No.

Republic of Cape Verde
Ministry of Tourism, Industry and Energy

Power Transmission and Distribution System Development Project in The Republic of Cape Verde

Final Report

July 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

Chubu Electric Power Co., Inc.

IDD
JR
10-062

Preface

In response to the request from the Government of the Republic of Cape Verde, the Government of Japan decided to conduct the "Power Transmission and Distribution System Development Project in The Republic of Cape Verde" and entrusted the Study to the Japan International Cooperation Agency (JICA).

JICA sent a Study Team, led by Mr. Keiji SHIRAKI and organized by Chubu Electric Power Co., Inc. to Cape Verde three times from November 2009 to May 2010.

The Team held a series of discussions with officials from the Ministry of Tourism, Industry and Energy and conducted related field surveys. After returning to Japan, the Team conducted further studies and compiled the final results in this report.

I hope that the report will contribute to the development of power system facilities, stable power supply in Cape Verde, and the enhancement of amity between our two countries.

I would also like to express my sincere appreciation to the officials concerned for their close cooperation throughout the Study.

July 2010

Atsuo KURODA
Vice President
Japan International Cooperation Agency

July 2010

Atsuo KURODA
Vice President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

We are pleased to submit to you the final report for the "Power Transmission and Distribution System Development Project in The Republic of Cape Verde".

The study was implemented by Chubu Electric Power Co., Inc. from October 2009 to July 2010 based on the contract with Japan International Cooperation Agency (JICA).

We formulated the feasibility study concerning improvement of the power transmission and distribution system, including the improvement of supply reliability by conditioning of the transmission and distribution system and rehabilitation of protection relay, and also, efficient reduction of distribution loss. The study was achieved with the cooperation of the Ministry of Tourism, Industry and Energy in Cape Verde.

We are convinced that the realization of the recommendations will lead to the acceleration of the power system development, which will surely contribute to the economic and social development in Cape Verde. We devoutly hope that the contents of this report can be reflected in the Power Transmission and Distribution System Development Project in Cape Verde.

Finally, we would like to express our deep gratitude to JICA, the Japanese Embassy in Senegal, the Ministry of Tourism, Industry and Energy in Cape Verde and other officials concerned for the close cooperation and assistance through the study.

Keiji SHIRAKI
Team Leader
Power Transmission and Distribution System Development Project in Cape Verde

Table of Contents

List of Figures

List of Tables

Acronyms

ADP	Águas de Portugal, SA
AfDB	African Development Bank
APP	Agua Ponta Preata
ARE	Agência de Regulação Económica
ARM	Agência de Regulação Multisectorial
BCA	Banco Comercial do Atlântico
CVE	Cape Verde Escudo 1.15227 JPY/CVE (2010.3.31)
DGA	Direcção Geral do Ambiente
DGPCP	Direcção-Geral do Património e de Contratação Pública
EBITDA	Earnings Before Interest, Tax, Depreciation, and Amortization
EDP	Energias de Portugal, SA
EIA	Environmental Impact Assessment
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GMT	Ground Mounted Transformer
IEA	International Energy Agency
IMF	International Monetary Fund
INE	Instituto Nacional de Estatística
MECC	Ministério da Economia, Crescimento e Competitividade
MTIE	Ministra do Turismo, Indústria e Energia (Ministry of Tourism, Industry, and Energy)
O&M	Operation and Maintenance
OHL	Over Head Line
PIU	Project Implementation Unit
PMT	Pole Mounted Transformer
UGL	Under Ground Line
UNDP	United Nations Development Programme
WEO	World Economic Outlook (of the IMF), （IMF）

Chapter 1 Introduction

1.1 Background of study

The Republic of Cape Verde is emphasizing improvement and development of its basic infrastructure as part of its strategy for mitigating poverty through economic growth set forth in its "Growth and Poverty Reduction Strategy (GPRS) 2004 - 2007". In the national five-year strategy (2006 - 2011), its aim is socioeconomic advancement and poverty mitigation based on infrastructural conditioning inclusive of the water and power sectors, around the pillars of sustained growth and improvement of the standard of living. The country depends heavily on tourism income, and its demand for power is rapidly increasing. There is an urgent need for conditioning of facilities for power generation, transmission, and distribution. As assistance to this end, a project for reinforcement of the power generation and transmission capacity on the island of Santiago began in March 2008 with yen loans. In Cape Verde, rural electrification is positioned as a priority policy agendum in the power sector. There are very wide interregional gaps in respect of access to electrical power. The electrification rate is 80 percent nationwide, but only 68 percent in Santiago island, which is home to about 60 percent of the population and is the center of economic activities. Furthermore, the operating voltage varies greatly (6, 10, and 20 kV), and is also the main cause of the high rate of transmission and distribution loss, which averages over 25 percent and is impeding optimization of the power network. This situation is having a huge negative impact on the finances of Empresa de Electriciadade e Agua SARL (ELECTRA), which is the seat of power supply in Cape Verde. ELECTRA does not have all the capabilities needed for conformance of the scope of protection (protection cooperation) and system design requiring technical expertise even for protection relays. It is apprehensive about phenomena such as the frequent incidence of breakdowns causing general outages on the Praia system supplying the national capital. Cape Verde is attaching great importance to resolution of such problems and preparation of a power supply setup with high levels of safety and reliability. This is vital not only for making a direct contribution to the stability of the national life but also for resolution of bottlenecks to the development of tourism in the country, whose economy depends on tourism income, and for assurance of sustained economic growth.

In this climate, JICA implemented a preliminary study for assistance with improvement of the water supply and power transmission and distribution system network in Cape Verde in February 2009, based on a request by the Ministry of Economy, Growth, and Competitiveness (MECC; the current Ministry of Tourism, Industry, and Energy, or MTIE). Based on the results of this study, it reached an agreement with the government of Cape Verde on the basic outline of a feasibility study (F/S) concerning improvement of the power transmission and distribution system in June 2009.

1.2 Purpose of this study

This study was aimed improvement of supply reliability by conditioning of the transmission and distribution system and rehabilitation of protection relay, and also, purpose for implementation of a feasibility study that is aimed efficient reduction of distribution loss.

1.3 Study coverage area

The study was coverage six islands（Santiago, Santo Antao, Sao Vicente, Sal, Maio, Fogo）in total nine island of Cape Verde except uninhabited island.

Chapter 2 Situation in the Power Sector

2.1 Course of the power sector - changes and current status

Up until 1999, electrical power was supplied by ELECTRA, which was established in 1982 as a state-owned enterprise. In this period, ELECTRA's finances were continually in the red, and its losses were covered by subsidies from the national government. Due to a shortage of public funds, the government decided to privatize it in 1999 in order to mobilize funds for investment in the power infrastructure.

The privatization policy called for sale of 51% of ELECTRA's stock and management of its business by private shareholders. To this end, the government enacted Decree-Laws 54[1] (Electricity Law) and 75[2] (Water Resources Law), thereby preparing the legal grounds. In addition to these two laws, it enacted Decree-Law 76[3] as the legal provision for the functions of the regulatory institution, i.e., the Multisectoral Regulation Agency (ARM: Agência de Regulação Multisectorial).

Through the process of privatization in 1999, 51% of ELECTRA's stock was sold to a consortium composed of the two firms Energias de Portugal, SA (EDP) and Águas de Portugal, SA (ADP). As a result, ELECTRA became ELECTRA S.A.R.L., a limited responsibility enterprise. In 2002, the privatized ELECTRA concluded an agreement with the government giving it a power transmission and distribution concession for the 36-year period from 2000 to 2035, and thereby acquired rights for supply of power to the whole country.

Upon privatization, ELECTRA promoted capital investment and strove to make its business more efficient, but continued to post deficits as a result of the lag between the time of investment and the surfacing of effects as well as the unconditioned state of the tariff regulation setup. Under these circumstances, it became difficult for the company to remain in business.

In addition to the critical situation surrounding the supply of power and water, the shareholders sought the implementation of far-reaching initiatives to enable ELECTRA to overcome its financial crisis. This led to the signing of a partnership restructuring agreement between the EDP/ADP Group and the government on 26 July 2006 for transfer of ELECTRA's management to the latter. In accordance with this agreement, rates of shareholder interest in ELECTRA changed from 51%, 37%, and 12% for the EDP/ADP Group, national government, and municipalities, respectively, to 51%, 34%, and 15% for the national government, the EDP/ADP Group, and municipalities, respectively.

Under the agreement, the EDP/ADP Group also consented to take over payment of the debt of CVE7.9 billion which ELECTRA owed to a Portuguese bank. As a result, ELECTRA became indebted to the EDP/ADP Group instead of the bank. This debt to the EDP/ADP

[1] Decreto-Lei No. 54/99
[2] Decreto-Lei No. 75/99
[3] Decreto-Lei No. 76/99

Group was to be repaid in full without interest over a period of 20 years, with government guarantees. Due to this measure, the EDP/ADP Group was freed from all obligations contained in the December 1999 technical proposal, which was presented at the time of the contracting whereby the EDP/ADP Group acquired 51% of ELECTRA's stock. At the same time, it was also freed from its obligations as a shareholder which concluded an agreement with the government.

In July 2008, the EDP/ADP Group withdrew completely from ELECTRA, which then acquired its current shareholder makeup, i.e., an 85% held by the national government and a 15% interest held by local governments.

As for the governmental organization, ARM was established as the regulatory institution in 2001 as noted above, but was dismembered at the end of 2002. The enactment of two laws in 2003 furnished the legal grounds for institution of an independent regulatory committee and establishment of the Agência de Regulação Económica (ARE). In 2004, the ARE inherited the regulatory functions of the ARM.

The authority for formulation of power sector policy resides with the Ministry of Tourism, Industry, and Energy (MTIE), an administrative institution.

As noted above, ELECTRA was privatized by sale of its stock in December 1999 and again nationalized in 2006, when it took its present form of a limited liability company owned by the government.

Besides supplying electrical power to the whole country, ELECTRA supplies water and wastewater treatment services to the islands of Brava, São Vicente, Sal, and Boavista.

As of the end of 2008, ELECTRA was supplying power to 94,461 households and water to 32,172 households. In the same year, it registered energy sales of 180GWh, water sales of 2.866 billion m^3, and total business revenue of CVE5.48 billion. (see Table 2.1)

Figure 2.1 presents an organizational chart for ELECTRA.

Table 2.1 Trend of ELECTRA business (2005 - 2008)

	2005	2006	2007	2008
Number of customers				
Power (houses)	76,895	82,880	88,169	94,461
Water (houses)	26,695	29,038	30,535	32,172
Sales				
Power (MWh)	161,676	164,774	168,472	176,353
Water (millions of m^3)	2,932	2,999	2,899	2,866
Number of employees (people)	659	679	655	687
Truenover (thousands of CVE)	3,649,444	4,171,271	4,813,691	5,479,342

Source: ELECTRA

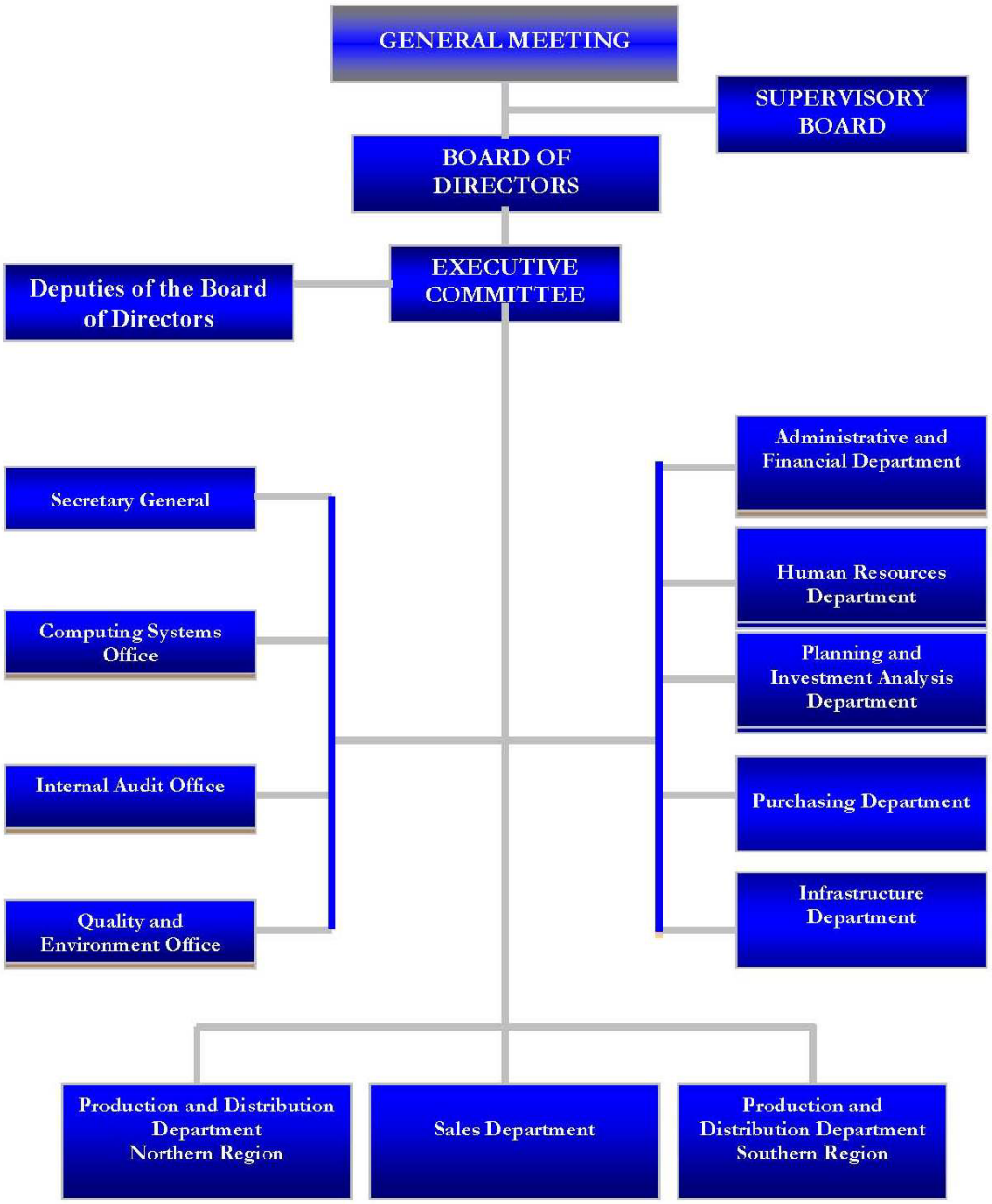


Figure 2.1 ELECTRA organizational chart

2.2 Current Status of Power Facilities

The current status of the power facilities in Cape Verde is as follows.

2.2.1 Generation facilities

The majority of the power generation facilities in Cape Verde are diesel generators. Table 2.2 shows figures for the present generation capacity on the six islands.

Table 2.2 Available Generation Capacity for Each Islands

Island	System	Available Capacity (kW)	
		Thermal (Diesel)	Wind Turbine
Santo Antao	Porto Novo	2,480	
	Rebeira Grande	3,650	
	Total	6,130	
Sao Vicente		18,352	900
Sal		8,352	300
Maio		680	
Santiago	Praia	33,462	
	Santa Catarina	2,160	900
	Tarrafal	2,160	
	Santa Cruz	2,688	
	Total	40,470	
Fogo	Sao Fillipe	3,280	
	Ponta Verde	168	
	Mosteiros	800	
	Total	4,248	

At present, ELECTRA has a plan to concentrate the generation facilities on each island in a single location and install large-scale diesel generators for lower fuel costs. Large diesel generators have already been installed in certain power stations, such as those at Palmarejo on Santiago, Lazareto on Sao Vicente, and Palmeira on Sal. ELECTRA intends to consolidate generation in such stations and phase out other old stations.

2.2.2 Transmission and distribution facilities

(1) Voltage classes

Table 2.3 shows the voltage classes in Cape Verde. There are no transmission or distribution lines operated at high voltage at present, but there are plans for construction of new 60-kV transmission lines and transformers in the project for reinforcement of generation and transmission facilities on Santiago, as described below. Medium-voltage facilities are operated at 20 kV as the standard voltage, but in some districts they are actually operated at 6, 10, or 15 kV. There are needs for unified 20-kV operation for the purpose of higher efficiency in the aspects of operation and material procurement.

Table 2.3 Definition of voltage classes

Voltage type	Voltage	Main facilities
High Voltage	More than 35 kV	60 kV Transmission line and transformer (constructed in the future)
Medium Voltage	More than 1 kV and less than 35 kV	6kV, 10kV, 15kV, 20kV Transmission and distribution line, transformer, etc.
Low Voltage	Less than 1 kV	220V, 380 V distribution line, etc.

(2) Specifications of transmission and distribution facilities

The existing transmission and distribution facilities have a diversity of specifications. ELECTRA is pursuing the unification of specifications in the interest of more efficient material procurement and management. Table 2.4 shows the specifications currently applied. In Cape Verde, there are many underground transmission and distribution lines; overhead lines are basically confined to mountainous areas and rural districts. The thickness of transmission and distribution cable and the transformer capacity are chosen to suit the situation as regards the load supplied. Generally speaking, thicker cables are selected for trunk lines, and thinner cables, for feeders. Pole-mounted transformers (PMT) are installed in some rural electrification (RE) districts, but ground-mounted transformers (GMT) are installed in almost all other districts.

Table 2.4 Specifications of transmission and distribution facilities

Facilities			Use
Transmission or Distribution line (MV)	OHL	Al 54.6 mm2	Branch line or trunk line of rural electrification
		Al 148 mm2	Trunk line
		Al 228 mm2	Special line (Trunk line for heavy load area, etc)
	UGL	Al 70 mm2	Branch line or trunk line of rural electrification
		Al 120 mm2	Trunk line or connection line
		Al 240 mm2	Trunk line
Distribution line(LV)	OHL	Cu 6 mm2	Drop wire
		Al 16 mm2	Branch line or drop wire
		Al 35 mm2	Branch line
		Al 70 mm2	Trunk line
	UGL	Cu 10 mm2	Drop wire
		Al 50 mm2	Branch line
		Al 95 mm2	Trunk line
		Al 185 mm2	Trunk line or out-going line from GMT
Secondary Substation	PMT	50 kVA	Light load of rural electrification area
		100 kVA	
	GMT	160 kVA, 250 kVA, 400 kVA, 630 kVA	Except for mentioned above

(3) Status of transmission and distribution facilities

Transformers and low-voltage lines near the coast have high degrees of deterioration from salt damage and urgently require repair. The medium-voltage transmission and distribution lines are comparatively new and do not have significant deterioration, although failures have occurred due to defective cables and insulators in some cases.

Figure 2.2 Deteriorative PMT and LV line

Figure 2.3 Deteriorative secondary substation and bus-bar

2.2.3 Protection relay system

(1)Current status of protection relay system

In Cape Verde, the protection relay system consists of relays that detect only short-circuit current and ground-fault current. This makeup does not mean any serious problems in a small-scale system, but makes it hard to properly trip in large systems with interconnection, like that on Santiago. Table 2.5 shows the locations where there are thought to be problems with the type of protection relay system as a result of the study of the power system in Cape Verde.

Table 2.5 Locations of problems with the type of protection relay system

P/S or S/S	Line Name	Problem	Others
Santiago			
-Palmarejo	Power Plant Feeder 1	3 circuits are operated in parallel	Carrier Relay has installed, but there are no communication line
	Power Plant Feeder 2		
	Power Plant Feeder 3		
-Gamboa	Power Plant Feeder 1	3 circuits are operated in parallel	Carrier Relay has purchased, but there are no communication line
	Power Plant Feeder 2		
	Power Plant Feeder 3		
Sao Vicente			
-Lazareto	Matiota 1	2 circuits are operated in parallel	Carrier Relay has installed, but there are no communication line
	Matiota 2		
-Matiota	Lazareto 1	2 circuits are operated in parallel	Carrier Relay has installed, but there are no communication line
	Lazareto 2		

(2)Current status of protection relay equipment and switching equipment

Figure 2.4 shows the distribution of the age of protection relays and switchgears on six islands (Santiago, Sao Vicente, Santo Antao, Sal, Maio, and Fogo).

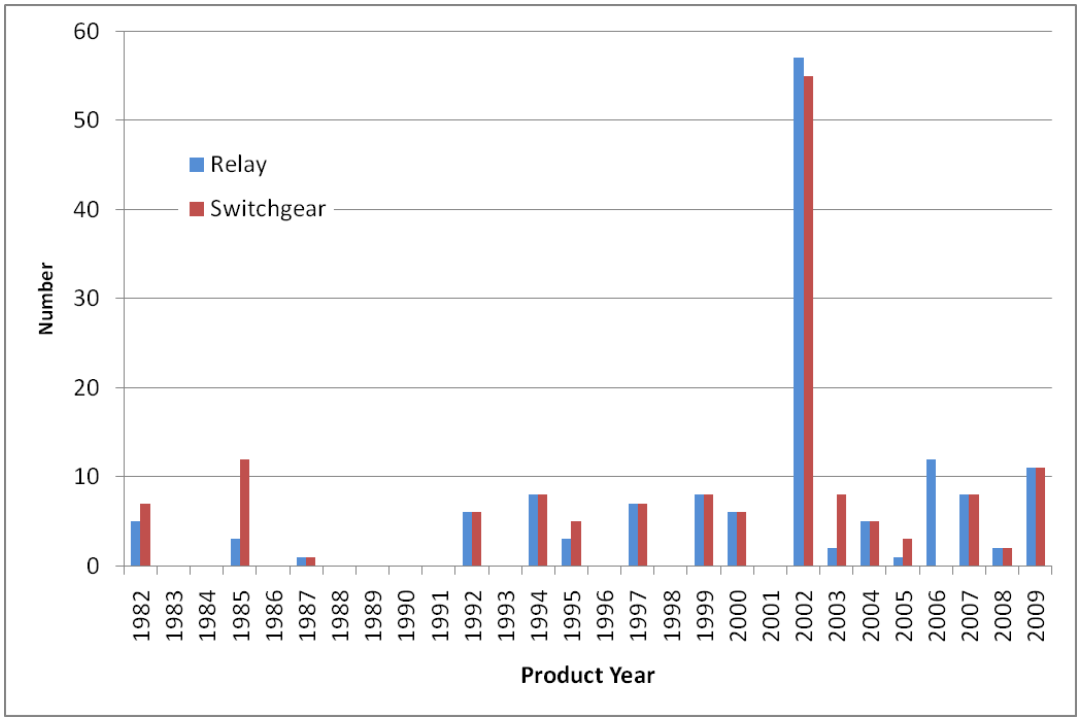


Figure 2.4 Distribution of the age of protection relays and switchgears

As is clear from Figure 2.4, a large quantity of protection relays and switchgears were installed in 2002. This is because the privatization of ELECTRA was followed by extensive repair of the system with foreign capital. There is consequently a big difference between the equipment installed before and after the privatization. After privatization, models were unified to facilitate diversion of parts in the event of equipment failure.

As for the equipment installed before the privatization, ELECTRA replaced protection relays when they were judged to have too much deterioration, but switchgears cost more to replace, and still in use. Figure 2.5 shows the old types of protection relay and switchgear, and Figure 2.6, the major corresponding types installed since 2000.

Most of the equipment installed before 1990 is located in the Gamboa and Matiota power stations. These old switches have a high degree of deterioration that is causing trouble with the switching function. This not only may make it impossible to disconnect failures and thereby acts to expand blackout, but could possibly cause fires and harm to people due to the continuation of ground-fault accidents. As such, countermeasures must be taken.

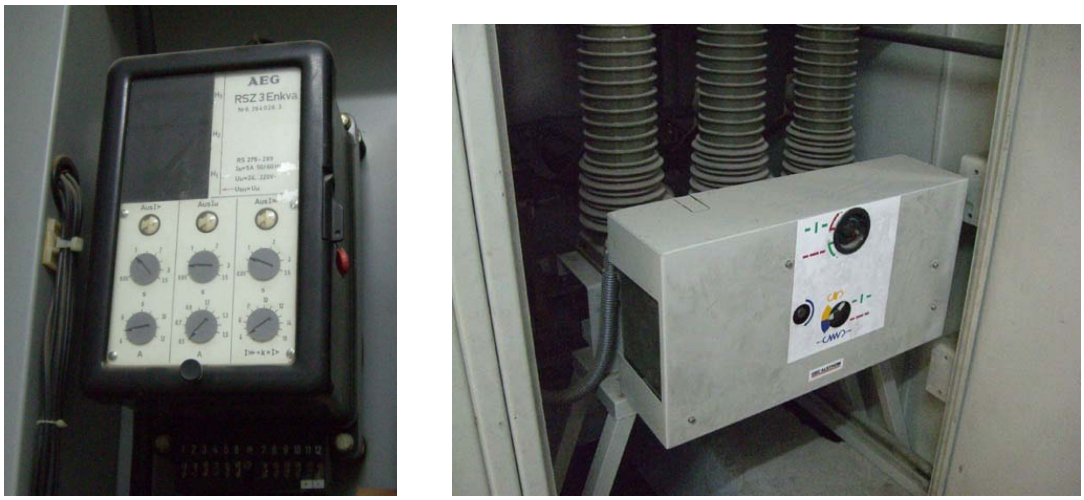


Figure 2.5 Old Protection Relay and Circuit Breaker

Figure 2.6 Protection Relay and Circuit Breaker after 2000

It may also be noted that, even when the year of installation is fairly recent, there are problems in the aspects of maintenance and installation work that have caused difficulties in some cases. This situation tends to appear in the case of facility installation in municipalities which lacked the requisite skills and experience and later transferred the facilities to ELECTRA, and in systems on islands that are small system and cannot employ a sufficient number of engineers.

(3)Current status of protection relay setting

Instead of setting calculation, only adjustment based on past experience is applied for protection relay setting in Cape Verde. So, some trouble has happened on protection coordination, and limitation of fault area is sometimes not correct.

Collected data of protection relay (for 41 Unit) has checked and extracted relays with protection coordination problem. The result is shown Table 2.6.

Table 2.6 Protection relays with protection coordination problem

P/S or S/S	Line Name	Problem
Santiago		
-Palmarejo Emeregency	Saída Praia Rural	Time coordination problem between Brace Brace substation in case of earth fault and short fault.
-Brace Brace	Saída Cidade Velha	Time coordination problem between Palmarejo Emergency power station in case of earth fault and short fault.
	S. Martinho	
-Gamboa	Saída Fazenda 1	Time coordination problem between P Achada S. Filipe substation in case of earth fault.
-Achada S. Filipe	Saída P. S. Variante	Time coordination problem between Variante substation and Gamboa power station in case of earth fault. In addition, it has Time coordination problem between Variante substation in case of short fault.
-Variante	Saída Milho Branco	Time coordination problem between Achada S. Filipe substation and Gamboa power station in case of earth fault. In addition, it has Time coordination problem between Achada S. Filipe substation in case of short
	Saída São Domingos	
Sao Vicent		
-Matiota	PS Palacio	Time coordination problem between Palacio substation in case of earth fault and short fault.
-Palacio	Hospital	Time coordination problem between Matiota power station in case of earth fault and short fault.
-Favorita	Liceu	Time coordination problem between Favorita-Lazareto line in case of earth fault and short fault.
	RJI	
	Lazareto	Time coordination problem between Favorita-Liceu and Favorita-RJI lines in case of earth fault and short fault.

It may also be noted that some medium-voltage (20-kV) systems are installed with a ground transformer and a resister for surer detection of earth fault. However, personnel have not been able to set protection relays to handle this equipment. As a result, the facilities are being operated with the ground transformer and resistor disconnected. This kind of problem is occurring on the islands of Santiago, Sao Vicente and Sal. The problem on Santiago islands will be solved by foreign consultant, but that on other islands should be solved by ELECTRA because there are not such plans. In addition, even on Santiago islands, re-calculation by ELECTRA will be necessary in case of system extension. So, transfer of technology related to relay setting is consequently indispensable.

2.3 Current status of the power demand

2.3.1 Energy sales

Overview

In Cape Verde, power consumption is currently restricted by the supply capability.

The trend of energy sales clearly reveals that the limited supply is curtailing consumption. The sales grew faster than the gross domestic product (GDP) from 2001 to 2005, but this growth slowed thereafter in spite of a rise in the rate of economic growth (see Figure 2.7). The main factors behind this deceleration were the disruption in management at ELECTRA following its renationalization in 2006, and the resulting delay in capital investment, which prevented the supply capacity from keeping pace with the demand increase. ELECTRA itself offers the same explanation.

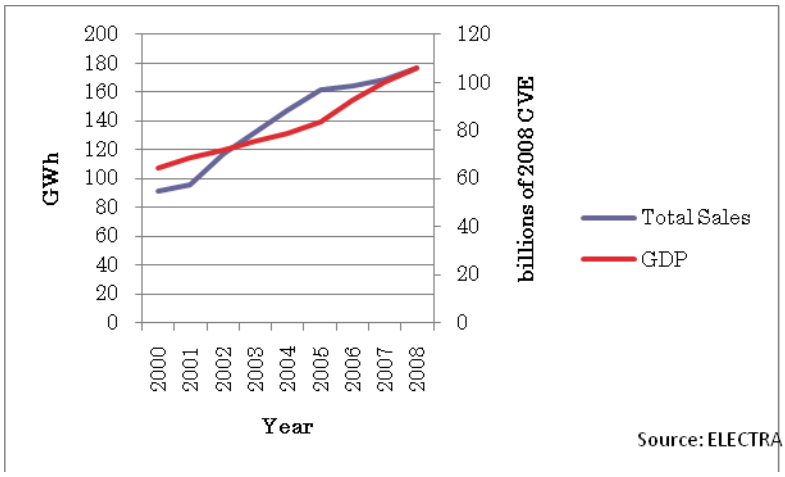


Figure 2.7 Trend of energy sales and GDP growth (2000 - 2008)

Over the period 2000 - 2008, energy sales increased by annual rates averaging 8.4%, with a GDP elasticity of 1.33. As noted above, however, the supply-demand situation changed substantially after ELECTRA was again nationalized.

While ELECTRA was a private enterprise in the years before 2006, its energy sales grew by annual rates averaging 12%, for an extremely high GDP elasticity of 2.23. Over the five-year period beginning in 2000, these sales consequently rose from 91.8 to 161GWh, for an increase of 76%.

Beginning in 2005, nevertheless, the situation changed completely. Because consumption was held down by the supply-side limitations, energy sales grew by an average annual rate of just 2.9%, for a GDP elasticity of only 0.36. Amounting to 161.7GWh in 2005, they increased by a mere 9% over the succeeding three years and rose no higher than 176.5GWh in 2008. Naturally, it is estimated that the latent demand over this period was much higher than the actual sales (see Figure 2.8 and Table 2.7).

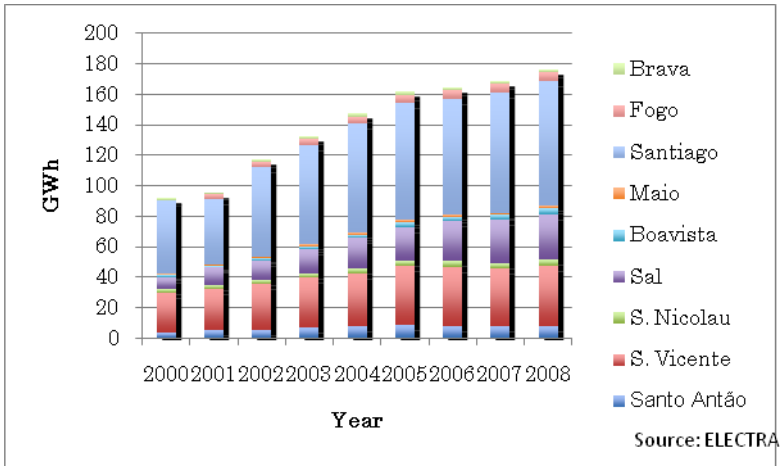


Figure 2.8 Trend of energy sales (2000 - 2008)

Table 2.7 Trend of energy sales and internal consumption (2000 - 2008)

(Unit: MWh, % p.a.)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	Growth Rate ('00-'05)	Growth Rate ('05-'08)	Growth Rate ('00-'08)
Santo Antão												
Sales	3,991	5,324	5,606	6,996	7,600	8,507	8,325	8,165	8,272	16.3%	-0.9%	9.5%
Internal use	38	33	15	21	19	15	13	14	17	-17.1%	4.1%	-9.7%
S. Vicente												
Sales	26,074	27,362	30,180	32,782	35,280	39,152	38,426	37,626	39,347	8.5%	0.2%	5.3%
Internal use	9,056	9,916	10,172	11,166	10,604	10,934	9,601	9,672	9,588	3.8%	-4.3%	0.7%
S. Nicolau												
Sales	2,065	2,356	2,391	3,061	3,100	3,617	3,756	3,741	4,023	11.9%	3.6%	8.7%
Internal use	11	25	21	25	23	19	10	11	13	10.8%	-11.4%	1.9%
Sal												
Sales	8,194	11,292	12,736	15,444	19,826	21,822	26,475	28,070	29,916	21.6%	11.1%	17.6%
Internal use	6,004	6,969	7,059	7,219	7,311	8,508	8,916	8,754	7,377	7.2%	-4.6%	2.6%
Boavista												
Sales	1,150	1,283	1,354	1,764	1,869	2,750	2,702	3,239	4,108	19.0%	14.3%	17.2%
Internal use	767	834	914	881	1,140	1,320	1,224	1,290	1,233	11.5%	-2.3%	6.1%
Maio												
Sales	754	971	1,175	1,380	1,746	2,010	1,652	1,591	1,730	21.7%	-4.9%	10.9%
Internal use	13	10	10	13	13	15	14	12	10	2.9%	-11.3%	-2.7%
Santiago												
Sales	48,234	42,945	58,781	65,069	71,236	76,269	75,886	78,489	81,416	9.6%	2.2%	6.8%
Internal use	9,685	8,849	9,569	11,177	11,786	12,656	12,271	12,501	14,618	5.5%	4.9%	5.3%
Fogo												
Sales	388	2,965	3,571	4,414	4,914	5,555	5,798	5,962	5,997	70.3%	2.6%	40.8%
Internal use	11	10	26	12	11	16	15	18	15	7.7%	-1.9%	4.0%
Brava												
Sales	907	1,121	1,277	1,590	1,735	1,995	1,755	1,588	1,545	17.1%	-8.2%	6.9%
Internal use	53	9	10	13	16	16	14	14	12	-21.6%	-9.1%	-17.1%
Total												
Sales	91,757	95,620	117,071	132,501	147,305	161,676	164,774	168,472	176,353	12.0%	2.9%	8.5%
Internal use	25,638	26,655	26,593	30,527	30,922	33,499	32,078	32,286	32,883	5.5%	-0.6%	3.2%

Note: Figures for internal use consumption include power for desalination and water pumps.
Source: ELECTRA

Situation on the islands

In 2008, the island of Santiago had the biggest share of the energy sales at 46% (81.4GWh), and was followed by São Vicente at 22% (39.3GWh) and Sal at 17% (29.9GWh). Taken together, these three islands accounted for 85% of the total.

In the 2000s, the demand has grown most significantly in Sal. Strictly speaking, the island of Fogo recorded the highest rate of growth, and that of Boavista also had a high one (see

Figure 2.9). However, energy sales on these two islands were originally on a very low level, and the rate of increase jumped with the rapid progress of electrification. In terms of the absolute amount of demand increase, the island of Sal clearly ranks at the top.

The demand on Sal is being pushed up by the development of tourism. The demand for power was swiftly driven up by the booming development of resorts and housing for people moving there from other countries. ELECTRA has been unable to meet this rapidly increasing demand. In one resort area[4] in the southern part of the island, a housing tract development company established a utility company[5] and is making arrangements for supply of power and water through it.

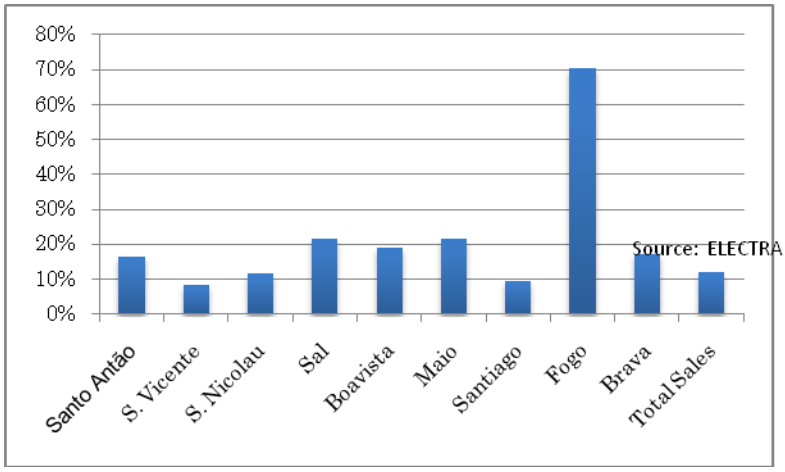


Figure 2.9 Comparison of energy sales growth rates on the islands (2000 - 2008)

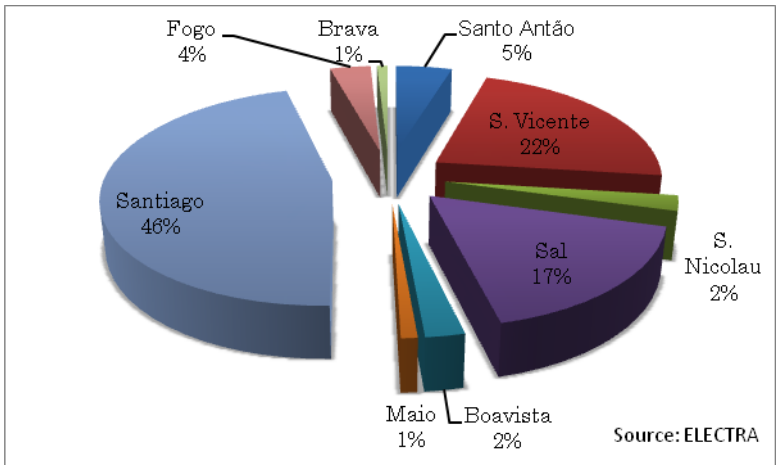


Figure 2.10 Breakdown of energy sales by island (2008)

[4] CABOCAN Project
[5] Agua Ponta Preata (APP)

Customer make-up

In terms of the tariff category, low-voltage customers in the residential and commercial sector accounted for the majority of the actual 2008 demand, with a 60% share of it. They were followed by medium-voltage customers comprising large-volume consumers at 25%. The special low-voltage customers in the industrial sector had the third-highest share at 12%.

