relation to Santa Cruz de la Sierra and other localities near said city.

The project's higher rates respond fundamentally to the fact that the project is an isolated small scale generation system that provides energy to a small and dispersed population. This increases both generation costs, since scale economies are minimum, and distribution costs since the service demands greater costs in poles, cables and inspection per user. The city of Santa Cruz, for instance, receives electric power from the Interconnected System<sup>10</sup>, which has generators of 20 to 50 MW. However, the San Ramon Rural Electrification Project uses generators of 0.956 MW<sup>11</sup>. While the city of Santa Cruz has approximately 227,000 users concentrated in one only geographic space, the San Ramon Rural Electrification Project only serves around 3,400 clients distributed in a much greater area than the one of Santa Cruz in 7 large localities and 13 smaller localities.

#### **4.2. Impact on the amount of user companies**

The execution of the Joint Rural Electrification Project San Ramon had as one of its main objectives to satisfy the demand for electric power of the companies established in the localities of the project's coverage area. Another main objective was to promote the economic growth of this region, overcoming the limitations of the isolated system mainly due to its low capacity to satisfy the demand for electric power of the companies.

The amount of user companies of electric power in the localities of San Ramon, San Javier and Ascensión de Guarayos in 2002, the third year of operations of the San Ramon Rural Electrification Project, was greater in 61%, 11% and 36% respectively, with respect to the amount of consumer companies of electric power from the isolated system in 1999, the year prior to the start of operations of the project, as seen in Table 7.

---

<sup>10</sup> The National Interconnected System integrates the main generation, transmission and distribution facilities of the departments of La Paz, Santa Cruz, Cochabamba, Oruro, Chuquisaca and Potosí. This system supplies electricity to the capital cities of the above mentioned departments and neighboring smaller towns, and the electricity rate is established based on demand and supply.

<sup>11</sup> San Ramon Rural Electrification Project uses three generators of 0,956 MW.

**Table 7**

The San Ramon Rural Electrification Project: Amount of user companies of electric power (number of companies)

Localities	1999	2002	Variation	Variation (%)
San Ramón	46	74	28	61
San Javier	93	103	10	11
Ascensión de Guarayos	111	151	40	36
Concepción	n.a.	105		
El Puente	n.a.	0		
San Julián	0	122	122	From 0 to 122
Yotaú	0	1	1	From 0 to 1
Other localities	0	51	51	From 0 to 51
Total	n.a.	607		
Note: n.a. = Not available				
Source: Own preparation based on the information from Cooperativa Rural de Crédito (CRE).				

The amount of consumer companies of electric power in the localities of San Julian, Yotaú and others in 2002, increased from 0 to 122, from 0 to 1 and from 0 to 51, respectively, with respect to the amount of consumer companies of electric power from the isolated system in 1999.

The increase of consumers of electric power in the localities of San Ramon, San Javier and Ascensión de Guarayos is due essentially to the appearance of companies that use high power machinery and equipment such as sawmills, mechanic repair shops, milk factories, gas stations, wood shops and parquet factories. In the localities of San Julian, Yotaú and other localities, this increase is due to the availability of electric power in those localities with the start of operations of the San Ramon Rural Electrification Project, since there were no generation plants in those localities to integrate the isolated system.

The Electric power Generation Plants of San Ramon, San Javier and Ascensión were administered by CRE and those in Concepción and El Puente by cooperatives established to that end. The Isolated System information of Concepción and El Puente could not be accessed because the electric power cooperatives that administered these systems disappeared when the San Ramon Project started operations.

Due to the difficulty to differentiate between some companies and homes<sup>12</sup> in these localities, some companies are apparently included within the residential category. This justifies why the locality of El Puente had no consumer companies of electric power in 2002, being the service available.

The companies with a demand for high voltage electric power, which were excluded from the isolated system on account of its limited capacity, and were therefore forced to resort

---

<sup>12</sup> Many companies in these localities, at least those smaller ones, begin operations in homes, and the members of the family are human resources of the starting company. This naturally makes it difficult to differentiate between companies and homes.

to diesel engines, became users of the project because this project exceeded the limitations of the previous system and because of the decrease in the electric power costs with respect to the previous system. Another group of companies that did not have access to this service could access it thanks to the project. Finally, a part of the companies that settled down after the start of operations of the project could not make investments in the region due partly to the limited capacity and the lack of continuous provision of the service of the isolated system. Consequently, the availability of good quality electric power stimulated some important investments in the area of the project, among which the largest company in the region at present stands out.

### 4.3. Impact on the consumption of electric power

The annual company consumption of electric power of the localities of San Ramon, San Javier and Ascensión de Guarayos in 2002 increased in 331%, 67% and 49% respectively, with respect to the annual company consumption of electric power in 1999 in the isolated system, as seen in Table 8. Likewise, the annual company consumption of electric power of the localities of San Julian, Yotaú and other localities in 2002 increased from 0 to 425,805, from 0 to 2,420 and from 0 to 224,628 kWh, respectively, with respect to the annual company consumption of electric power in 1999.

**Table 8**

The San Ramon Rural Electrification Project: Company electric power consumption (kWh – year)

Localities	1999	2002	Variation	Variation (%)
San Ramón	56,974	245,584	188,610	331
San Javier	302,226	503,317	201,091	67
Ascensión de Guarayos	175,999	262,923	86,924	49
Concepción	n.a.	664,923		
El Puente	n.a.	0		
San Julián	0	425,805	425,805	From 0 to 425,805
Yotaú	0	2,420	2,420	From 0 to 2,420
Other localities	0	224,628	224,628	From 0 to 224,628
Total	n.a.	2,329,600	1,331,472	
Note: n.a. = Not available				
Source: Own preparation based on the information of Cooperativa Rural de Credito Rural (CRE).				