Consumption by large-volume customers for whom medium-voltage rates are applied has continued to increase at a high rate. In contrast, the rate of increase in the residential and commercial sector for which low-voltage rates are applied has slowed considerably since 2005. This is presumably because of the progress of electrification and resulting shrinkage of the margin for additional customers in that sector.

Nationwide, the household based rate of electrification already reaches 79.4% (it is 98.5% in urbanized areas and 60.3% in rural ones). The islands of São Vicente and Sal are almost completely electrified, and the only island with a large demand where electrification is lagging is Santiago. In many cases, the lag is due to delayed connection from low-voltage lines to houses. The situation is consequently different from that seen in many so-called low-income developing countries where extension of transmission and distribution lines to rural areas is a key agendum for increase in the electrification rate.

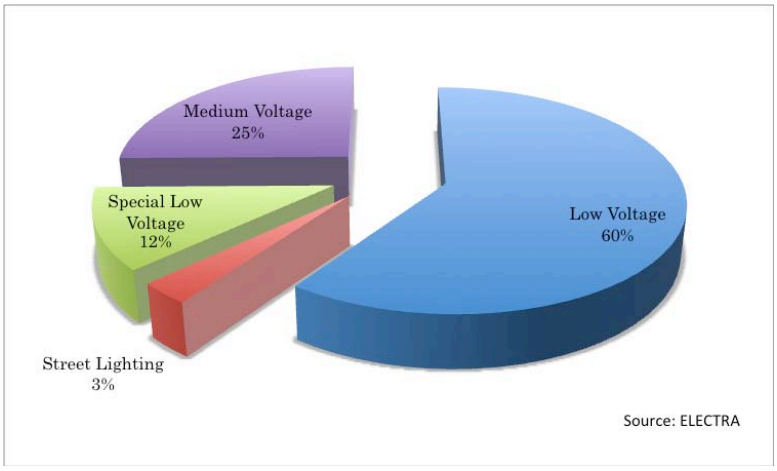


Figure 2.11 Breakdown of energy sales by tariff category (2008)

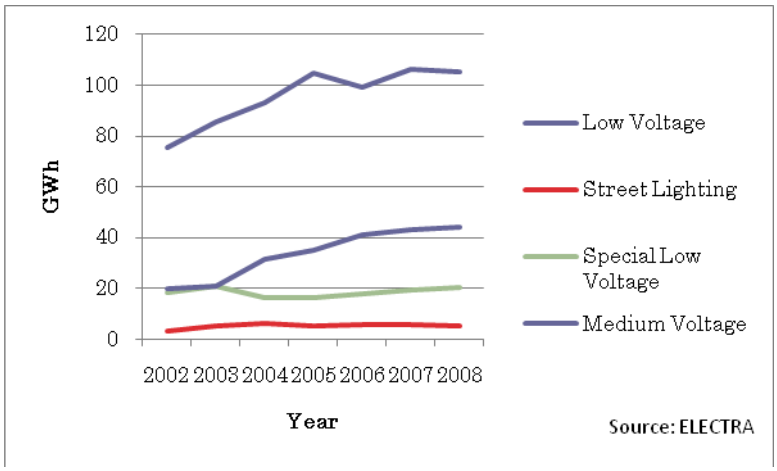


Figure 2.12 Trend of energy sales in each tariff category (2002 - 2008)

Table 2.8 Trend of energy sales in each tariff category (2002 - 2008)

(Unit: MWh, % p.a.)

	2002	2003	2004	2005	2006	2007	2008	Growth Rate		
								('02-'05)	('05-'08)	('02-'08)
Low Voltage	75,696	85,462	93,241	104,659	99,441	106,141	105,190	11.4%	0.2%	5.6%
Street Lighting	3,475	5,103	6,043	5,284	6,002	6,002	5,424	15.0%	0.9%	7.7%
Special Low Voltage	18,291	20,908	16,316	16,475	17,952	19,371	20,633	-3.4%	7.8%	2.0%
Medium Voltage	20,150	21,027	31,706	35,259	41,380	42,959	44,246	20.5%	7.9%	14.0%
Source: ELECTRA										

Table 2.9 Household based electrification rate - trend and forecast (2008 - 2011)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*	2010*	2011*
S.Antão	52%	61%	63%	67%	68%	72%	74%	76%	81%	84%	88%	92%
S.Vicente	78%	80%	83%	86%	89%	93%	98%	100%	100%	100%	100%	100%
S.Nicolau	62%	68%	72%	76%	79%	84%	91%	100%	100%	100%	100%	100%
Sal	63%	66%	68%	74%	83%	94%	100%	100%	100%	100%	100%	100%
Boavista	66%	64%	64%	64%	65%	77%	77%	100%	100%	100%	100%	100%
Maio	54%	62%	63%	64%	68%	71%	79%	83%	81%	86%	90%	95%
Santiago	43%	43%	43%	43%	43%	59%	63%	66%	68%	72%	77%	82%
Fogo			32%	34%	38%	46%	50%	54%	59%	65%	71%	78%
Brava	57%	69%	76%	81%	84%	93%	100%	100%	100%	100%	100%	100%
Total	46%	53%	58%	61%	64%	69%	73%	76%	80%	84%	89%	95%
*: Projection												
Source: ELECTRA												

2.3.2 Generated output

Table 2.10 show the generated output in 2008. The gross generated output came to about 286 GWh. Excluding about 33 GWh in station-use power and power for water services (desalination and pumps), the remaining power of approximately 253 GWh was supplied to distribution lines.

Table 2.10 Generated output in 2008

Island	Power Plant	Production	Gross electrical consumption of Power Plants				Supply to the distribution network		
			Desalination	Internal Consumption	Consumption of Water Pumping	Total production comsumption	2008	2007	2008-2007
Santo Antao	Porto Novo	3,945,542		9,755		9,755	3,935,787	3,799,925	
	Ribeira Grande	7,547,257		7,093		7,093	7,540,164	7,156,453	
	Paul	0		0		0	0	0	
	Total Santo Antao	11,492,799		16,848		16,848	11,475,951	10,956,378	519,573
S. Vicente	Matiota	21,055,058	5,567,938	819,950	1,347,852	7,735,740	13,319,318	11,574,702	
	Lazareto	39,192,580		1,852,125		1,852,125	37,340,455	37,282,755	
	Total S. Vicente	60,247,638	5,567,938	2,672,075	1,347,852	9,587,865	50,659,773	48,857,457	1,802,316
S. Nicolau	Ribeira Brava	0		0		0	0	0	
	Tarrafal	4,743,813		13,266		13,266	4,730,547	4,375,286	
	Total S. Nicolau	4,743,813		13,266		13,266	4,730,547	4,375,286	355,261
Sal	Total Sal(Palmeira)	38,867,702	3,951,686	2,720,228	705,152	7,377,066	31,490,636	29,783,666	1,706,970
Boavista	Sal-Rei	5,953,466	1,122,342	100,530	9,405	1,232,277	4,721,189	3,454,449	
	Rabil	0		0		0	0	0	
	Norte	194,382		882		882	193,500	186,302	
	Total Boavista	6,147,848	1,122,342	101,412	9,405	1,233,159	4,914,689	3,640,751	1,273,938
Maio	Total Maio(Maio)	2,318,881		10,291		10,291	2,308,590	2,187,069	121,521
Santiago	Cidade da Praia	12,833,917		1,333,914		1,333,914	11,500,003	35,917,607	
	Palmarejo	118,998,128	8,469,200	4,014,650	767,400	13,251,250	105,746,878	72,811,907	
	Porto Mosquito	26,554		0		0	26,554	46,153	
	S.Cruz	5,397,670		9,023		9,023	5,388,647	4,535,095	
	Total Praia	137,256,269	8,469,200	5,357,586	767,400	14,594,186	122,662,082	113,310,762	9,351,320
	Assomada(Sta. Catarina)	8,719,637		15,586		15,586	8,704,051	7,761,102	
	Riba da Barca(Sta. Catarina)	277,085		119		119	276,966	173,951	
	Tarrafal Santiago	5,004,894		8,277		8,277	4,996,617	4,596,489	
	Calheta de S. Miguel	0		0		0	0	456,881	
	Orgaos					0	0	0	
	Total Interior Santiago	14,001,616	0	23,982	0	23,982	13,977,634	12,988,423	989,211
	Total Santiago	151,257,885	8,469,200	5,381,568	767,400	14,618,168	136,639,716	126,299,185	10,340,531
Fogo	S.Filipe	7,186,141		5,747		5,747	7,180,394	6,665,731	
	Cova Fiqueira	0		0		0	0	137,200	
	Mosteiros	1,442,378		8,899		8,899	1,433,479	1,308,110	
	Total Fogo	8,628,519		14,646		14,646	8,613,873	8,111,041	502,832
Brava	Total Brava(Favatal)	2,089,634		11,774		11,774	2,077,860	2,021,617	56,243
Total		285,794,719	19,111,166	10,942,108	2,829,809	32,883,083	252,911,636	236,232,450	16,679,186

2.3.3 Electrification rate

Cape Verde is promoting electrification toward its goal of raising the electrification rate to 95 percent by 2011 and 100 percent by 2015. As shown in Table 2.11, five of the nine islands have already been completely electrified.

The electrification rate is lowest on the islands of Santiago and Fogo. An increase in the rate on these two islands is the key to attainment of the target.

In Cape Verde, electrification means the installation of transmission and distribution facilities in villages to give residents access to electricity. The actual use of electricity is not in question. However, the MTIE is considering the payment of subsidies to enable access to electricity to villages electrified from now on.

The electrification rate is calculated as the percentage of all households occupied by those which have access to electricity.

Table 2.11 Electrification rate and future plan

	2008(Actual)	2009(Planning)	2010(Planning)	2011(Planning)
S.Antão	81%	85%	90%	95%
S.Vicente	100%			
S.Nicolau	100%			
Sal	100%			
Boavista	100%			
Maio	81%	86%	90%	95%
Santiago	68%	72%	76%	81%
Fogo	59%	65%	72%	80%
Brava	100%			
TOTAL	80%	85%	91%	98%

Table 2.12 shows listed area for electrification plan after 2010 of MTIE.

Table 2.12 Listed area for electrification plan

Island		Area
Santiago	Ribeira Grande de Santiago	Belém, Pico Leão, Tronco, Chã Gonçalves
	São Lourenço dos Orgãos	Montanha, Boca Larga, Montaínhas, Longueira Cima
	São Domingos	Mendes Falero, Chaminé, Banana, Mitra, Mato Afonso, Pau de Saco, Djambam, Cambulhane, Ribeirão de Cal, Cabral
	São Salvador do Mundo	Burbur, Rebelo Acima e Mato Dentro, Degredo, Mato Limão, Lém da Rua
	Santa Catarina	
	Tarrafal	Achada Lagoa, Achada Biscainho, Bimbirin, Ganchemba, Achada Carreira, Achada Portal
	Santa Cruz	Ribeirão de Almaço, Torril, Aguada, Gil André, Aguada de Monte Negro, Matinho, Boca Larga Baixo
	São Miguel	Bacio, Ribeirão Milho, Garçote, Chã de Ponta, Chacha, Gongon
Fogo	Mosteiro	Aldeia, Ligeirão, Atalaia, Ribeira Ilheu
	São Felipe	Miguel Gonçalves, Curral Ochô Cima, Cutelo Capado, Cidreira
	Santa Catarina	Cabeça Fundão, Chã das Caldeiras

2.3.4 Situation of black-outs

Table 2.13 shows Black-Outs in Cape Verde. Most areas' interruption in 2008 is higher than those occurred in 2007. This event is determined by systematic breakdowns in the power stations. Because of this, duration of interruption is getting longer. For example, the duration of interruption is about 430 minutes per one interruption(i.e. 89,414 minutes divided by 208 interruptions) at S.Cruz.

The System Average Interruption Duration Index (SAIDI) commonly used as a reliability indicator by electric power utilities is not used in Cape Verde. SAIDI is the average outage duration for each customer served (unit is minutes per a customer).

For reference purposes, Table 2.14 and Table 2.15 show the occurrence of outages over the years 2002 - 2006.

Table 2.13 Situation of blackout

Black-Outs **(Quantity and duration)**

Islands	Systems	2008		2007		Var. 2008-2007	
		Qt	Dur.(min)	Qt.	Dur.(min)	Qt.	Dur.(min)
Santo Antão	*Porto Novo*	62	6,502	8	568	**54**	5,934
	Ribeira Grande	9	1,620	2	145	**7**	1,475
	Paúl					0	0
S. Vicente	*S.Vicente*	18	377	17	773	**1**	-396
S. Nicolau	*Ribeira Brava*	0	0	0	0	0	0
	Tarrafal	16	424	9	566	**7**	-142
Sal	*Sal*	14	1,541	6	493	**8**	1,048
Boavista	*Sal-Rei*	12	808	8	360	**4**	448
	Rabil					0	0
	Norte	5	640	8	940	-3	-300
Maio	*Maio*	19	887	43	2,697	-24	-1,810
Santiago	*Cidade da Praia*	31	1,290	18	1,063	**13**	227
	Porto Mosquito	0	0	0	0	0	0
	Assomada (Sta Catarina)	77	23,605	79	15,698	-2	7,907
	Rib[a] da Barca (Sta. Catarina)	0	0	0	0	0	0
	Tarrafal Santiago	37	13,295	84	21,486	-47	-8,191
	Calheta de S. Miguel	0	0	1	60	-1	-60
	S.Cruz, Órgãos	208	89,414	125	18,568	**83**	70,846
Fogo	*S.Filipe*	12	453	30	1,110	-18	-658
	Cova Figueira	0	0	0	0	0	0
	Mosteiros	23	3,492	30	1,631	-7	1,861
Brava	*Fajetal*	52	5,844	57	2,869	-5	2,975

Table 2.14 Occurrence of outage (frequency)

(Unit: Times)

Island/System		2002	2003	2004	2005	2006
Santo Antão	Porto Novo	23	2	3	3	4
	Ribeira Grande	28	6	14	6	1
	Paúl	5	-	-	-	-
S.Vicente	S.Vicente	51	20	22	10	22
S. Nicolau	Ribeira Brava	9	14	25	8	0
	Tarrafal	7	9	12	23	18
Sal	Sal	14	11	10	20	12
Boavista	Sal-Rei	9	14	21	10	4
	Rabil	-	4	2	-	-
	Norte	-	-	5	1	3
Maio	Maio	40	41	4	5	23
Santiago	Cidade da Praia	50	21	11	15	11
	Porto Mosquito	-	-	-	-	-
	Assomada (Sta Catarina)	51	60	28	49	102
	Rib[a/] da Barca (Sta. Catarina)	-	1	12	7	2
	Tarrafal Santiago	15	4	13	33	70
	Calheta de S. Miguel	32	57	64	38	36
	S.Cruz	48	32	39	41	55
	Órgãos	-	16	-	-	-
Fogo	S.Filipe	10	12	7	5	8
	Cova Figueira	-	-	2	-	-
	Mosteiros	2	14	32	22	13
Brava Favetal	Favetal	44	30	60	39	60

Source: ELECTRA annual reports, various issues

Table 2.15 Occurrence of outage (duration)

(Unit: Minutes)

Island/System		2002	2003	2004	2005	2006
Santo Antão	Porto Novo	425	390	110	78	133
	Ribeira Grande	390	200	1,345	1,625	45
	Paúl	68	-	-	-	-
S.Vicente	S.Vicente	970	965	245	581	851
S. Nicolau	Ribeira Brava	-	210	1,215	57	-
	Tarrafal	-	135	199	268	516
Sal	Sal	170	462	240	216	653
Boavista	Sal-Rei	610	210	857	600	720
	Rabil	-	60	25	-	-
	Norte	-	-	273	210	250
Maio	Maio	1,489	615	338	406	2,535
Santiago	Cidade da Praia	-	630	548	557	266
	Porto Mosquito	-	-	-	-	-
	Assomada (Sta Catarina)	760	3,360	1,376	6,570	24,142
	Rib[a/] da Barca (Sta. Catarina)	-	15	4,517	3,280	50
	Tarrafal Santiago	335	1,246	301	1,583	4,194
	Calheta de S. Miguel	7,140	520	3,870	4,440	8,000
	S.Cruz	3,125	988	2,694	2,499	8,494
	Órgãos	-	646	-	-	-
Fogo	S.Filipe	-	73	74	100	205
	Cova Figueira	-	-	60	-	-
	Mosteiros	300	758	920	1,170	485
Brava Favetal	Favetal	-	434	1,709	1,904	3,135

Source: ELECTRA annual reports, various issues

2.4 Transmission and distribution loss

Table 2.18 shows the transmission and distribution loss in Cape Verde. In 2008, the rate of such loss averaged 30 percent, or about 1.6 percentage points more than in 2007. For the purpose of reference, Table 2.19 shows the trend of transmission and distribution loss over the years 2002 - 2006.

People interviewed at ELECTRA indicated that much of this loss was of the non-technical type associated with surreptitious use (theft), and this observation was corroborated by the estimate of technical loss made by the Study Team. The following section describes the results of this technical loss estimate.

2.4.1 Loss on medium-voltage lines

The Study Team calculated technical loss on existing transmission and medium-voltage distribution lines using analytical software. As is also shown in Table 2.16, the level of transmission and distribution loss in Cape Verde is extremely low. This low level derives from the comparatively short extended lengths of such lines because Cape Verde is an island country, and the low level of load connected to a single distribution line.

Table 2.16 Loss on medium-voltage lines on 6 islands(calculated on 2008)

Island	Loss on medium-voltage lines
Sao Vicente	0.5 %
Santo Antao	1.2 %
Sal	0.8 %
Maio	0.1 %
Santiago	0.9 %
Fogo	0.6 %
Average 6 islands	0.8 %

2.4.2 Loss on low-voltage lines

Because of the lack of single-line connection diagrams and the huge number of distribution lines, the Study Team estimated the level of technical loss on low-voltage distribution lines by first estimating the loss at present and after repair in low-voltage distribution systems confirmed to require repair on the site, and then using the result to estimate the rate of technical loss on low-voltage distribution lines in the country as a whole[6].

As a result, it was estimated that, while the rate of technical loss on distribution lines

[6] It is impossible to survey all low-voltages lines so that we consider the estimated low-voltage technical loss by sampling. Therefore the precision of these estimates may not be very high, because they are based on a limited amount of data.

was in the range of 10 - 20 percent in some cases, it was on a favorable level (only about 3.7 percent) nationwide. This is thought to reflect ELECTRA efforts to extend low-voltage distribution lines for a distance of no more than 500 meters at maximum.

2.4.3 Non-technical loss

The estimated level of non-technical loss is obtained by subtracting the estimated technical loss from the total level of power loss on the six islands. The result is shown in Table 2.17. The estimated rate of non-technical loss is high, in the range of 23 - 36 percent, on the islands of Santiago, Santo Antao, and Fogo. On the other hand, that of resort island Sal, which has a lot of large customers such as hotel and restaurant, is nearly zero.

The factors presumed to be behind non-technical loss are theft from low-voltage distribution lines (especially bare ones), theft at locations of indoor wiring concealment, and mistaken metering by watt-hour meters.

Table 2.17 The estimated rate of non-technical loss on 6 islands

Island	Loss ratio	Technical loss			Non-technical loss
		Medium-voltage	Low-voltage	total	
Santiago	40.4%	0.9 %	3.7 %	4.6%	About 36 %
Sao Vicente	22.2 %	0.5 %		4.2%	About 18 %
Santo Antao	27.9 %	1.2 %		4.9%	About 23 %
Sal	5.0 %	0.8 %		4.5%	Nearly 0 %
Fogo	30.4 %	0.6 %		4.3%	About 26 %
Maio	25.1 %	0.1 %		3.8%	About 21 %
6 islands	30.3 %	0.8 %	3.7 %	4.5%	About 26 %

Table 2.18 Transmission and distribution loss

(Unit: kWh)

Island	Generation station	Production A	Gross Electrical Consumption on Power Plant and Water Plant B	Sales C	Transmission & Distribution Loss		
					2008 D=A-B-C	Loss Ratio 2008 D/(A-B)	Loss Ratio 2007
Santo Antao	Porto Novo	3,945,542	9,755	2930184	1,005,603	25.6%	21.1%
	Ribeira Grande	7,547,257	7,093	5,341,492	2,198,672	29.2%	27.8%
	Paul	0	0				
	Total Santo Antao	11,492,799	16,848	8,271,676	3,204,275	27.9%	25.5%
S. Vicente	Matiota	21,055,058	7,735,740				
	Lazareto	39,192,580	1,852,125				
	Total S. Vicente	60,247,638	9,587,865	39346865	11,312,909	22.3%	23.0%
S. Nicolau	Ribeira Brava	0	0				
	Tarrafal	4,743,813	13,266				
	Total S. Nicolau	4,743,813	13,266	4022590	707,957	15.0%	14.5%
Sal	Total Sal(Palmeira)	38,867,702	7,377,066	29,916,251	1,574,385	5.0%	5.8%
Boavista	Sal-Rei	5,953,466	1,232,277				
	Rabil	0	0				
	Norte	194,382	882				
	Total Boavista	6,147,848	1,233,159	4107659	807,030	16.4%	11.0%
Maio	Total Maio(Maio)	2,318,881	10,291	1,730,097	578,493	25.1%	27.3%
Santiago	Cidade da Praia	12,833,917	1,333,914				
	Palmarejo	118,998,128	13,251,250				
	Porto Mosquito	26,554	0				
	S.Cruz	5,397,670	9,023				
	Total Praia	137,256,269	14,594,186	73426738	49,235,345	40.1%	38.2%
	Assomada(Sta. Catarina)	8,719,637	15,586	5,248,594	3,732,423	41.6%	32.5%
	Riba da Barca(Sta. Catarina)	277,085	119				
	Tarrafal Santiago	5,004,894	8,277	2,740,489	2,256,128	45.2%	38.4%
	Calheta de S. Miguel	0	0				
	Orgaos		0				
	Total Interior Santiago	14,001,616	23,982	7,989,083	5,988,551	42.8%	34.7%
	Total Santiago	151,257,885	14,618,168	81,415,821	55,223,895	40.4%	37.9%
Fogo	S.Filipe	7,186,141	5,747	4,934,488	2,245,906	31.3%	28.6%
	Cova Fiqueira	0	0				
	Mosteiros	1,442,378	8,899	1,062,281	371,198	25.9%	15.4%
	Total Fogo	8,628,519	14,646	5,996,769	2,617,104	30.4%	26.5%
Brava	Total Brava(Favatal)	2,089,634	11,774	1,544,994	532,866	25.6%	21.4%
Total		285,794,719	32,883,083	176,352,721	76,558,915	30.3%	28.7%

Table 2.19 Trend of transmission and distribution loss

(Unit: %)

Island	2002	2003	2004	2005	2006
Santo Antão	28.2%	18.2%	17.0%	14.7%	19.9%
S. Vicente	21.1%	18.8%	18.8%	14.4%	20.3%
S. Nicolau	26.7%	9.7%	10.5%	7.7%	13.0%
Sal	13.9%	16.7%	9.6%	11.6%	8.1%
Boavista	25.4%	13.2%	8.3%	-	9.1%
Maio	12.9%	19.7%	10.2%	4.9%	9.3%
Santiago	27.0%	24.5%	27.1%	27.2%	32.6%
Fogo	28.2%	17.1%	21.6%	19.6%	24.4%
Brava	26.9%	18.7%	13.6%	-	15.8%
Total ELECTRA	24.2%	21.2%	21.6%	20.2%	24.7%

Source: ELECTRA annual reports

2.5 Unit costs of facility construction

Table 2.20 and Table 2.21 show the unit costs of construction at ELECTRA for distribution lines and transformers, respectively. For the cost of removal, ELECTRA's accounts show figures only for labor costs directly involved in the removal work; they do not show figures for profit on sale or reuse of the removed items, or processing costs accompanying scrapping. These items are consequently excluded from consideration.

Table 2.20 Unit Cost of Distribution Lines

	Item		Unit price of labour [1000CVE/km] A	Unit price of materials [1000CVE/km] B	Total cost [1000CVE/km] A+B
Installation	Overhead line(MV)	54 mm2	569.92	1,329.81	1,899.73
		148 mm2	847.99	1,978.65	2,826.64
	Overhead line(LV)	35 mm2	379.02	884.37	1,263.39
		70 mm2	477.00	1,112.99	1,589.99
	Underground line(MV)	70 mm2	2,417.01	2,417.01	4,834.03
		120 mm2	2,575.71	2,575.71	5,151.43
		240 mm2	2,972.46	2,972.46	5,944.93
	Underground line(LV)	50 mm2	970.03	970.03	1,940.05
		95 mm2	1,190.25	1,190.25	2,380.50
		185 mm2	1,423.13	1,423.13	2,846.25
Removal	Overhead line(MV)	54 mm2	284.96		284.96
		148 mm2	424.00		424.00
	Overhead line(LV)	35 mm2	189.51		189.51
		70 mm2	238.50		238.50
	Underground line(MV)	70 mm2	2,417.01		2,417.01
		120 mm2	2,575.71		2,575.71
		240 mm2	2,972.46		2,972.46
	Underground line(LV)	50 mm2	970.03		970.03
		95 mm2	1,190.25		1,190.25
		185 mm2	1,423.13		1,423.13

Source: ELECTRA

Table 2.21 Unit Cost of Substations

	Item		Unit price of labor [1000CVE/Unit] A	Unit price of materials [1000CVE/Unit] B	Total cost [1000CVE/Unit] A+B
Installation	Pole Mounted Transformer	50 kVA	200.00	1,511.49	1,711.49
		100 kVA	200.00	1,679.43	1,879.43
	Transformer station	160 kVA	200.00	2,885.94	3,085.94
		250 kVA	200.00	3,402.92	3,602.92
		400 kVA	200.00	3,701.86	3,901.86
		630 kVA	200.00	4,265.81	4,465.81
Removal	Pole Mounted Transformer	50 kVA	200.00		200.00
		100 kVA	200.00		200.00
	Transformer station	160 kVA	200.00		200.00
		250 kVA	200.00		200.00
		400 kVA	200.00		200.00
		630 kVA	200.00		200.00

Source: ELECTRA

Table 2.22 shows the recent unit cost of land acquisition at ELECTRA for reference. In the report on the project for reinforcement of power generation and transmission capacity on the island of Santiago (begun in March 2008), the unit cost of land acquisition was estimated at a uniform 1,000 CVE per square meter.

Table 2.22 Unit cost of land acquisition at ELECTRA

	Unit Cost（CVE/m^2）
Private property	4,500
Government / Municipality property	2,000

Source: ELECTRA

2.6 Power tariffs

Tariff schedule

As noted in Section 2.3.1 (Energy sales), the power tariff schedule is divided into the categories of low-voltage, special low-voltage, medium-voltage, and streetlight. The industrial-use special low-voltage and medium-voltage tariffs have a two-tiered structure consisting of the capacity charge and the energy charge, but the residential-and-commercial-sector low-voltage and streetlight tariffs consist solely of the energy charge. Comparison of energy charge rates excluding the streetlight category reveals a gap of 1:1.4 between the lowest at CVE21.40/kWh in the medium-voltage category and highest at CVE29.94/kWh in the low-voltage category (above 60 kWh). Although this gap is not an extremely wide one, it should be noted that, even within the low-voltage category, consumption of no more than 69 kWh is eligible for a preferential rate of CVE22.77/kWh.

In addition, customers are also charged a rental fee for kWh meter.

Table 2.23 Power tariff schedule (as of December 2009)

Low-voltage	Up to 60kWh	Over 60kWh
	CVE22.77/kWh	CVE29.94/kWh
Special low-voltage	Capacity charge: CVE317.63/kW	
	Energy charge: CVE25.92/kWh	
Medium-voltage	Capacity charge: CVE292.55/kW	
	Energy charge: CVE21.40/kWh	
Street lighting	20.95 CVE/kWh	
Note: Including value-added tax (VAT; 15% x 30%T)		
Source: ELECTRA		

Table 2.24 Rental fee for kWh meter

(Unit: CVE)

		Rental fee	VAT	Total
Single-phase	Up to 10A	41.4	1.86	43.27
	Over 15A	100.55	4.52	105.08
Three-phase	Up to 10A	265.09	11.93	277.02
	Over 15A	369.89	16.65	385.54
Note: VAT = 15% x 30%T				
Source: ELECTRA				

Average power tariff

Obtained by dividing the energy sales revenue by the energy sales amount, the average power tariff increased by 68%, from CVE14.22/kWh in 2000 to CVE23.84/kWh in 2008 in terms of nominal prices. In terms of real (constant) prices calculated by adjusting these figures by the GDP deflator, however, the corresponding increase rate is 37%.

For ELECTRA, the power tariff level is a matter of importance to management. Although it was privatized in 2000, ELECTRA was nationalized again in 2006. The tariff problem was one of the major reasons for the failure of privatization. At present, tariffs must be approved by the Agência de Regulação Económica (ARE). Upon ELECTRA's renationalization in 2006, the authorities embarked on efforts to condition the tariff scheme through steps including adjustment for fuel cost fluctuation, but this task has not yet been completed (at present, work is in the stage of preparing management indicators and revising rules for fuel price adjustment).

Although it has promoted a tariff hike and a reform of the tariff scheme thus far, ELECTRA continues to post net deficits because of inability to meet its costs with tariff revenue (for ELECTRA's financial position, see Section 2.7 (Financial position)).

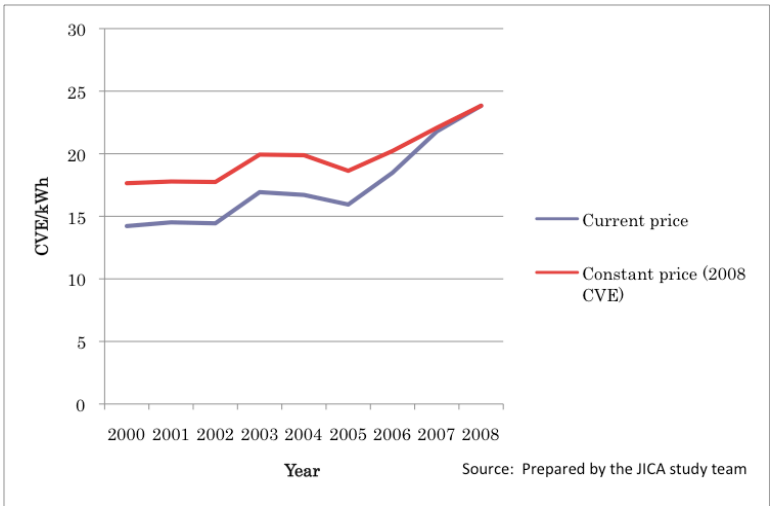


Figure 2.13 Trend of the average power tariff (2000 - 2008)

Table 2.25 Trend of the average power tariff (2000 - 2008)

(Unit: CVE/kWh)

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Current price	14.2	14.5	14.4	16.9	16.7	15.9	18.5	21.8	23.8
Constant price (2008 CVE)	17.4	17.6	17.5	19.7	19.6	18.2	19.8	22.6	23.8

Source: ELECTRA annual reports and IMF WEO data

2.7 Financial position

Chronic deficit

The major purposes of ELECTRA's privatization in 2000 were to improve its management and promote capital investment to expand its supply capacity. For the few years following the privatization, however, priority was placed on leading investment without a clear definition of the tariff regulatory system as noted above. As a result, ELECTRA continued to post deficits and eventually became effectively bankrupt (it posted a excess of liabilities in 2002, 2005, and 2005).

In 2006, the situation of a liability excess was resolved by reducing the amount of debt

through refinancing, and the company was again nationalized. The extraordinary profit of CVE3.5 billion recorded on the 2006 profit-loss statement derived from the debt refinancing made at this time. In other words, there was no injection of capital by the government to resolve the excess of liabilities on the occasion of the 2006 renationalization[7].

Even at present, nevertheless, ELECTRA is unable to realize a profit; there has been no improvement in its financial position, which continues to worsen by the year. Its operating profit has been in the red each year since 2000; ELECTRA has never turned a net profit in any single year during this period. Even viewed on the basis of cash flow (i.e., earnings before interest, tax, depreciation, and amortization; EBITDA), ELECTRA recorded plus figures only in 2003 - 2005 and 2008. As far as its finances are concerned, ELECTRA does not have a sustainable business setup.

While it extricated itself from the situation of excess liabilities by refinancing in 2006, ELECTRA continues to dip into its shareholder's equity. It recorded ordinary profit deficits of CVE1.59 billion and CVE1.17 billion in 2007 and 2008, respectively, on corresponding operating revenue of CVE4.87 billion and CVE5.48 billion. As a result, its shareholder's equity had fallen to CVE550 million by the end of 2008. Unless something is done to correct this situation, ELECTRA will almost certainly again be posting an excess of liabilities.

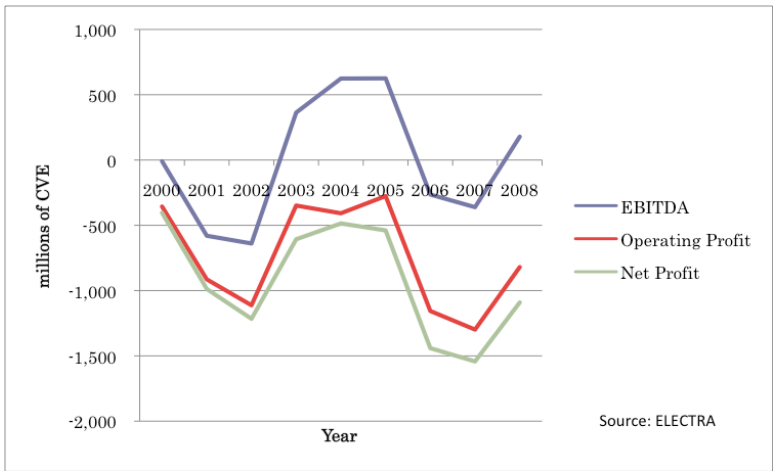


Figure 2.14 Trend of profit (2000 - 2008)

[7] In August 2006, Energias de Portugal, SA (EDP) and Águas de Portugal, SA (ADP), which were ELECTRA shareholders during the privatization years, took over a total of CVE7.83 billion of its debt. At this time, ELECTRA owed a total of CVE7.89 billion to EDP/ADP, and was to repay this debt without interest over a period of 20 years. In December 2006, the Banco Comercial do Atlântico (BCA) took over this debt owed to EDP/AdP for CVE4.39 billion, such that ELECTRA became a debtor relative to BCA. The difference of CVE3.5 billion is equivalent to the debt reduction and was posted as extraordinary profit. Shareholder's equity had been completely exhausted by the preceding year and was in the minus column, but a sum of 2.77 billion escudos representing the difference between assets and the reduced debt was posted as shareholder's equity in the year-end statement for 2006. As such, the situation of excess liabilities was resolved.