Likewise, the annual consumption of electric power by company unit in the localities of San Ramon, San Javier and Ascensión de Guarayos in the third year of operation of the San Ramon Rural Electrification Project, increased in 169%, 50% and 10% respectively, with respect to the annual consumption of electricity by company unit in the last year of operations of the isolated system, as seen in Table 9.

**Table 9**

The San Ramon Rural Electrification Project: Average company electric power consumption (kWh – year)

Localities	1999	2002	Variation	Variation (%)
San Ramón	1,239	3,319	2,080	168
San Javier	3,250	4,887	1,637	50
Ascensión de Guarayos	1,586	1,741	156	10
Concepción	n.a.	6,333		
El Puente	n.a.			
San Julián	0	3,490	3,490	From 0 to 3,490
Yotaú	0	2,420	2,420	From 0 to 2,420
Other localities	0	4,404	4,404	From 0 to 4,404
Total	n.a.			
Note: n.a. = Not available.				
Source: Own preparation based on the information of Cooperativa Rural de Credito Rural (CRE).				

Likewise, the average company electric power consumption of the localities of San Julian, Yotaú and other localities in 2002 increased from 0 to 3,490, from 0 to 2,420 and from 0 to 4,404 kWh, respectively, with respect to the average company electric power consumption in 1999 from the isolated system.

The increase in the company electric power consumption and the consumption by company in the localities of San Ramon, San Javier and Ascensión de Guarayos is due, essentially, to the joining/entrance of companies such as sawmills, mechanic repair shops, milk factories, gas stations, wood shops and parquet factories, which before the start of operations of the San Ramon Rural Electrification Project could not access the electric power service from the isolated system. These companies use high power machinery. In the localities of San Julian, Yotaú and other localities, this increase is due to the availability of electric power with the start of operations of the project.

In 2002, the localities of Concepción and San Javier had highest consumption by company of the region, due to the presence of a parquet factory in Concepción, the largest company in the area, a quarry company that provides gravel to the construction company building San Javier highway-Concepción, that is transitorily operating in the region, and the milk and milk byproducts factory in San the Javier, the most important of the region in its field.

To sum up, the annual company electric power consumption provided by the ERC of the localities of the project's coverage area increased considerably in the localities of San Ramon, San Javier and Ascensión de Guarayos. Part of this increase is simply a substitution of own generation sources. Another part of the increase would be justified by the increase of the amount of consumer companies of electric power and by the increase of the consumption by company unit. The increase of the average company consumption is due to the increase of the proportion of companies using high power machinery and electric equipment and to the consumption increase of companies that consumed a lower amount than expected due to the lack of provision of electric power 24 hours a day. The company electric power consumption in those localities that before the project did not have access to the isolated system is to a great extent a result of the substitution of own



generation sources due to the availability of good quality electric power as from the start of operations of the project.

#### **4.4. Impact on the physical capital of companies: electric machinery**

As seen in Table 10, the amount of electric machines used by the companies in the project's coverage area in their productive processes of 2002 increased in all the more important economic activities of the region, with respect to the amount of electric machines used by the companies in 1999.

Most of the machinery and electric equipment of the average handicrafts workshop, of the diverse manufactured products activity, did not comprise any electric device in 1999. The electric power was only used to light the atmosphere of the shop. Until 2002, however, a ventilator was added up in order to cool the temperature of the shop. In this type of companies, the work is essentially performed based on manual work.

The stock of machinery and electric equipment of the average slaughter house, of the activity of fresh and prepared meats, comprised 2 electric devices in 1999, a bone cutter and a refrigerator, and 4 devices in 2002, a ventilator and a meat grinder, in addition to the two devices already in use in 1999.

In the dairy products activity, most of the machinery and electric equipment of the milk and milk byproducts factory consisted of 11 machines or appliances in 1999: computer equipment, a set of ventilators, a water pump, an electric furnace, a milk and steam pump, a pasteurizer, an air compressor, a gas compressor, an electric kettle, a centrifuge and a refrigerator chamber. Between 2000 and 2002, a cooling tower was added to the aforementioned machines, increasing them to 12.

**Table 10**

San Ramón Rural Electrification Project: Amount of electric machines or appliances used by companies

Activities	1999	2002	Increase
Diverse manufactured products	0	1	1
Commerce	1	4	3
Restaurants and hotels	3	8	5
Financial services	2	5	3
Recreational services	3	6	3
Communications	1	6	5
Livestock products	5	7	2
Prepared and fresh meats	2	4	2
Mill products and bakery	1	2	1
Repair services	4	5	1
Dairy products	11	12	1
Lumber and wooden products	4	5	1
Average	3	5	2
Source: Own preparation based on the information collected in the survey of companies.			

In 1999 the average wood shop of the lumber and wooden products activity, employed 4 different electric machines or appliances. In the period 2000-2002 added to its machinery, two more appliances. Likewise, the average company of the various most important activities of the region increased its machinery and electric equipment in different levels, from small appliances, in the case of most of the companies, to the set up of a factory, in one case.

Among the companies which could not access the electric power service due to the limited capacity of the isolated system, we can mention sawmills, wood shops, mechanic repair shops, milk and dairy factories and rice peelers. On the other hand, among the companies which faced serious difficulties in the use of the electric power supplied by this system, due to the lack of energy supply 24 hours a day and unexpected outages are slaughter houses, restaurants and hotels, computer and internet companies and electronic games companies.

However, the biggest investments in electric machinery were constituted by new investments. Such is the case of a parquet factory in the locality of Concepción, which is at present the biggest company in the region. Computer and internet companies in the localities of Ascensión de Guarayos, San Javier and San Julián with an average of 6 computers each were also established. During the interviews, it became evident that the availability of electric power supplied by the project weighed significantly on the decision to invest in these companies. The most relevant case is the parquet factory INPAR because of the amount of electric power consumed, the employment generated and the type of product.

**The INPAR Parquet factory** is located in the locality of Concepción. It was established after the implementation of the San Ramón Rural Electrification Project and its products

are exported to Paraguay. This company consumes 17.8 times what the average company of the coverage area of the San Ramón Project, representing 2.9% of the total company consumption and 1.3% of the total consumption (homes, business and state power services). It employs around 40 people, while the most important companies of the region only employ between 10 and 15 people. INPAR Parquet could not have been established before the implementation of the San Ramón Electrification Rural Project because the electric power generation plant of Concepción, with an installed capacity of 164 kW<sup>13</sup>, supplied electric power only to homes and small companies, whose electric power consumption is similar to that of homes.

**Computer and internet cafes** were set up in Ascensión de Guarayos, San Javier and San Julián, supplying services to homes, companies and the public sector of these localities. Before the implementation of the project, opening Computer centers and internet cafés was just not feasible, since the electric power supplied by the generation plants of Ascensión de Guarayos and San Javier had many voltage fluctuations and unexpected outages, which lasted many hours and even days. The implementation of the project supplying electric power 24 hours a day and steady voltage made it possible for small investors to invest in computer centers and internet cafés,

#### **4.5. Impact on production**

The increase of investment in machinery and electric equipment and the decrease in the electric power rate did not necessarily translate in an increase in production of the industries established in the area before the project was implemented, mainly due to the market situation.

##### **Companies which did not increase their production**

The companies which did not increase their production or increased it in amounts lower than those expected due to lack of market share, are related to the production of non-tradable goods and services<sup>14</sup> such as commerce, restaurants and hotels, communications and financial services or goods that despite being tradable, are not exported. However, for many reasons such as production costs higher than international costs, lack of market knowledge and international marketing mechanisms, these finally become non-tradable goods and services, as is the case of livestock, carpentry, handicrafts, and dairy products.

---

<sup>13</sup> The installed capacity of the Electricity Generation Plan of Concepción was 164 kW. However, there was another generator of 85 kW, which operated 4 to 5 hours a day.

<sup>14</sup> As per the Standard Industrial Classification, (SIC) of the United Nations, goods and services are classified in accordance with their tradability level in 9 different categories according to industries: agriculture, hunting, fishing and silviculture; mining; manufacture; electricity, gas and water; construction; wholesale and retail, hotels and restaurants; transport; storage and communications; financial services, insurance, real estate and commercial brokerage and community, social and personal services. The goods of the first three industries are considered typically tradable. On the contrary, goods of the remaining industries are considered non-tradable.

Most companies of the localities of the project's coverage area are probably among the group of business establishments limited in their growth by the restricted local market volume, either regional or national. The generation of more reliable and cheaper electric power supplied by the project, led these companies to invest in machinery and equipment, allowing them to improve the products or services but not to overcome the main barriers which hinder their expansion and development.

As examples of this type of companies we could mention a tourist complex in the locality of San Javier, a ranch in the locality of Yotaú, an cheese factory in San Javier and a small milk and dairy factory in the locality of Ascensión de Guarayos.

***The tourist complex Laguna Soboroqui***, located in the locality of San Javier, lodges local and foreign tourists, especially for the festivities at the end of the year. After the start of operations of the San Ramón Rural Electrification Project, this complex was connected to the project network through an important investment of many kilometers of electric wire, and the provision of electric appliances and a great number of lights on the lagoon and in the park, intended to provide a better service and attract a higher number of visitors. This investment allowed improving the quality of the services but the number of visitors did not increase due to the economic recession suffered by the region and the country.

***The Leche Leche Ranch***, is located on the Santa Cruz - Trinidad highway, in the Yotaú canton. The main investment of this ranch was the connection to the project's power network, approximately one kilometer long, apart from electrical appliances for the owner's and the administrator's use and lights for some of the stables. The project's electric power substituted the power generated by a diesel engine and a solar panel. This investment has not produced an increase in the cattle production, because the electric power, aside from being used to light the stables for the delivery of cattle, is probably not directly used in the livestock activity of the region.

***The San Javier Cheese Plant***, established before the implementation of the San Ramón Rural Electrification Project. It is the most traditional company of its type in the region, whose products are sold in the main cities of the country. Even though this company invested in electric machinery, it cannot expand due to a lack of market, especially caused by the competition of imported products, which have lower production costs on account of a large scale production. For instance, SANCOR of Argentina processes 6 million liters of milk a day while the cheese plant only processes 5 thousand liters of milk a day, making its production cost per kilo 12% higher than SANCOR's.

***The former milk and dairy factory of the locality of Ascensión de Guarayos***, established after the implementation of the Project, it was a small scale undertaking looking to expand in the future. This project was established by the owner of a ranch, encouraged by the availability of electric power in that locality and the objective of taking advantage of the milk production of the region and selling its production locally, at least at the beginning. The above mentioned rancher invested in machinery and training of human resources by Colombian technicians for this project. However, soon after he started operations, he had to close down since his product was not making it into the market.

### **Companies which increased their production**

The companies which increased their production considerably are those that produce tradable goods and services and companies which produce new non-tradable goods and

services in the localities of the region. We could mention from the first group, the parquet factory in Concepción and from the second, a computer and internet café.

**The INPAR Parquet Factory**, as referred to above, is the most important company of the region due to the number of jobs it generates and its electric power consumption. It was established in view of the availability of electric power supplied by the San Ramón Rural Electrification Project. Based on the experience of INPAR Parquet, the production increase would depend on the conjugation of the production of tradable goods and the use of the main local products, such as lumber, forest products and bovine meat.