Table 2.26 Profit and loss statement (2000 – 2008)

(Unit: thousands of CVE)

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Proveitos Operacionais Operating Revenue									
Vendas Electricidade Sales of Electricity	1,304,665	1,388,808	1,698,228	2,243,321	2,461,358	2,577,407	3,045,753	3,669,768	4,203,699
Vendas Água Sales of Water	434,729	463,817	521,396	770,425	790,146	826,879	883,361	912,460	927,001
Prestação de Serviços Services Rendered	103,032	111,338	127,294	235,813	244,139	244,139	242,157	230,982	289,359
Trabalhos para a própria Empresa Company own Works	0	0	0	60,635	46,771	46,771	30,071	28,880	27,875
Outros Others	15,065	18,520	32,160	21,995	21,593	21,593	53,455	27,512	31,408
Total	1,857,492	1,982,483	2,379,078	3,332,189	3,564,007	3,650,675	4,254,797	4,869,602	5,479,342
Custos Operacionais Operating Cost									
Custo das Existências Consumidas Direct activity cost 1/	1,058,061	1,535,803	2,001,970	1,988,494	1,971,768	2,075,258	3,302,567	3,970,672	4,095,027
Subcontratos Subcontracts	110,001	117,996	66,000	66,000	66,000	66,000	53,916	16,540	0
Fornecimentos e S. de Terceiros Supply and services	194,145	248,355	250,867	243,037	233,295	261,507	392,578	460,790	420,548
Despesas com o Pessoal Personnel cost	577,085	630,269	662,157	648,987	640,535	668,346	704,880	721,324	742,290
Amortizações do Exercício Amortization 2/	259,257	330,555	461,986	711,965	734,666	712,171	705,154	692,947	795,049
Impostos Taxes	13,360	13,615	18,425	19,574	24,770	24,588	31,188	34,351	38,056
Provisões do exercício Provisions	0	3,329	11,210	0	297,155	189,303	186,711	244,578	198,630
Outros Custos operacionais Other operating cost	1,780	16,374	18,815	2,706	3,657	29,776	34,019	26,897	4,786
Total	2,213,689	2,896,295	3,491,430	3,680,763	3,971,847	4,026,949	5,411,013	6,168,098	6,294,385
EBITDA 3/	-9,694	-579,928	-639,155	363,390	623,981	625,300	-264,350	-360,971	178,636
Resultado Operacional Operating Profit	-356,198	-913,812	-1,112,352	-348,575	-407,840	-276,174	-1,156,216	-1,298,496	-820,140
Resultados Financeiros Financial Profit	-16,429	-57,190	-77,109	-277,586	-215,334	-215,823	-240,432	-287,361	-351,051
Resultados Correntes Current (Ordinary) Profit	-372,627	-971,002	-1,189,461	-626,161	-623,175	-491,997	-1,396,648	-1,585,856	-1,171,191
Resultados Extraordinários Extraordinary Profit	-6,610	-7,099	-11,532	1,278	142,976	-9,447	3,500,918	29,213	42,835
Resultados Exercícios Anteriores Deferred Profit from the Previous Year	-25,104	-9,365	-14,928	17,922	-5,419	-37,571	-46,569	14,118	37,512
Resultados antes de Impostos Profit Before Tax	-404,341	-987,466	-1,215,921	-697,961	-485,617	-539,015	2,057,700	-1,542,525	-1,090,845
Corporate Income Tax	0	0	0	0	0	0	0	0	0
Resulto Líquido do Exercício Net Profit	-404,341	-987,466	-1,215,921	-606,961	-485,617	-539,015	-1,440,690	-1,542,525	-1,090,845
Restructuring Operation Profit							3,498,390		
Net Income of the Year							2,057,700		-1,090,845

1/ Corrected from the subsidy to diesel.
2/ Corrected from amortizations of assets allocated to concession and subsidies.
3/ Operating Profit + Amortization + Provisions
Source: ELECTRA annual reports

Table 2.27 Balance sheet (2000 – 2008)

(Unit: thousands of CVE)

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Activo Assets									
Activo Circulante Current Assets	1,285,341	1,373,497	1,248,187	1,695,399	1,968,727				
Activo médio e longo prazo Medium and long-term Assets	0	0	0	1,143,431	1,143,431				
Disponibilidades Cash and cash equivalent						181,486	34,521	87,362	44,605
Clientes líquido Net customers						1,221,627	1,651,076	1,492,164	1,779,100
Existências Inventories						387,857	472,853	615,670	721,327
Outros Devedores Other debtors						1,804,329	1,185,117	1,630,371	1,184,922
Imobilizado líquido (Activo Fixo) Fixed assets	3,880,697	7,531,474	10,658,272	10,150,736	9,704,957	8,825,310	8,220,610	8,468,270	8,140,665
Total do Activo Assets Total	5,166,038	8,904,971	11,906,459	13,453,024	12,819,628	12,420,609	11,564,177	12,293,836	11,870,618
Passivo Liabilities									
Passivo Circulante Current Liabilities	1,119,678	1,879,263	2,309,254	3,134,074	2,959,179				
Passivo médio e longo prazo Medium and long-term liabilities	793,339	3,407,488	7,429,773	7,409,808	8,060,847				
Acréscimos e diferimentos Deferred liabilities	900,356	2,638,519	2,473,593	2,285,315	2,138,178				
Receitas antecipadas Advanced Revenue						1,931,766	1,736,832	1,529,400	1,379,451
Dívida financeira Financial Debts						8,459,706	4,997,520	6,596,984	6,655,719
Outros credores Other Creditors						2,421,127	2,060,321	2,508,113	3,281,533
Total do Passivo Liabilities Total	2,813,373	7,925,270	12,212,620	12,829,197	13,158,204	12,812,599	8,767,673	10,634,498	11,316,703
Situação Líquida Shareholders' Equity	2,352,665	979,701	-306,161	160,369	-341,090	-391,991	2,769,504	1,659,338	553,917
Total do Passivo e Situação Líquida Liabilities & Equity Total	5,166,038	8,904,971	11,906,459	13,453,024	12,819,628	12,420,609	11,537,177	12,293,836	11,870,618
Source: ELECTRA annual reports									

Arrears problem

ELECTRA has a serious problem of arrears, i.e., uncollected tariff revenue. As of the end of 2008, the amount of arrears totaled CVE3.014 billion. Of this total, CVE1.375 billion were occupied by arrears for at least one year, and CVE1.639 billion, by arrears for less than one year.

As percentage of the total billed amount, the total amount collected was on the level of about 90% over the three years 2006 - 2008. It rose to 97% in 2007, but this is probably because of lump-sum payment of cumulative arrears by the government and public enterprises. In 2007, the government and public enterprises made payments that were 19% and 24% higher, respectively, than the amounts billed in that year. This could only be because they repaid arrears from past years (see Table 2.28 and Table 2.29).

The arrears problem is particularly serious in connection with billing of municipalities. Amounts received have not risen above the order of 40% of the amounts due over the last three years, and the cumulative arrears continue to increase. In 2008, the cumulative amount was 2.8 times as high as the amount due in that year.

Among enterprises, the situation is still relatively good. The rates of retrieval from private enterprises are comparatively high, and public enterprises as well have begun paying off accumulated arrears over the last three years.

Table 2.28 Trend of amounts billed and amounts received (2006 - 2008)

(Unit: thousands of CVE)

	2006	2007	2008
Government	209,527	293,139	328,980
	181,844	348,851	371,769
	86.8%	119.0%	113.0%
Municipalities	163,941	185,230	200,943
	67,226	76,274	98,096
	41.0%	41.2%	48.8%
Domestic Consumers	2,068,790	2,384,710	2,663,920
	1,801,693	2,228,586	2,424,479
	87.1%	93.5%	91.0%
Public Enterprises	149,371	155,294	161,248
	156,579	192,053	140,674
	104.8%	123.7%	87.2%
Private Enterprises	1,139,018	1,357,492	1,646,522
	1,034,859	1,379,578	1,597,490
	90.9%	101.6%	97.0%
Total	3,730,647	4,375,865	5,001,613
	3,242,202	4,225,342	4,632,508
	86.9%	96.6%	92.6%

Note: Figures on the upper, middle, and lower rows indicate amounts billed, amounts collected, and retrieval rates, respectively.

Source: ELECTRA annual reports

Table 2.29 Trend of cumulative arrears (2006 - 2008)

(Unit: tousands of CVE)

	2006	2007	2008
ESTADO State	281,182	200,763	173,720
	134%	68%	53%
AUTARQUIAS Municipalities	367,126	464,451	564,643
	224%	251%	281%
DOMÉSTICOS Domestics	1,356,538	1,556,402	1,785,529
	66%	65%	67%
EMPRESAS PÚBLICAS Public Enterprise	59,930	25,320	29,401
	40%	16%	18%
EMPRESAS PRIVADAS Private Enterprise	457,470	419,202	460,972
	40%	31%	28%
Total	2,522,245	2,666,139	3,014,265
	68%	61%	60%

Note: Percentage figures indicate the amount of cumulative arrears as percentage of the total amount billed in said year.

Source: ELECTRA annual reports

Structural problems in the financial aspect

The tariff problem and the low level of management efficiency may be pointed out as factors behind the continuing deficits posted in ELECTRA's business results. As self-help agenda, ELECTRA must strive to make its management more efficient and especially to reduce power loss, which is now on a high level. Reduction of power loss, however, will not be enough to fully improve its financial position. In 2008, for example, the rate of transmission and distribution loss was 30.3%. This loss consists of technical loss and non-technical loss. Assuming that surreptitious use accounts for 15 percentage points of it, retrieval of tariff payments for this portion would add CVE630 million in revenue. Nevertheless, the operating deficit in the same year came to CVE820 million, and the addition consequently would not erase the deficit. In this sense, the financial problems saddling ELECTRA are of a structural nature and cannot be fundamentally resolved without the implementation of comprehensive countermeasures encompassing the tariff problem.

Chapter 3 Ongoing and Planned Power Projects

3.1 Project for reinforcement of generation and transmission on Santiago

There is an ongoing project on the island of Santiago based on coordinated financing by the African Development Bank (AfDB) and the Japan International Cooperation Agency (JICA). The aims are as follows: 1) to install two diesel generators with a capacity of about 10 MW each in the Palmarejo power station, 2) to construct a connection with the Calheta power station by a 60-kV transmission line, 3) to construct another connection from Calheta to the Santa Cruz, Santa Catalina, and Tarrafal power stations by a 20-kV transmission line, to enable the abolition of these superannuated power stations. The AfDB also has plans for expanded installation of wind farms with an output of about 10 MW. Figure 3.1 outlines this project.

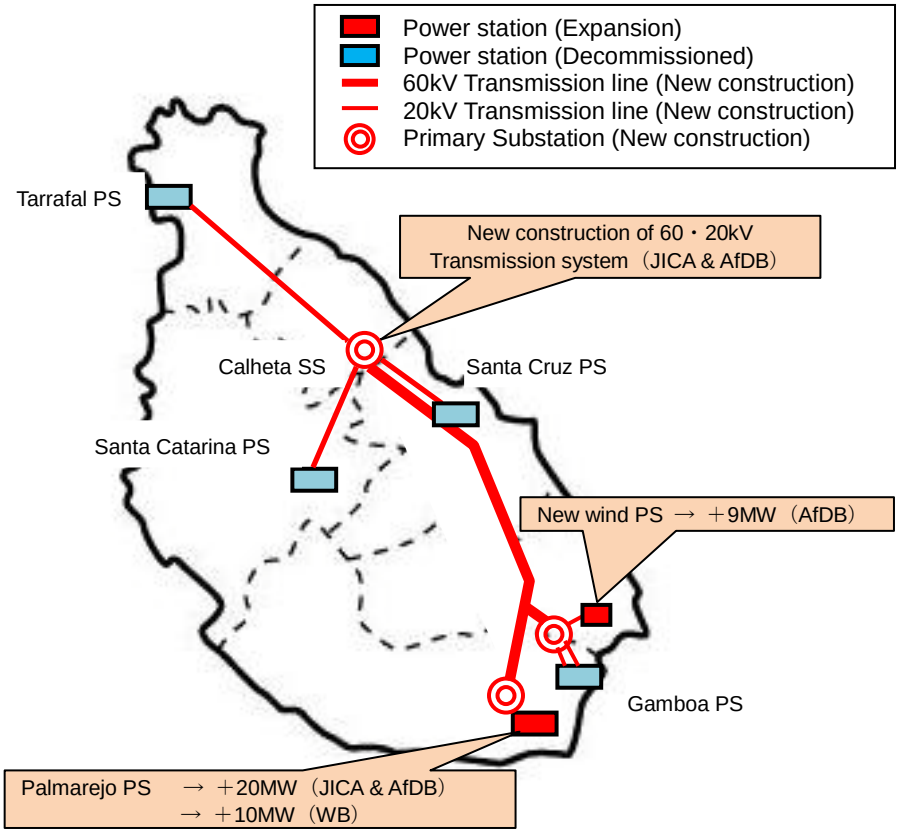


Figure 3.1 Outline of Santiago projects

3.2 Project for reinforcement of generation and distribution on the islands of Santo Antao, Fogo, Sao Nicholau, and Boavista

The project is aimed at reinforcing the generation, transmission, and distribution facilities on these islands. Half (50 percent) of the total cost is being met by grant aid from the Dutch ORET program, and the other half, by loans from OPEC.

(1)Santa Antao project

The purpose of the project is to construct a new power station at Porto Novo and abolish the existing Porto Novo power station. In addition, the new station will be connected with the Ribeira Grande power station by a 20-kV distribution line (if the new Porto Novo power station is connected with the Ribeira Grande power station by a separate transmission line, the latter is to be abolished). The project includes construction for system interconnection of districts where power is currently supplied by small-scale generation systems. The project is outlined in Figure 3.2.

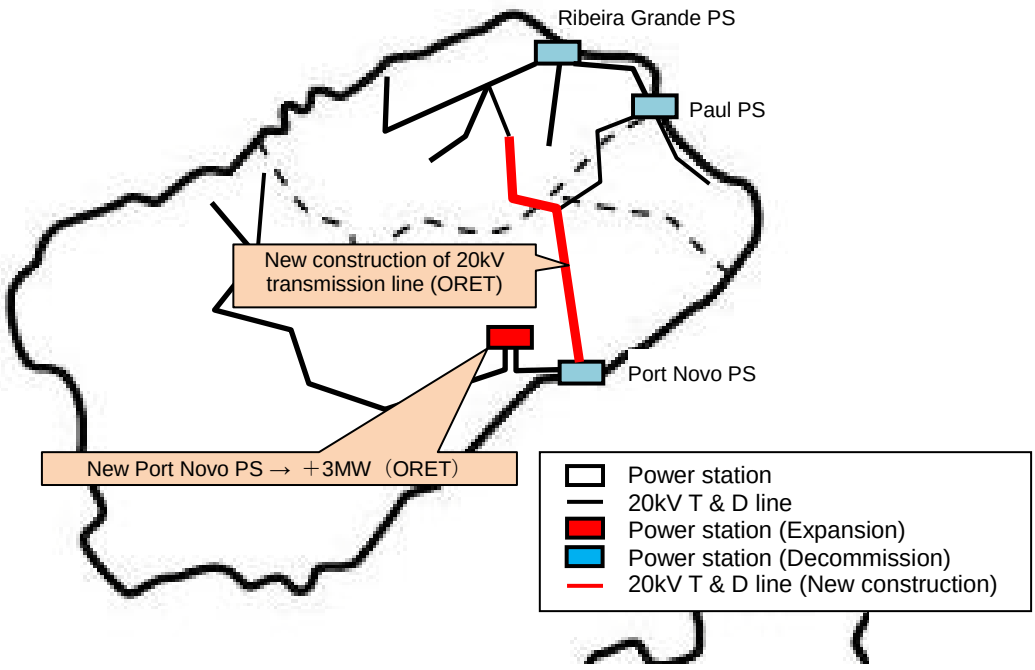


Figure 3.2 Outline of Santo Antao projects

(2)Fogo island project

The project is to construct a new power station at Sao Filipe, and abolish the existing Sao Filipe power station. In addition, the new station will be connected with the Mosteiros power station by a 20-kV distribution line (if the new Sao Filipe power station is connected with the Mosteiros power station by a separate transmission line, the Ponta Verde and P. Lapa power stations are to be abolished).

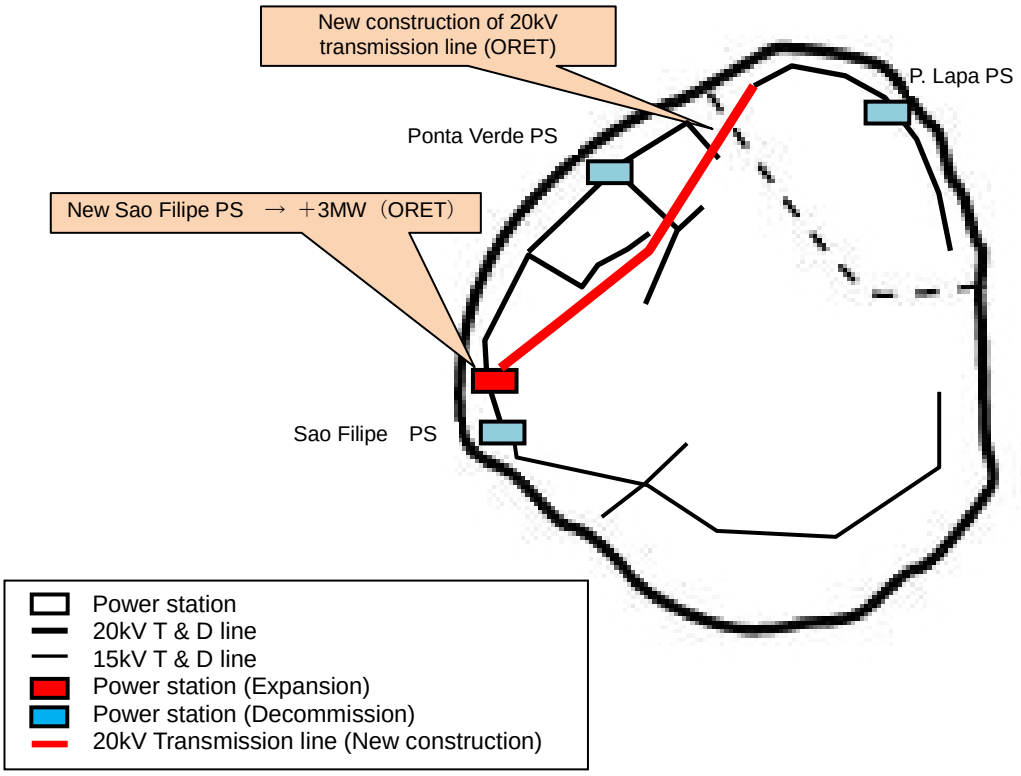


Figure 3.3 Outline of Fogo projects

3.3 Plan for reinforcement of generation facilities on the islands of Sao Vicente and Sal

Aside from the two projects outlined above, the World Bank and the French Development Agency (AFD) are currently making plans for reinforcement of generation facilities.

The World Bank is promoting plans for construction of a 5.5-MW[8] power station on the island of Sao Vicente, while the French Development Agency is conducting a feasibility study for an increase in power generation capacity on the island of Sal. In addition, the AfDB has a plan for wind power development on the islands of Sao Vicente and Sal.

(1)Sao Vicente island project

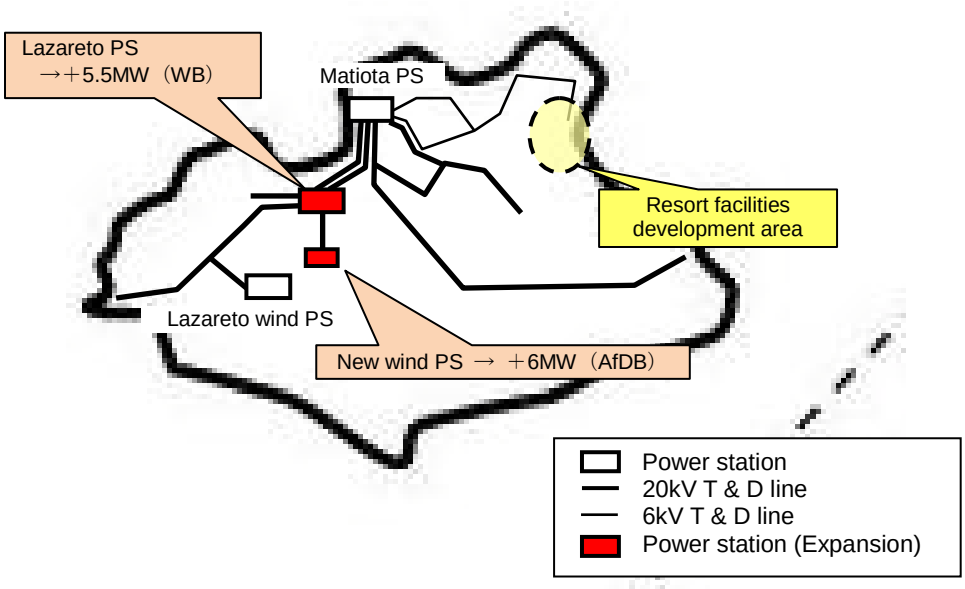


Figure 3.4 Outline of Sao Vicente projects

[8] Depending on the budget available, there is also a possiblity of installation of two 5.5-MW units.

(2)Sal island project

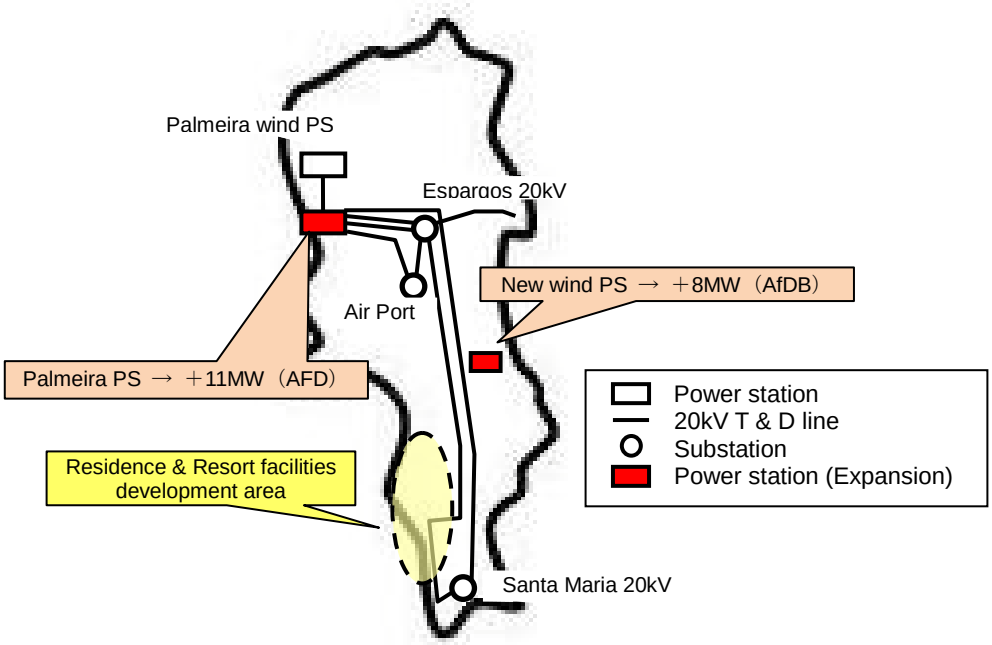


Figure 3.5 Outline of Sal projects

Chapter 4 Power Demand Forecast

ELECTRA reviews its power demand forecast every year.

Apart from ELECTRA, Ministry of Tourism, Industry, and Energy (MTIE) made a study to forecast the power demand in 2008. This forecast was based on the so-called macroeconomic procedure, and the analysis emphasized elements such as the tourism demand in Cape Verde, resort development, and emigration from other countries. The situation in the market associated with the tourism demand and resort development changed greatly under the influence of the worldwide financial crisis that struck in the fall of 2008. As such, the demand forecast derived from the study is thought to be on the high side. The MTIE, too, has commented that the figures need to be revised.

For this reason, this chapter reviews only the results of the demand forecast made by ELECTRA in 2009.

4.1 Energy demand (kWh)

As noted in Section 2.3 (Current status of the power demand), the demand is, in effect, currently being curtailed by the constraints on the supply side. To resolve this problem, ELECTRA plans to build up its power sources toward 2013.

Investments are being made to alleviate the power shortage particularly on the islands of Santiago and Sal. As a result, energy sales are anticipated to increase rapidly from 2009 to 2013. The average annual rates of increase are forecast in double digits, at 14.1% for Santiago and 19.9% for Sal. Around 2013, nevertheless, the corresponding rates are expected to drop to 9.7% and 9.9%, respectively, as the supply-demand imbalance is basically resolved and growth in energy sales begins to parallel GDP growth.

On the island of Boavista, there is a plan to offer a concession for supply of power and water to a private enterprise[9], and ELECTRA is planning to withdraw from business there eventually. For this reason, the demand increase envisioned in the current plan is confined to the residential and commercial sector (ultimately, the supply of power in this sector will also be transferred to the new private enterprise).

Viewing the prospect for the islands as a whole, along with the progress of measures to address the supply shortage, energy sales are forecast to increase by average annual rate of 13.5%, from 186GWh in 2009 to 308GWh, 1.7 times as high, in 2013. In succeeding years, growth should slow to a corresponding 8.6% p.a., in line with economic growth, once the power supply shortage is on the road to resolution. Therefore, energy sales are projected to reach 467GWh in 2018, or 2.5 times as high as in 2009.

[9] ELECTRA is going to participate in the new private enterprise as a shareholder.

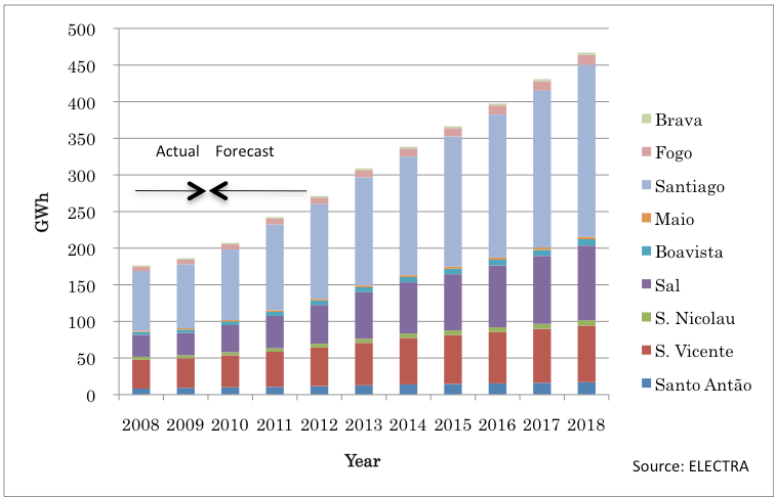


Figure 4.1 Energy sales forecast (2008 - 2018)

Table 4.1 Forecast of sales and internal power consumption (2008 - 2018)

(Unit: MWh, % p.a.)

	Actual		Projection									Growth Rate	
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	('09-'13)	('13-'18)
Santo Antão													
Sales	8,272	9,274	10,012	10,609	11,630	12,751	13,983	14,682	15,416	16,187	16,996	8.3%	5.9%
Internal use	17	19	19	19	19	19	19	19	19	19	19	0.1%	0.0%
S. Vicente													
Sales	39,347	40,403	43,636	47,955	52,751	57,895	63,546	66,724	70,060	73,563	77,241	9.4%	5.9%
Internal use	9,588	8,253	8,501	9,077	9,700	12,236	13,578	14,581	15,667	16,844	18,288	10.3%	8.4%
S. Nicolau													
Sales	4,023	4,091	4,377	4,683	5,152	5,667	5,950	6,248	6,560	6,888	7,232	8.5%	5.0%
Internal use	13	15	15	15	15	15	15	15	15	15	15	0.0%	0.0%
Sal													
Sales	29,916	30,714	36,857	44,228	52,999	63,516	69,867	76,804	84,432	92,821	102,045	19.9%	9.9%
Internal use	7,377	6,700	6,656	8,385	9,562	10,489	11,438	12,566	13,835	15,534	17,659	11.9%	11.0%
Boavista													
Sales	4,108	4,293	5,046	5,551	6,106	6,705	7,116	7,472	7,845	8,238	8,650	11.8%	5.2%
Internal use	1,233	1,900	1,018	1,044	1,061	1,098	1,139	1,181	1,226	1,274	1,324	-12.8%	3.8%
Maio													
Sales	1,730	1,845	2,000	2,155	2,298	2,444	2,591	2,749	2,919	3,083	3,257	7.3%	5.9%
Internal use	10	12	12	12	12	12	12	12	12	12	12	0.0%	0.0%
Santiago													
Sales	81,514	87,214	96,227	117,174	129,118	147,697	162,118	177,854	195,139	214,126	234,985	14.1%	9.7%
Internal use	14,619	14,473	16,799	25,484	27,269	28,985	30,465	32,025	33,554	35,829	38,562	19.0%	5.9%
Fogo													
Sales	5,997	6,633	7,296	8,093	9,033	9,937	10,930	11,477	12,516	13,142	13,799	10.6%	6.8%
Internal use	17	18	20	23	23	23	23	23	23	23	23	6.2%	0.0%
Brava													
Sales	1,545	1,697	1,867	1,960	2,058	2,161	2,269	2,382	2,501	2,626	2,758	6.2%	5.0%
Internal use	14	14	15	16	16	16	16	16	16	16	16	2.5%	0.0%
Total													
Sales	176,452	186,163	207,317	242,408	271,144	308,772	338,371	366,391	397,389	430,673	466,962	13.5%	8.6%
Internal use	32,888	31,404	33,055	44,075	47,676	52,892	56,704	60,437	64,366	69,564	75,916	13.9%	7.5%

Note: Internal consumption include power for desalination and water pumps (i.e., power used by the water business).
Source: ELECTRA

4.2 Peak power (kW)

The increase in peak power is biggest on the island of Sal. For the reasons noted above, peak power there is anticipated to increase at a very high rate—20.1% p.a.—over the four years 2009 - 2013. In other words, the peak power, which stood at 6.7MW in 2009, is expected to more than double and reach 13.9MW in 2013. After that year, the rate of increase is projected to fall to a corresponding 10.1% p.a., but the peak power would nevertheless come to 22.5MW,

for a 3.4-fold increase, in 2018.

After Sal, the rate of peak power increase is forecast to be highest on Santiago. It is projected to average 12.0% p.a. from 2009 to 2013, and to drop to 7.7% p.a. thereafter. As a result, the peak power on Santiago is expected to exhibit a 1.6-fold increase from 28.5MW in 2009 to 44.7MW in 2013, and a 2.3-fold increase from that year to 64.7MW in 2018.

Table 4.2 Peak power forecast (2008 - 2018)

(Unit: kW, % p.a.)

	Actual		Projection									Growth Rate	
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	('09-'13)	('13-'18)
Santo Antão	2,550	2,703	2,860	2,992	3,239	3,508	3,799	3,941	4,089	4,261	4,474	6.7%	5.0%
S. Vicente	10,100	10,900	11,405	12,339	13,363	14,846	16,333	17,221	18,160	19,154	20,242	8.0%	6.4%
S. Nicolau	1,007	1,010	1,068	1,129	1,227	1,350	1,417	1,488	1,562	1,640	1,722	7.5%	5.0%
Sal	6,400	6,700	8,174	9,890	11,766	13,924	15,300	16,820	18,498	20,399	22,539	20.1%	10.1%
Boavista	960	1,296	1,238	1,346	1,463	1,593	1,686	1,767	1,853	1,943	2,038	5.3%	5.0%
Maio	518	578	617	656	691	725	759	795	834	871	909	5.8%	4.6%
Santiago	26,707	28,470	29,832	37,047	40,124	44,721	48,083	51,695	55,579	59,939	64,731	12.0%	7.7%
Fogo	1,706	1,900	2,060	2,258	2,485	2,698	2,929	3,037	3,265	3,395	3,530	9.2%	5.5%
Brava	508	580	617	640	664	688	714	749	787	826	867	4.4%	4.7%

Source: ELECTRA

Chapter 5 Study of Project Scope

5.1 Definition of each type of construction

In making an examination on the project scope, the Study Team classified the types of construction for transmission and distribution lines into three categories to assist assessment of effect: expansion (through installation of new facilities), reinforcement (of existing facilities), and renewal (of existing superannuated facilities). The following kinds of attendant work are included in each.

5.1.1 Expansion (installation of new facilities)

(1) Installation of new transmission and distribution lines for development of housing tracts and resorts

Plans for development of resorts and other facilities on the islands of Sao Vicente and Sal are anticipated to result in additional demand on a substantial scale. New transmission and distribution lines are to be installed to meet this demand.

(2) Electrification of as yet unelectrified villages

Supply of electricity to villages still without it is being promoted under governmental leadership. This task has basically been completed on all islands except Santiago and Fogo. Even on these islands, there are plans to ascertain the situation in these villages and swiftly electrify them, but progress is being hindered by a shortage of funds. Even in districts that have been electrified, financial difficulties are holding back the reinforcement of facilities, such that some demand is on standby and does not have access to power. Such electrification plans were therefore included within the scope of this project.

5.1.2 Reinforcement of existing facilities

(1) Increase in medium-voltage

In Cape Verde, the standard voltage of medium-voltage lines is 20 kV, but some distribution lines are being operated at voltages including 6, 10, and 15 kV. The existence of different voltage classes does not cause any electrical problems, but it does leave issues in the aspect of facility operation. As such, voltage should be unified in the 20-kV class while taking account of factors such as the deterioration of distribution lines.

(2) Reinforcement of medium-voltage distribution lines

① Reinforcement of medium-voltage distribution lines

The existing medium-voltage distribution system consists of facilities with capacities sufficient for the load and basically have little need for reinforcement. As shown in Table 5.1, the drop in voltage on medium-voltage distribution lines is on an extremely low level. However, the results of the macroscopic demand forecast indicate that the voltage drop on some distribution lines will exceed 5 percent in supply of demand beginning in 2013. Factors such as this point to a need for some countermeasures, and related construction is

therefore to be undertaken for these lines.

② Looping of medium-voltage distribution lines

Cape Verde has adopted policy to consolidate the power stations on each island in a single location on each, and to abolish superannuated power stations with a low efficiency. Although such stations are to remain at ready for backup use for the time being, their eventual removal will require the looping of transmission and distribution lines to form a system capable of reverse transmission in the event of failure, in order to assure reliability. Construction for looping is to be undertaken on the islands of Sao Vicente, Fogo, and Maio, where the system is not yet looped.

(3) Reinforcement of low-voltage distribution lines

Improvement of voltage on low-voltage distribution lines is highly important for contribution to reduction of power loss in addition to improvement of power quality.

ELECTRA has posted a target maximum length of 500 meters for low-voltage distribution lines, but in some places the length runs to about 2 kilometers. These places are also where trouble is occurring due to voltage drop, but improvement is lagging because the medium-voltage lines cannot be extended due to funding problems. Construction is therefore to be executed to reinforce low-voltage distribution lines..

(4) Installation of breakers with protection relays on long-distance distribution lines

Besides having a large scope of outage in the event of failure, long-distance distribution lines entail a long time for determination of faulty spots and resumption of service. They are consequently factors lessening system reliability. Avoidance of a low reliability demands the installation of breakers with protection relays en route along distribution lines to reduce the scope of outage and the time required for service resumption in the event of outage.

(5) Introduction of monitoring and control system

The ELECTRA power system is virtually unequipped for surveillance and communications. Quite often, even if trouble occurs with the system, the abnormality goes undetected until a call is received from a customer. Similarly, even system changeover in response to faults cannot be made until ELECTRA personnel arrive at the concerned substation. These drawbacks are magnified at places where the system is on a large scale, and require installation of SCADA or an analogous system for system surveillance and control.

(6) Installation of communication lines for protection relays

One of the problems with protection relays in the modal aspect is the application of simple current relays even in spots actually requiring more sophisticated relays, such as

parallel circuits. Although carrier relays were installed during the period of privatization, the lack of funds prevented installation of communication lines for them, and the carrier relays consequently do not function. The requisite measure here is therefore installation of communication lines for these carrier relays so they can provide proper protection and heighten system reliability.

(7) Installation of fault locators

On many distribution lines in Cape Verde, it takes a long time to ascertain the problem locations in the event of failure because of installation underground or overhead on routes through mountainous areas. In addition, the overhead lines are installed with few switches en route, and this makes it difficult to isolate the faulty sections. As a result, resumption of service requires considerable time, and this is another factor lowering the system reliability. In response, distribution lines must be installed with units for locating faults and switches along the way to shorten the time required for resumption of service after distribution line failure.

5.1.3 Renewal of existing dilapidated facilities

(1) Renewal of medium-voltage lines

Some medium-voltage distribution lines were installed more than 40 years ago and have been left in operation instead of being replaced, due to the lack of funds. In some districts of Santo Antao and Maio, facilities have a high level of deterioration due to damage from salt and urgently require repair. In these districts, the supply of power is suspended for washing insulators, and this also detracts from supply reliability. On the occasion of replacement, measures such as the use of insulators with a high insulating strength should presumably be taken. Similarly, some of the facilities transferred from municipalities are of a poor quality below ELECTRA standards. As they often cause faults, these facilities must be repaired. In this project, salt-resistant insulators are to be installed to reduce salt damage on Santo Antao and Maio. The prospective types are insulators coated with silicon rubber or long-shaft insulators.

(2) Renewal of low-voltage distribution lines

Although the new low-voltage lines use ABC cable, bare cable was strung on new lines up until the early 1980s. These lines, which have been installed for more than 25 years, have a significant degree of deterioration, and must be replaced. Because thin cable is used on bare lines, technical loss could be reduced by replacement with cable of the optimal size. Similarly, replacement with insulated cable could be expected to reduce theft (non-technical loss) and help to prevent electric shocks.

(3) Replacement of watt-hour meters

In Cape Verde, periodic checking and replacement of watt-hour (electrical energy) meters were carried out in the past, but are not being executed at present, because of a shortage of technical capabilities and funds. As a result, not a few such meters have been in use for more than 40 years. Superannuated meters have a lower measurement precision and generally tend to make measurements on the short side. They are consequently thought to be one of the factors behind the high level of non-technical loss. This situation demands the reinstatement of a setup for periodic checking of watt-hour meters and replacement of particularly old meters to rationalize metering as a measure for the immediate future. The superannuated meters should be replaced with mechanical models, which have long been in use in Cape Verde, to assist procurement, checking, and maintenance.

Table 5.1 Calculation Result of Voltage Drop on Medium Voltage Distribution Lines

【Condition of analysis】

・Voltage drop of each nominal transmission & distribution(hereinafter T&D) system was analyzed with PSSE/ADEPT.
('α' means 'less than 0.5%')

・The maximam demand of each secondary substation was estimated with actual data measured by ELECTRA and the total demand of each island.

・The ongoing projects were reflected with the T&D system on 2013. The T&D system on 2018 is same components as the one on 2013 and using with the demand on 2018.