**The Internet Company COTAS MUNDO**, operating in Ascensión de Guarayos, is a company which provides telephone and internet communication services. This was operational before the implementation of the project as a long distance call company, and it became a part of the internet service encouraged by the availability of electric power and it is the first internet company in that locality. By contrast with other companies which produce non-tradable goods, it has not only gained a place in the local market, but it has also sustained as an expanding company.

The first three companies of this type in the area are the computer and internet companies established in the localities of San Javier and San Julian respectively, along with Cotas Mundo in Ascensión de Guarayos.

#### **Projects in preparation**

In Santa Rosa de la Mina, one of the smaller localities which forms part of the coverage area of the San Ramón Rural Electrification Project, and prompted by the availability of electric power supplied by the project, the establishment of an aloe cosmetics factory is being looked into<sup>15</sup>. This locality already has aloe plantations. The owners of the project recently announced the construction of the plant. If this project becomes a reality, it might constitute another significant project for the region, similar to the INPAR Parquet Factory and the first in the locality of Santa Rosa de la Mina and in the municipality of San Ramón.

#### **4.6. Impact on the economic growth**

The San Ramón Rural Electrification Project had a positive and significant effect on the potential growth of the region. This effect is fundamentally originated by the supply of relatively cheap and high quality electric power, continuous 24 hours a day, with acceptable voltage fluctuations and enough power to cover the needs of industrial middle size companies. However, this power has been partially developed only due to external factors to the project itself, among which the market, for one, stands out. Consequently, the most significant increase in the production of goods and services, enabled by the electric power generated by the project, is seen in industries producing export goods or those exploiting new market segments, such as internet services. Although companies with traditional markets invested in machinery and electric equipment, they were unable to increase their production due to the limitations of the local or domestic market itself. There was even a case in which company had to close down.

---

<sup>15</sup> Aloe vera is a tropical plant to which many therapeutic properties are attributed. This plant is also widely used in cosmetics products due to its property of smoothing and protecting the skin.

Table 11 below summarizes the impact of the project on the economic growth of the region in accordance with market determinants which influenced the accomplishment of the economic potential growth brought on by the project.

**Table 11**

San Ramón Rural Electrification Project : Impact on the economic growth

Type of goods and services		Impact on the production		
		Level	Market	Tendency
Tradable goods		Higher	Limited	Growth
Non-tradable goods	New products in the locality	Higher	Limited	Stagnation risk
	Old goods in the locality	Null – minor	Limited	Stagnation
Source: Own source.				

The impact on the production of tradable goods and services to be commercialized in the international market, of an unlimited size for a small economy like the Bolivian economy, has the possibility to maintain and expand with time. On the contrary, the impact on the production of new non-tradable goods and services in the localities of the region, to be commercialized in the domestic market, of a reduced and limited size, face the risk of stagnation.

One factor that counteracts the reduced size of the local markets is the prevailing high growth rate of the area. However, it does not change the limited nature of these markets. On the other hand, one factor that weighs down the reduced size of the local markets is poverty and, consequently, the low purchase capability of considerable sectors of the population.

#### **4.7. Impact on the education service**

The main limitations of the isolated system for the educational units were, as described above, the lack of a continuous electric power supply or the lack of this service in some of the localities, and unexpected outages and voltage fluctuations.

During 1999-2000, the supply of equipment to the educational units of the localities of the region improved on different levels, depending on the funds allocated to each of them, as shown in Table 12.

For instance, the Educational Unit of San Javier Agreement, before the implementation of the San Ramón Rural Electrification Project used 3 machines or appliances, one computer for the administration, one type writer and one VCR. In 2002, the third year of operations of the project, these numbers increased to 9 machines, 5 computers for the computer room for students and teachers and one ventilator, apart from the 3 machines or appliances employed in 1999. This educational unit, aside from the computer room, has cable TV service which allows the diversification of audiovisual instruction and it is the only educational unit in the region which offers this kind of services to its students. Finally, the above mentioned educational unit is developing a Project to get internet services for administrative and academic purposes.

The Educational Unit of San Ramón did not use any machines or electric equipment in 1999, the year before the implementation of the San Ramón Rural Electrification Project. In 2002, it had 1 computer for administrative purposes.

**Table 12**

San Ramón Rural Electrification Project: Amount of electric equipment items employed by the educational units

	1999	2002	Population of the locality
Educational Unit of San Javier Agreement	3	9	5,538
Educational Unit of San Ramón	0	1	4,746
Source: Own preparation based on the information collected in the survey of public sector establishments.			

The Educational Unit of San Javier Agreement takes better advantage of the availability of electric power because it has more spending capabilities than the Educational Unit of San Ramón. This unit is located in a larger town and it is an educational unit supported by an agreement with a catholic church institution. On the other hand, the Educational Unit of San Ramón is located in a less populated town and it is a fiscal educational unit.

The impact of the availability of electric power supplied by the project on the educational service, produced by the decrease in the electric rate and the availability of a continuous and adequate service for all purposes is positive. It facilitated the use of electric appliances available since 1999 and new electric equipment to benefit education and educational administration. However, the importance of the impact would depend on the spending capabilities of these units in order to improve the equipment and pay the electric power service, being this impact higher in the educational units with more spending capabilities, such as the educational units supported by agreements and located in more populated localities, and lower in fiscal educational units located in less populated localities.

In accordance with the perception of directors and teachers of educational units, the electric power supplied by the San Ramón Rural Electrification Project facilitates the improvement of teaching. However, the level of the impact depends on the resources of these educational units. For instance, the implementation of computer and internet rooms, supplied with enough computers according to the number of students, would represent a qualitative advance for the quality of the educational service.

#### **4.8. Impact on the health service**

The main limitations of the isolated system for hospitals and health posts were practically the same as those related to the education service. In this case, the lack of electric power supply in the early morning required the use of gas lamps and even candles for the attention of childbirths. To counteract these limitations, hospitals and health posts resorted to the use of diesel generators, solar panels, gas lamps and candles, for the attention of childbirths.

Since the implementation of the project the use of electric power in the health posts of the localities of the region increased in different levels, as this is a significant factor for medical equipment and other electric appliances, as inferred from Table 13, depending, mainly, on the financial position of said health centers.

For instance, the hospital in Ascensión de Guarayos, before the implementation of the San Ramón Rural Electrification Project, had 11 electric appliances among medical equipment and other appliances. With the implementation of this project, the electric appliances used increased to 18. See Table 13.

**Table 13**

San Ramón Rural Electrification Project: Amount of medical related electric appliances and equipment used by the health centers

Health centers	1999	2002	Population of the locality
Ascensión de Guarayos Hospital	11	18	12,284
San Javier Hospital	12	16	5,538
Yotaú Health Post	0	Lighting	1,267
Source: Own preparation based on the information collected in the survey of public sector establishments.			

The Yotaú Health Post did not use electric power before the project implementation. In 2002, the third year of operations of the project, the post had electric power only for the lighting of medical care rooms and offices. However, it did not have any electric medical equipment.

The Hospital in Ascensión de Guarayos is located in an urban locality, province and municipality capital, with around 12,300 inhabitants. It receives consequently, more substantial financial support from the municipal town hall and has more income from services rendered. On the contrary, the Yotaú Health Post is located in a locality which is a canton capital, with around 1,300 inhabitants. Under these circumstances, it receives little support from the municipal town hall and does not perceive income for services, since medical care is free.

In the opinion of doctors and hospital and health posts administrators and the mayors of the municipal town halls of the region, the impact of the San Ramón Rural Electrification Project is positive, even if this energy is only used for the lighting of medical care rooms, which is indispensable for the provision of health services in the evening.

The impact of the electric power supplied by the San Ramón Rural Electrification Project on health services is positive, since it enables the use of medical equipment when it is necessary, moments such as childbirths which take place at dawn and medical emergencies, and because it allows the implementation of new medical equipment. The importance of the impact depends, however, on the spending capabilities of these establishments in order to improve the equipment and pay the consumption of electric power. The greater impact is on hospital and health posts with more spending capabilities and in those located in more populated localities; and, it is less in hospitals and health



posts with lesser spending capabilities, such as those located in less populated communities and distant from municipalities.

#### 4.9. Impact on the potable water service

The main limitation of the isolated system for the potable water service was the limited installed capacity, which prevented the electric power supply from getting to the water pumps of the potable water cooperatives, which forced them to resort to the use of diesel generators.

Between 1999 and 2002, the potable water cooperatives increased, in different degrees and depending on their spending capabilities, the use of the electric power as an indispensable component of the potable water pumping system and appliances to be used by the administration. See Table 14. In 1999, for instance, the Potable Water Cooperative of Ascensión de Guarayos used 2 electric machines, the most significant of which was the water pumping system. In 2002 it employed 4 machines, increasing its equipment by a factor of two. In 1999, the Potable Water Cooperative of San Ramón had one electric machine, the water pumping system, and in 2002 it had 2 machines or appliances. This cooperative, besides adding to its machinery and equipment, substituted the water pump on account of the convenience of having the electric power supplied by the project. Thus, the potable water services reached the higher neighborhoods of the town.

**Table 14**

San Ramón Electrification Rural Project: Amount of electric machines or appliances used by the potable water cooperatives

Potable Water Cooperatives	1999	2002	Locality population
Ascensión de Guarayos	2	4	12,284
San Ramón	1	2	4,746
Source: Own preparation based on the information collected in the survey of public sector establishments.			

The potable water cooperative of Ascensión de Guarayos uses more machines or electric appliances than the potable water cooperative of San Ramón because it is a company located in the highest populated locality of the region, as shown in Table 15 below, and it has consequently, the largest number of users and greater spending capabilities.

The impact of the availability of the electric power supplied by the San Ramón Rural Electric power Project on the potable water services was also positive since (i) it facilitated the substitution of the pumping water systems; (ii) it made it possible to implement the office electric equipment for the administration and (iii) it made it possible to decrease the pumping system energy costs, by substituting the expensive diesel generators energy with cheaper energy supplied by the project. The importance of this impact depends, however, on the number of users and their payment capability, which in turn, is directly related to the number of inhabitants of the town.

Furthermore, the availability of the electric power supplied by the project made it possible for the potable water cooperatives to increase, somehow, the service coverage and improve the administrative efficiency. The potable water services coverage however, depends a great deal, on the payment capability of the users. For instance, the increase

of the installed capacity of the potable water services of San Ramón cannot be completely developed because the average income of the homes located in distant neighborhoods does not allow them to pay for the services, let alone the connection to the service.

#### **4.10. Impact on the Municipalities**

Between 1999, the year before the implementation of the San Ramón Rural Electrification Project, and 2002, the third year of operations of this project, the municipalities increased the use of electric appliances and equipment at different levels, depending on their spending capabilities, which in turn depends on the number of inhabitants of the municipalities, as shown in Table 15 below.

In 1999, the Municipality of Ascensión de Guarayos had 2 electric machines or appliances and in 2002 these were increased to 12. Likewise, in 1999 the Municipality of San Javier had 2 electric machines or appliances and in 2002 these were 11. In 1999, the Municipality of San Ramón did not have any electric appliance and in 2002 it had 6 electric machines or appliances.