Island		PS / PST /SS	Feeder	Voltage (kV)	Feeder Capacity (A)	2008		2013		2018		Remark
						current (A)	Voltage drop	current (A)	Voltage drop	current (A)	Voltage drop	
Santo Antao		Port Novo PS	1	10	152	9	2%	17	3%	21	4%	*Assume the Porto Novo and Paul PS are stopped generating.
			2	10	152	34	1%	52	2%	65	2%	
		Riveira Grande PS	1	10	140	15	1%	21	4%	27	5%	
			2	10	130	15	1%	21	4%	27	4%	
			3	10	140	54	6%	21	2%	27	3%	
		Paul PTS	1	10	130	6	1%	7	α	8	1%	
			2	10	130	9	1%	15	1%	17	1%	
Sao Vicente		Matiota PS	1	6	196	100	1%	147	2%	202	2%	*Asuume the wind PS is stopped generating. *Overload on Matiota PS No.1 feeder in 2018 can be resolved by switching over some loads to No.2 feeder.
			2	6	196	44	1%	65	2%	89	3%	
			3	6	323	35	α	51	α	70	α	
			4	6	285	91	α	134	α	182	α	
			5	6	196	93	4%	139	5%	193	7%	
			6	6	317	109	4%	160	5%	221	8%	
		Matiota SS	1	20	196	9	α	12	α	16	1%	
			2	20	361	2	α	2	α	2	1%	
		Palacio PTS	1	20	196	33	α	48	1%	66	1%	
		Favorita PTS	1	20	196	17	α	25	1%	34	1%	
			2	20	196	23	α	34	1%	45	1%	
			3	20	252	10	1%	14	1%	19	2%	
		Lazareto PS	1	20	196	22	α	33	1%	45	1%	
			2	20	317	13	α	20	α	27	α	
Sal		Santa Maria PTS	1	20	152	21	1%	45	3%	79	5%	
			2	20	196	11	1%	23	2%	40	5%	
			3	20	367	31	1%	67	2%	116	4%	
		Espargos PS	1	20	252	18	1%	38	2%	67	3%	
			2	20	252	17	1%	37	2%	64	3%	
			3	20	252	31	1%	67	2%	115	3%	
			4	20	152	3	1%	7	2%	13	3%	
		Palmeira PS	1	20	252	11	α	22	α	37	α	
		Central Velha SS	1	20	252	0	α	0	α	0	α	
Maio		Torril PS	1	20	140	10	α	14	α	18	α	
			2	20	140	1	α	2	α	2	α	
			3	20	140	4	α	5	1%	7	1%	
Santiago	Praia	Palmarejo PS	1	20	196	23	1%	40	1%	58	2%	*Assume the Gamboa PS is stopped generating.
			2	20	367	–	–	31	α	44	α	
			3	20	367	–	–	68	1%	99	1%	
		Gamboa PS(20kV)	1	20	196	37	1%	64	2%	93	2%	
			2	20	196	23	1%	39	2%	56	2%	
			3	20	196	62	2%	106	2%	155	4%	
			4	20	196	27	1%	46	2%	67	3%	
			5	20	252	127	3%	133	3%	194	4%	
		Gamboa PS(15kV)	1	15	285	17	2%	22	2%	32	3%	
			2	15	252	86	2%	160	2%	234	4%	
			3	15	317	45	2%	58	2%	85	3%	
			4	15	196	41	2%	52	2%	77	3%	
			5	20	196	—	–	34	3%	50	5%	
		Terra Branca PT	1	20	196	66	2%	37	2%	54	3%	
			2	20	196	32	1%	54	2%	79	3%	
			3	20	252	30	1%	52	2%	76	2%	
			4	20	252	51	2%	64	2%	93	2%	
	Assomada	Santa Catarina PS	1	20	190	57	2%	98	4%	146	7%	
	Santa Cruz / Calheta	Santa Cruz PS	1	20	190	12	α	21	1%	31	2%	
			2	20	196	23	2%	39	3%	57	6%	
	Tarrafal	Tarrafal PS	1	10	190	7	1%	12	2%	17	3%	
			2	20	190	4	1%	7	1%	10	2%	
			3	20	190	14	1%	24	1%	35	2%	
			4	20	196	13	1%	22	2%	32	3%	
Fogo		Ponta Verde PS	1	20	196	0	α	0	α	1	1%	*Assume the Pnta Verde amd Mosteiros PS will be stopped generating after the completion of ongoing projects.
			2	20	196	2	α	2	α	2	1%	
			3	20	196	1	α	1	α	2	1%	
		P. Lapa PS (Mosteiros)	1	20	165	8	α	13	1%	17	1%	
			2	20	165	2	α	4	1%	5	1%	
		S. Filipe PS(15kV)	1	15	152	18	3%	29	3%	39	4%	
		S. Filipe PS(6kV)	1	6	186	20	2%	9	α	12	α	

(4) Renewal of protection relay systems

In Cape Verde, more than 60 percent of the switches and protection relays were installed beginning in 2000. Most of those installed earlier are scheduled for renewal under the ORET project and other projects. In some cases, ELECTRA itself is performing replacement of single protection relays, which can be done at comparatively low cost. However, there are no projects or plans especially for protection relay renewal. Moreover, some switches, whose replacement entails considerable expense, have been in service for more than 20 years. Switches of the old type at Gamboa and Matiota are marked by a degree of deterioration that is high enough to impair the switching action. This not only holds the risk of making normal exclusion of failures impossible and thereby widening the scope of outage but also could possibly cause fires and harm to people due to the continuation of ground-fault accidents. As such, countermeasures must be taken.

It may also be noted that, even when the year of installation is fairly recent, there are problems in the aspects of maintenance and installation control that have caused difficulties in some cases. This situation tends to appear in the case of facility installation in municipalities which lacked the requisite skills and experience and later transferred the facilities to ELECTRA, and in systems on islands that are small in size and cannot employ a sufficient number of engineers. Some of these facilities require renewal.

The majority of the equipment and materials used in the power system in Cape Verde date from the privatization of ELECTRA, and the types are virtually unified. Table 5.2 shows the main types of protection relay and switching equipment in use in the country.

Table 5.2 Main protection relay and switchgears

	Type Name	Manufacturer
Protection Relay	MRI-3	SEG
Circuit Breaker (for main power station)	VD4	ABB
Switchger (for substation)	Normafix	EFACEC

In countries such as Cape Verde, where the scale of the power enterprises is limited, such unification of types saves time and trouble in procurement of spare parts and maintenance. The Study Team consequently recommends the use of equipment and materials that have a high compatibility with the existing ones in the course of future equipment renewal and system expansion work.

5.2 Project scope in each category of work type

This section defines the specific scope of project work in each category. The scope considered in this study consisted of tasks deemed important for improvement of supply reliability through improvement of the transmission and distribution system, and rehabilitation of protection relays as well as reduction of distribution loss through construction of a more efficient distribution network on the six islands covered. The order of priority was set in accordance with the following standard.

In the table shown below, tasks with a priority in the A class are related to the projects of other donors, and would prevent the aid from these donors from taking full effect unless they are implemented in this project. Tasks in the B class require urgent execution because problems have already surfaced. Tasks in the C class are considered necessary in spite of the lack of problems at present, because problems are likely to arise in the near future. Tasks in the A class therefore have the highest priority. Those in the C class are important for Cape Verde, but have less priority than those in the A or B class.

Table 5.3 shows the cumulative base cost in accordance with the project priorities.

Table 5.3 Cumulative base cost in line with the project priorities

Priority	**Category**	Works	Base Cost million EUR	Cumulative Cost million EUR
A	Expansion	Extension of MV T&D line for town and resort development	17.2	17.2
A	Reinforcement	Connection of T&D networks (loop system)	3.9	21.1
A	Reinforcement	Installation of CB/ SCADA/ FL	8.3	29.4
B	Reinforcement	LV voltage development	0.8	30.2
B	Renewal	Rehabilitation of LV conductor	1.1	31.3
B	Reinforcement	Upgrading of MV voltage	3.0	34.3
B	Renewal	Rehabilitation of MV facility	0.8	35.1
B	Renewal	Replacement of WHM	1.2	36.3
C	Reinforcement	Reinforcement MV network	0.8	37.1
C	Expansion	Electrification	9.2	46.3

5.2.1 Expansion (installation of new facilities)

Table 5.4 shows the project scope of expansion.

Table 5.4 Project scope (Expansion)

	Outline of construction [order of priority]	Quantity of works (Approximate value)		Construction Cost (Approximate price) 【million EUR】
Santo Antao	Town development for Port Novo, Paul and Ponta do Sol in Santo Antao island[A]	Installation for MV UGL 120mm^{2}cable-1circuit	6.1 km	1.5
		240mm^2 cable-1circuit	0.2 km	
		Installation for LV UGL 95mm^2 cable	14 km	
		LV OHL(over head line) ABC70mm^2	12 km	
		GMT(ground mounted transformer)	8 units	
	Electrification for non-electrified town[C]	Quantity of PMT(pole mounted transformer) (Number of town)	6 units	0.7
Sao Vicente	Town and housing development for Mindelo[A]	MV UGL 240mm^2 cable 1 circuit	10.2 km	0.7
	Resort development for Salamansa area[A]	Installation for MV UGL 500mm^2 cable 1 circuit	27 km	3.3
		Installation for MV UGL 240mm^2 cable 1 circuit	3.5 km	
		Installation for secondary substation	2 units	
	Housing development[A]	Installation for MV UGL 120mm^2 cable 1 circuit	9 km	1.6
		Installation for GMT	13 units	
		Installation for LV UGL 95mm^2 cable	4 km	
		Installation for LV OHL ABC70mm^2	18 km	
Sal	Resort and town development for S.Maria and Pedra de Lume[A]	Installation for MV UGL 500mm^2 cable 2 circuit	52 km	6.9
		Installation for MV UGL 500mm^2 cable 1 circuit	12 km	
	Installation for Murdeira substation and outlet of lines from Palmeira power station[A]	Switch gear and protection relay for Murdeira	4 set	0.4
		Murdeira substation	1 unit	
		Switch gear and protection relay for Parmeira	2 set	
		communication line	22 km	
Santiago	Industrial area and resort development for Achada Grande Tras[A]	Installation for MV UGL 240mm^{2}cable-1circuit	8km	0.6
		Installation for circuitbreakers and	2 set	

		protection relays		
		Installation for disconnecting switch	2 set	
		Construction for substation	1 unit	
	Housing development[A]	Installation for MV UGL 240mm^{2}cable-1circuit	7.0 km	1.2
		Installation for LV ABC	7.0 km	
		GMT	7 units	
	Electrification for non-electrified town[C]	Quantity of PMT (Number of town)	6 units	6.7
Fogo	Electrification for non-electrified town[C]	Quantity of PMT(pole mounted transformer) (Number of town)	15 units	1.8
	Housing development for Sao Filipe[A]	Installation for MV UGL 120mm^{2}cable-1circuit	2.6 km	1.0
		GMT	4 units	
		LV UGL 95mm^2 cable	8 km	
		LV OHL ABC70mm^2	17 km	

5.2.2 Reinforcement of facilities

Table 5.5 shows the project scope of reinforcement.

Table 5.5 Project scope (Reinforcement)

	Outline of construction [order of priority]	Quantity of works (Approximate value)		Construction Cost (Approximate price) 【million EUR】
Santo Antao	Upgrading 10kV distribution line to 20kV[B]	Replacement of conductor	6.5km	0.8
		Replacement of transformers	6 units	
	Looping of medium-voltage distribution lines between Porto Novo and Ribeira Grande[A]	New additional line of 1 circuit 240mm^2 cable	37 km	3.1
		Installation for pole mounted switches	15 units	
	Installation of fault locator and pole mounted switches[A]	Fault Locator (for underground line)	15 pieces	0.3
		Fault Locator (for overhead line)	30 pieces	
		Installation for pole mounted switches	15 units	
Sao Vicente	Replacing the 6kV secondary transformers to 20kV ones Not necessary for replacing the conductors[A]	Replacement of transformers	12 units	0.8
		New additional line of 1 circuit 240mm^2 cable	4.0 km	
		Installation for secondary substation	1 units	
	Reinforcement of low-voltage distribution lines[B]	Replacement for LV	20.0 km	0.4
	Installation of SCADA system and fault locator[A]	SCADA Main Unit	1 unit	1.9
		Remote Terminal Unit	5 units	
		Communication Line(Underground)	31 km	
		Fault Locator (for underground line)	60 units	
Sal	Reinforcement for MV line between Espargos and Palmeira[C]	Installation for MV UGL 120mm^2 cable	3.0 km	0.3
		GMT	4 units	
	Installation of SCADA system and fault locator[A]	Installation of SCADA Main Unit	1 unit	1.6
		Installation of Remote Terminal Unit	6 units	
		Installation of Communication Line (Underground)	32.5 km	
		Fault Locator (for underground line)	30 units	

Maio	Looping of medium-voltage distribution lines between Figueira Seca and Alcatraz[A]	New additional line of 1 circuit 54.6mm^2 overhead line	9 km	0.5
		GMT	2 units	
		Installation for pole mounted switches	5 units	
		Construction for substation	1 unit	
	Reinforcement for MV line for Airport development[C]	New additional line of 1 circuit 240mm2 cable	5.8 km	0.5
		Construction for substation	1 unit	
	Installation of Fault Locator and pole mounted switches[A]	Fault Locator (for overhead line)	10 units	0.1
		Pole Mounted Switch	5 units	
Santiago	Replacing the 10kV secondary transformers to 20kV ones (Replacing the insulators Not necessary for replacing the conductors)[B]	Replacement of transformers	6 units	0.4
		Replacement of insulators	160 pieces	
	Reinforcement of low-voltage distribution lines[B]	Replacement for LV	21.0 km	0.4
	Installation of SCADA system, Fault Locator and pole mounted switches[A]	Installation of SCADA Main Unit	1 unit	4.1
		Installation of Remote Terminal Unit	10 units	
		Installation of Communication Line (Underground)	22 km	
		Installation of Communication Line(Overhead)	60 km	
		Fault Locator (for underground line)	100 units	
		Fault Locator (for overhead line)	50 units	
		Pole Mounted Switch	50 units	
Fogo	Upgrade voltage on the Sao Filipe 15 kV system to 20 kV[B]	Installation for MV UGL 240mm^2 cable 1 circuits	2.5 km	1.0
		Installation for MV UGL 120mm^2 cable 1 circuits	0.8 km	
		Replacement for MV OHL 148mm^2	8.0 km	
		Replacement for MV OHL 54.6mm^2	5.6 km	
		Replacement for transformers (15kV→20kV)	8 units	
	Looping of medium-voltage distribution lines between Tinteiras and Relvas[A]	New additional line of 1 circuit 148mm^2 overhead line	7 km	0.3
	Installation of Fault Locator and pole mounted switches[A]	Fault Locator (for underground line)	10 units	0.3
		Fault Locator (for overhead line)	20 units	
		Pole Mounted Switch	6 units	

5.2.3 Renewal of existing dilapidated facilities

Table 5.6 shows the project scope of renewal.

Table 5.6 Project scope (Renewal)

	Outline of construction [order of priority]	Quantity of works (Approximate value)		Construction Cost (Approximate price) 【million EUR】
Santo Antao	Renewal of medium-voltage distribution line[B]	Replacement of 240mm2 Cable	5.5 km	0.6
		Rehabilitation for secondary substation	3 units	
	Replacement of watt-hour meters[B]	Replacement of watt-hour meters	2,100 pieces	0.1
Sao Vicente	Renewal of Low-voltage distribution line [B]	Replacement of bare conductor with ABC Cable	14.2 km	0.3
	Replacement of watt-hour meters[B]	Replacement of watt-hour meters	4,900 pieces	0.3
Sal	Renewal of Low-voltage distribution line[B]	Replacement of bare conductor with ABC Cable	7.0 km	0.1
	Replacement of watt-hour meters[B]	Replacement of watt-hour meters	1,500 pieces	0.1
Maio	Renewal of medium-voltage distribution line[B]	Replacement of 54 mm^2 line	51 km	0.2
	Renewal of Low-voltage distribution line[B]	Replacement of bare conductor with ABC Cable	9.0 km	0.2
	Replacement of watt-hour meters[B]	Replacement of watt-hour meters	400 pieces	0.02
Santiago	Renewal of Low-voltage distribution line[B]	Replacement of bare conductor with ABC Cable	20.0 km	0.4
	Replacement of watt-hour meters[B]	Replacement of watt-hour meters	10,200 pieces	0.6
Fogo	Renewal of Low-voltage distribution line[B]	Replacement of bare conductor with ABC Cable	7.0 km	0.1
	Replacement of watt-hour meters[B]	Replacement of watt-hour meters	1,100 pieces	0.1

Chapter 6 Packaging of the project scope

6.1 Composition of the package

The results presented in Chapter 5 provided the basis for packaging the project scope on each island. The packaging results are shown in Table 6.1. For more efficient construction, supervision, and management of equipment and materials, as well as in light of the project scale, the basic units of the project shall be the islands. The portion related to SCADA systems will be conducted as a separate project to enable interconnection testing (connection of on-site facilities and SCADA systems etc.) to be implemented after completion of the distribution line construction on each island.

Table 6.1 Packaging of the project scope

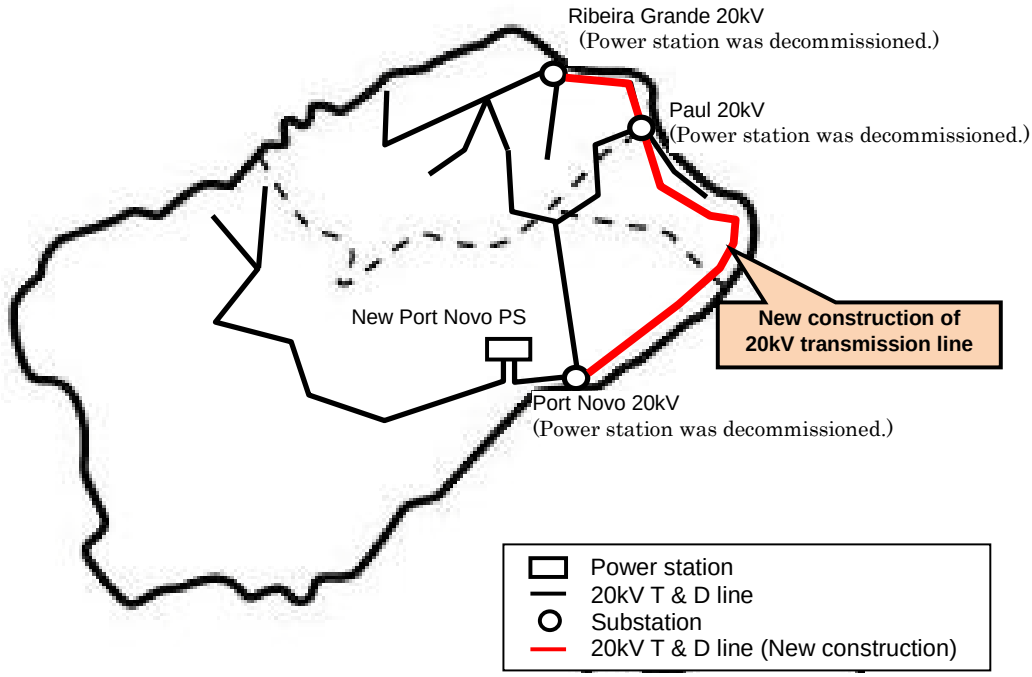
Project [order of priority]	Contents	Construction Cost (Million EUR)
Santo Antao T&D line construction	Construction work of expansion, reinforcement, renewal and electrification for transmission & distribution lines	6.8
Sao Vicente T&D line construction	Construction work of expansion, reinforcement and renewal for transmission & distribution lines	7.4
Sal T&D line construction	Ditto	7.8
Maio T&D line construction	Ditto	1.4
Santiago T&D line construction	Construction work of expansion, reinforcement, renewal and electrification for transmission & distribution lines	10.3
Fogo T&D line construction	Ditto	4.3
SCADA, fault locator and pole mounted switches installation	Design and installation for SCADA & Fault locator	8.3
Total		46.3

6.2 Packaged project for targeted islands

Appendix 1 shows system planning maps for each island.

6.2.1 Santo Antao island

【Outline of construction works】



【Contents of construction works】

	Outline of construction [order of priority]	Quantity of works (Approximate values)		Construction Cost (Approximate price) 【million EUR】
Expansion	Town development for Port Novo, Paul and Ponta do Sol[A]	Installation for MV UGL(under ground line) 120mm^{2}cable-1circuit	6.1 km	1.5
		240mm^2 cable-1circuit	0.2 km	
		Installation for LV UGL 95mm^2 cable	14 km	
		LV OHL(over head line) ABC70mm^2	12 km	
		GMT(ground mounted transformer)	8 units	
Expansion	Electrification for non-electrified town[C]	Quantity of PMT(pole mounted transformer) (Number of town)	6 units	0.7

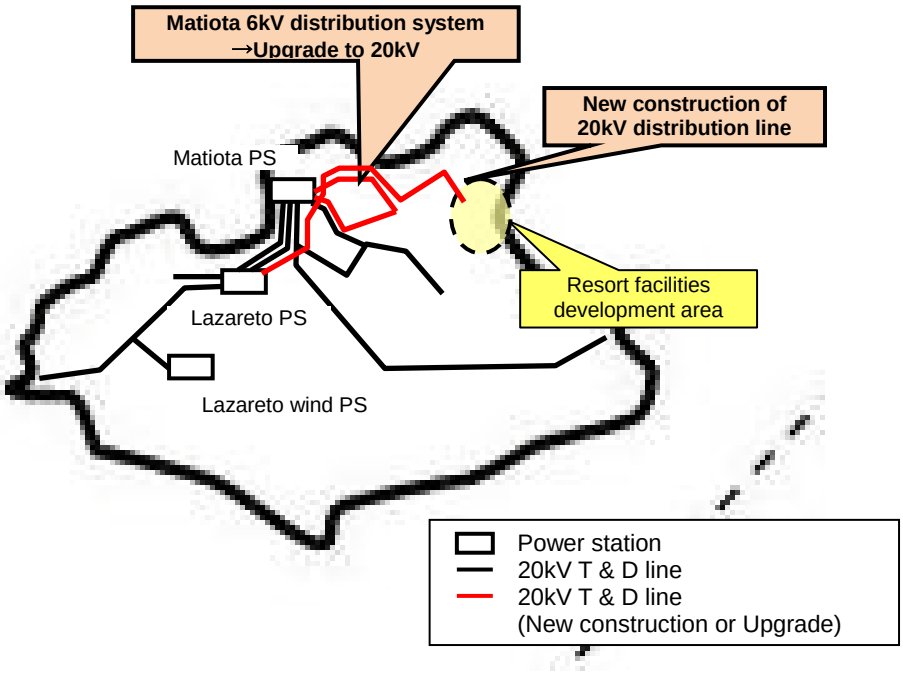
Reinforcement	Upgrade voltage on the Rebeira Garnde / Ponta do Sol 10 kV system to 20 kV[B]	Replacement for MV	6.5 km	0.8
		Replacement for transformers (10kV→20kV)	6 units	
Reinforcement	Looping of MV distribution line from Porto Novo to Ribeira Grande[A]	Installation for MV OHL 240mm^2 cable 1 circuits	37 km	3.1
Reinforcement	Rehabilitation for MV line[B]	Replacement for MV line 240mm^2	5.5 km	0.6
		Replacement for secondary substation	3 units	
Reinforcement	Replacement for watt hour meters[B]	Replacement for watt hour meters	2,100 pieces	0.1
Total				6.8

【Main materials】

Materials		Quantity
MV UGL	AL240mm^2	49 km
	AL120 mm^2	6 km
LV line	UGL	14 km
	OHL	12 km
Secondary substation	GMT	21 unit
Watt hour meter		2,100 pieces

6.2.2 Sao Vicent island

【Outline of construction works】



【Contents of construction works】

	Outline of construction [order of priority]	Quantity of works (Approximate values)		Construction Cost (Approximate price) 【million EUR】
Expansion	Town development for Mindelo[A]	Installation for MV UGL 240mm^2 cable 1 circuit	10.2 km	0.7
	Resort development for Salamansa area[A]	Installation for MV UGL 500mm^2 cable 1 circuit	27 km	3.3
		Installation for MV UGL 240mm^2 cable 1 circuit	3.5 km	
		Installation for secondary substation	2 unit	
Expansion	Housing development[A]	Installation for MV UGL 120mm^2 cable 1 circuit	9 km	1.6
		Installation for GMT	13 unit	
		Installation for LV UGL 95mm^2 cable	4 km	
		Installation for LV OHL ABC70mm^2	18 km	
Reinforcement	Upgrade voltage on the Matiota 6kV system to 20kV[B]	Replacement for transformers (10kV→20kV)	12 unit	0.8
		Replacement for MV line 240mm^2 UGL 1 circuit	4.0 km	
		Installation new secondary substation	1 unit	

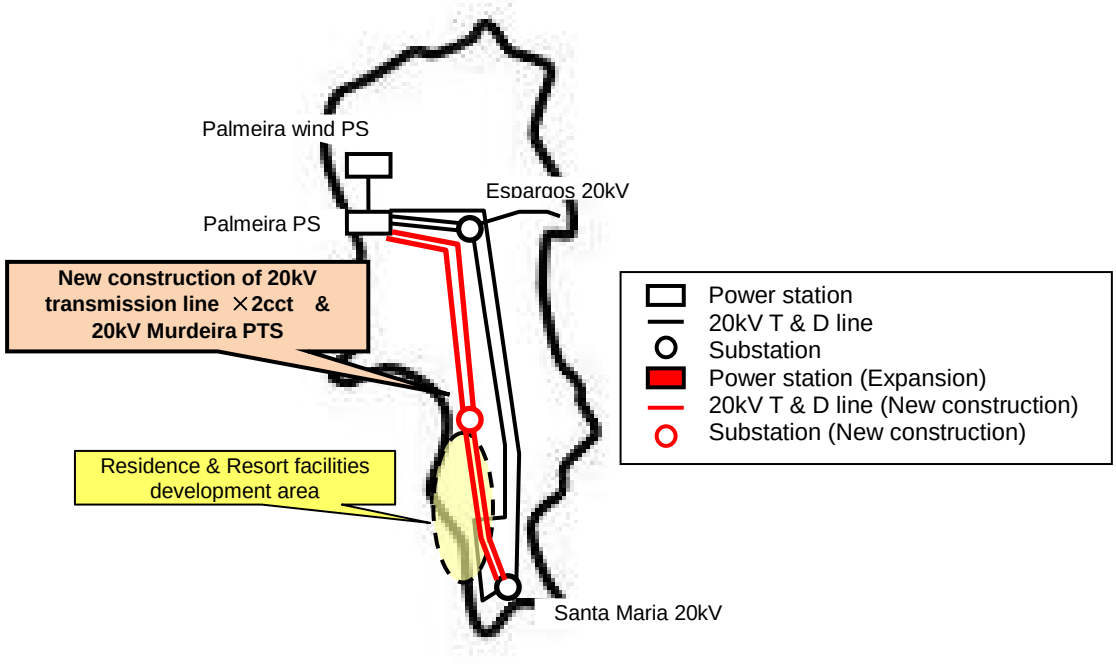
Reinforcement	Reinforcement for LV line[B]	Replacement for LV line	20.0 km	0.4
Renewal	Rehabilitation for LV line[B]	Replacement for LV bare conductor	14.2 km	0.3
Renewal	Replacement for watt hour meters[B]	Replacement for watt hour meters	4900 pieces	0.3
Total				7.4

【Main materials】

Materials		Quantity
MV UGL	AL500mm^2 cable	27km
	AL240mm^2 cable	18km
	AL120 mm^2 cable	9km
LV line	UGL	4km
	OHL	52km
Secondary substation	GMT	27 unit
Watt hour meter		4,900 pieces

6.2.3 Sal island

【Outline of construction works】



【Contents of construction works】

	Outline of construction [order of priority]	Quantity of works (Approximate values)		Construction Cost (Approximate price) 【million EUR】
Expansion	Resort and town development for S.maria and Pedra de Lume[A]	Installation for MV UGL 500mm^2 cable 2 circuit	52 km	6.9
		Installation for MV UGL 500mm^2 cable 1 circuit	12 km	
	Installation for Murdeira substation and outlet of lines from Palmeira power station[A]	Switch gear and protect ion relay for Murdeira	4 set	0.4
		Murdeira substation	1 unit	
		Switch gear and protect ion relay for Parmeira	2 set	
		communication line	22 km	
Reinforcement	Reinforcement for MV line between Espargos and Palmeira[C]	Installation for MV UGL 120mm^2 cable	3.0 km	0.3
		GMT	4 unit	

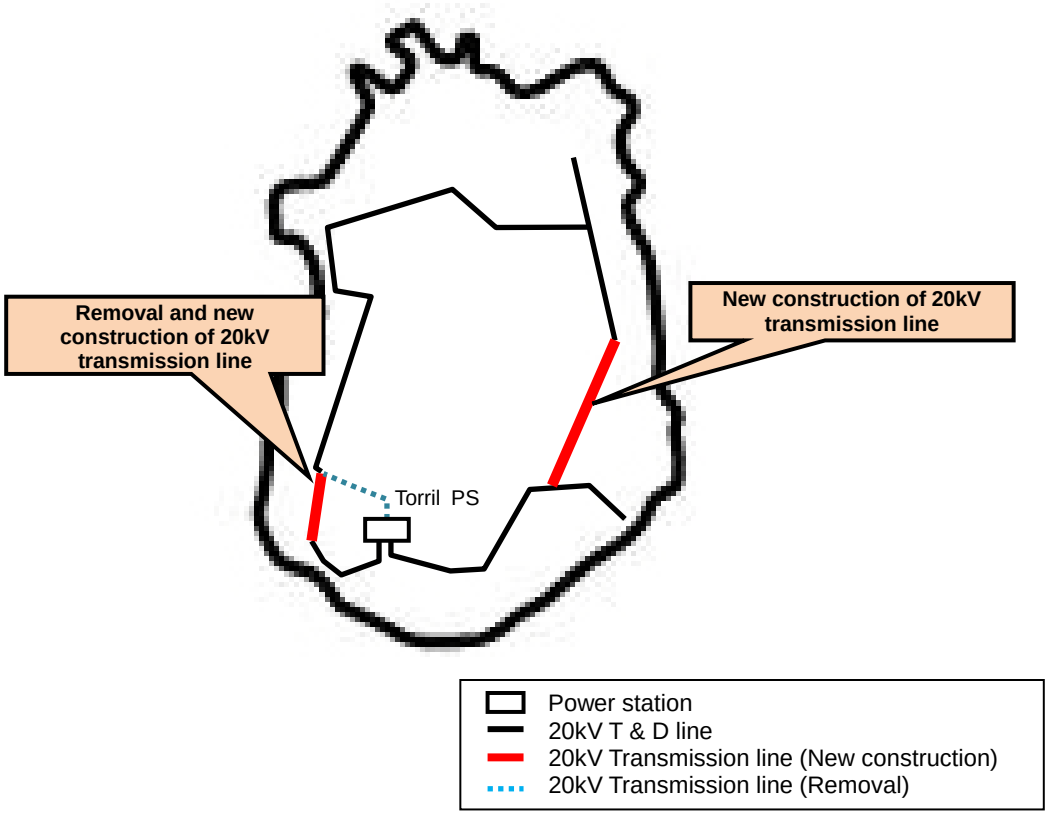
Renewal	Rehabilitation for LV line[B]	Replacement for LV bare conductor	7.0 km	0.1
Renewal	Replacement for watt hour meters[B]	Replacement for watt hour meters	1500 pieces	0.1
Total				7.8

【Main materials】

Materials		Quantity
MV UGL	AL500mm^2 cable	64 km
	AL240mm^2 cable	4 km
	AL120 mm^2 cable	3 km
LV OHL	ABC	7 km
Communication line	UGL	22 km
Secondary substation	GMT	4 unit
Watt hour meter		1,500 pieces

6.2.4 Maio island

【Outline of construction works】



【Contents of construction works】

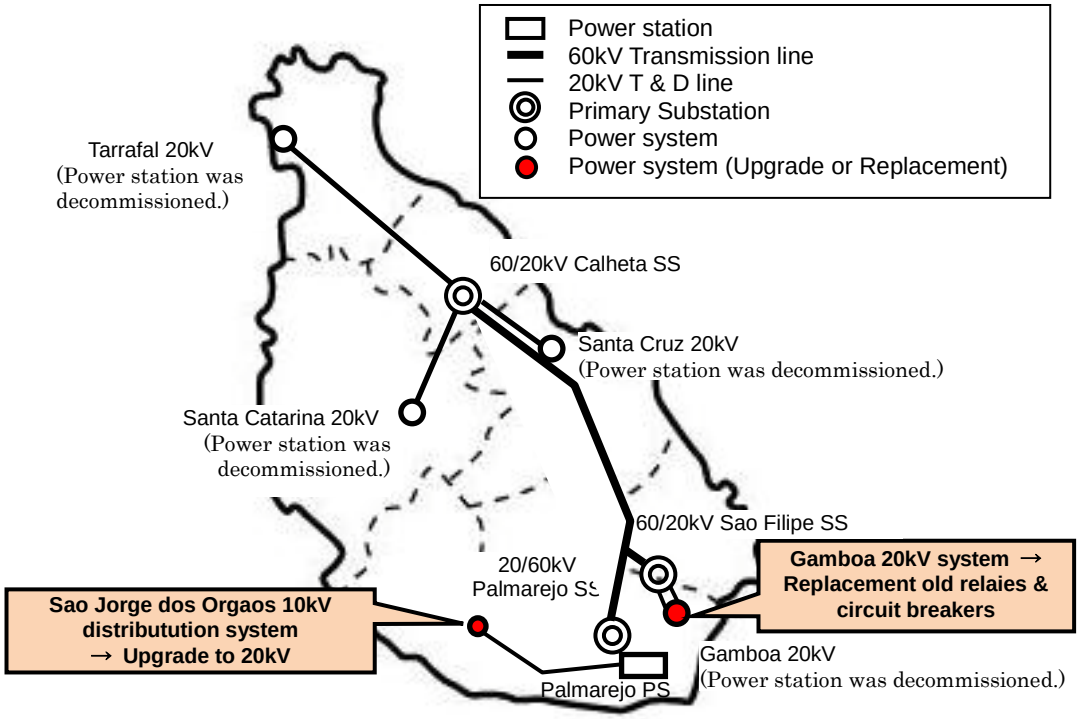
	Outline of construction [order of priority]	Quantity of works (Approximate values)		Construction Cost (Approximate price) 【million EUR】
Reinforcement	Looping of MV distribution line from Figueira Seca to Alcatraz[A]	Installation for MV OHL 54.6mm^2	9 km	0.5
		GMT	2 unit	
		Installation for substation	1 unit	
Reinforcement	Reinforcement for MV line for Airport development[C]	Installation for MV UGL 240mm2 cable	5.8 km	0.5
		Installation for substation	1 unit	
Renewal	Rehabilitation for MV line[B]	Replacement for MV OHL 54.6mm^2	51km	0.2
Renewal	Rehabilitation for LV line[B]	Replacement for LV bare conductor	9.0km	0.2
Renewal	Replacement for watt hour meters[B]	Replacement for watt hour meters	400 pieces	0.02
Total				1.4

【Main materials】

Materials		Quantity
MV UGL	AL240mm^2 cable	6 km
MV OHL	Aster54.6mm^2	61 km
LV OHL	ABC	9 km
Secondary substation	GMT	2 unit
Watt hour meter		400 pieces

6.2.5 Santiago island

【Outline of construction works】



【Contents of construction works】

	Outline of construction [order of priority]	Quantity of works (Approximate values)		Construction Cost (Approximate price) 【million EUR】
Expansion	Industrial area and resort development for Achada Grande Tras[A]	Installation for MV UGL 240mm^{2}cable-1circuit	8km	0.6
		Installation for circuitb reakers and protection relays	2 set	
		Installation for disconn ecting switch	2 set	
		Construction for substa tion	1 unit	
Expansion	Housing development[A]	Installation for MV UGL 240mm^{2}cable-1circuit	7.0 km	1.2
		Installation for LV ABC	7.0 km	
		GMT	7 unit	

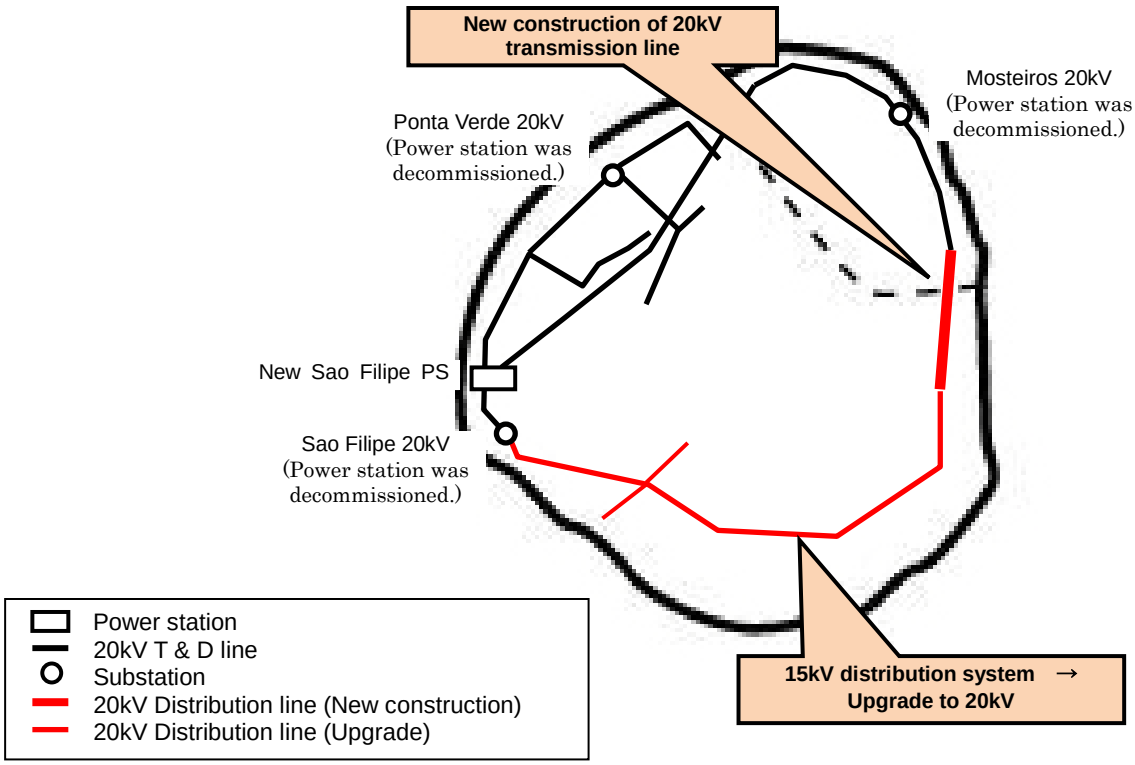
Expansion	Electrification for non-electrified town[C]	Quantity of PMT (Number of town)	6 unit	6.7
Reinforcement	Upgrade voltage on the Sao Jorge dos Orgaos do Sol 10 kV system to 20 kV [B]	Replacement for transformers (10kV→20kV)	6 unit	0.4
		Replacement for insulators (10kV→20kV)	160 pieces	
Reinforcement	Reinforcement for LV[B]	Replacement for LV	21.0 km	0.4
Renewal	Rehabilitation for LV line[B]	Replacement for LV bare conductor	20.0 km	0.4
Renewal	Replacement for watt hour meters[B]	Replacement for watt hour meters	10,200 pieces	0.6
Total				10.3

【Main materials】

Materials		Quantity
MV UGL	AL500mm^2 cable	8 km
	AL240mm^2 cable	7 km
MV OHL	Aster54.6 mm^2	7 km
LV OHL	ABC	67 km
Secondary substation	GMT	8 unit
	PMT	6 unit
Watt hour meter		10,200 pieces

6.2.6 Fogo island

【Outline of construction works】



【Contents of construction works】

	Outline of construction [order of priority]	Quantity of works (Approximate values)		Construction Cost (Approximate price) 【million EUR】
Expansion	Electrification for non-electrified town[C]	Quantity of PMT(pole mounted transformer) (Number of town)	15 unit	1.8
Expansion	Housing development for Sao Filipe[A]	Installation for MV UGL 120mm^{2}cable-1circuit	2.6 km	1.0
		GMT	4 unit	
		LV UGL 95mm^2 cable	8 km	
		LV OHL ABC70mm^2	17 km	

Reinforcement	Upgrade voltage on the Sao Filipe 15 kV system to 20 kV [B]	Installation for MV UGL 240mm^2 cable 1 circuits	2.5 km	1.0
		Installation for MV U GL 120mm^2 cable 1 circuits	0.8 km	
		Replacement for MV OHL 148mm^2	8.0 km	
		Replacement for MV OHL 54.6mm^2	5.6 km	
		Replacement for transf ormers (15kV→20kV)	8 unit	
Reinforcement	Looping of MV distribution line from Tinteiras to Relvas[A]	Installation for MV OHL 148 mm^2 Aster	7.0 km	0.3
Renewal	Rehabilitation for LV line[B]	Replacement for LV bare conductor	7.0 km	0.1
Renewal	Replacement for watt hour meters[B]	Replacement for watt hour meters	1,100 pieces	0.1
Total				4.3

【Main materials】

Materials		Quantity
MV UGL	AL240mm^2	3 km
	AL120 mm^2	3 km
MV OHL	Aster148 mm^2	15 km
	Aster54.6 mm^2	6 km
LV line	UGL	8 km
	OHL	24 km
Secondary substation	GMT	12 unit
Watt hour meter		1,100 pieces

6.2.7 SCADA & Fault locator installation (6 islands)

【Contents of construction works】

	Outline of construction [order of priority]	Quantity of works (Approximate values)		Construction Cost (Approximate price) 【million EUR】
Reinforcement	Installation of fault locator and pole mounted switches for Santo Antao island[A]	Fault locator (UGL)	15 unit	0.3
		Fault locator (OHL)	30 unit	
		Pole mounted switch	15 unit	
Reinforcement	Installation of SCADA system and fault locator for Sao Vicente island[A]	SCADA	1 unit	1.9
		Communication line (UGL)	31 km	
		Fault locator (UGL)	60 unit	
Reinforcement	Installation of SCADA system and fault locator for Sal island[A]	SCADA	1 unit	1.6
		Communication line (UGL)	33 km	
		Fault locator (UGL)	30 unit	
Reinforcement	Installation of Fault Locator and pole mounted switches for Maio island[A]	Fault locator (OHL)	10 unit	0.1
		Pole mounted switch	5 unit	
Reinforcement	Installation of SCADA system, Fault Locator and pole mounted switches for Santiago island[A]	SCADA	1 set	4.1
		Communication line (UGL)	26 km	
		Communication line (OHL)	60 km	
		Fault locator (UGL)	100 unit	
		Fault locator (OHL)	50 unit	
		Pole mounted switch	50 unit	
		Improvement for substation	1 unit	
Reinforcement	Installation of Fault Locator and pole mounted switches for Fogo island[A]	Fault locator (UGL)	10 unit	0.3
		Fault locator (OHL)	20 unit	
		Pole mounted switch	6 unit	
		Improvement for substation	1 unit	
Total				8.3

【Main materials】

Materials		Quantity
Communication line	UGL	90 km
	OHL	60 km
Fault locator	UGL	215 unit
	OHL	110 unit
Pole mounted switch		76 unit
SCADA		3 set

6.3 Estimation of total project cost

Table 6.2 shows the rough cost estimation for this project.