The use of electric power does not only depend on its availability, but also on other factors such as the spending capacity of the municipalities to equip themselves with electric machines and equipment in order to improve their efficiency. In 2002, the municipalities of Ascensión de Guarayos and San Javier had better equipment than the Municipality of San Ramón, because they have a larger population. This entails greater income and more spending capability. A factor that hinders the municipalities' spending capability is the great number of poor homes within the municipality.

**Table 15**

San Ramón Rural Electrification Project: Electric machines and equipment used by the municipalities

<b>Municipalities</b>	<b>1999</b>	<b>2002</b>	<b>Municipal population</b>	<b>Poor homes (%)</b>
Ascensión de Guarayos	2	12	16,984	87.5
San Javier	2	11	11,316	82.9
San Ramón	0	5	5,660	79.5
Source: Own preparation based on the information collected in the survey of public sector establishments.				

The scarce equipment of the municipalities until one year before the implementation of the San Ramón Rural Electrification Project and the accelerated improvement of such equipment once the project started operations reveal that the lack of good quality electric power service constituted a real restraint for the equipment of the municipalities.

In the opinion of municipal councilmen and technicians, the availability of electric power generated by the project facilitated the improvement of the equipment of the municipalities and contributed significantly to the improvement of municipal administrative efficiency. The performance quality of the many activities carried out by the municipalities, such as plan formulations, municipal programs and projects, Annual Operational Plan (AOP), Municipal Development Program (MDP), municipal budget and taxpayers' registry, showed significant improvement. Likewise, thanks to the availability of computers, fax,

photocopier machines, overhead projector and internet (in some of the municipalities) the amount of time incurred in each work decreased.

#### **4.11. Impact on social development**

The conducted analysis shows that the San Ramón Rural Electrification Project contributed to improve health, education, potable water services and the administrative attention in municipalities. It becomes evident that stable and cheaper energy creates an interesting potential to improve the above mentioned services. However, the total accomplishment of this potential depends greatly on the local government investment capability. The number of inhabitants is in this regard, a determinant factor.

Highly populated localities are the ones to benefit from the opportunities created by the project, not only because they have greater investment capability but because they have economies currently developing infrastructure. Population's poverty constitutes another determinant factor, although in this case, it restrains the profitability of the opportunities generated by the project. Consequently, in those less populated smaller localities with high levels of poverty, the project accomplished very little improvement of social development.

#### **4.12. Impact on the level of life at homes**

The main limitations of the isolated system for homes were, as previously analyzed, the lack of a continuous supply of the service or the non-existence of it in some localities, the unexpected prolonged outages and voltage fluctuations. The San Ramón Rural Electrification Project made available to homes 24 hours a day electric power with enough installed capacity to supply electric power to any electric appliance, programmed outages lasting less than one hour each and exceptionally more than one hour; and less pronounced fluctuations than those originated by the previous system.

##### **4.12.1. Consumers**

In the last three years, the amount of electric power home consumers in the localities of San Ramón, San Javier and Ascensión de Guarayos increased, as shown in Table 16, in 26%, 11% and 50% respectively. During the same period, the number of electric power home consumers in the localities of San Julián, Yotaú and other localities increased from 0 to 335, 0 to 42 and 0 to 258, respectively.

The lower increase rate of consumers in the locality of San Javier reflects, somehow, the influence of the lower electric power decrease rate in this locality.

**Table 16**

San Ramón Rural Electrification Project: Home consumers (number of homes)

Localities	1999	2002	Variation	Variation (%)
San Ramón	244	308	64	26
San Javier	475	526	51	11
Ascensión de Guarayos	412	618	206	50
Concepción	n.a.	609		
El Puente	n.a.	80		
San Julián	0	335	335	From 0 to 335
Yotaú	0	42	42	From 0 to 42
Other localities	0	258	258	From 0 to 258
Total	n.a.	2,776		

Note: n.a. = Not available.

Source: Own elaboration based on the information from Cooperativa Rural de Crédito (CRE).

#### 4.12.2. Consumption

Between 1999, a year before the start of operations of the project, and 2002, the third year of operations of the project, the electric power consumption in homes in the localities of San Ramón, San Javier and Ascensión de Guarayos, increased, as shown in Table 17, in 181%, 4% and 40%, respectively. Furthermore, during the same period, the electricity consumption in homes in the localities of San Julián, Yotaú and other localities increased from 0 to 255,685, from 0 to 41,998, and from 0 to 203,084 kWh, respectively.

**Table 17**

San Ramón Rural Electrification Project coverage area: Consumption in homes (kWh – year)

	1999	2002	Variation	Variation (%)
San Ramón	103,560	290,755	187,195	181
San Javier	567,413	588,007	20,594	4
Ascensión de Guarayos	394,445	552,468	158,023	40
Concepción	n.a.	515,227		
El Puente	n.a.	83,892		
San Julián	0	255,685	255,685	
Yotaú	0	41,998	41,998	
Other localities	0	203,084	203,084	
Total	n.a.	2,531,116	845,698	

Note: n.a. = Not available.

Source: Own elaboration based on the information from Cooperativa Rural de Crédito (CRE).

The lower electric power consumption increase rate in the locality of San Javier shows the high consumption sensitivity with respect to the electric power rate.

In the analysis period, the consumption by home in the locality of San Ramón increased 122% and in the localities of San Javier and Ascensión de Guarayos, it decreased 6% and 7% respectively. See Table 18. The above mentioned decrease was caused by the

economic recession prevailing in the region and the country during the last years, since the electric power rate in these localities decreased 16 and 34%, respectively.