Table 6.2 Rough Cost Estimation for the Project

(Million EURO)

Item		Total
A. ELIGIBLE PORTION		
Ⅰ)	Procurement / Construction	51
	1. Santo Antao	7
	2. Sao Vicente	7
	3. Sal	8
	4. Maio	1
	5. Santiago	10
	6. Fogo	4
	7. SCADA and Fault Locator	8
	8. Soft Componet	0
	Base cost for JICA financing	46
	Price escalation	2
	Physical contingency	2
Ⅱ)	Consulting services	1
	Base cost	1
	Price escalation	0
	Physical contingency	0
Total (Ⅰ + Ⅱ)		52
B. NON ELIGIBLE PORTION		
a	Administration cost	3
b	VAT	0
c	Import Tax	0
Total (a+b+c)		3
TOTAL (A+B)		55
C. Interest during Construction		1
	Interest during Construction(Const.)	1
	Interest during Construction (Consul.)	0
D. Commitment Charge		0
GRAND TOTAL (A+B+C+D)		56
E. JICA finance portion incl. IDC (A + C + D)		53

<Calculate Condition>
Price Escalation = 2.0%
Physical Contingency = 5%
Administration Cost = 5%
Interest During Construction = 0.65%
VAT and Import TAX are not considered
Comittment charge is not considered

6.4 Project schedule

(1) Schedule

The schedule for implementation of the project shall be as Table 6.3.

Table 6.3 Project schedule

			Month
		2011 / 2012 / 2013 / 2014 / 2015	
	Pledge	2011/1	0.0
	E/N		0.0
	Signing of Loan Agreement		0.0
	DPP Approval		0.0
1	**Selection of Consultant (All)**		6.0
2	**Design Stage**		0.0
	Review of design documents / Detail Design		6.0
	EIA Study / Review		0.0
3	**Tendering Stage**		0.0
	Preparation of construction / procurement schedule		1.0
Pre-Qualification	Preparation of pre-qualification documents for Turn-key Works		1.0
Pre-Qualification	Review of bidding documents		3.0
Pre-Qualification	Evaluation of pre-qualification of bidders		1.0
Pre-Qualification	Bids floating		2.0
Pre-Qualification	Bids evaluation		3.0
Pre-Qualification	Concurrence of Donor on Bids evaluation results		0.5
Pre-Qualification	Assist for contract negotiation	Sign	1.5
ICB/LCB	Bids floating		1.5
ICB/LCB	Bids evaluation		3.0
ICB/LCB	Concurrence of Donor on Bids evaluation results		0.5
ICB/LCB	Assist for contract negotiation	Sign	1.0
4	**Construction Monitoring Stage**		0.0
	Preparation of power interruption and construction plan		4.0
	Checking and approval of drawings and documents		6.0
	Monitoring of construction work		40.0
	Monitoring / Evaluation of social development	during this period	47.0
5	**Manufacturing, Transportation, Installation etc.**		0.0
	Manufacturing of equipment and materials		36.0
	Transportation to the site		34.0
	Installation / construction work in Santo Antao		24.0
	Installation / construction work in Sao Vicente		20.0
	Installation / construction work in Sal		20.0
	Installation / construction work in Maio		10.0
	Installation / construction work in Santiago		31.0
	Installation / construction work in Fogo		11.0
	Installation / construction work for SCADA & Fault locator		24.0
	Final test / commissioning		32.0
			0.0

(2) Funding plan

Table 6.4 shows the funding plan for the project, based on the schedule for its implementation.

Table 6.4 Funding plan

Unit; million EUR

Project	1st year	2nd year	3rd year	Total
Santo Antao T&D line construction	3.4	3.4	0.0	6.8
Sao Vicente T&D line construction	4.4	3.0	0.0	7.4
Sal T&D line construction	4.7	3.1	0.0	7.8
Maio T&D line construction	1.4	0.0	0.0	1.4
Santiago T&D line construction	4.0	4.0	2.3	10.3
Fogo T&D line construction	4.3	0.0	0.0	4.3
SCADA, Fault locator and pole mounted switches installation	1.0	4.2	3.1	8.3
Total	23.2	17.7	5.4	46.3

Chapter 7 Reduction of Transmission & Distribution loss and green house gas

7.1 Reduction of transmission and distribution loss

7.1.1 Reduction of technical loss

As noted in Chapter 2, technical loss in Cape Verde is enough low (0.8% for medium voltage line, and 3.7% for low voltage line). But, transmission and distribution loss will increase if there is no reinforcement. For example, loss of medium voltage line will be 3.0 % at 2013 without any countermeasure. If the project scope of this study has done, loss of medium voltage line at 2013 will be 1.3%[10], and it has 1.7% loss reduction effect although it is aimed to improve reliability of power system, not aimed for loss reduction.

On the other hand, loss of low voltage line will be 3% (0.7% reduction) if the scope of voltage improvement for low voltage line has performed.

7.1.2 Reduction of non-technical loss

Non-technical loss is reduced not only by facility measures but also by routine surveillance and warnings. In this study, it is estimated that non-technical loss could be reduced to the level of around 10 percent (15 percent including technical loss) by a switch to insulated cable for low-voltage lines currently strung with bare cable, replacement of superannuated watt-hour meters, reinforcement of action to reduce non-technical loss at ELECTRA, and a rise in the morals of the populace along with economic advancement.

7.1.3 Reduction of GHG emissions

Reduction of emissions of greenhouse gases (GHG) by project scope of this study has considered. The reduction of GHG accompanying reduction of loss will derive from reduction of technical loss. As noted above, however, the reduction of technical loss will be limited in extent, and the corresponding GHG emission reduction is consequently put at only about 4,300 tons per year at 2013. The conditions applied in the related calculation are as follows.

* Unit calorific value: 41.7 GJ/kl
* Emission coefficient: 0.0195 tC/GJ
* Fuel consumption: 220 g/kWh
  (equivalent level of consumption by the Palmarejo generator)
* Specific gravity: 0.94 kg/l
* Technical loss reduction: 2.4% of energy sales
* Energy sales: 308,772 MWh (Demand forecaset in FY2013)

[10] Loss of medium voltage line will increase than present loss (0.8%), but it is very low than normal system because of small load, and loss of 1.3% is also enough low.

Chapter 8 Project Economic and Financial Analyses

8.1 Perspectives on the prospective investment project

8.1.1 Categorization of types of facility construction

We divided the work of the anticipated facility construction for the transmission and distribution systems into the following three categories based on differences of purpose: renewal of existing facilities (renewal), reinforcement of existing facilities (reinforcement), and expansion through installation of new facilities (expansion; see Table 8.1).

Table 8.1 Categories of construction work

	Renewal	Reinforcement	Expansion	
Facilities	Distribution			Transmission
Expected demand	− Demand in the existing supply areas (including increase)	− Increased demand in the existing supply areas − Demand in new supply areas	− Demand in new areas	
Source of revenue	− Reduction of loss − Revenue from the existing supply areas (including increase)	− Reduction of loss − Increased revenue from the existing supply areas and revenue from new supply areas	− Revenue from new supply areas	
Required Cost	− Capital cost − O&M cost − Fuel cost	− Additional capital cost − Additional O&M cost − Additional fuel cost	− Capital cost − O&M cost − Fuel cost	
Source: Prepared by the JICA study team				

8.1.2 Definition of project units and grouping of projects

In making economic and financial calculations, the Study Team treated each island as a single investment project unit. In other words, although two or more construction works may take place on one island, the Study Team treated them as a single one.

In reality, naturally, there are constraints on the supply of human and other management resources. For this reason, the different construction works making up the investment project may start at different times even on the same island, and the timing of investment on one island may differ from that on another. At present, however, it is not possible to set a detailed and specific schedule. Therefore, in the calculation, we set the year of the start of the investment project at 2009 and assumed that all construction works will begin at the same time.

8.1.3 Project term

The calculations in the economic and financial analyses also assumed that the project life would be 20 years counting from the start of facility operation.

8.1.4 Demand increase and reduction of transmission and distribution loss

The increase in demand during the project life was forecast (estimated) for each project based on the current business planning at ELECTRA.

As for transmission and distribution loss, we posted the target of reduction ultimately to 15%

as a whole. We also assumed that, on islands where this level is currently exceeded, the loss would be reduced by 1 percentage point per year after the commencement of operation, until this target is met. Similarly, on islands where this target is already met, it was assumed that the status quo would be maintained (see Figure 8.1).

Table 8.2 presents forecast figures for the power demand and transmission and distribution loss forming the premises of the investment project.

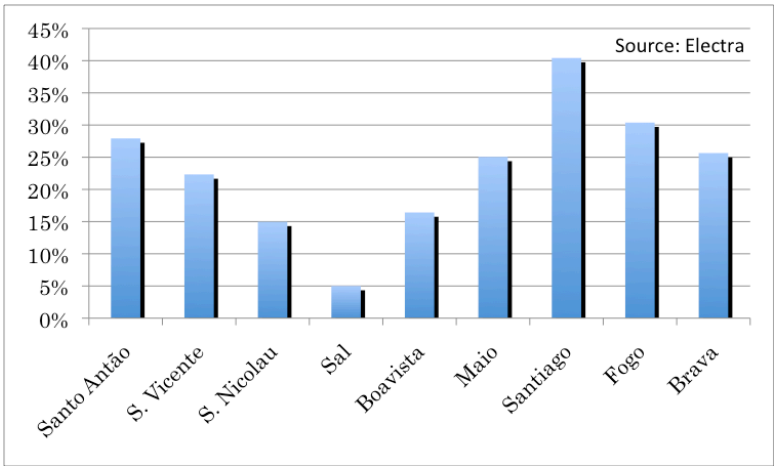


Figure 8.1 Transmission and distribution loss on each island (as of the end of 2008)

Table 8.2 Trend of power demand and transmission and distribution loss during the project life

(Unit: MWh, %)

	Year																					
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Santiago	2,320	4,154	8,922	11,640	15,889	19,152	22,734	26,668	30,990	35,738	40,948	46,666	52,941	59,827	67,384	75,677	84,777	94,765	105,725	117,753	130,953	145,438
	40.4%	39.4%	38.4%	37.4%	36.4%	35.4%	34.4%	33.4%	32.4%	31.4%	30.4%	29.4%	28.4%	27.4%	26.4%	25.4%	24.4%	23.4%	22.4%	21.4%	20.4%	19.4%
S. Vicente	0	356	8,016	16,043	24,231	32,535	41,668	49,967	58,319	66,729	75,195	79,618	84,263	85,699	87,207	88,790	90,452	92,198	94,030	95,955	97,975	100,097
	22.3%	21.3%	20.3%	19.3%	18.3%	17.3%	16.3%	15.3%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
Sal	0	99	49,042	49,958	51,048	52,355	53,144	128,466	129,413	130,456	131,602	132,862	134,247	135,770	137,444	139,284	141,308	143,532	145,978	148,667	151,623	154,872
	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Sant Antão	215	600	901	1,144	1,561	2,018	2,520	2,805	3,104	3,418	3,748	4,095	4,459	4,841	5,242	5,663	6,105	6,569	7,057	7,569	8,106	8,670
	28%	27%	26%	25%	24%	23%	22%	21%	20%	19%	18%	17%	16%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Maio	0	32	74	117	156	196	236	280	326	371	419	470	523	579	638	701	768	838	912	990	1,072	1,160
	25%	24%	23%	22%	21%	20%	19%	18%	17%	16%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Fogo	649	863	1,150	1,495	1,902	2,294	2,724	2,961	3,411	3,682	3,967	4,266	4,580	4,909	5,255	5,619	6,000	6,401	6,821	7,263	7,727	8,214
	30%	29%	28%	27%	26%	25%	24%	23%	22%	21%	20%	19%	18%	17%	16%	15%	15%	15%	15%	15%	15%	15%

Note: Figures on the top rows indicate the power demand, and those on the bottom rows, transmission and distribution loss.

Source: Prepared by the JICA study team.

8.1.5 Facility construction cost and annual cost

It was assumed that orders would be placed with construction companies for construction on the turnkey basis, based on the calculated (added-up) totals for each construction work. In other words, the facility construction cost was obtained by adding the contingency figure to the material cost and construction cost addition items and the project management cost (see Table 8.3).

Of the annual cost components, it was not possible to make a precise estimate for the generation cost because the depreciation costs for the existing generation facilities are not clear

and the power sources per se will be renewed during the anticipated 20-year project term. For this reason, the fuel cost forecast contained in the latest business planning (2009 - 2018) was used for the generation cost[11]. The transmission and distribution facility operation and maintenance (O&M) costs were put at 3% of the investment cost, based on actual figures at ELECTRA.

Table 8.3 Facility construction costs (at 2009 prices)

(1)

Island	Santiago		S. Vicente	Sal	Sant Antão	
Work No.	1	2	1	1	1	2
Work category	Renewal & Reinforcement	Expansion	Renewal & Reinforcement	Renewal & Reinforcement	Renewal & Reinforcement	Expansion
Investment cost	€ 7,793,027	€ 7,377,907	€ 10,281,723	€ 10,427,610	€ 7,000,488	€ 817,982
	CVE 859,204,606	CVE 813,436,358	CVE 1,133,590,817	CVE 1,149,675,230	CVE 771,824,803	CVE 90,184,969
Materials & work	€ 7,084,570	€ 6,707,188	€ 9,347,021	€ 9,479,645	€ 6,364,080	€ 743,620
	CVE 781,095,096	CVE 739,487,599	CVE 1,030,537,106	CVE 1,045,159,300	CVE 701,658,912	CVE 81,986,336
Contingency	€ 354,229	€ 335,359	€ 467,351	€ 473,982	€ 318,204	€ 37,181
	CVE 39,054,755	CVE 36,974,380	CVE 51,526,855	CVE 52,257,965	CVE 35,082,946	CVE 4,099,317
Management	€ 354,229	€ 335,359	€ 467,351	€ 473,982	€ 318,204	€ 37,181
	CVE 39,054,755	CVE 36,974,380	CVE 51,526,855	CVE 52,257,965	CVE 35,082,946	CVE 4,099,317
Annual O&M cost	€ 233,791	€ 221,337	€ 308,452	€ 312,828	€ 210,015	€ 210,015
	CVE 25,776,138	CVE 24,403,091	CVE 34,007,725	CVE 34,490,257	CVE 23,154,744	CVE 23,154,744

(2)

Island	Maio	Fogo	
Work No.	1	1	2
Work category	Renewal & Reinforcement	Renewal & Reinforcement	Expansion
Investment cost	€ 1,616,138	€ 3,667,787	€ 1,974,269
	CVE 178,184,019	CVE 404,384,542	CVE 217,669,080
Materials & work	€ 1,469,216	€ 3,334,352	€ 1,794,790
	CVE 161,985,472	CVE 367,622,311	CVE 197,880,982
Contingency	€ 73,461	€ 166,718	€ 89,740
	CVE 8,099,274	CVE 18,381,116	CVE 9,894,049
Management	€ 73,461	€ 166,718	€ 89,740
	CVE 8,099,274	CVE 18,381,116	CVE 89,740
Annual O&M Cost	€ 48,484	€ 110,034	€ 59,228
	CVE 5,345,521	CVE 12,131,536	CVE 6,530,072

Exchange rate: €1 = CVE 110.253

Source: Prepared by the JICA study team.

8.1.6 Power retail prices

The average power tariffs on each island at present (power sales revenue divided by amount of power sold) was used for the retail prices (the 2009 price was taken as the zero-year price).

[11] In a new large-scale diesel-fueled power station of the latest type using fuel oil 380, fuel costs would account for just under 90% of the generation cost excluding the fund procurement cost.

8.2 Economic analysis

8.2.1 Cost and Benefit

(1)Cost items

The initial investment cost was equally divided for the two-year construction period; one half was allocated to Year 0 and another half, Year 1.

With regard to the annual cost, as mentioned above, the fuel cost was used for the generation cost, and 3% of the initial investment cost, for the O&M cost.

(2)Benefit items

In the case of renewal and reinforcement, benefit (economic value) was calculated by multiplying demand increase, for which the additional capacity reinforced by the work would supply power, and the market value of power (i.e., the average power tariff).

In case of expansion, benefit was calculated by multiplying power demand arising from the new area, in which the expansion work would cover, and the market value of power.

8.2.2 Analysis results

The economic internal rates of return (EIRR) in the projects on each island are shown in Figure 8.2 (the detailed profit calculation sheet is shown in Attachment 2). As can be seen from the results, the EIRR values are low on islands where economic development is lagging. However, the investment would be made on the government, and this would rule out decisions in favor of investment in economically affluent islands and against that in poor ones. In other words, the objective is the country's socioeconomic advancement, and this requires a perspective regarding the entire country as the subject of the investment project.

We consequently obtained the EIRR when the aggregate of all construction (covering the whole country) is viewed as a single investment project, and assumed that the result could be used to assess the investment efficacy. Taking a hurdle rate of 12% as the assessment criterion, calculation of cost to benefit for the project as a whole yielded an EIRR of 20.7%, indicating that the investment would be effective.

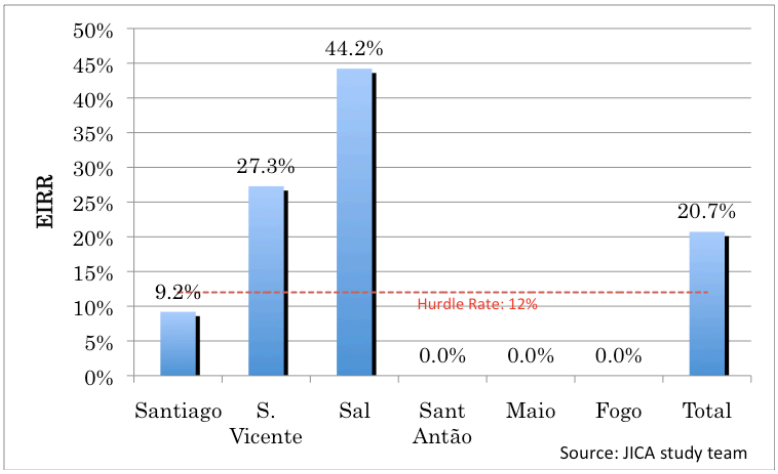


Figure 8.2 Economic internal rate of return (EIRR) of each project

Cautions regarding the economic calculation results

The analysis results indicate that the project as a whole will clear the hurdle rate (12%), but it should be noted that one of the major premises of the economic calculation is the fuel conversion to fuel oil 380 for power sources and reduction of transmission and distribution loss as envisioned in the business planning. This is to say that the analysis results will change if efforts to improve the business do not achieve the results anticipated in the planning.

To make the investment project effective, it is therefore essential to promote it in coordination with the program of ELECTRA business reform now under way. Of particular importance is the reduction of transmission and distribution loss on islands that currently have high levels of the same, which was assumed in the analysis. If this reduction is not achieved, the EIRR will drop. For example, the calculation assumed a loss reduction of one percentage point per year beginning in Year 0, for eventual reduction to the targeted level of 15%. As noted above, the EIRR of all six islands will be 20.7% in this case. If, however, the loss remains at the current rate of 38.8%, the EIRR will be 19.1%, 1.6 percentage points lower.

In addition, one of the factors of uncertainty is the pace of resort development. There are many plans for development of resorts on the island of Sao Vicente and Sal, and the calculations assume that the demand for power will increase considerably as a result of this development. As shown in Figure 8.2, it must be borne in mind that the high EIRR values on these two islands are pulling up the overall project EIRR value.

8.3 Financial analysis

8.3.1 Assumptions regarding fund procurement

Table 8.4 shows the assumptions applied for fund procurement based on the financing conditions in the Power Generation, Transmission, and Distribution Capacity Development Project on Santiago Island, which is currently being implemented by the JICA assistance.

Because the project term is put at 20 years, however, the financial calculation assumed that

repayment of loans due beyond this period would be made in a lump sum ahead of schedule in the final year (i.e., the 20th year after the start of facility operation). It may be added that this is a supposition for the purpose of financial calculation, and does not mean that such a step will actually be taken in the project.

Table 8.4 Escalation of cost items in the financial analysis

Financing rate	80% of the project investment (20% equity)
Financing conditions	Interest: 0.65% p.a. Repayment period: 40 years Included grace period: 10 years

Source: Prepared by the JICA study team based on the on-going financing conditions.

8.3.2 Costa and revenue

(1)Cost items

The initial investment cost was equally divided for the two-year construction period; one half was allocated to Year 0 and another half, Year 1.

With regard to the annual cost, as mentioned above, the fuel cost was used for the generation cost, and 3% of the initial investment cost, for the O&M cost.

(2)Revenue items

In the case of renewal and reinforcement, revenue was calculated by multiplying demand increase, for which the additional capacity reinforced by the work would supply power, and the retail power price (i.e., the average power tariff).

In case of expansion, revenue was calculated by multiplying power demand arising from the new area, in which the expansion work would cover, and the retail power price.

8.3.3 Escalation of cost items in the financial analysis

(1)Fuel cost

As shown in Figure 8.3, oil prices were driven steeply upward by the flow of speculative funds into the oil market beginning in the mid 2000s, but crashed in reaction to the financial crisis that broke out in the fall of 2008. Since then, prices have gradually recovered somewhat, but it is hard to predict their future course under the present circumstances.

Because making a forecast of oil prices is not the objective here, we estimated the future fuel cost on each island based on the actual figure in 2009 and in accordance with the anticipated fuel conversion envisioned in ELECTRA's business planning.

The nominal prices for each year during the project life were obtained by assuming maintenance of the real 2009 prices and escalating them by the inflation rate of 2% (see Figure 9.4).

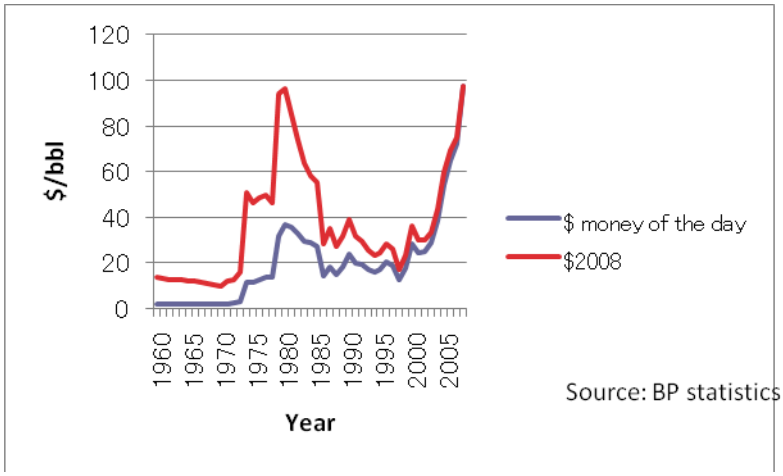


Figure 8.3: Trend of crude oil prices (1960 - 2008)

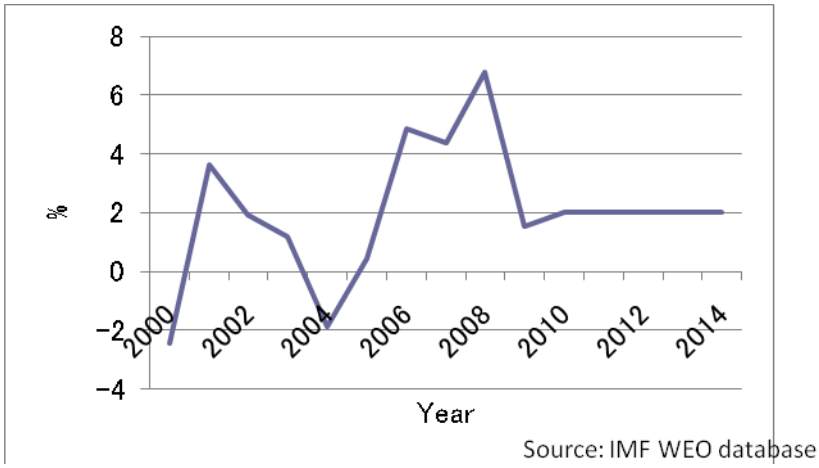


Figure 8.4 Trend of inflation rate in Cape Verde - actual and forecast (2000 - 2014)

(2)Retail power prices (tariffs)

Power tariffs are regulated, and their revision requires approval by the regulatory agency. As such, escalation of the retail power price is required in the context of the financial calculation. However, it is impossible to estimate the levels of approved tariffs in the future[12]. To maintain the 2009 tariff level in terms of real prices, the value was escalated by the 2% inflation rate.

[12] At present, the regulatory agency (i.e., the ARE) is in the process of examining the tariff scheme, and has not yet established new rules for tariff (rate) revisions. Between the renationalization of ELECTRA in 2006 and 2009, there was a substantial tariff hike. More specifically, tariffs were raised by an annual average rate of 12%, which is much higher than the inflation rate. The period coincided with the start of efforts to rebuild ELECTRA's finances through renationalization, and it is not clear whether or not big tariff hikes of this sort will continue to be made in the future.

(3)Other cost items

For other cost items, the 2009 prices were applied to Year 0 and escalated at the rate of 2% annually in each subsequent year.

8.3.4 Analysis results

Figure 8.5 presents basic figures for the financial internal rate of return (FIRR) obtained in the financial analysis of investment projects on each island (see Attachment 2 for the detailed calculation results). As in the economic analysis, the FIRR values are low for islands where economic development is lagging. The calculation results are presented here for each island separately for the purpose of viewing the characteristics of the different projects. As noted in connection with the results of the economic analysis, the work on the various islands will be undertaken as a government project, and an assessment will be made of all projects as a single aggregate.

In such overall terms, the project FIRR is projected at 20.1%. This is definitely not a low rate of return for a project.

It may be added that the equity IRR is very high, but this is primarily because 80% of the requisite funding would be procured through yen loans bearing the extremely low interest rate of 0.65% per year; equity capital would account for only 20%. Another reason is the loans under favorable conditions that would be inconceivable in private financing, i.e., a repayment term of 40 years, including a 10-year grace period. These factors make for an ample cash flow in the first half after the start of project operation. In this respect, it would not be correct to conclude from the results of the trial calculation of the equity IRR alone that the investment project has an extremely high rate of return (because the interest taken by the lender side would amount to just 0.55% per year).

In contrast, if the investment project were a purely private-sector one, funds could not be procured under such soft terms, and the equity IRR obtained from the project would be lower. For example, when an ordinary private company borrows from a private bank, it is required to put up its own capital to cover at least 40% of the total funding requirement, with the other 60% occupied by the loan. In the case of a project covering all six islands, for example, the equity IRR figure would drop from 50.7% to 31.5% if the conditions were changed to a borrowing rate of 60%, interest rate of 3% (obtained by adding a rate of just over 1% to the six-month London interbank offered rate; LIBOR), a repayment term of 20 years, and a grace period of five years.

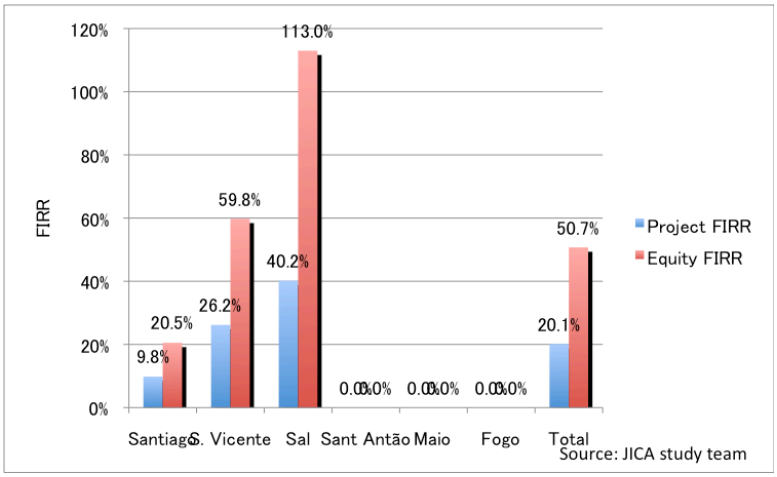


Figure 8.5 Internal rates of return (project and equity FIRRs) for each project

8.4 Indicators of operating efficiency

This section presents an account of figures obtained by the financial analysis for three indicators, i.e., debt service coverage ratio (DSCR), return on assets (ROA), and return on rate base (RORB).

DSCR

If the overall project is operated as a single enterprise, the DSCR would constantly be over 10 and the cash flow would be maintained on a sufficient level. This indicates that there would not arise a situation in which the loans could not be repaid. Figure 8.6 excludes figures for Year 21 (the 20th year after the start of facility operation). These figures were abnormal because the calculation in the financial analysis assumed lump-sum repayment of the entire loan balance in the final fiscal year.

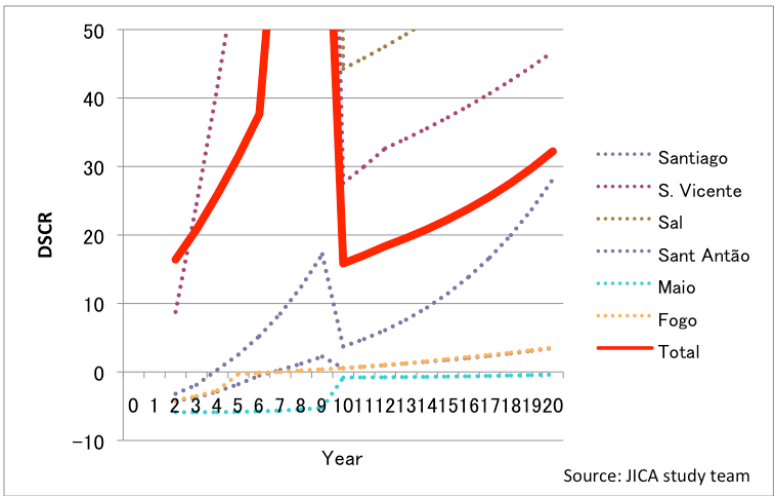


Figure 8.6 Trend of DSCR during the project life

ROA

The ROA value is low immediately after the start of the project, but could basically stay on approximately equal or more than 10% toward the final year beginning around Year 7 (the sixth year after the start of facility operation).

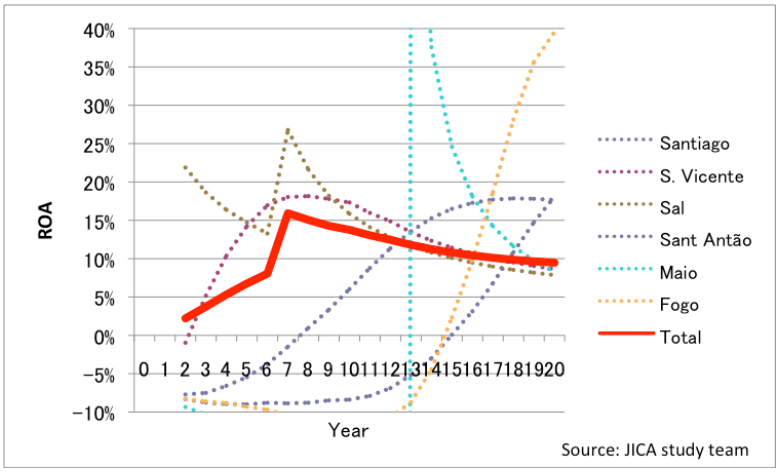


Figure 8.7 Trend of ROA during the project life

ROBR

The RORB would initially be in the area of 7% and eventually increase to just under 27%.

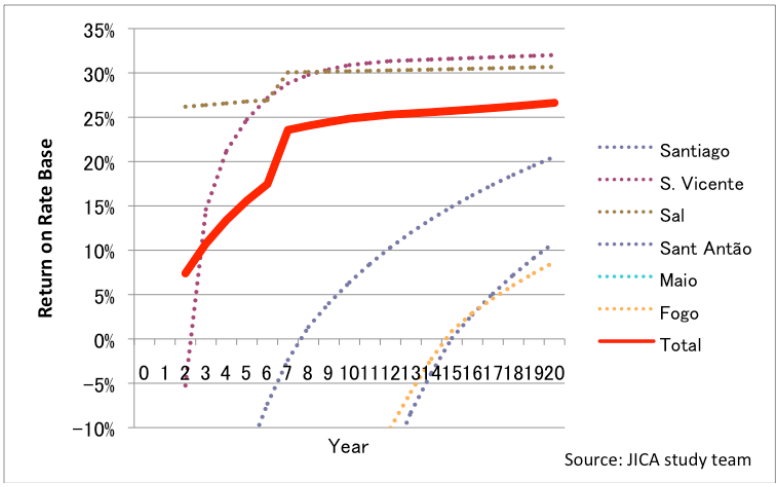


Figure 8.8 Trend of RORB during the project life

Setting of target values for operating efficiency indicators

The values for operating efficiency indicators obtained in the calculation are all favorable. As noted in the section on the economic analysis, however, it must be borne in mind that the calculation rests on several assumptions, and specifically the smooth conversion from gas oil to fuel oil 380 for fuel; a reduction of transmission and distribution loss by 1 percentage point per

year, until the targeted 15% level is reached; and development of resorts on the islands of Sao Vicente and Sal as planned.

The indicator values will naturally fall if the efforts to improve management efficiency at ELECTRA do not make good progress or the resort development does not proceed on schedule. In other words, the indicator values obtained from the calculation may be regarded as representing the best results following from effective management efforts and smooth demand growth.

International financial institutions set various terms as contents for borrowers on the occasion of structural reform of the power sector in the so-called developing countries, with respect to items such as DSCR, ROA, RORB, and investment equity ratio. For example, in programs for rebuilding the business of state power enterprises as part of power sector reform in Asian countries, these institutions have often applied a DSCR of 1.0 immediately after leveraging and 1.3 thereafter, an ROA of 8%, RORB of 8%, and equity ratio of 20%.

In this investment project as well, it would be overly optimistic to take the calculation results as target values. Therefore, it would probably be necessary to take aim at the aforementioned values (DSCR of 1.3, ROA of 8%, and RORB of 8%) as minimum requisite conditions.