**Table 18**

San Ramón Rural Electrification Project: Consumption by home (kWh – year)

<b>Localities</b>	<b>1999</b>	<b>2002</b>	<b>Variation</b>	<b>Variation (%)</b>
San Ramón	424	944	520	122
San Javier	1,195	1,118	-77	-6
Ascensión de Guarayos	957	894	-63	-7
Concepción	n.a.	846		
El Puente	n.a.	1,049		
San Julián	0	763		
Yotaú	0	1,000		
Smaller localities	0	787		
Total	n.a.	912		
Note: n.a. = Not available.				
Source: Own elaboration based on the information from Cooperativa Rural de Credito (CRE).				

The consumption by home in the locality of San Ramón, whose 2002 rate is lower than that of San Javier, increased significantly since its base line was very low, see Table 18, since this locality was supplied electric power for only 6 hours a day in 1999.

The increase in consumers in the localities of San Ramón, San Javier and Ascensión de Guarayos, which baseline information is available, and the decrease in home consumption in the localities of San Javier and Ascensión de Guarayos are due to the fact that the new consumers are homes located in marginal neighborhoods with a consumption by home lower than the average of the locality.

#### **4.12.3. Rate of electric power coverage**

The rate of the electric power service coverage between 1999 and 2002 increased in the localities of San Julián, Yotaú and Ascensión de Guarayos, maintained the same level in San Ramón and decreased in San Javier, as shown in Table 19.

**Table 19**

San Ramón Rural Electrification Project: Coverage of electric power service in homes.

	<b>1999</b>	<b>2002</b>	<b>Variation</b>
San Ramón	31%	31%	0%
San Javier	54%	49%	-5%
Ascensión de Guarayos	21%	27%	6%
Concepción	n.d.	58%	
El Puente	n.d.	18%	
San Julián	0%	20%	20%
Yotaú	0%	16%	16%
Total	n.d.	32%	
Nota: n.a. = Not available.			
Source: Own preparation based on information from Cooperativa Rural de Electrificación Rural (CRE).			

The decrease in the rate of electric power service coverage in San Javier is due to the fact that between 1999 and 2002, the home growth rate, 7% annual, was greater than the consumer increase rate of 3% annual.

#### **4.12.4. Use of electric power**

Homes use the electric power to light house spaces and to supply electric power to household appliances. Lighting is the main use given to electric power which contributes to work carried out at home and children's studying. The work at home has the objective of producing goods and services for domestic consumption and for the market.

The main activities carried out at home are commerce, weaving and tailoring of garments, bakery products and wooden handicrafts. The availability of electric power 24 hours a day without unexpected outages, helped homes to take better advantage of their facilities for the production and commercialization of different products. For instance, the production of bread, cakes and soft drinks takes place during the night and in the early morning in order for these to be sold the next day. Thanks to the lighting, children are able to help their parents for an increased amount of hours a day, in the morning or afternoon and study more hours at night. For this reason, the availability of good quality electric power helped homes to generate additional income, increasing their income in some cases or offsetting in others the decrease in the family income due to the economic recession undergone by the region and the country.

The availability of good quality electric power 24 hours a day encourages the children to devote more hours to studying, without schedule restrictions or interruptions due to unexpected power outages. The persisting restriction in the homes of the region, which hinders a greater use of electric power for study, is the low family income.

In 1999, the year before the implementation of the San Ramón Rural Electrification Project, the most frequently used electric appliances at home were the radio, the refrigerator, the TV set and the stereo. In 2002, the third year of operations of the project, such appliances as the ventilator/fan, the blender and the iron were added to the list. However, the diversification in the use of appliances did not necessarily result in an increase in electric power consumption. On account of the decrease in income as a result

of the economic recession, families make a more rational use of electric power, reducing the time of use of high electric power consumption appliances.

---

## 5. ELECTRIC POWER SERVICE AND POVERTY

---

The monthly electric power consumption per home of the localities of the coverage area of the San Ramón Rural Electrification Project range between US\$ 11 and US\$ 16, being the region average consumption US\$ 13, as shown in Table 20 below.

The monthly income of low income homes, such as sawmill and freelance workers, in the project's coverage area, is approximately US\$ 70 to US\$ 140. The most of the homes of the region belong within this income category. On the other hand, the municipalities to which the localities of the coverage area of this project belong, are amongst those with higher percentages of impoverished population in the department and the country (See Table 2).

The monthly electric power consumption per home of the localities of the coverage area of the San Ramón Rural Electrification Project represents between 8% and 15% of the monthly income of low income homes in the locality of San Julián and between 11% and 23% in the locality of San Javier. The region average is between 9% and 18%. See Table 20.

**Table 20**

San Ramón Rural Electrification Project: Degree of poverty, home electric power consumption and home income (one worker)

Localities	Level of poverty (%)	Monthly home consumption (\$us)	Monthly Income per home (\$us.)	Home Consumption / Home income	
San Ramón	79.5	13	70 to 140	19%	10%
San Javier	82.9	16	70 to 140	23%	11%
Concepción	87.5	12	70 to 140	17%	9%
San Julián	84.6	11	70 to 140	15%	8%
Ascensión de Guarayos	92.3	13	70 to 140	18%	9%
El Puente	81.6	15	70 to 140	21%	11%
Yotaú	92.3	14	70 to 140	20%	10%
Other localities		11	70 to 140	16%	8%
Total		13	70 to 140	18%	9%

Source: Own elaboration based on information from the CRE and that gathered through field work.