8.5 Setup for project implementation

Although it went through two major changes of management setup in the form of privatization in 2000 and renationalization in 2006, ELECTRA has continued to post net deficits each year up to the present. In this sense, it clearly could not expect to achieve a sustainable management merely by maintaining its current business setup.

Needless to say, improvement of management efficiency as an electric power enterprise is indispensable for resolution of the management problems confronting ELECTRA. As noted in Section 2.7 on the financial position, however, a fundamental resolution would be difficult to achieve without a far-reaching reform of the entire power sector, inclusive of the tariff (rate) issue.

8.5.1 Separate accounts for water business and power business

The task of rebuilding the business setup would have to begin with a clarification of the costs in each division, clear definition of business responsibilities in each, and efforts to improve efficiency. ELECTRA basically consists of two divisions: the power business and the water business, which account for 77% and 17%, respectively, of its sales. Nevertheless, the funds are pooled, and the entire company is managed as a single whole. While it is true that the business costs in each division can be distinguished even at present in the financial statements, this does not go beyond the level of formal processing. In the current situation, ELECTRA is managed by combining the revenue from the power and water businesses and using this combined revenue to meet companywide costs.

To rebuild the business, it is consequently necessary to make a clear separation in accounting between the water and power businesses in light of their mutually different fields, and to strictly

manage the costs in each.

8.5.2 Rigorous cost management in the power business

ELECTRA's business is characterized by a complete separation of the power supply systems on each island. In view of this characteristic, it would be better to rigorously manage the balance of payments and costs in units of islands. Even at present, the business environment differs considerably depending on the island. For example, while the island of Sal has little transmission and distribution loss and a high electrification rate, that of Santiago is marked by a high rate of loss and lagging electrification (see Figure 8.1 and Figure 8.9).

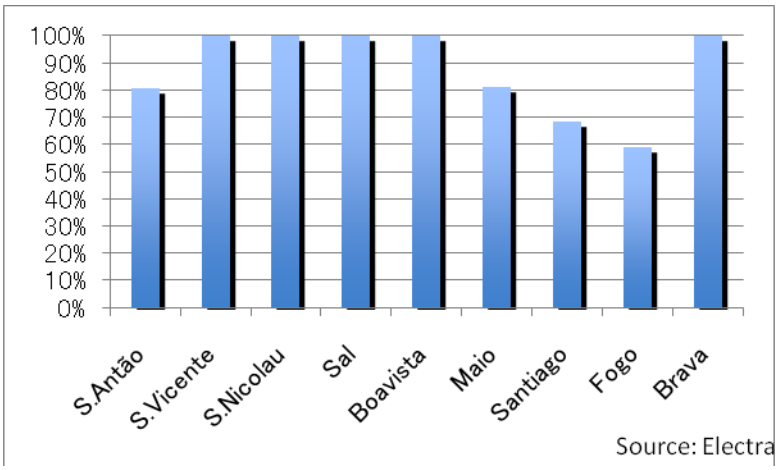


Figure 8.9 Comparison of electrification rates (2008)

In addition to the fact that ELECTRA's power supply must depend on diesel generation, the demand is small and dispersed among the islands. The company therefore cannot avoid a business environment with chronically high costs. As a result, correction of its deficit disposition faces obstacles that cannot be overcome simply by improving its management. The status of management is shaped largely by the tariff settings. Even after its renationalization in 2006, the company has continued to post deficits and dig into its equity. Considering this financial situation, the government will have to continue providing some kind of support in the funding aspect.

The situation points to the need for making a clear separation between business areas where it is inherently impossible to turn a profit and those where profits are assured even at present. After mounting the maximum management effort, the company should identify any areas where deficit is still inevitable and target them alone for official aid. This approach is absolutely necessary for sure fulfillment of accountability obligations by the government.

8.5.3 Geographical redistribution of management functions

The island with the largest demand is Santiago (which occupied 46% of ELECTRA's energy sales in 2008). The demand is expected to grow at the highest rate (17%) on the island of Sal. Santiago is saddled with problems in the aspect of promotion of electrification as well.

The ELECTRA organization is currently concentrated in Mindelo on the island of Sao Vicente, where its head office is located. It does not make sense to base all activities for Santiago and Sal, which pose business issues, in Mindelo, which is physically distant from these islands. As this suggests, it is necessary to make a geographical redistribution of the ELECTRA organization (business functions). There is a strong need for reinforcement of the business setup on Santiago at the very least.

8.5.4 Perspectives on business units

For clarification of costs and accurate response to issues in each business, it would be advisable to divide business functions into units as a first step. Units could be formed by making a separation in accounts between the water and power businesses, which are the profit centers. It would also be possible to establish business units in terms of islands or island groups, and to manage costs separately for each. However, the treatment of all islands as separate, independent units could possibly detract seriously from economy of scale. To avoid this problem, it would be advisable to establish units with Santiago and Sao Vicente at the cores. If there are good prospects for business on any other islands to be self-supporting, these could be established as independent units themselves. Conversely, if there are not, the other islands could be included in the Santiago or Sao Vicente unit.

The Government of Cape Verde and the World Bank led an examination concerning the reform of ELECTRA, and the consultants to whom this study was outsourced submitted a final report to the government at the end of March 2010. In response to this report, the government decided to implement a program of reform resting on division of ELECTRA's transmission and distribution division into two subsidiaries (northern and southern), and placement of these subsidiaries under an ELECTRA holding company. It announced this decision in the official gazette dated 16 April 2010. However, the details of the business model and particulars such as the time required for the organizational transition are not yet clear.

8.5.5 Cautions regarding reform of the business setup

The aforementioned perspectives on reform of the business setup at ELECTRA proceed from the objective of managing costs, clearly defining responsibility for the same, and improvement of management efficiency, but this would not be enough to resolve the problems saddling ELECTRA. Behind these problems lie a complex intertwining of various factors, including the difficulty of preventing power theft (surreptitious use), the propriety of the tariff settings, high fuel costs, and shortage of funds.

In the first place, resolution of chronic deficits at ELECTRA requires investment not only in facilities to reduce costs but also in human resources. Although funding is needed for such investment, ELECTRA currently does not have any funds to direct to it. Even if ELECTRA were to get loans from banks, the poor state of its finances would undoubtedly make it impossible for the company to obtain credit easily. As such, to procure the funds needed for the coming management reform, it would have to get assistance from the government.

In the second place, ELECTRA depends on diesel generation, and its balance of business

payments fluctuates greatly along with fuel costs. In 2008, when crude oil prices jumped, prices for gas oil for high-speed diesel engines rose to a level about 80% higher than prices in the international market, and put a squeeze on the business (see Figure 8.10). To reduce fuel costs and avoid price fluctuation, ELECTRA is planning to switch from gas oil to fuel oil 380 for fuel. Facilities for unloading and storing fuel oil 380 are currently located only on the island of Sao Vicente, at Mindelo. The fuel would have to be retransported from Mindelo to the other islands by local ships. This would lead to higher costs for domestic transport of fuel.

Conditioning of logistics for domestic supply of fuel is indispensable for reduction of fuel costs, which now account for most of the generation cost. Specifically, facilities for fuel unloading and storage would have to be built on the other islands, but ELECTRA does not have the margin for the requisite investment.

As related in connection with the economic analysis, the economic feasibility of projects for investment in the transmission and distribution system considered in this study depends heavily on the reduction of fuel costs (through the switch to fuel oil 380). The fuel conversion is consequently an urgent and vital task, and the government should swiftly construct the domestic storage and transport facilities needed for fuel supply as a part of the efforts to rebuild the power sector.

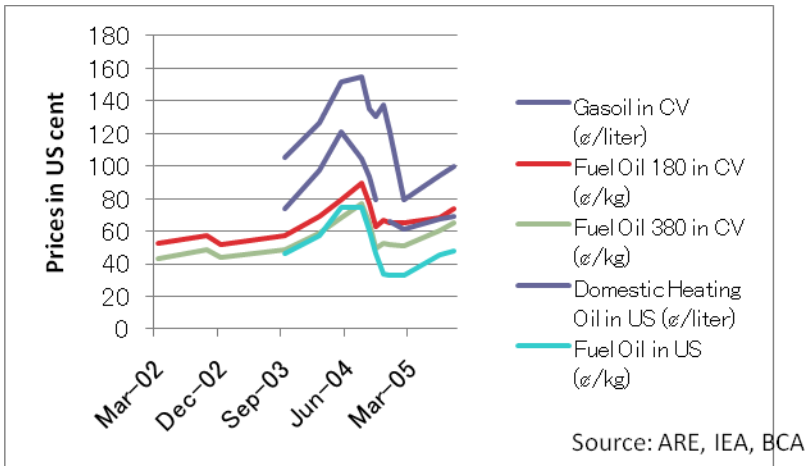


Figure 8.10 Comparison of petroleum product prices

In the third place, ELECTRA does not have enough personnel for facility operation and maintenance (O&M), and must reinforce its staff in order to assure a stable supply of power into the future.

It goes without saying that personnel expenses will inevitably rise, but this may be considered extra cost required for improvement of business efficiency. Of the total expenditures by ELECTRA in 2008, personnel expenses accounted for 17%. Instead of cutting back on personnel expenses, it is much more important to make the business more efficient and reduce other costs (especially for fuel) and expand revenue (by reducing transmission and distribution loss).

8.5.6 Specification of project beneficiaries

The perspectives on reform of the business setup related above derive solely from the aim of pursuing cost management and responsibility, and making the business more efficient. The problems involved in ELECTRA's management cannot all be resolved simply by the self-help efforts of its management team. This points to the need for consideration of the benefit delivered by the investment in ELECTRA distribution network facilities as the subject of this study, i.e., the prospective yen loan project.

(1)Macroeconomic development

The scenario for economic growth drawn by the Cape Verde government envisions a heavy dependence on income from tourism, including resort development. The stabilization and reinforcement of the power supply as a key element of the socioeconomic infrastructure are consequently indispensable for support of such growth. At present, however, power cannot be supplied to resorts aimed at tourists from other countries or to residential facilities for citizens returning to Cape Verde after stays in other countries.

Under these circumstances, investment in transmission and distribution facilities is a key task for improving the social overhead capital and promoting economic advancement.

(2)Resolution of power unavailability to 100,000

Cape Verde has attained a high overall rate of electrification nationwide; the rate reached 80% at the end of 2008. Nevertheless, on the island of Santiago, which has the largest population, the corresponding rate is low at 68%. In terms of population, about 100,000 of the national total of some 500,000 people are still waiting for distribution lines to reach them, and about 90% of this subtotal live on the island of Santiago.

In many cases, the reason why areas remain unelectrified is delay in connection of distribution lines to their houses, which, moreover, would not entail long-distance extension of the lines. As such, investment in the transmission and distribution system would represent the finishing stage in efforts to raise the national electrification rate to 100%.

(3)Resolution of frequent outages

Outages occur most frequently on the island of Santiago. In 2008, the total outage duration there reached 127,600 minutes (or about 89 days). This amounts to 88% of the corresponding total duration on all islands, and indicates that Santiago accounts for by far the largest share of the total. Outages are sometimes caused by factors on the generation side and sometimes by factors on the transmission and distribution side. According to ELECTRA, factors on the transmission and distribution side are estimated to account for about half of the outages on Santiago.

As this suggests, investment in transmission and distribution facilities on the island of Santiago is essential for assuring the qualitative stability of the power supply.

(4)Rebuilding of the power sector

For ELECTRA, the only enterprise in the country's power sector, the construction is a type of capital investment required for improvement of its management picture, inclusive of its financial position. It will be linked to an increase in income due to the demand growth and

decrease in costs along with the reduction of transmission and distribution loss. In this sense, it is obvious that ELECTRA is one of the beneficiaries alongside the aforementioned 100,000 people waiting for access to electricity.

As these observations indicate, the benefits of the investment project are not limited to any specific party; the project will help to condition the socioeconomic infrastructure needed for future economic advancement, resolve the unavailability of power to residents of as yet unelectrified districts, improve the quality of the power supply, and assure rebuilding of the business of ELECTRA. In other words, the project is one of investment to endow Cape Verde with the socioeconomic infrastructure indispensable for its future advancement. Conversely, if this investment is delayed, the improvement of ELECTRA's business would also be delayed, and this, by extension, could impair the country's long-term economic advancement.

As such, the investment project ought to be viewed as one that should be implemented as an aid for resolution of prevailing problems in the power sector, inclusive of the government, customers, and electric power company.

Chapter 9 Opinions offered concerning operational aspect

The Study Team also conducted a study on the operation of the power system in Cape Verde. This study revealed the following issues.

9.1 Issues in the operational aspect

ELECTRA employs 59 engineers (30 electrical and 29 mechanical). There are thought to be no problems as regards the complement of personnel needed for the operation and maintenance (O&M) setup after completion of the work. It has been confirmed that the participants in the seminars held for technology transfer in this study and the engineers interviewed in field surveys have the basic amount of related ability and knowledge. However, both knowledge and technical skills are lacking in the areas of protection relays and O&M, and efforts must be made to develop personnel able to handle these areas by the time of project completion. Technology transfer making effective use of soft components will presumably enable ELECTRA to build a setup for future O&M.

The following section presents the issues in the operational aspect at ELECTRA.

(1) Keeping of records of outages and failures

Cape Verde has many power outages, which are said to require countermeasures. In spite of this, when outages actually occur, almost no records are made of the causes. This, in turn, makes it hard to establish guidelines for points to be emphasized in efforts to improve system reliability. In addition, because records are not kept of failure causes, failures that occurred in one location are liable to occur in others due to the same cause. These considerations point to the need for making arrangements to keep records on outages and failures.

(2) Keeping of records and preparation of manuals for checking

At present, checks are made of facilities owned by ELECTRA, but records are not kept on the results. Similarly, manuals have not been prepared for checking work. This is reflected in variation in the maintenance status depending on the place. Although they have been in service for only about ten years, some facilities are already in poor condition. These may be exemplified by control units with a high degree of deterioration due to dirt and grime, and breakers which have a slow action and are on the verge of functional incapacity. Furthermore, the apprehension of such states of disrepair must rely on the memory of on-site engineers. As such, it is difficult to obtain proper data on the occasion of planning for facility improvement. These circumstances underscore the need to keep records of and prepare manuals for checking work. The standards thought to be urgently required are as follows.

1) Facility design manual

Although there are certain rules for design of transmission and distribution facilities, there are no explicit standards and item specifications set down in writing, and the work depends on the knowledge of individual engineers. Besides impeding the smooth transmission of technology, this situation can lead to problems including failure to construct proper distribution facilities by parties other than ELECTRA, such as municipalities. Preparation of manuals for facility design is consequently an urgent agendum.

2) Standards for facility checking and maintenance

Although there are certain rules for facility inspection and maintenance, no explicit standards have been set down in writing, and the work depends on the knowledge of individual engineers. Besides impeding the smooth transmission of technology, this situation can lead to problems such as failure to execute proper checking and maintenance of facilities. Preparation of manuals for facility checking and maintenance is consequently an urgent agendum.

3) Manuals for operation of transmission and distribution lines

Although there are certain rules for the operation of transmission and distribution facilities, they have not been set down in writing, and the work depends on the knowledge of individual engineers. Besides impeding the smooth transmission of technology, this situation can lead to problems such as failure to execute proper operation. Preparation of manuals for operation of transmission and distribution facilities is consequently an urgent agendum.

(3) Transmission of technology and approaches to advanced technology

There is a limit to manpower at ELECTRA, where only one engineer is assigned mainly to protection relays and switching equipment. This suggests that there is also a limit to abilities for transmission of technology and approaches to advanced technology, and that technical assistance is required in this aspect.

The following are the prospective items on the major menu of technology transfer.

1) Relay-related technology

ELECTRA performs the setting and operation of protection relays. The following issues have arisen due to the shortage of personnel and technical capabilities.

- The ELECTRA head office organization has only one engineer is in charge of protection relays and switching equipment. Apart from this engineer, there is only about one engineer assigned to protection relays along with other equipment on each island. This imposes a limit on ability to cope with unforeseen occurrences and makes it difficult to assure a high level of technical expertise.
- The setting of protection relays is based on past experience; personnel do not make setting calculations.

- For accurate detection of ground-fault failures, neutral grounding resistors were installed at Palmarejo, Lazareto, and Palmeira. However, these systems have been disconnected and the facilities are being operated without them, due to an inability to make calculations for setting the protection relays at the time of their installation. It is indispensable to heighten technical expertise for the setting and operation of protection relays by ELECTTRA engineers.

2) SCADA operation technology

This study proposes the introduction of a SCADA system into Cape Verde. When facilities are introduced, manuals for them are provided by their manufacturers. Generally speaking, the manuals are voluminous in content and likely to be written in English. These factors would presumably make it difficult for ELECTRA engineers to master the technology by studying them on their own. This points to a need for full education at the time of SCADA system introduction. This education must impart the knowledge needed for SCADA system maintenance as well as for operation.

3) Technology against salt damage

In Cape Verde, an island country, protection of transmission and distribution facilities from salt damage is an important task. Damage from salt is particularly severe on islands such as Santo Antao and Maio. On these islands, facilities can become significantly deteriorated only about ten years after installation. In addition, service is suspended to allow the washing of insulators for the purpose of avoiding damage due to salt, and this is lowering the supply reliability.

The degree of salt damage depends largely on the natural environment, and it would be difficult to mount measures for uniform application. The key tasks on this front are acquisition of basic technology related to measures to combat salt damage, standardization of such measures in terms of districts, and reflection of these standards in manuals.

4) Maintenance technology

ELECTRA has not compiled manuals or standards for maintenance of transmission and distribution facilities, and the maintenance level varies greatly from island to island. In addition, the maintenance performed is not sufficient in content. Some of the transmission and distribution facilities in Cape Verde have broken down and are not discharging their functions due to lack of maintenance, even though they are comparatively new (installed less than ten years ago). Besides preparing manuals and establishing standards for maintenance, it is consequently necessary to transfer maintenance-related technology in order to improve system reliability and extend the service life.

5) Technology for checking watt-hour meters

Correct metering is a prime prerequisite for gaining and keeping the trust of customers. In Cape Verde as well, watt-hour meters used to be periodically checked and replaced, but such

checking is no longer being performed. This is because the transmission of technology stopped and there were no longer any engineers with the knowledge needed for checking watt-hour meters. Superannuated watt-hour meters lead to a decline in metering precision. Because they generally produce readings that are lower than the actual amount of energy use, they are also a factor behind non-technical loss. It is therefore vital for engineers to acquire the technical knowledge needed for the checking of watt-meters and to perform this checking.

For the time being, the urgent agendum in technology transfer will be acquisition of the requisite technical skills by ELECTRA engineers. Further in the future, however, ELECTRA will need trainer's training to groom personnel for technical instruction for the purpose of assuring that the technology transferred in this project will be passed down by its own personnel to their successors.

9.2 Technical assistance package

Provision of the technical assistance noted in the preceding section will require a combination of more than one means of assistance, in correspondence with the contents. This section presents a proposed package of such assistance means.

(1) Technical assistance package in training in Japan

Besides enabling them to experience the latest Japanese technology, the provision of training and other TA components in Japan holds the benefit of allowing the participants to practice skills upon inspection of the actual equipment. For this reason, it would be advisable to transfer technology in the areas noted below, which are part of the tasks in the operational aspect described in the preceding section, through intensive training conducted in Japan.

- Relay adjustment technology

-Technology for preventing salt damage

-Technology for maintenance of transmission and distribution facilities, and related technology

Place of implementation	Japan
Period of implementation	About four weeks
Training participants	About three ELECTRA engineers
Rough cost	About 10million JPY(=about 90,000EUR) (excluding airfare & accommodation)

(2) Technical assistance package for SCADA

Transfer of technology at the time of SCADA introduction requires use of the actual system or a corresponding simulator. As such, it would be most efficiently performed by implementation at a SCADA manufacturer. It would therefore be advisable to implement it in a third country containing a SCADA manufacturer.

The training will be provided to two types of engineer: operating engineers who will handle SCADA software and facility engineers who will manage the hardware.

Training site	SCADA manufacturer	
Items of training	Software operation and maintenance	Hardware operation and maintenance
Training period	5-7weeks	4-5weeks
Trainees	About 3 engineers who will operate SCADA at ELECTRA	About 3 facility engineers at ELECTRA
Rough cost	About 100,000EUR(excluding airfare & accommodation)	

(3)Technical assistance package in Cape Verde

The preparation of checking logs (for record-keeping) and manuals must take account of the status of the subject facilities and their actual operation. For this reason, it would be advisable to perform the following tasks in the form of, for example, a technical assistance project in Cape Verde.

- Establishment of standards for facility planning, design, checking, and maintenance
- Preparation of a manual for facility design
- Preparation of a manual for operation of transmission and distribution lines
- Keeping of records for outages and failures

Place of implementation	Cape Verde and Japan
Period of implementation	2 years
Trainees	ELECTRA engineers
Areas for dispatch of experts	- Team Leader / facility operation - Distribution technology - Transformation technology - Distribution O&M - Transformation O&M - Protection relay O&M

Chapter 10 Assessment of the capabilities of construction companies

There is a limited supply of businesses capable of doing the requisite construction work in Cape Verde. To make the project plan for receiving financial assistance more effective, the Study Team held interviews with the three major firms undertaking most of the work for ELECTRA and also performing jobs outsourced by the national government (i.e., MTCV, Electromec, and Electric), in order to confirm matters such as their execution capabilities and quality. The table below outlines the execution capacities of each.

Table 10.1 Outline of construction companies

Name (Area)	Number of wokers (unit:peoples)	Number of annual construction works (Proceed including materials cost)	Ability of construction work	Quality of works
MTCV (Praia)	120 [details] Engineer:3 Assistant engineer:7 Electrical technitian:30 Laborer:80	72 man per year (660 million CVE)	OHL 1km ; 5days(8 peoples) UGL 1km(pavement) ; 10days(9 peoples) Secondary substation 1 unit; 20days(5 peoples and outsourcing)	It is considered their quality and ability are high. It is a leading company of Cape Verde and has plenty workers.
Electromec (Praia)	40 [details] Engineer:2 Electrical technitian:7 Laborer:31	30 man per year	OHL 1km ; 10days(8 peoples) UGL 1km(pavement) ; 15days(8 peoples) Secondary substation 1 unit; 45days(8 peoples and outsourcing)	It is considered their quality and ability are high. Employee is former ELECTRA engineer.
Electric (S.Vicente)	50 [details] Engineer:4 Electrical technitian:10 Laborer:36	46 man per year	OHL 1km ; 10days(7or8 peoples) UGL 1km(pavement) ; 15days(10 peoples) Secondary substation 1 unit; 25days(7 peoples)	It is considered their quality and ability are high. Employer and a employee are former ELECTRA engineer.

In the actual execution of construction based on international tenders, it is unlikely that a Cape Verde firm would be perform work independently. Thus far, the normal procedure has been to execute jobs through the formation of joint ventures with firms from other countries such as Portugal and France. Therefore, it is also conceivable that management technicians and electrical engineers would be sent over from foreign firms. In contrast, workers would basically be recruited from within Cape Verde.

As a result of examinations concerning the project considered in this study based on such circumstances, it was decided that the planned period of about three years would be fully practicable for implementation.

Chapter 11 Environmental and Social Considerations

11.1 Environmental and Social Conditions of Project Areas

11.1.1 Current Status of Natural Environment

(1) Geographical and Natural Conditions

The Republic of Cape Verde is an island state which is located at 460 km to 830 km west from the western coast of the African Continent. It stretches from the latitude of 14 degrees 48 minutes north to 17 degrees 12 minutes north, and the longitude of 22 degrees 44 minutes west and 25 degrees 22 minutes west. The total surface area of the country is 4,033 km^2. There are nine (9) inhabited islands in the country, and six (6) out of them are the target of this study. The overviews of the target islands are described below.

1) Santo Antão

The Santo Antão Island is situated in the most northern part of the Cape Verde archipelago, and the second largest island in the country. It is located between the latitude of 16 degrees 50 minutes north and 17 degrees 5 minutes north, and between the longitude of 25 degrees 10 minutes and 25 degrees 20 minutes west. It stretches approximately 43 km northeast and southwest, and approximately 24 km northeast and southwest. The surface area of the island is 779 km^2. There is a chain of mountains with the altitude between 1,000 m and 1,300 m which lies east and west in the central part of the island. The highest peak of the island is 1,979 m of Tope de Coroa, located in the western edge of the island. Tope de Coroa is designated as a protected area.

The width of flat plains of coastal areas is generally narrow, and mountains extend to the shorelines. The coastline of the western, northern, and eastern part has particularly steep slants, and the width of the flat plains is very narrow. On the other hand, in the southern part where Porto Novo, the main city of the island, is located, the slope is more gentle, and the flat plains are wider than the other parts. There are many rivers such as the Lindo Guincho near Porto Novo, the Patas in the southern part, the Paul in the northeastern part, and the Alto Mira in the northern part, and they formulate large-scale valleys with very deeply eroded topography. Rivers in the northern, eastern and western parts, in particular, flow into the sea with steep slants. Many rivers dry up in the dry season, but rivers in the northeastern part such as the Paul and the Torre are semi-permanent rivers.

The Santo Antão is a volcanic island with predominance of basaltic rocks. As the altitude exceeds about 700 to 800 m, the precipitation will in general increase, and thus the vegetation becomes richer. There is a water source called Cova with the altitude of 1166 m in the northeastern region, and the forest can be found on the edge of Cova. Five protected areas including Cova are designated in the northeastern region. On the other hand, vegetation in the southern and northwestern regions is generally scarce. In particular, soils of low land in the southern coastal area consist of sand mixed with volcanic ash, and thus most lands are not utilized. However, even in the southern and northwestern regions, trees and weeds are found along rivers. In addition, there are many villages in high altitude areas with richer vegetation, and maze and beans are cultivated.

2) São Vicente

The São Vicente Island is situated in the northern part of the Cape Verde archipelago. It is located between the latitude of 16 degrees 46 minutes north and 16 degrees 55 minutes north, and between the longitude of 24 degrees 51 minutes west and 25 degrees 5 minutes west. It stretches approximately 16 km north and south, and approximately 24 km east and west. The surface area of the island is 227 km^2. The island is dotted with hills with altitude of about 500

m, but it is gently undulated compared with the other islands. The highest peak of the island is 750 m of Monte Verde, located in the northeastern part of the island. Monte Verde is designated as a protected area.

There is a large flat plain in the central part of the island, and farmland and villages can be found in the plain. The coastal area from northeastern to eastern regions is low land, and sandy beaches can be frequently found. In these areas, resort development projects are planned and ongoing. There is a bay in the north, and Mindelo city, a representative port of Cape Verde, lies on the bay. Major rivers include the Chão do Madeiral in the east, and the Julião in the central part, but all of them dry up in the dry season.

The precipitation of the island is smaller than the other islands, and thus the vegetation is also scarce. Villages dot in the coastal areas or the flat plain in the central part, and agricultural lands are found in these parts. When water flows completely dry up in the dry season, lands in river channels are sometimes cultivated for maze and beans.

3) Sal

The Sal Island is elongated from north to south. It is located between the latitude of 16 degrees 31 minutes north and 16 degrees 36 minutes north, and between the longitude of 22 degrees 53 minutes west and 23 degrees 00 minutes west. It stretches approximately 30 km north and south, and approximately 11 km east and west. The surface area of the island is 216 km^2. The highest peak of the island is 406 m of Monte Grande, located on the edge of the northeastern part of the island. In addition to Monte Grande, some areas along the coastline are designated as protected areas.

The island has almost no hills, and flat and dry low deserted areas stretch. There are sandy beaches in Santa Maria and the surrounding areas in the southern part, and the areas are the base of tourism development. The center of the island is Espargos, located in the central part. Lands are almost unutilized except for towns and tourism development areas. Major rivers include the Beirona and the Padra in the central part, but the number of rivers is very small. All rivers dry up in the dry season.

The annual precipitation of the island is only about 60 mm, and thus the island is very dry. Vegetation is also very much scarce, but some plant species such as *Prosopis Juliflora* which adapted to the sandy and dry ecosystem can be found. There are few lands suitable for agriculture, and agricultural activities are hardly observed.

4) Maio

The Maio Island is in the elliptical form from north to south. The center of the island is Vila do Maio, situated in the southwestern coastal area. It is located between the latitude of 15 degrees 6 minutes north and 15 degrees 21 minutes north, and between the longitude of 23 degrees 5 minutes west and 23 degrees 14 minutes west. It stretches approximately 25 km north and south, and approximately 16 km east and west. The surface area of the island is 269 km^2. The highest peak of the island is 436 m of Monte Penoso, located in the eastern part of the island. From Monte Penoso to the west, there are hills with the altitude of approximately 200 m, and there is Monte Batalha with the altitude of 294 m on the western edge of the hills. In addition to Monte Penoso, Monte de Santo António in the north of Monte Penoso and the basin of the Figueira in the southern part are designated as protected areas.

The island has no high mountains and hills, and is characterized by gentle hills. There are rivers including the Morro in the western part, the Figueira in the southern part, and the Chico, but all of them dry up in the dry season.

The annual precipitation of the island is very scarce, and the vegetation is also scarce in general. Most of plant species observed are shrubs and weeds which adapted to dry climate conditions. Forests can be found in the basin of the southern part, and the western coastal areas of the central part.

5) Santiago

The Santiago Island is the largest island in Cape Verde, and the capital city of Praia is located in the southern part of the island. The island is located between the latitude of 14 degrees 54 minutes north and 15 degrees 21 minutes north, and between the longitude of 23 degrees 25 minutes west and 23 degrees 47 minutes west. It stretches approximately 55 km north and south, and approximately 30 km east and west. The surface area of the island is 991 km^2. The island consists of volcanic rocks and debris, and there is a chain of mountains with the altitude between 500 m and 1,300 m which lies north and south in the central part of the island. There are two major mountains in the chain of mountains, i.e., Pico da Antonia with the altitude of 1394 m in the south, and Serra da Malagueta with the altitude of 1064 m, which are designated as protected areas. Between the mountains is Assomada Highland with the altitude between 400 m and 600 m.

The width of flat plains of coastal areas is in general narrow, and mountains extend to the shorelines. In particular, the coastline of the western part has a steep slant, thus the width of flat plain is very narrow in the part. On the other hand, in the southern part where the capital city Praia is located and in the south-east part of the island, the slope is relatively gentle, and the flat plains are wider than the western part. There are many rivers including the Flamengos, the Santa Cruz, the Picos, and the Seca, in the eastern slope of the island, and they formulate large-scale valleys with deeply eroded topography. Rivers in the western part such as the Barca, the Charco, and the Aguas Belas, flow into the sea with steep slants. All rivers do not have permanent flow, and dry up in the dry season.

Vegetation is in general scarce due to the shortfall of precipitation. Along the coastal areas, unutilized land stretches with dotted acacia shrubs and weeds. As altitude increases, precipitation also increases, and thus the vegetation become richer. At high altitude areas, trees and weeds can be found on gentle slopes and along valleys. There are many plots for agricultural cultivation, such as maize and beans. As there are no permanent water flows in the rivers of the island, lands in river channels are sometimes cultivated.

6) Fogo

The Fogo Island is a volcanic island in the form of approximate circle. It is located between the latitude of 14 degrees 48 minutes north and 15 degrees 3 minutes north, and between the longitude of 24 degrees 16 minutes west and 24 degrees 30 minutes west. The island stretches approximately 25 km north and south, and approximately 23 km east and west. The surface area of the island is 476 km^2. The highest peak of the island is 2,829 m of Pico de Fogo, located in the central part of the island. It is a Konide-type active volcano, and the recent eruption was 1995. A caldera basin with the altitude of around 1,700 m is located within the outer rim of crater, whose altitude is about 2,200 m, and there is the village of Chã das Caldeiras in the basin.

Slope land extends from the outer rim of the crater to the coastal areas, and thus the width of the flat plains is narrow. Flat plains are hardly found along the shoreline. Compared to the western and southern parts, the interval of contour in the eastern and northern parts is narrow, and in particular the eastern coastline is almost steep cliff. Areas covered by lava flows and volcanic ash are frequently observed in the eastern part where vegetation is, in particular, scarce.

There are many rivers in the island, such as the Trindade flowing around São Filipe which is the economic center of the island, and the Vicente Dias. Almost all rivers radiate outward from the central volcano to the sea. All rivers do not have permanent flow, and dry up in the dry season.

The precipitation of the island is scarce, although it is higher than the other islands. The vegetation cover is generally scarce in the island. As altitude increases, precipitation also

increases, and thus richer vegetation such as trees and weeds are found at high altitude areas.

The circumferential road of the island passes between the altitude of about 300 m and 600 m except the São Filipe in the western part and Mosteiros in the northern part. Major villages are located along this road and at the altitude of about 400 m, but small villages are dotted on the slope up to 1200 m. Maze, beans and cassava are main crops, and cattle and goats graze in many areas. Vegetable, coffee, and grapes are cultivated on the highlands with much water.

(2) Meteorological Conditions

In Cape Verde, the average low temperature in Cape Verde is about 20 degrees Celsius, and the high is about 28. There are no significant differences among islands. Table 11.1 demonstrates the mean monthly temperatures of target islands. However, it should be noted that these are temperatures at observation points, and in islands with high altitude areas such as Santiago, Fogo, and Santo Antão, the temperature may significantly vary even in the same islands.

Table 11.1 Mean Monthly Temperatures of Target Islands (Average from 2000 to 2009)

Temp. (°C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Santo Antão (Lombo de Santa)												
Average	18.2	18.2	18.6	19.2	20.3	21.4	22.3	23.0	23.0	22.3	20.7	18.9
High	21.8	22.9	23.3	23.8	24.9	26.0	26.7	27.4	27.2	27.0	25.3	23.3
Low	14.2	13.5	14.0	15.5	15.6	16.8	17.8	19.7	19.7	18.8	17.5	16.2
São Vicente (Observer)												
Average	26.1	25.9	27.8	26.7	27.1	28.4	29.5	30.9	30.9	30.0	28.6	27.2
High	28.6	27.5	30.0	31.2	30.5	31.2	33.2	33.0	33.6	32.2	31.5	29.0
Low	24.4	23.5	25.0	24.8	25.0	27.0	27.6	29.0	28.5	27.5	25.8	25.5
Sal (Airport)												
Average	22.4	21.7	22.8	22.6	23.6	24.7	27.7	26.9	27.3	27.0	25.4	23.5
High	24.1	24.1	24.0	23.3	24.6	26.2	26.8	28.1	28.1	27.8	26.4	24.9
Low	21.2	19.9	21.5	21.8	22.7	24.1	24.5	25.9	26.2	25.6	24.4	20.0
Maio (Calheta Monte Vermelho)												
Average	23.2	23.3	23.0	23.4	24.4	25.4	26.2	27.3	27.9	27.5	25.9	23.9
High	23.7	29.4	27.0	25.6	25.5	27.6	28.0	28.7	28.9	29.9	28.5	27.5
Low	17.5	17.3	16.7	17.4	18.2	19.4	21.3	22.5	23.1	21.9	21.0	18.5
Santiago (Praia Airport)												
Average	23.4	23.4	24.0	24.2	25.1	25.9	27.0	27.1	27.5	27.4	26.2	24.0
High	24.1	24.3	25.6	25.6	26.9	27.1	28.0	28.4	28.6	28.6	27.2	25.6
Low	22.4	22.2	23.1	23.0	23.8	24.9	25.7	26.5	27.0	26.5	25.5	22.9
Fogo (Chã das Caldeiras)												
Average	16.9	16.3	17.9	20.8	20.6	21.7	20.1	19.4	18.4	17.7	17.3	15.7
High	21.6	22.3	23.2	25.8	25.3	25.9	24.5	24.2	22.8	22.2	22.4	20.9
Low	11.8	10.3	12.4	15.2	15.7	17.2	16.0	15.3	14.5	13.6	12.5	11.0

(Source) Instituto Nacional de Meteorologia e Geofisica

The climate of Cape Verde is largely characterized by the dry and rainy seasons. The rainy season starts in July and ends in October. The dry season is from November to June. Table 11.2 shows the mean monthly precipitations of target islands. However, it should be noted that these are the figures at observation points, and there may be significant variations in the same islands since the precipitations increase as the altitude become higher.

Table 11.2 Mean Monthly Precipitations of Target Islands (Average from 2000 to 2009)

Precipitation (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Santo Antão (Figueiral Paul)												
Average	19.5	1.3	1.0	3.6	3.7	0.0	25.7	77.0	90.5	162.3	94.8	19.9
High	90.0	13.0	8.2	25.0	37.0	0.0	72.0	181.5	126.3	613.0	275.0	103.9
Low	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	12.0	0.0	0.0	0.0
São Vicente (Observer)												
Average	13.5	0.8	0.6	1.1	0.0	0.0	4.0	18.9	43.9	24.4	13.2	0.7
High	62.2	8.1	5.9	11.2	0.0	0.0	34.4	74.2	126.2	63.2	97.3	3.5
Low	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sal (Airport)												
Average	5.5	0.2	0.0	0.0	0.5	0.0	0.8	24.1	18.6	9.5	0.3	0.6
High	21.7	1.6	0.0	0.0	5.0	0.0	6.2	91.9	68.3	75.9	1.6	4.8
Low	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maio (Calheta Monte Vermelho)												
Average	0.0	0.0	0.0	0.0	0.0	0.0	3.4	42.2	40.2	26.8	0.0	0.0
High	0.0	0.0	0.0	0.0	0.0	0.0	29.9	137.3	239.7	106.0	0.0	0.0
Low	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.2	0.0	0.0	0.0
Santiago (Praia Airport)												
Average	1.9	1.2	0.2	0.1	0.0	0.0	6.6	46.2	68.4	32.1	3.8	0.2
High	11.9	10.8	1.8	0.5	0.0	0.0	15.6	77.4	203.4	155.2	37.5	1.8
Low	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	3.9	0.0	0.0	0.0
Fogo (Mosteiros)												
Average	7.0	0.0	3.8	0.5	0.0	0.0	7.3	58.8	88.8	54.6	20.4	2.5
High	70.0	0.0	38.0	4.5	0.0	0.0	17.3	124.5	248.3	271.0	114.0	25.2
Low	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	0.0	0.0	0.0

(Source) Instituto Nacional de Meteorologia e Geofisica

11.1.2 Current Socioeconomic Status

(1) Population

According to the survey conducted in 2008 by INE (Instituto Nacional de Estatística), population in Cape Verde is approximately 500,000. By island, Santiago has about 283,000 and accounts for 56.6 % of the total population, followed by São Vicente whose population is about 78,000 (15.6%), and Santo Antão whose population is about 49,000 (9.8%). The populations and population densities of each island are given in Table 11.3.

Table 11.3 Population and population density of each island

Island	Population	Rate	Area (km^2)	Density /km^2
Santiago	282,730	56.6 %	991	285.3
Santo Antão	48,761	9.8 %	779	62.6
São Vicente	78,176	15.6 %	227	344.4
São Nicolau	19,398	3.9 %	349	55.6
Sal	12,940	2.6 %	216	59.9
Boa Vista	5,785	1.2 %	620	9.3
Maio	7,967	1.6 %	269	29.6
Fogo	37,798	7.6 %	476	79.4
Brava	6,241	1.2 %	64	97.5
Total	499,796			

(Source) INE

(2) Economic Situations

1) GDP

The recent trend of GDP in Cape Verede is presented in Table 11.4.

Table 11.4 Trend of GDP in Cape Verde

	2001	2002	2003	2004	2005	2006	2007	2008	2009
GDP (USD million)	559	617	809	918	997	1,192	1,513	1,744	1,755
GDP per Capita (USD)	1,264	1,370	1,763	1,964	2,094	2,457	3,080	3,464	3,419

Note: Figures in 2008 and 2009 is estimates by IMF

(Source) IMF, World Economic Outlook Database, October 2009

GDP in 2009 is USD 1,755 million. GDP per capita exceeded over USD 3,000 in 2007, and is 3,419 in 2009, thus the Republic of Cape Verde is classified as middle income country. In terms of the breakdown of GDP, the primary and secondary sectors have changed slightly in the recent 10 years, but the growth of the tertiary sector has been significant. The tertiary sector is considered to contribute greatly to the economic growth in recent years.

2) Poverty

Table 11.5 demonstrates the poverty ratio presented in the poverty reduction workshop held in 2007. The definition of poverty here is CVE 49,485 of annual income that was adjusted from the poverty line, CVE 43,250 of annual income, adopted in IDRF 2001/2002.

Table 11.5 Poverty Ratio in Cape Verde

Island	Municipality	Poverty ratio (%)
Santiago	Praia	11.6
	Ribeira Grande Santiago	39.3
	São Domingos	37.8
	Santa Cruz	46.0
	São Lourenço Orgaos	34.8
	Santa Catarina	42.8
	São Salvador Mundo	24.1
	São Miguel	45.9
	Tarrafal	42.1
Santo Antão	Ribeira Grande	44.0
	Paúl	54.1
	Porto Novo	43.5
São Vicente	São Vicente	13.6
São Nicolau	Ribeira Brava	18.2
	Tarrafal São Nicolau	22.7
Sal	Sal	4.0
Boa Vista	Boa Vista	8.0
Maio	Maio	15.0
Fogo	Mosteiros	51.7
	São Filipe	28.8
	Santa Catarina Fogo	59.0
Brava	Brava	35.1

(Source) 2007 Cape Verde Poverty Reduction Workshop

With respect to the target islands of the Study, the poverty ratios of Santiago, Santo Antão and Fogo are high, indicating from 30 % to 50 % or more.

11.2 Institutional Framework for Environmental and Social Considerations

11.2.1 Legal and Policy Framework for Environmental and Social Considerations

Laws and policies relevant to the environmental and social considerations of the Project are listed below.

1) Lei no 86/IV/93, de 26 de Julho: Basic law for environmental policy
2) Decreto-legislativo no 14/97, de 1 de Julho: Presentation of basic principles of the basic law
3) Decreto-Lei no 29/2006 de 6 de Março: Legal framework for environmental impact assessment
4) Lei no 137/IV/95, de 3 de Julho: Legal framework for environmental crimes and penal rules
5) Lei no 102/III/90, de 29 de Dezembro: Legal framework for cultural and natural heritages
6) Decreto-Lei no 3/2003, de 24 de Fevereiro: Legal framework for protected areas for nature conservation
7) Lei no 48/V/98, de 6 de Abril: Legal framework for forest management
8) Decreto-Regulamentar no 7/2002, de 30 de Dezembro: Legal framework for endangered species
9) Decreto-Lei no 5/2003, de 31 de Março: Legal framework for air pollution prevention
10) Decreto Presidencial no 22/98, de 25 de Maio: Legal framework setting standards for noise caused by construction works and other activities
11) Decreto-Lei no 7/2004, de 23 de Fevereiro: Legal framework for sewage
12) Decreto-Lei no 8/2004, de 23 de Fevereiro: Legal framework for water quality conservation
13) Decreto no 31/ 2003 de 1 de Setembro: Legal framework for municipality wastes and industrial wastes
14) Decreto-lei no 81/2005 de 5 de Dezembro: Legal framework for environmental information system
15) Plano de Acção Nacional para o Ambiente II: Second national action plan for the environment
16) Decreto-Legislativo 3/2007 de 19 Julho: Legal framework for land acquisition

(1) Legal and regulatory framework for environmental impact assessment

Decreto-Lei no 29/2006 de 6 de Março stipulates the procedures for environmental impact assessment (EIA) of development projects. Annex I and II of the Decreto-Lei no 29/2006 lists the categories of development projects that are required to conduct EIA. According to the General Direction of the Environment (DGA: Direcção Geral do Ambiente), the list was revised recently, and the latest version is enclosed as Appendix 3. The project categories that are relevant to the Projects are presented in Table 11.6. Whether a project falls under the category of Article 31 of Annex I is individually judged by DGA according to its components.

Table 11.6 Projects that are required to conduct EIA

Project category	Relevant articles
Facilities aiming to the transmission of electricity by aerial and underground cables	Annex I, Article 19 b)
Projects with significant impacts on water sources, forests and other resources, and soil erosion and other processes	Annex I, Article 31

Article 5 of Decreto-Lei no 29/2006 stipulates that EIA procedures may be exempted exceptionally by the decision of the Minister of Environment, Rural Development and Marine Resources if a project is deemed to cause minimal or negligible environmental impacts. A project proponent who wants to get the EIA exemption shall submit an application to DGA. The following documents shall be attached to the application: 1) Description of the project; 2) Description of activities to be conducted; 3) Major environmental effects; 4) Justification of the exemption. DGA assesses the application, and in case that the exemption is considered to be justified, DGA proposes the exemption of EIA to the Minister of Environment, Rural Development and Marine Resources within 20 working days from the reception of the application. The proposal shall indicate necessary mitigation measures against key environmental impacts. The Minister, in response to the proposal of DGA, will make a

decision of the exemption within 15 working days. The decision of the exemption and its justification will be disclosed to the interested parties based on the Decerto-Lei.

As a result of the above screening process, if EIA is required for a project, a project proponent shall elaborate an EIA report, and undergo the evaluation by DGA. When an EIA report is submitted to DGA, the Evaluation Committee, consisting of DGA, external experts, and representatives of Municipalities, evaluates the report. In the process of the evaluation, the contents of the report will be open to the public to invite public opinions. The result of the evaluation by the committee will be reported to the Minister of the Environment, Rural Development and Marine Resources, and the Minister will make a final decision on approval of the implementation of the Project.

According to DGA, the contents of EIA shall cover the following in general, though Decreto-Lei no 29/2006 does not specify the detailed contents of EIA reports. EIA reports shall be formulated based on the following contents, taking into account project components and potential impacts.

1) Project description covering the following
   - Physical characteristics of the project at construction and operation phases
   - Major characteristics of the manufacture process, types, natures and quantities of used materials
   - Types and quantities of wastes and gases to be emitted, in particular, water, atmosphere, soil, noise, vibration, light, heat, and radiation.
2) Major alternatives and their environmental characteristics
3) Current situation of the project site and environmental elements that could be affected by the project, including local residents, flora and fauna, soil, water, atmosphere, meteorology, construction and historical heritage, and their correlations.
4) Potential environmental impacts and their magnitudes
   - Overview of the project
   - Natural resource utilization
   - Emission of pollutants, environmental disturbance, and treatment of solid and liquid wastes
5) Methodology of prediction of environmental impacts and their scientific basis
6) Measures and technique for the following
   - Prevention, mitigation and compensation of adverse environmental impacts
   - Prediction of type and quantity of wastes and their recycling
   - Prevention of accidents
7) Monitoring plan for construction, operation, and closure
8) Difficulties and challenges with respect to technique and knowledge
9) Nontechnical summary, i.e. summary for people without expert knowledge

According to Decreto-Lei no 29/2006, acquisition of EIA approval will require 4 months, considering the durations set for each procedure by Decreto-Lei no 29/2006. According to DGA, based on the past experiences, EIA procedures will take two (2) to five (5) months in general. EIA procedures for projects with high priority, however, may be able to be completed in the shorter term.

Article 25 of Decreto-Lei no 29/2006 stipulates environmental monitoring. Project implementation entities are required to monitor environmental impacts as per the frequency specified by EIA reports. Monitoring items and methodologies will be chosen according to the project components and site characteristics. Project implementation entities shall formulate monitoring reports and submit them to DGA. DGA will check the reports and, when found violation of laws and regulations or insufficiency of mitigation measures, DGA can request the improvement of the entities' practices.

(2) Legal and regulatory framework for nature conservation

Decreto-Lei no 3/2003 de 24 de Fevereiro provides the legal framework for protected areas. The Annex of the Decreto-Lei designates a total of 47 protected areas, and there are 27 in the target islands (Appendix 4). Protected areas are categorized into each of the following: Natural Reserve (Reservas Naturais), National Park (Parque Nacional), Natural Park (Parque Natural), Natural Monument (Monumento Natural), Landscape Conservation Area (Paisagem Protegida), and Site of Scientific Interest (Sitio de Interesse Cientifico). In these protected areas, development activities, such as reclamation of land, construction and rehabilitation of buildings and cutting of trees, and sales and purchases of land are regulated according to the categories. Persons who plan to implement such development activities and sales and purchases of land shall acquire the permission from the management offices of protected areas in advance (Article 13 of Decreto-Lei no 3/2003). In addition, in Reservas Naturais Integrais, a sort of Natural Reserves, all activities that have potential to affect ecosystem, including inhabitating and storing materials, are strictly prohibited. Development activities to be permitted can vary depending on the categories of protected areas, and detailed criteria for the permission will be clarified by a management plan of each protected area.

However, almost all protected areas do not function in practice at present. Although boundaries of the many protected areas are declared by official gazettes, management system for them is not well established. A project aiming to establish management system for selected protected areas (Integrated participatory ecosystem management in and around protected areas), assisted by Global Environmental Facility (GEF) and United Nations Development Programme (UNDP), is ongoing, however, protected area management plans have not been formulated yet in protected areas except those being assisted under the GEF-UNDP project. Likewise, area management offices have not been established. As a result, if some construction works are planned in and around such protected areas, conservation measures shall be elaborated on case-by-case basis. Therefore, persons planning to such works need to have consultations with DGA about conservation measures at earlier stages.

With respect to islands investigated under the Study, area management plans are being formulated under the GEF-UNDP project for Serra da Malagueta in Santiago, Moroços and Cova, Ribeira de Torre and Ribeira de Paul in Santo Antão, Monte Verde in São Vicente, and Cha das Caldeiras in Fogo.

The Republic of Cape Verde ratified the Ramsar Convention[13], and registered three (3) wetlands in July 2005 (Table 11.7). All of the wetlands are located in the other islands than those to be investigated in the Study.

Table 11.7 Ramsar Wetlands in Cape Verde

Name of Wetland	Island/ Location	Registration
Curral Velho	Boa Vista island	July 2005
Lagoa de Pedra Badejo	An uninhabited island located in the weste-northwest of Brava island	July 2005
Lagoa de Rabil	An uninhabited island located in the north of Brava island	July 2005

(Source) Website of the Ramsar Convention <http://www.ramsar.org/index.html#top>

(3) Legal and regulatory framework for pollution prevention

Legal and regulatory framework for pollution prevention is deemed not to be well established in Cape Verde. In terms of air pollution control, Decreto-Lei no 5/2003 presents

[13] The Convention on Wetlands of International Importance especially as Waterfowl Habitat

basic principles of air pollution prevention, but environmental quality standards for air and emission standards of air pollutants are not established. Environmental standards for noise are not established yet, and DGA refers to European standards when it evaluates EIA reports. Water quality standards for sewage are provided by Decreto-Lei no 7/2004 de 23 de Fevereiro, and standards for potable water and other water bodies are presented by Decreto-Lei no 8/2004 de 23 de Fevereiro.

(4) Legal framework for land management

Land in Cape Verde falls into each of the following three categories: state land, municipality land, and private land. The ownership of the land is secured by the registration. The Conservatória Registo PREDIAL under the Ministry of Justice is responsible for the land registration.

Land for public projects are, in general, acquired through negotiations between a project implementing agency and land owners. The implementing agency will identify land owners through a line route survey, and negotiate with them. For the state land and municipality land, the agency will obtain consents of relevant government agencies and municipalities for the use of their lands. With respect to private land, the agency will negotiate with land owners, and give compensation for the use of their lands. The above process of land acquisition for public projects, including the evaluation and estimation of compensation, is under the jurisdiction of the General Direction of Property and Public Procurement (DGPCP: Direcção-Geral do Património e de Contratação Pública) under the Ministry of Finance. DGPCP, responding to the request from the implementing agency, forms a land evaluation committee for respective public projects, and the committee estimates the standard costs for land to be acquired. DGA is not engaged in the land acquisition process.

If compulsory land acquisition is required due to difficulties in negotiations or other reasons, necessary procedures in accordance with Decreto-Legislativo 3/2007 de 19 Julho will be taken. An implementing agency, MTIE in case of the Project, is responsible for the arrangement of necessary procedures including the approval of the cabinet meeting. In case of the compulsory land acquisition, necessary compensations will be paid to land owners. The Decreto-Legislativo classified land into urban plots and rural plots, and different criteria are set for the calculation of compensation. The amount of compensation will be calculated based on location and building prices in urban areas, and on agricultural produce and locations in rural areas. According to the Decreto-Legislativo, compensation includes not only for the values of properties to be acquired but the cost for livelihood restoration. On the other hand, there are no laws and regulations related to involuntary resettlement.

According to DGPCP, no compulsory land acquisition has taken place in Cape Verde to date. Land owners are usually cooperative with the public projects such as electricity development and road construction, and necessary land can be acquired usually through negotiations.

(5) Legal framework for cultural heritage

Lei no 102/III/90 de 29 de Dezembro stipulates the conservation of cultural properties. Cultural properties designated as those with cultural, historical, scientific and artistic values by the Minister of Culture and Sports are conserved under the law. It is restricted to make changes to the designated properties without the Minister's permission. The law requires the Ministry of Culture and Sports to formulate the inventory of cultural properties, however, the preparation of the inventory has not been completed at present according to the Ministry.

The Lei stipulates that if buried cultural properties are found during construction works, the project developer shall report to the Minister of Culture and Sports and investigate the properties in detail. The developer will, after the investigation, consult with the Ministry of Culture and Sports about conservation measures for the properties.

The Republic of Cape Verde ratified the 1972 World Heritage Convention in June 1984. Cidade Velha, Historic Centre of Ribeira Grande was inscribed on the World Heritage List at present, and five (5) properties were submitted on the tentative list (Table 11.8). In relation to the Project, an underground transmission line is planned to be constructed around Cova e Montantes de Ribeiras da Torre et do Paul. No construction works are planned in the vicinity of the other properties listed.

Due considerations should be given to the other properties than the above because there may be ancient and historical sites, historical buildings, geologically valuable sites and other important sites in the vicinity of the project sites.

Table 11.8 World Heritages in Cape Verde (including tentatively registered properties)

Name	Category	Status	Location
Cidade Velha, Historic Centre of Ribeira Grande	Cultural	Inscribed	Southern part of Santiago, about 10 km east of Praia
Camp de concentration de Tarrafal	Cultural	Tentative	Northern part of Santiago, Tarrafal
Cova e Montantes de Ribeiras da Torre et do Paul	Natural	Tentative	Santo Antão, about 5 km southwest of Port Novo
La Saline de Pedra Lume	Mixed	Tentative	Sal, about 6 km northeast of Espargos
Le Plateau de la ville de Praia	Mixed	Tentative	Santiago, Praia
Ville de São Filipe	Cultural	Tentative	Fogo, about 3 km southeast of São Felipe

(Source) UNESCO World Heritage Website ＜http://whc.unesco.org/＞

11.2.2 JICA Policy for Environmental and Social Considerations

"Japan Bank for International Cooperation Guidelines for Confirmation of Environmental and Social Considerations[14]" published in 2002 (JBIC Environmental Guidelines) is applied to the Project. The guidelines aim at contributing to sustainable development by developing countries, through ensuring appropriate environmental and social considerations. Environmental and social considerations here cover the conservation of the environment, and social impacts such as involuntary resettlement and respect for the human rights of indigenous peoples.

JICA, based on JBIC Environmental Guidelines, implements the following to ensure environmental and social sustainability of all projects to be funded by JICA.

- Screening: to classify the project into one of the categories of A, B, C and FI, according to the intensity and extent of the projects[15]
- Environmental Review: to review environmental and social considerations, when making a decision on funding, to confirm that the environmental requirements are satisfied
- Monitoring: Conduct monitoring and follow-up after the decision has been made on funding

The Project falls into the Category-B project because of the following reasons.

- The potential impacts of the Project are expected to be less adverse than those of

[14] New environmental guidelines were proclaimed in April 2010, which covers all projects performed by JICA after the merge with JBIC in October 2008. The new guidelines will come into force in July 2010, therefore, the old JBIC Environmental Guidelines is applied to the Project.

[15] JBIC Environmental Guidelines categorizes development projects into each of the four following categories.
Category A: a project that is likely to have significant adverse impacts on the environment
Category B: a project whose adverse environmental impacts are less adverse than that of Category A projects
Category C: a project that is likely to have minimal or no adverse impacts
Category FI: a project whose actual subprojects cannot be identified before JICA's approval of the funding, and which is likely to have adverse environmental impacts

Category-A projects.

- The potential adverse impacts are largely site-specific, and thus can be mitigated easily and effectively.
- The only irreversible impacts are loss of agricultural and other privately-owned land, but the scale of the land acquisition under the Project is expected to be small.

JICA conducts an environmental review on a Category-B project based on information provided by borrowers and related parties. The scope of the review may vary from project to project, assessing the environmental and social impacts and mitigation measures against adverse impacts. If an EIA report has been prepared, the EIA report may be referred to in the review process. The environmental checklists for each sector attached to the JBIC Environmental Guidelines will be referred to in conducting the environmental reviews.

11.2.3 Organizations for Environmental and Social Considerations

(1) General Direction of Environment

DGA of the Ministry of Environment, Rural Development and Marine Resources are responsible for the EIA of development projects. DGA consists of three (3) directions, i.e., the Direction of Juridical Services, Inspection and Environmental Impact Assessment, the Direction of Natural Resources Management and the Direction of Information and Monitoring of Environmental Quality, and the General Director supervises them. Decreto-lei no 56/2005 de 22 de Agosto mandates respective departments. The Direction of Juridical Services, Inspection and Environmental Impact Assessment is in charge of the evaluation of EIA reports. There are nineteen (19) staff in DGA at present, and of the total, fourteen (14) are technical staff, two (2) are assistants, and three (3) are administrative staff.

(2) ELECTRA

In terms of the organizational structure for environmental management of ELECTRA, there is the Office of Quality and Environment in ELECTRA, but no staff of the headquarters is assigned to the Office. The Office is supervised by the Assistant Councilor for Management. Main tasks of the Office are the compilation of data reported from laboratories in Praia and São Vicente and the check of the result of water quality inspection. No staff is dealing with environmental and social issues related to electricity supply. Such tasks will be contracted out to external consultants when necessary.

11.3 Environmental and Social Impacts

11.3.1 Project Component and Necessity of EIA

(1) Project Component

The components of projects planned in the Study are indicated in Table 11.9.

Table 11.9 Planned project component

Category	Work	Location/ Island
Transmission	Construction and replacement of aerial cables	Construction: Maio and Fogo Replacement: Santo Antão, São Vicente, Fogo and Maio
	Construction and replacement of underground cables	6 islands
	Installation of Circuit Breaker, SCADA and Fault Locator	6 islands
Distribution	Construction and replacement of distribution lines	6 islands
	Construction of secondary substations	6 islands

Aerial 20 kV transmission lines are usually wired on wooden poles with 12 m height, but in some cases on 15-meter-high wooden poles. In urban areas and areas susceptible to salt corrosion such as coastal areas, underground cables are usually adopted. Most underground cables are constructed in road reserves. Even in sections where underground cables are planned, aerial cables may be partly selected for some sections where the construction of underground cables is difficult due to geological and geographical condition.

For the distribution of electricity, main components are the construction and rehabilitation of distribution lines in urban areas and villages. Aerial distribution lines are wired on 10-meter-high wooden poles, but underground lines are usually selected for urban areas. With respect to secondary substations, a transformer and related facilities are in general installed in a building about 4 to 5 meters square or on polls. The former type of substations will be constructed on unused land.

(2) Necessity of EIA

Out of planned project components, components that EIA is required in accordance with the Decreto-Lei no 29/2006 are the construction of aerial and underground transmission and distribution lines (Annex I, Article 19 b).

Aerial lines which may cause adverse environmental and social impacts are planned in Fogo and Maio. Replacement of aerial lines is planned in Santo Antão and São Vicente. On the other hand, underground lines are planned to be constructed in all six (6) islands. Therefore, it is concluded that, in all target islands, projects that EIA is required are planned.

For works that may not have significant environmental and social impacts, EIA can be exempted as per Article 5 of Decreto-Lei no 29/2006. Whether EIA is exempted is judged by DGA based on the evaluation on an application form which describes planned works and locations and specifications of facilities. Hence at this moment, it is impossible to identify the works that are exempted from EIA. With respect to the installation of secondary substations, circuit breakers and SCADA, EIA is not necessary as per Decreto-Lei no 29/2006. However, in relation to secondary substations, proper disposal and storage of waste transformers should be given due attention as discussed later.

Furthermore, whether some projects fall under the category of Article 19 of Annex I should

be confirmed. Although such projects are not identified at present, there may be some projects that may have significant impacts on natural resources and processes, depending on the geological, geographical and other site-specific conditions. It is necessary to confirm such conditions at the D/D phase.

When conducting EIA, packaging individual works by the islands can be an efficient option since conducting EIA for individual works respectively may result in too complicated and cumbersome procedures. DGA also supports such packaging ideas. In all islands, EIA is expected to be required since construction and/or rehabilitation of aerial and/or underground transmission lines are planned in all islands. In particular, for Santo Antão, São Vicente, Maio and Fogo where aerial lines are planned to be constructed and rehabilitated, EIA will be essential. It should be noted that even if EIA is exempted, an application form which describes the main activities and potential impacts shall be prepared and submitted to DGA. In addition, an environmental review shall be conducted in accordance with the JBIC Environmental Guidelines.

As of May 2010, MTIE as a project implementing agency is preparing the implementation of EIA, such as the elaboration of TOR for consultants. MTIE has also started to consult with DGA about the EIA procedure for the Project. MTIE states that it will take necessary procedures to acquire the EIA approval from DGA before the loan agreement of the Project.

11.3.2 Methodology for Study on Environmental and Social Considerations

The Study on Environmental and Social Considerations identifies potential adverse impacts and elaborates necessary mitigation measures through reviews on relevant laws and regulations and literatures, on-site investigations on planned project sites, investigations on existing transmission and distribution facilities, and interviews with relevant entities and other stakeholders. With respect to on-site investigations, sampling surveys on existing facilities and expected projects are conducted since it is difficult to cover all the planned projects within the limited study duration, and it is impossible to conduct detailed surveys when detailed routes are not yet determined.

Table 11.10 shows the sampled facilities under this study.

Table 11.10 List of sampled facilities

Category	Location/ Island
MV transmission and distribution lines	Santo Antão, São Vicente, Sal, Santiago, and Fogo
Secondary substations	São Vicente, Sal, Santiago, and Fogo

11.3.3 Scoping Table

Table 11.11 provides the framework of the scoping for environmental and social impacts of the Project. The scoping table was elaborated based on the general specifications of power transmission and distribution facilities, and environmental and social situations in Cape Verde.

Table 11.11 Scoping table for potential impacts

Impact	Construction	Operation
Air pollution		
Water pollution		
Noise and vibration	B	
Waste	B	B
Soil contamination		
Protected areas/ Biodiversity	B	C
Hydrology/ Groundwater		
Soil erosion/ Landslide	B	
Involuntary resettlement		
Land acquisition	C	C
Livelihood/ Income		
Cultural heritage	C	C
Landscape	C	C
Ethnic minorities/ Indeginous peoples		
Infetious diseases	B	B
Accident/ Safety	B	B

[Legend] A: Significant impacts expected B: Certain impacts expected
C: Existence of impact unknown No mark: Negligible impacts

(1) Air pollution

Certain amount of air pollutants will be emitted from construction vehicles, however, the impacts is negligible since 1) there are no or less pollution sources in Cape Verde, thus there is no concerns about cumulative air pollution, and 2) the construction works will be completed in the short term. No pollutants will be emitted from the transmission and distribution facilities themselves after the completion of the works.

(2) Water pollution

There is no concern about water pollution caused by the construction of transmission and distribution lines and secondary substations.

(3) Noise and vibration

Construction works will cause noise and vibration, and thus the noise and vibration may disturb local people's livelihoods if they are planned in the vicinity of residential areas. Operation of transmission and distribution facilities will not cause noise and vibration.

(4) Waste

Waste soils and other construction wastes will be generated by construction works. Waste transformers may be generated by replacing old transformers with new ones. PCBs may be contained in the oil of old transformers.

(5) Soil contamination

Construction of power transmission and distribution lines and secondary substations will not cause soil contamination.

(6) Protected areas and biodiversity

Vegetation removals and tree cutting during construction works for power transmission and distribution lines may cause certain impacts on protected areas and wildlife. However, impacts associated with construction works are considered limited since the planned works such as installment of poles, wiring of cables, and construction of secondary substations are small-scale, and many of planned routes are along the existing road reserves. Collisions of birds with aerial cables may take place when overhead cables are wired in the vicinity of breeding sites or colonies of sea fowls and other birds. The existence/nonexistence of such impacts and their extents rely on the location of the related facilities. Although such breeding sites and colonies

are not found along the planned transmission and distribution lines at present, it is necessary to confirm the existence/nonexistence of such sites through on-site investigations and interviews with local residents.

In terms of individual projects, a part of transmission lines to be constructed under the Project of Closing of Maio Ring will pass the Barreiro e Figueira Natural Park (Parque Natural de Barreiro e Figueira). This aerial line may also pass at the edge of Monte Penoso e Monte Branco Protected Landscape. The impacts of this aerial line are expected minor since the line will be constructed along the existing road. It is, however, necessary to confirm existence of birds' colonies as stated above. In addition, the construction of an aerial transmission line is planned between Tinteiros- Relvas in Fogo. This aerial line is not expected to cause significant impacts since it is planned to be constructed along the existing road reserve. However, it is necessary to check birds' colonies.

(7) Hydrology and groundwater

Construction of power transmission and distribution lines and secondary substations will not have adverse impacts on hydrology and groundwater.

(8) Soil erosion and landslide

Soil erosion may be caused by construction works when power transmission and distribution lines are constructed in the mountainous or slope areas.

(9) Involuntary resettlement

The facilities of power transmission and distribution lines and secondary substations are in general small scale, and the construction of such facilities will usually avoid houses and other buildings. In terms of facilities for power transmission and distribution, no technical problems are expected even if there are differences of several tens of meters between planned transmission and distribution routes and sites for related facilities, and the actual routes and sites. It is, therefore, possible to avoid the buildings when determining routes and sites if buildings are found on planned routes and sites for facilities. Involuntary resettlement is not anticipated.

(10) Land acquisition

Aerial transmission and distribution lines are wired on wooden poles, and thus a small land plots for the construction of wooden poles are required. In terms of secondary substations in Cape Verde, a transformer is placed in a building about 4 to 5 meters square in general, and a land plot for the construction of such building is necessary to be acquired. Although it is at present impossible to identify whether planned sites for secondary substations are private lands, small-scale land acquisition is anticipated. However, the extent of impacts is unclear since detailed routes and sites for related facilities are not yet determined. Impacts caused by land acquisition will continue after the operation of related facilities.

(11) Livelihoods and living standards

Construction of power transmission and distribution lines and secondary substations will not have adverse impacts on local peoples' livelihoods and living standards.

(12) Cultural heritage

Certain impacts on cultural heritage may be caused when transmission and distribution lines are constructed in the vicinity of cultural heritages. In addition to the culturally and traditionally valuable heritages, sites and properties closely related to local residents' livelihoods, including cemeteries, shall be given due attention. The impacts rely on the location of the related facilities, thus the existence/nonexistence of the impacts and their extent are unclear at present. It is necessary to confirm the existence of cultural heritages in the vicinity of planned routes and sites during line-route surveys at the D/D phase.

With respect to individual projects, an underground transmission line is planned to be constructed around Cova e Montantes de Ribeiras da Torre et do Paul, thus there may be certain visual or other impacts on the heritage. No construction works are planned in the vicinity of

the other heritages.

(13) Landscape

Certain visual impacts may be caused since aerial lines are planned to be constructed on wooden poles with 12 meters height, though the possibility to cause significant impacts is low. The impacts and their extents rely on the location of the related facilities, and thus existence/nonexistence is unclear at present.

In terms of individual projects, a part of transmission lines to be constructed under the Project of Closing of Santo Antão will pass the Pombas Protected Landscape. Although underground lines will be adopted in the project, certain impacts may be caused during construction works. An aerial line is also planned along the existing road passing the edge of Monte Penoso e Monte Branco Protected Landscape in Maio. Certain impacts might be caused, although the impacts are considered insignificant since the line is planned along the existing road, and the height is as low as 12 meters.

(14) Ethnic minorities and indigenous peoples

According to MTIE and DGA, there is no legal framework for the protection of ethnic minorities and indigenous peoples in Cape Verde and no habitats for them are designated.

(15) Infectious disease

HIV prevalence in Cape Verde is relatively low, being estimated about 0.8 % in 2007[16]. However, possibility of spread of HIV and other infectious diseases due to the inflow of construction workers is undeniable.

(16) Accident and safety

There are possibilities of accidents during construction works, traffic accidents caused by construction vehicles, breakdown of power lines due to disasters, and electric shock caused by the broken lines.

11.4 Mitigation Measures

This section discusses mitigation measures against impacts predicted in 11.3.3.

(1) Noise and Vibration

Construction works, if conducted in the vicinity of residential areas, should avoid midnight and early morning. Impacts of noise and vibrations on nearby households should be mitigated by prior notification of the date and time and duration of construction works. Regular maintenance of construction vehicles and heavy machines shall be ensured to mitigate noise and vibration.

(2) Waste

Waste soil generated by construction works shall be used for back-filling. Construction companies and workers shall be guided not to leave waste soils and other wastes to construction sties. Articles requiring proper disposal of construction wastes shall be incorporated into the contract with construction companies to ensure proper waste disposal.

Waste transformers shall be properly stored to prevent leakages of waste oils. In Cape Verde, a system for proper disposal of PCB wastes is not established. When transformers are found to have possibilities of including PCB, it is crucial to properly store PCB waste oil to prevent the leakage into the environment. When new transformers are procured, PCB free transformers shall be chosen. The following measures are set in the guidelines to store PCB wastes specified by Japanese Waste Management Law. MTIE and ELECTRA need to properly

[16] Website of Ministry of Health (http://www.minsaude.gov.cv/index.php)

store PCB wastes in reference to the guidelines.

1) Take necessary measures to prevent the volatilization of PCB such as storing PCB oil into sealed containers, and to prevent exposure of PCB oil to high temperature.
2) Take necessary measures to prevent the decay of containers of PCB wastes.
3) Set fences around storage sites.
4) Put a board indicating the followings in a prominent part of storage sites.
   a) That PCB waste is stored here
   b) Name of personnel or organization responsible for the storage and its contact information
5) Take necessary measures to prevent splash, leakage, and infiltration into the ground of PCB waste, and emission of offensive odors from PCB waste.
6) Take necessary measures to prevent rats, and mosquitoes, flies and other harmful insects.

(3) Protected areas and biodiversity

Vegetation removal and tree cutting during construction works shall be minimized. It is necessary to conduct detailed surveys on flora and fauna, and distribution of their habitats and protected areas within and around planned project sites. The environmental conservation measures shall be elaborated based on the above survey results. In particular, breeding sites and colonies of birds should be given due attention to avoid the construction of transmission lines on the migratory routes of birds. The environmental conservation measures should be considered in line with the following steps.

1) Line route surveys shall be conducted prior to the determination of the detailed routes of transmission and distribution lines. When protected areas and habitats of valuable or endangered species are identified in the vicinity of the planned line routes, it is necessary to avoid them as much as possible.
2) If some impacts are unavoidable, it is necessary to minimize the impacts by the adjustment of construction schedule and methods. The following measures shall be undertaken.
   - Suspension of civil works and change of working hours during breeding period
   - Conservation of vegetation around the habitats of valuable species and the surrounding environment
   - Minimization of the clearance of obstacle trees
   - Appropriate storage of waste soils and construction materials
   - Alteration of planned works from aerial lines to underground lines around the breeding sites and colonies of birds to minimize the risk of bird collision with aerial cables
3) After the completion of construction works, re-vegetation shall be undertaken according to the surrounding environment.

(4) Soil erosion and landslide

To prevent soil erosion, avoidance of civil works during the rainy season, construction of drainage with enough capacity, minimization of vegetation clearance, re-vegetation of construction sites, and compaction of soils after civil works shall be undertaken.

(5) Land acquisition

It is necessary to conduct line route surveys prior to the formulation of the detailed project plans, and to identify land owners. In particular, when private lands need to be acquired, it is necessary to consult with affected land owners and to obtain their agreement. If large-scale land acquisition is expected, a plan for land acquisition indicated shall be formulated to ensure smooth implementation of the acquisition (Table 11.12). Even if the expected number of affected land owners is considered small, it is recommended to incorporate critical items listed in Table 11.12 into an environmental management plan. The critical items here include prior consultations with local residents and consensus building, compensation, cost for land

acquisition, and monitoring system.

Table 11.12 Framework for land acquisition

1. Scope of land acquisition • Objectives of land acquisition • Scope of land acquisition and resettlement with map information, and the necessity, etc.
2. Socioeconomic information • Definition and number of people to be affected • Impacts on people to be affected, taking into account social, cultural and economic parameters • Identification of all assets to be affected, etc.
3. Policy framework • Key national and local policies, laws, and guidelines for land acquisition and compensation • Eligibility of people who receive compensation and other supports, etc.
4. Public consultation and grievance redress • Mechanisms for stakeholder participation in planning, management, monitoring, and evaluation. • Identification of local institutions or organizations to support people affected, and potential role of NGOs • Procedures for redress of grievance by people affected, etc.
5. Implementation of land acquisition • Determination of compensations, and provision of compensations • Special measures for addressing gender issues and those related to vulnerable groups • Plan to support income restoration such as provisions for income substitution, etc.
6. Institutional framework • Institutional mechanism in charge of planning, negotiating, coordinating, implementing, and monitoring • Review of the mandates of implementing agencies responsible for land acquisition, etc.
7. Budget and financing • Identification of land acquisition costs and their financial sources • Preparation of an annual budget and a plan of timing for release of funds, etc.
8. Implementation schedule • Time schedule showing start and finish dates by major task, etc.
9. Monitoring and evaluation • Plan for internal monitoring, key indicators of progress, mechanisms for reporting • Evaluation plan including external and independent evaluation, etc.

(Source) Modified from *ADB Handbook on Resettlement: A Guide to Good Practice*

(6) Cultural heritage

If certain impacts on cultural heritages are predicted, it is necessary to consult with relevant municipality governments, local residents, and the Ministry of Culture and Sports, and to consider mitigation measures such as the modifications of part of planned routes and relocation of the heritages. When buried cultural properties are found, it is necessary to consult with the Ministry of Culture and Sports about detailed investigations on the properties, and to elaborate conservation measures such as change of construction plans and facility specifications, and relocation of the properties.

(7) Landscape

It is necessary to consult with local governments, local residents and DGA on whether visual impacts are predicted, and to take mitigation measures such as the modifications of part of the project plan including route changes and adoption of underground cables, coloring of wooden poles, and re-vegetation after civil works.

(8) Infectious disease

Education and promotion activities on infectious diseases shall be provided to construction workers and local residents.

(9) Accident and safety

Safety education to prevent accidents shall be provided to construction workers and maintenance and management staff. Regular patrols on the conditions of transmission and

distribution lines are also necessary.

11.5 Environmental Management Plan and Environmental Monitoring

11.5.1 Environmental Management Plan

To avoid and/or mitigate the environmental and social impacts caused by the Project, it is essential to conduct environmental monitoring as well as to take necessary mitigation measures proposed in EIA reports. An environmental management plan can be an effective tool to ensure proper implementation of such environmental measures.

It is therefore necessary to formulate an environmental management plan which covers the following points, referring to EIA reports.