The electric power cost plus the consumption per home of other modern energies<sup>16</sup>, such as liquified gas and kerosene, should not exceed 10-15% of the home income, in

---

<sup>16</sup> The term "modern energy services" refers to sources of energy and fuel which are not primitive or traditional (for example charcoal, wood and manure) and, in general, are produced by commercial companies (R. Lamech, K. O'Sullivan and L. Lovei, Energy Sector, Draft for Comments, August, 2000)



accordance with experts of the energy sector<sup>17</sup>. Otherwise, a subsidy policy for the population with the lowest income would become necessary. Please note that in the localities of the coverage area of the San Ramón Rural Electrification Project, the electric power consumption, which does not include liquefied gas and kerosene, reaches percentages over 10-15% for the homes of most of the localities of the region. This leads to consider the possibility of subsidizing, at least partially, the electric power cost supplied by the project in order to contribute to alleviate poverty and improve life conditions in the poorest homes of the region.

### **5.1. Towards a cross-subsidy regime that would improve the socio-economic impact of the project**

A cross-subsidy policy in order to favor the consumption of electric power of the poorest economic strata of the coverage area of the project, by means of subsidized rates for the poorest segments of the region, financed with encumbered rates to the richest segments of such region, does not seem to be feasible, since the poor population of the region, as shown in Table 2, represents between 80 and 92% and the non-poor population only between 8 and 20%. Consequently, a possible cross-subsidy in the scene of the coverage area of the project would require a substantial increase in the electric power rate for some users that would only achieve a small decrease for the subsidized sector rate. Moreover, due to the incipient company development in the coverage area of the project the application of taxes to a determined sector of the economy of the region to subsidize the poorest segments does not seem to be feasible either.

A subsidy policy at a departmental or national level would be more feasible for it would at least allow increasing scale economies in the distribution of SIN to the isolated systems, particularly the San Ramón Rural Electrification Project. A policy of this sort could be implemented in several ways. More specifically, the government considers that to determine rates, the distributor companies should integrate into their distribution costs the cost incurred by small distributors of isolated systems, over which they have influence and jurisdiction.<sup>18</sup> In the case of the project, for instance, the distribution costs of CRE in Santa Cruz would include the distribution costs of the Project, the greatest part of which would be paid by the users located in the city of Santa Cruz.

One of the advantages of this cross-subsidy system is its simplicity, because the population to be burdened, the urban electric power consumers, as well as the population to be subsidized, the rural electric power consumers, are clearly identified. On the contrary, one of the flaws of this system is that there is poor population in the urban area; unemployed population, for instance. Thus, the system would partly produce the transfer

---

<sup>17</sup> R. Lamech, K. O'Sullivan and L. Lovei, Energy Sector, Draft for Comments, August, 2000.

<sup>18</sup> The Bolivian government, after studying several cross-subsidy alternatives, recently approved a legal framework for the implementation of a cross-subsidy policy of this sort, which would allow integrating urban area and rural area electricity distribution costs (S.D. 27030, dated May 8, 2003). The Regulator of Electricity, the sector regulatory entity and in charge of the execution of this policy, is looking into a specific way to implement it. This policy would be implemented within three years and would allow a decrease in the electric power rate of the San Ramón Rural Electrification Project and other systems non-integrated to the SIN of around 30%, within three years.

of one sector of poor population to another sector of the same population. Consequently, an urban subsidy policy to the rural area could generate a certain degree of opposition from the burdened sectors, especially low income groups. In order to minimize or avoid this situation, the Regulator of Electricity has proposed the gradual implementation of the subsidy until 1,2% a year through monthly increases which would not exceed 0.1% each month. The rate studies in this regard are presently being considered by the Regulator of Electricity.

## **BIBLIOGRAFÍA**

1. Baseline and Greenhouse Gas Emissions Reduction Study for the San Ramon Joint Implementation Rural Electrification Project, Proef Projecten Programma Joint Implementation The Netherlands, La Paz – Bolivia, 2000.
2. San Ramón Rural Electrification Project, Feasibility Project, Annex G.
3. National Institute of Statistics, Population and Housing National Census 2001, Data Base, Santa Cruz, Beyond 20/20, 2002.
4. National Institute of Statistics, Population and Housing National Census 2001, Bolivia: Poverty Map 2001, 2002.
5. R. Lamech, K. O’Sullivan and L. Lovei, Energetic Sector, Draft for Comments, August, 2000.
6. Large Mines and the Community, Socioeconomic and Environmental Effects in Latin America, Canada, and Spain, Edited by Gary McMahon and Felix Remmy, Bolivia: Tunrning Gold Into Human Capital, Fernando Loayza, Ismael Franco, et al, The World Bank, Washington DC – USA, International Development Research Centre, Ottawa – Canada, 2001

## ANNEX 1

**Table 21**

San Ramón Rural Electrification Project coverage area: Use of energy as combustible to cook (2001)

	<b>Firewood</b>	<b>Gas</b>	<b>Electric power</b>	<b>Others</b>	<b>No use</b>	<b>Total</b>
Yotaú	88%	11%	0%	1%	1%	100%
El Puente	84%	13%	0%	0%	3%	100%
Asc. Guaragos	73%	26%	0%	0%	1%	100%
San Julián	71%	26%	0%	1%	2%	100%
Concepción	53%	45%	0%	1%	1%	100%
San Javier	50%	48%	0%	0%	1%	100%
San Ramón	50%	46%	0%	0%	4%	100%
	65%	33%	0%	0%	2%	100%

Source: Prepared based on information from the National Institute of Statistics, INE, Data Base, Population and Housing National Census - 1992 and 2001, Santa Cruz, CD Beyond 20/20.

Evaluación de Impacto en el Desarrollo Sostenible del  
Proyecto de Implementación Conjunta de Electrificación Rural  
San Ramón

**Protocolo del Estudio**

**La Paz, enero de 2003**