Table 11.13 Framework for Environmental Management Plan

1) Mitigation measures against potential adverse impacts
• Clarification of necessary mitigation measures
• Implementation mechanism and responsibility of mitigation measures
2) Monitoring of adverse impacts
• Monitoring of the implementation status of mitigation measures, and their effectiveness (monitoring items and methodology)
• Monitoring of environmental quality such as air, water, and noise (monitoring items and methodology)
• Monitoring of unexpected impacts (monitoring items and methodology)
• Measures to be taken based on the monitoring results
3) Implementation mechanism of the Environmental Management Plan
• Appointment of staff in charge of environmental management, and clarification of his/her responsibilities
• Training for staff and contractors
4) Disclosure and public participation
• Disclosure of the progress of projects
• Disclosure of the implementation status of mitigation measures and monitoring results
• Setting of stakeholder meetings
• Procedures for processing complaints
5) Implementation schedule
• Implementation schedule by individual task

11.5.2 Environmental monitoring item

Environmental monitoring of adverse impacts is a critical component of an environmental management plan. Through the monitoring activities, whether mitigation measures proposed in EIA are appropriately implemented and whether adverse impacts unexpected by EIA are observed can be confirmed. In addition, revising an environmental management plan based on the monitoring results will enhance the effectiveness of environmental measures.

As per the requirements of Article 25 of Decreto-Lei no 29/2006 and the JBIC Environmental Guidelines, MTIE as the implementing agency is responsible for the environmental monitoring of the Project. To implement the environmental monitoring, an environmental monitoring mechanism should be established within the Project Implementation Unit.

The monitoring form for the Project is formulated based on the scoping results and considerations of mitigation measures (Appendix 5). Main monitoring items indicated in the form is described in Table 11.14.

Table 11.14 Main monitoring items

Category	Monitoring item
EIA process	• Response to comments from DGA and the public • Compliance with conditions if they are imposed on the approval of EIA
Wastes	• Check whether construction wastes are properly disposed of • Check whether old transformers are properly disposed of or stored
Noise/ Vibration	• Check whether construction works are conducted during daytime hours • Check whether local residents are informed of the schedule of works
Protected areas/ Biodiversity	• Check whether projects cause large-scale vegetation clearance • Check existence/nonexistence of breeding sites and colonies of birds • Check whether proposed conservation measures are properly undertaken such as switch from aerial to underground cable
Soil erosion	• Check whether earthworks are undertaken in the dry season • Check whether soil protection measures, such as drainage construction, minimization of vegetation clearance, re-vegetation, and soil compaction are properly undertaken • Check the conditions of construction sites to evaluate adequacy of soil protection measures
Land acquisition	• Check whether the land acquisition procedure is properly undertaken, focusing on consent of affected land owners, proper compensation, and attention to vulnerable persons • Confirm the perceptions and complaints of affected land owners
Cultural heritages	• Check whether consultations with local stakeholders are properly undertaken • Implementation of investigation if buried cultural properties are found • Check whether the proposed mitigation measures are properly undertaken
Landscape	• Check whether consultations with local stakeholders are properly undertaken • Check whether mitigation measures such as the adoption of underground cables are properly undertaken
Infectious disease	• Check the progress and contents of education activities for construction workers and local residents
Accident/ Safety	• Check whether potential safety hazards are explained to construction workers • Check whether the proposed safety measures are undertaken • Confirm the perceptions of local residents
General	• Check the effectiveness of the proposed mitigation measures • Check whether unexpected impacts occur

11.5.3 Environmental monitoring mechanism

The Project Implementation Unit (PIU[17]) is primarily responsible for an environmental monitoring mechanism. The organizational structure for the PIU of the Project has not determined yet. However this section describes the PIU for the ongoing "Power Supply and Transmission Line Project" (AfDB-JICA Project) assisted by African Development Bank (AfDB) and JICA as a reference. The PIU for the AfDB-JICA Project was established in the Special Project Management Unit (UGPE) of the General Direction of Energy (DGE) of MTIE. The PIU is primarily responsible for the environmental and social impact study and environmental monitoring of AfDB-JICA Project, and the necessary tasks are contracted out to the external consultants.

ELECTRA, on the other hand, does not have primary responsibility for the environmental and social study and environmental monitoring, though ELECTRA provides technical assistance and information according to the requests from the PIU. In fact, as described in 11.2.3, human resources of the Quality and Environmental Office of ELECTRA are very limited, and it is unrealistic for ELECTRA to conduct environmental monitoring of the Project.

Taking into account the above, the PIU to be established for the Project should bear direct

[17] CEP (Célula de Execução do Projecto = Project Execution Unit) in Portuguese

responsibility for environmental monitoring and, as appropriate, external consultants need to be utilized. It is, therefore, necessary for the PIU to enhance the capacity to elaborate the Terms of References for the consultants and to check the monitoring results reported by the consultants. MTIE, therefore, should establish an effective monitoring mechanism by ensuring the capacity of staff in charge of monitoring on environmental measures and land acquisition.

11.6 Environmental Checklist

As part of the Study on Environmental and Social Considerations, the Environmental Checklist is formulated to properly conduct the environmental review on the Project based on the JBIC Environmental Guidelines (Appendix 6).

Table 11.15 Environmental check items to be given due attention

Environmental Item	Check Item	Points to be noted
EIA	Progress of EIA procedures	• EIA is necessary since there are projects that EIA is mandatory.
Protected areas	Projects in protected areas	• Careful considerations is necessary since the Project of Closing of Maio Ring will be implemented in a protected area
Ecosystem	Migratory routes of wildlife	• Confirmation of breeding sites and colonies of birds
Topography and geology	Possibility of soil erosion	• Confirmation of the conduct of the following soil protection measures - Avoidance of the rainy season - Compaction of soil after civil works - Re-vegetation after civil works
Land acquisition	Occurrence/ nonoccurrence of land acquisition and its scale	• Identification of private lands and land owners through line route surveys
	Prior consultation	• Prior consultations with land owners and consensus building
	Compensation	• Adequacy of the amount of compensation
Landscape	Impacts on landscape	• Confirmation of occurrence of impacts on landscape • Confirmation of appropriateness of consultations with local residents
Impacts during civil works	Implementation of mitigation measures	• Confirmation of appropriateness of mitigation measures against noise such as prior notification of work schedule and avoidance of civil works during early morning and nighttime • Confirmation of appropriateness of disposal of construction wastes
Monitoring	Monitoring plan	• Confirmation of whether monitoring plans are formulated • Check appropriateness of the contents of monitoring plans

The check items for the Checklist was elaborated based on the Environmental Checklist attached to the JBIC Environmental Guidelines, referring to the information obtained from DGA, MTIE and other relevant agencies. Modifications, such as the addition of check items regarding land acquisition and the indication of relevant institutions and laws, are made according to the characteristics of the Project.

The checklist was filled out with the result of confirmation at this feasibility study phase based on the on-site investigations, local stakeholder interviews, and interviews with relevant organizations. MTIE shall confirm the check items in the process of project formulation, since the check items include those to be confirmed before the beginning of the Project. It shall follow up the progress as appropriate.

Items to be given due attention are presented in Table 11.15.

11.7 Land acquisition

The process of land acquisition for the public project is presented in 11.2.1(4). This section will estimate the scale of land acquisition.

To estimate the scale of land acquisition, the transmission and distribution line routes and locations of secondary substations need to be determined. After the determination, line route surveys or on-site investigations on planned substation sites will be conducted to investigate land use statuses and to identify land owners to be affected.

However, details of routes and locations are unclear at this feasibility phase, and thus it is impossible to identify how many areas of private lands will be acquired under the project. Line route surveys shall be conducted at subsequent phases such as the D/D phase, and the shapes of land plots to be acquired and their owners is necessary to be identified. It is therefore impossible to conduct a detailed estimation on the scale of land acquisition under the project.

The Study, therefore, identifies the categories of land to be acquired and categories of project components, and makes rough estimation on the scale of land acquisition under the Project. The categories of land to be acquired under the Project are listed in Table 11.16

Table 11.16 Category of land to be acquired

Category of work	Category of land to be acquired
Transmission	• Land plot necessary for the installment of wooden poles for new transmission lines (within 1 m^2 in general)
Distribution	• Land plot necessary for the installment of wooden poles for new distribution lines (within 1 m^2 in general) • Land plot necessary for the construction of secondary substations (within 15 to 20 m^2 in general)

Table 11.17 shows the number of wooden poles to be installed and the number of substations to be built on the ground estimated by the planned project components. The number of poles to be installed was estimated by dividing the total length of aerial power lines by the average intervals, i.e. 80 m for MV lines and 30 m for LV lines.

Table 11.17 Number of facilities that will be installed under the Project (Estimate)

	MV Pole	LV Pole	Pole (Total)	Secondary Substation
S.Antão	0	400	400	17
S.Vicente	0	1,740	1,740	25
Sal	0	233	233	4
Maio	113	283	396	2
Santiago	880	608	1,488	8
Fogo	258	810	1,068	12
Total	1,251	4,074	**5,325**	**68**

The number of poles to be installed is estimated 5,325 and the number of secondary substations to be built on the ground is estimated 68. However, it should be noted that the figures are rough estimation at the planning stage. In particular, the number of poles that will be installed actually will be different from the above estimation since the construction method of poles will be determined according to the geographical and geological conditions of construction sites.

Land acquisition may not be necessarily required for all the facilities. Many secondary substations are considered to be constructed on the state land or Municipality's land. Many MV lines and LV lines are also considered to be constructed along existing road reserves. In particular in town areas, most LV lines will be constructed along existing streets, thus the case requiring land acquisition will be small in number. Taking this into consideration, 50 % of

MV lines, 20 % of LV lines, and 50 % of secondary substations are estimated to require land acquisition. The estimated scale of land acquisition under the Project is shown in Table 11.18. The estimation demonstrates that about 0.2 ha or 2,121 m^2 of land will be acquired under the Project. This implies that the Project will require small-scale land acquisition as infrastructure projects.

Table 11.18 Scale of land acquisition under the Project (estimation)

	MV Line	LV line	Pole (Total)	Secondary Substation
Number of facilities	1,251	4,074	**5,325**	**68**
Estimated case requiring land acquisition	626	815	**1,441**	**34**
Area to be acquired for unit facility (m^2)	1	1	**1**	**20**
Scale of land acquisition (m^2)	626	815	**1,441**	**680**

11.8 Recommendations on Environmental and Social Considerations

11.8.1 Implementation of EIA

According to Decreto-Lei 29/2006, EIA is mandatory for the construction of aerial and underground transmission and distribution lines, as described in 11.3.1. EIA is therefore necessary to implement such construction works. In particular, EIA shall be conducted at Fogo and Maio where the construction of aerial lines is planned, and at Santo Antão and São Vicente where rehabilitation of aerial lines is planned, since aerial lines are expected to have significant impacts compared to underground lines. For these islands, environmental and social impacts such as ecosystem, landscape, cultural heritage and land acquisition shall be properly addressed. For the other islands such as Sal and Santiago where underground lines are planned, EIA will be required according to Decreto-Lei 29/2006. Some projects may be exempted from EIA depending on the planned works and activities, but it is necessary to closely consult with DGA about the preparation of the application form for the exemption.

In principle, EIA shall be conducted for individual projects, however, according to DGA, it is possible to bundle some projects and to conduct EIA on an island basis, since each project will not have significant environmental and social impacts. MTIE shall consult with DGA about the scope of EIA, and effective and efficient methods should be pursued.

When conducting EIA, packaging individual works by the islands can be an efficient option since conducting EIA for individual works respectively may result in too complicated and cumbersome procedures. MTIE shall pursue an effective and efficient way of EIA implementation in consultation with DGA.

11.8.2 Items to be studied at the D/D phase

There are some environmental and social impacts that cannot be predicted at the F/S phase, as described in the section of the scoping of environmental and social impacts. Most of such impacts cannot be assessed unless detailed routes of transmission and distribution lines and detailed sites for secondary substations are determined. However, they should be assessed at least when conducting line route surveys at the D/D stage.

In particular, the confirmation of breeding sites and colonies of birds, and identification of land owners are important. Existence/nonexistence of cultural heritages around sites for related facilities and occurrence/nonoccurrence of impacts on landscape are also necessary to be confirmed. Sufficient consultations with local government and local residents shall be held when collecting such information.

11.8.3 Formulation of Environmental Management Plan

It is necessary to formulate an Environmental Management Plan (EMP) that addresses environmental measures and monitoring at the operational and maintenance phase as well as environmental measures at the construction phase, and then to avoid and minimize potential adverse impacts. In particular, environmental monitoring on ecosystem is critical since impacts on ecosystem cannot be thoroughly assessed in advance.

The reinforcement of the environmental management system of the PIU of the Project is an important challenge since the PIU is responsible for the implementation of the EMP. It is necessary for the PIU to ask for the cooperation of relevant institutions such as DGA, and to utilize the external resources such as consultants as appropriate. MTIE therefore shall pursue the reinforcement of the capacity of MTIE, such as securing adequate human resources to prepare TOR for the consultants and to manage the quality of their outputs.

Chapter 12 Social Considerations

12.1 Outline of Socioeconomic Survey

12.1.1 Objectives of the Survey

The target of electrification rate provided in the Energy Policy 2008 is to increase the rate to 95 % by 2011, and to 100 % by 2015. To achieve the target, it is necessary to accelerate rural electrification in the country. In particular, it is essential to identify barriers for rural electrification, and to undertake measures against the barriers. A socioeconomic survey on households was, therefore, conducted to identify the current status and targets of rural electrification and to clarify challenges to promote rural electrification. The survey aims at collecting necessary basic information to estimate willingness to pay and affordability for electricity tariffs of rural households. The survey also targets to identify the social development effects of rural electrification.

For the socioeconomic survey, two (2) islands were selected out of six (6) islands to be investigated in the Study, taking into account the social and economic conditions such as electrification rates and poverty ratio. Approximately 30 households were sampled in each island, thus a total of about 60 households were sampled for the survey. Main households to be surveyed are un-electrified households, but electrified households were also surveyed for the purpose of comparison to identify the social development effects such as the improvement of the living standards.

The socioeconomic survey was conducted by the Cape Verdean consultants[18] under the supervision of the Study Team from late January to early February 2010.

12.1.2 Sampling Methodology

Random sampling is principally desirable for the socioeconomic survey. In the socioeconomic survey, however, the following sampling steps were taken. This is because the survey duration was very limited. In addition, it was necessary to select particular types of Localities to compare un-electrified households with electrified ones.

- Step 1: Selection of islands

  Islands to be surveyed were determined based on the electrification rate provided by MTIE and the poverty ratio of each island
- Step 2: Selection of Municipalities

  Municipalities to be surveyed were determined based on the electrification rate and rural electrification plans provided by MTIE

[18] ENGIC Lda was selected as a consultant to be engaged in the socioeconomic survey.

- Step 3: Selection of Localities

  Localities to be surveyed were determined in consultation with the selected Municipalities, taking into account the electrification status, number of households, and poverty ratio.
- Step 4: Selection of households

  Households to be surveyed were randomly sampled within the selected Localities.

It should be noted that the households sampled as per the above steps may not fully represent the rural households of Santiago and Fogo islands. The socioeconomic survey has such limitations in sampling methodology as well as the insufficiency of the sample number.

12.1.3 Selection of Households to be Surveyed

Households to be surveyed were selected as per the steps described in 12.1.2. Islands to be surveyed were first determined based on the list of un-electrified Localities and rural electrification plans of respective islands provided by MTIE. With respect to six (6) islands to be investigated in the Study, Sal and São Vicente have achieved 100 % of electrification, and Santo Antão and Maio are expected to achieve almost 100 % by the planned rural electrification projects according to MTIE. On the other hand, electrification rates of Santiago and Fogo are lower, and there are no electrification plans in the near future. In addition, the two involve higher occurrence of poverty than the others. Santiago and Fogo were therefore selected for the socioeconomic survey. With respect to Santiago, the northern part of the island was prioritized since the northern part suffers from lower electrification rates.

Table 12.1 List of un-electrified Localities in Santiago and Fogo

Island	Municipality	Locality
Santiago	Ribeira Grande de Santiago	Belém, Pico Leão, Tronco, Chã Gonçalves
	São Lourenço dos Orgãos	Montanha, Boca Larga, Montaínhas, Longueira Cima
	São Domingos	Mendes Falero, Chaminé, Banana, Mitra, Mato Afonso, Pau de Saco, Djambam, Cambulhane, Ribeirão de Cal, Cabral
	São Salvador do Mundo	Burbur, Rebelo Acima e Mato Dentro, Degredo, Mato Limão, Lém da Rua
	Santa Catarina	
	Tarrafal	Achada Lagoa, Achada Biscainho, Bimbirin, Ganchemba, Achada Carreira, Achada Portal
	Santa Cruz	Ribeirão de Almaço, Torril, Aguada, Gil André, Aguada de Monte Negro, Matinho, Boca Larga Baixo
	São Miguel	Bacio, Ribeirão Milho, Garçote, Chã de Ponta, Chacha, Gongon
Fogo	Mosteiro	Aldeia, Ligeirão, Atalaia, Ribeira Ilheu
	Santa Catarina	Cabeça Fundão
	São Felipe	Miguel Gonçalves, Curral Ochô Cima, Cutelo Capado, Cidreira

(Source) MTIE

The list of un-electrified Localities in Santiago and Fogo obtained from MTIE are indicated

in Table 12.1. Out of the Municipalities in these two islands, São Salvador do Mundo and São Miguel of Santiago Island, and Mosteiros and Santa Catarina of Fogo island were selected respectively in consultation with MTIE, taking into account the electrification status, rural electrification plans, and poverty ratios.

Two (2) un-electrified Localities and one (1) electrified Localities were then selected from the two Municipalities of each island respectively. Ten (10) households were sampled from each Locality. Sampled Localities and the number of households to be surveyed were listed in Table 12.2. In practice, however, some households were sampled from the neighboring Localities due to the ambiguity of boundaries of Localities and the limitations of accessibility to some households.

Table 12.2 Sampled Localities and the Number of Households to be Surveyed

Island	Municipality	Locality	Electrification Status	No. of Sample
Santiago	São Salvador do Mundo	Burbur	Un-electrified	10
	São Miguel	Chã de Ponta	Un-electrified	10
		Djeu	Electrified	10
Fogo	Mosteiros	Ribeira lhéu	Un-electrified	10
		Relvas	Electrified	11
	Santa Catarina	Cabeça Fundão	Un-electrified	10

(Source) JICA Study Team

12.1.4 Items to be Surveyed

Major items surveyed by the socioeconomic survey are indicated in Table 12.3. Questionnaires for the survey are attached to Appendix 7.

Table 12.3 Items to be Surveyed in the Socioeconomic Survey

Category	Description
Household income and expenditure	• Balance of income and expenditures • Energy-related expenditures etc.
Affordability	• Affordability to pay for electricity tariffs • Willingness to pay for electricity tariffs
Social Development effects	• Benefits of electrification

(Source) JICA Study Team

12.2 Results of Socioeconomic Survey

12.2.1 Balance of Income and Expenditures of Sampled Households

Table 12.4 shows the balance of average income and average expenditures of sampled households that was estimated by the socioeconomic survey. The average income and average expenditure per month are in principle balanced, but their figures were different in many sampled households. More specifically, the amount of the average income was larger than that of the average expenditure for most of sampled households. The survey asked reasons why the

figures of incomes and expenditures are different. The answers include that local residents do not have ideas about the precise amounts of their incomes and expenditures, precise incomes and expenditures are difficult to be identified since many local residents obtain agricultural and forestry products by themselves, and the estimation of precise incomes and expenditures are difficult due to high variations of incomes and expenditures month by month. It should be noted that there were such limitations in identifying the balance of incomes and expenditures of sampled households.

Table 12.4 Balance of Income and Expenditures of Sampled Households (CVE)

	Un-electrified Households			Electrified Households		
	Santiago	Fogo	Total	Santiago	Fogo	Total
Average Income/ Month	33,845	31,045	32,445	23,915	22,016	22,920
Average Expenditure/ Month	21,232	22,131	21,682	11,656	15,207	13,516

(Source) JICA Study Team

12.2.2 Affordability and Willingness to Pay for Electricity Tariff

The Study Team estimated the amount of affordability and willingness to pay for electricity tariff based on the results of socioeconomic survey. The affordability and willingness to pay are important data to be considered when promoting rural electrification. The methodology and estimated amounts are presented in this section.

(1) Estimation of Affordability for Electricity Tariff

Current energy-related expenditures, in particular expenditures for light which can be replaced by electricity, were surveyed through questionnaires. Expenditures for light can be considered as the minimum amount of affordability for electricity tariffs, since electric appliances such as TVs and radios are expected to be used in addition to lighting equipments when electrified. In the context of the access of the poor to electricity, such estimation is considered to be conservative. Monthly average expenditures for light of sampled households are presented in Table 12.5.

Table 12.5 Monthly Average Energy-related Expenditures for Light (CVE)

Energy source	Un-electrified	Electrified	Total
Electricity from ELECTRA grid	0	916	305
Candle	419	179	339
Kerosene lantern	174	79	142
Gas lantern	27	0	18
Solar lantern	0	0	0
Diesel generator	206	0	138
Other	177	16	123
TOTAL	**1,003**	**1,189**	**1,065**

Note: This table may include rounding errors since the figures are rounded to the whole number.

(Source) JICA Study Team

Expenditures for light on average are CVE 1,003 for un-electrified households and CVE 1,189 for electrified ones, and electrified households pay more than un-electrified ones. Within the sample households of the socioeconomic surveys, electrified households pay more for light, though average income of electrified households are less than that of un-electrified ones, as described in Table 12.4. This may imply the possibility that cost for light may increase after electrification.

Even electrified households use other energy sources than electricity. Candles and kerosene lantern are main sources for light. Although Table 12.5 indicates high cost of diesel generators, they are not widely used in rural areas. In fact, the socioeconomic survey identified only five (5) households using generators, and thus they cannot be considered as one of the main sources for light in Cape Verde. On the other hand, electricity is the main source for light of electrified households, but candles are deemed to be used often. Candles are complementarily used in case of load shedding.

Considering the above, CVE 1,003, the average amount of expenditures for light of un-electrified households can be considered as the current affordability for electricity tariffs.

(2) Estimation of Willingness to Pay

A simple question on how much local residents want to pay for electricity tariffs will not lead proper and meaningful answers. This is because local residents will often answer without careful considerations on their income and expenditure, and as a result unrealistic figures will be frequently included in the answers.

In the socioeconomic survey, the amount of willingness to pay was, therefore, estimated by comparing the current expenditures for light. More specifically, it was asked whether local residents are willing to pay more or less than the current expenditures for light. Questions comparing the current expenditures are expected to avoid unrealistic figures that may be answered from the simple question.

Answers related to willingness to pay by un-electrified households are presented in Table 12.6.

Table 12.6 Willingness to Pay (CVE)

Option	Valid Response	Willingness to Pay	Total
Same as current spending	20	1,003	20,060
Willing to pay more	13	1,367	17,771
Willing to pay less	3	750	2,250
No answer	5	-	-
TOTAL	**41**	**1,113**	**40,081**

Note: This table may include rounding errors since the figures are rounded to the whole number.

(Source) JICA Study Team

Half of the samples answered that the monthly expenditure to be paid for electricity tariffs should be the same as the current expenditures for light, followed by the answer willing to pay

more. Many answered that they accept more economic burden if their living standards become higher or if the use of electricity for 24 hours a day is ensured. On the other hand, just three (3) respondents answered that they are willing to pay less, since their income is low and thus they want to reduce expenditures for electricity tariffs.

With respect to respondents who answered that electricity tariffs should be the same as the current expenditures, their willingness to pay can be estimated as CVE 1,003 (Table 12.5) since the amount of willingness to pay corresponds to that of affordability. The amount of willingness to pay of those who are willing to pay more is CVE 1,367 on average. On the other hand, the amount of willingness to pay of those who are willing to pay less is CVE 750. However, the latter should be dealt with provisional figures since the sample number of the latter is very limited.

Taking into account the above, the amount of willingness to pay of the whole sampled households (36 valid responses) is estimated as CVE 1,113. However, there is the limitation of insufficient number of samples. In addition, answers of local residents may still be intuitive without detailed considerations. It should be noted that there were such limitations in estimating the amount of willingness to pay.

(3) Comparisons with Electricity Tariffs

It is extremely hard to predict, in advance of electrification, the expenditures for electricity when electrified. This section, therefore, calculates the average expenditure for electricity of electrified households, and compares the average expenditure with the amount of affordability and willingness to pay.

Table 12.7 Comparison of Expenditures, Affordability and Willingness to Pay

Affordability	Willingness to Pay	Expenditures for Electricity of Electrified Households
CVE 1,003	CVE 1,113	CVE 1,154

Note: All figures are monthly payment

(Source) JICA Study Team

The average monthly expenditure for electricity of electrified households is calculated as CVE 1,154. This is almost the same as CVE 1,113, the amount of willingness to pay of un-electrified households. It can be concluded that average households will not encounter severe difficulties to pay for electricity after the electrification (Table 12.7). However, it should be noted that there are not a few low-income-households who cannot afford to pay the average amount.

12.2.3 Social Development Effects by Electrification

The socioeconomic survey aimed to identify social development effects by electrification through questions on what changes were observed before and after electrification in electrified

Localities, and what kind of expectations the local residents have in un-electrified Localities. Furthermore, the results of local stakeholder meetings, which were conducted as part of environmental and social considerations study, are also presented in this section.

(1) Benefits of Electrification

Benefits of electrification were investigated through the questionnaire survey on what changes were experienced before and after electrification in recently electrified Localities, and what benefits local residents expect in un-electrified Localities. Table 12.8 lists major benefits to be expected after electrification.

Table 12.8 Benefits to be Expected after Electrification

Experienced positive effects/ Expected benefits	Elec.	(%)	Un-elec.	(%)
Village will become/ became safer	22	(88.0 %)	34	(100.0 %)
Nighttime will become/ became more enjoyable	20	(80.0 %)	33	(97.1 %)
Leisure time (e.g. TV watching, radio listening) will become /became longer	18	(72.0 %)	33	(97.1 %)
Studying/ reading at night will become/ became easier	14	(56.0 %)	26	(76.5 %)
Cooking will become/ became easier	11	(44.0 %)	12	(35.3 %)
Economic activities/ rural industry in the area will become/ became activated	6	(24.0 %)	15	(44.1 %)
Markets/ shops operating in the night will increase/ increased	9	(36.0 %)	8	(23.5 %)

(Source) JICA Study Team

Many residents in electrified Localities answered that they experienced many benefits of electrification. Such benefits include that village became safer, that activities during nighttime was enabled, and that leisure time became longer. Local residents in un-electrified Localities also have extremely high expectations for these three points. In addition, electrified households experienced the enhancement of local economic activities and the reduction of the burden of housework, and un-electrified households showed high expectations on them.

When comparing un-electrified households with electrified ones, the rate of un-electrified households that have high expectations tends to be higher than that of electrified households who experienced benefits. This may imply the high expectations of un-electrified households for electrification.

(2) Negative Impacts and Concerns of Electrification

The socioeconomic survey investigated negative impacts and concerns caused by electrification through questionnaire survey. Table 12.9 demonstrates the result of the survey.

Major concerns associated with electrifications were reduced sleeping time, increased working/ business hours, and loosened community relationship. In particular, concerns about increased work hours of housewives are indicated in both electrified and un-electrified Localities. There is a concern about increased working hours due to enabling activities of

nighttime and early morning. Loosened community relationship, on the other hand, can be considered as the effect of social modernization rather than as the direct impact of electrification.

Table 12.9 Negative Impacts and Concerns Caused by Electrification

Experienced negative impacts/ concerns	Elec.	(%)	Un-elec.	(%)
Sleeping hours will become/ became shorter	17	(68.0 %)	19	(55.9 %)
Working/business hours per day will become/ became longer	10	(40.0 %)	16	(47.1 %)
Housewives' work will become/ became longer	18	(72.0 %)	25	(73.5 %)
Community will become/ became loose	13	(52.0 %)	7	(20.6 %)

(Source) JICA Study Team

Respondents demonstrate few concerns about economic burden associated with the payment of electricity tariffs. This is in line with the result that 81.3 % of electrified households consider the current electricity tariff level appropriate, taking into account the service quality of ELECTRA.

(3) Result of Local Stakeholder Consultations

As part of environmental and social considerations study, local stakeholder consultations were held in Fogo Island to identify social development effects of electrification. Major social development effects pointed out in the consultations are indicated below.

- Quality of life is enhanced by using lighting equipment and other electric appliances.
- Social security is improved by the installment of street light.
- Economic activities are encouraged trough the enhancement of commercial activities, and the mechanization and electrification of craft shops.
- Small-scale agriculture using drop irrigation system is promoted.

As described above, local residents seem to have significant expectations on the improvement of the quality of lives and the enhancement of economic activities. On the other hand, they did not demonstrate significant concerns about electrification. Most of local residents considered that positive impacts of electrification are much larger than the negative impacts, and they showed favorable feelings for electrification.

12.3 Challenges

Under rural electrification projects implemented by the government, initial costs for the connection with the ELECTRA grid are paid by the government. The economic burden of local residents in un-electrified Localities is, therefore, not so significant, only the payment of monthly electricity tariffs.

Approximately 40 kWh of electricity can be consumed per month by CVE 1,003, the estimated amount of affordability for electricity tariffs. Likewise, about 44 kWh can be

consumed by CVE 1,113, the estimated amount of willingness to pay. Such electric energy is enough to use electricity for lighting and other purposes, and thus to ensure good levels of quality of lives, taking into account that the use of two 60 W light bulbs for eight hours per day will require less than 30 kWh per month. However the discussion here is based on the average values, thus there is a possibility that low-income households may suffer from increased economic burden. For instance, households whose expenditures for electricity are less than CVE 500 per month (equivalent to about 17 kWh per month) account for 25 % of the total sampled households. These households will be particularly required to reduce the consumption of electricity. However, they can still enjoy benefits of electrification to some extent since 17 kWh per month allow residents to use two 60 W light bulbs for 4.5 hours per day.

As far as the current scheme that initial connection costs are paid by the government is maintained, and the current level of electricity tariff are kept, the payment of electricity tariffs cannot be considered as significant economic burdens for local residents, and thus no special considerations need to be given at present. The reason why electrification has not been fully implemented in Santiago and Fogo is deemed to be the lack of financial resources, and thus how to ensure the investment finance is the key challenge. However, if the level of electricity tariffs is raised, economic burdens on low-income households may become significant. It is therefore necessary to pay due attention to negative effects on low-income households when discussing the raise of electricity tariffs. In such case, electricity tariff system that gives due considerations on low-income households may need to be set up as appropriate.

Appendix

Appendix 1. System Planning Map for Each Islands

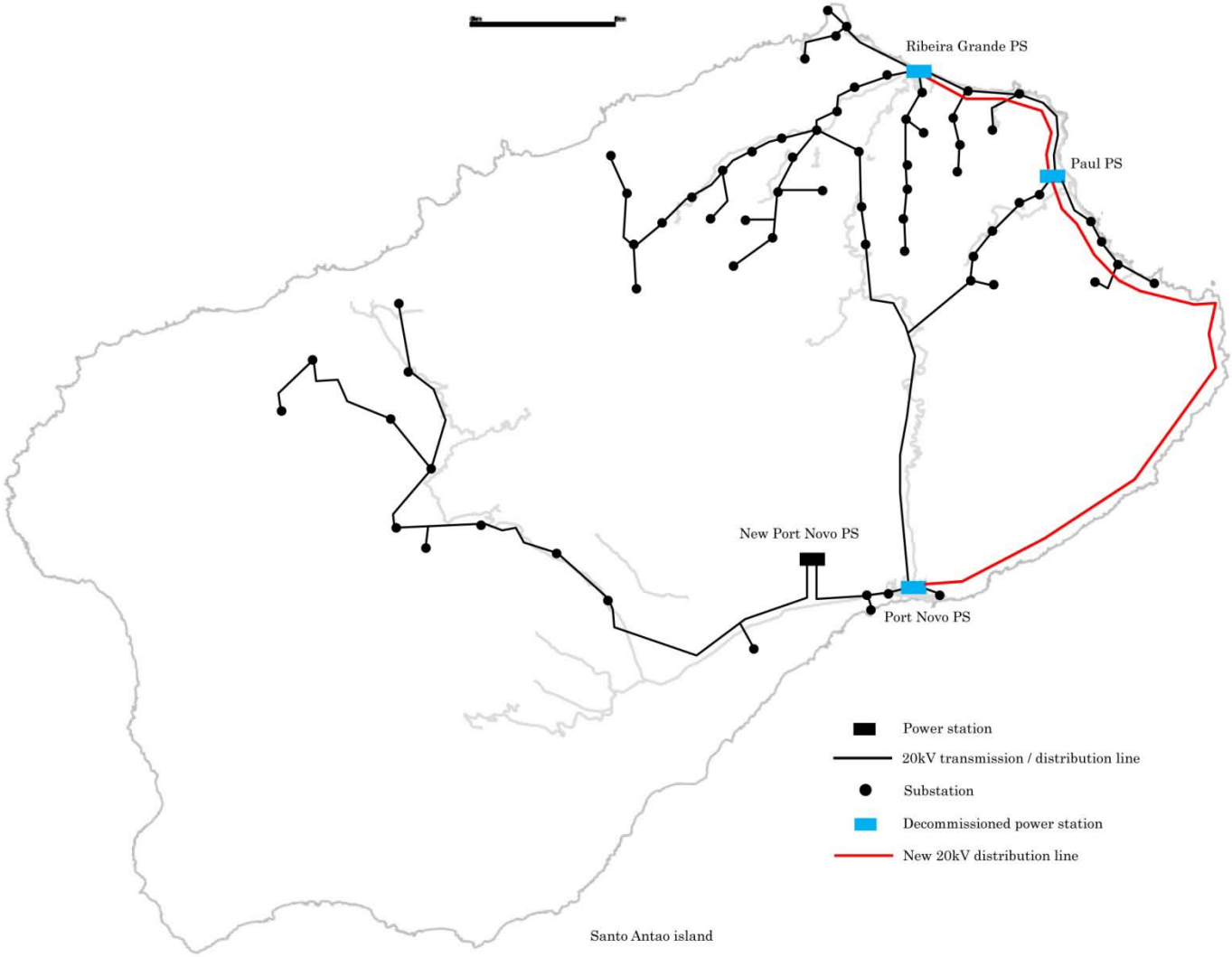


Figure A- 1.1 System Planning Map for Santo Antao Islands

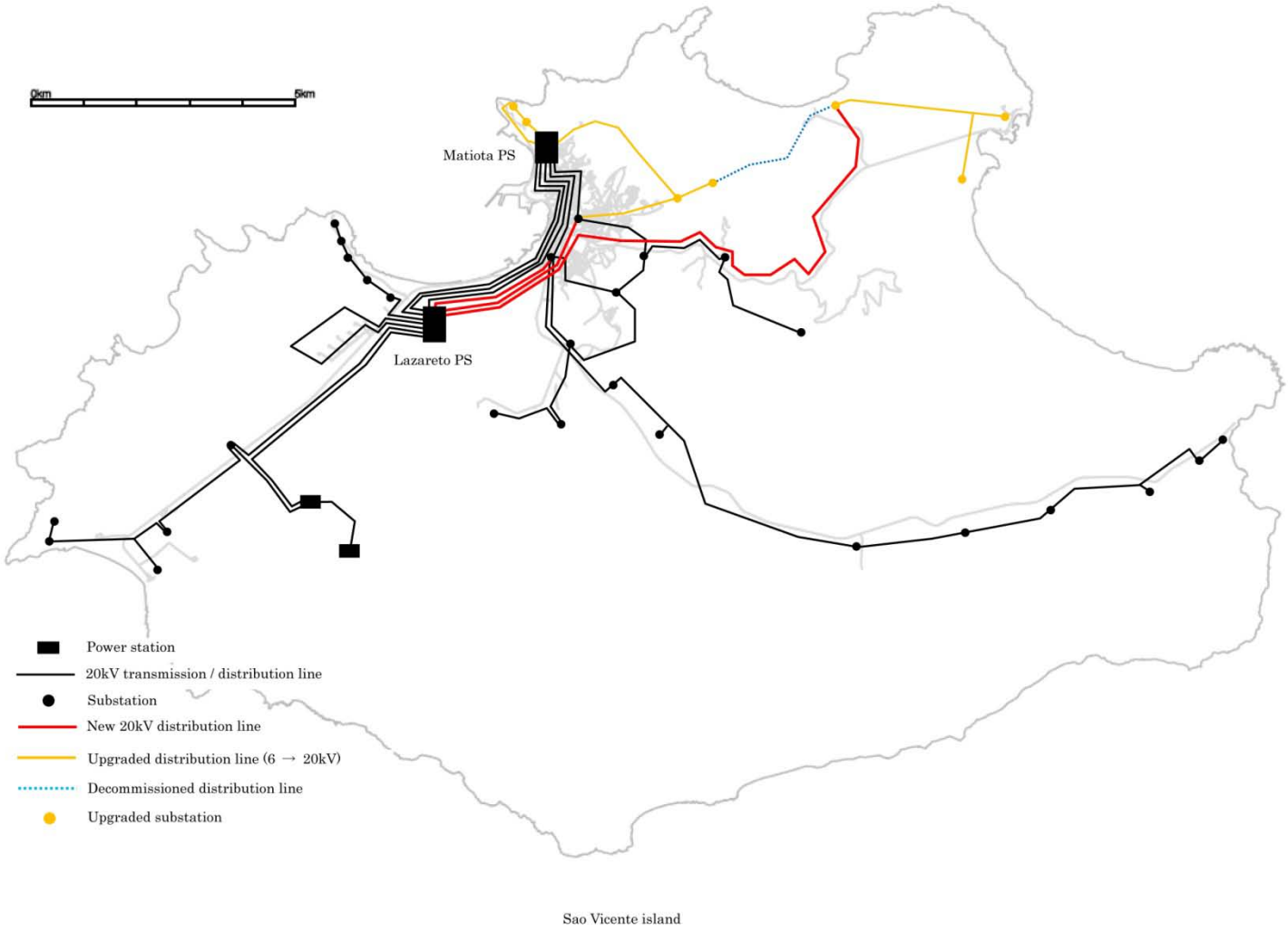


Figure A- 1.2 System Planning Map for Sao Vicente Islands

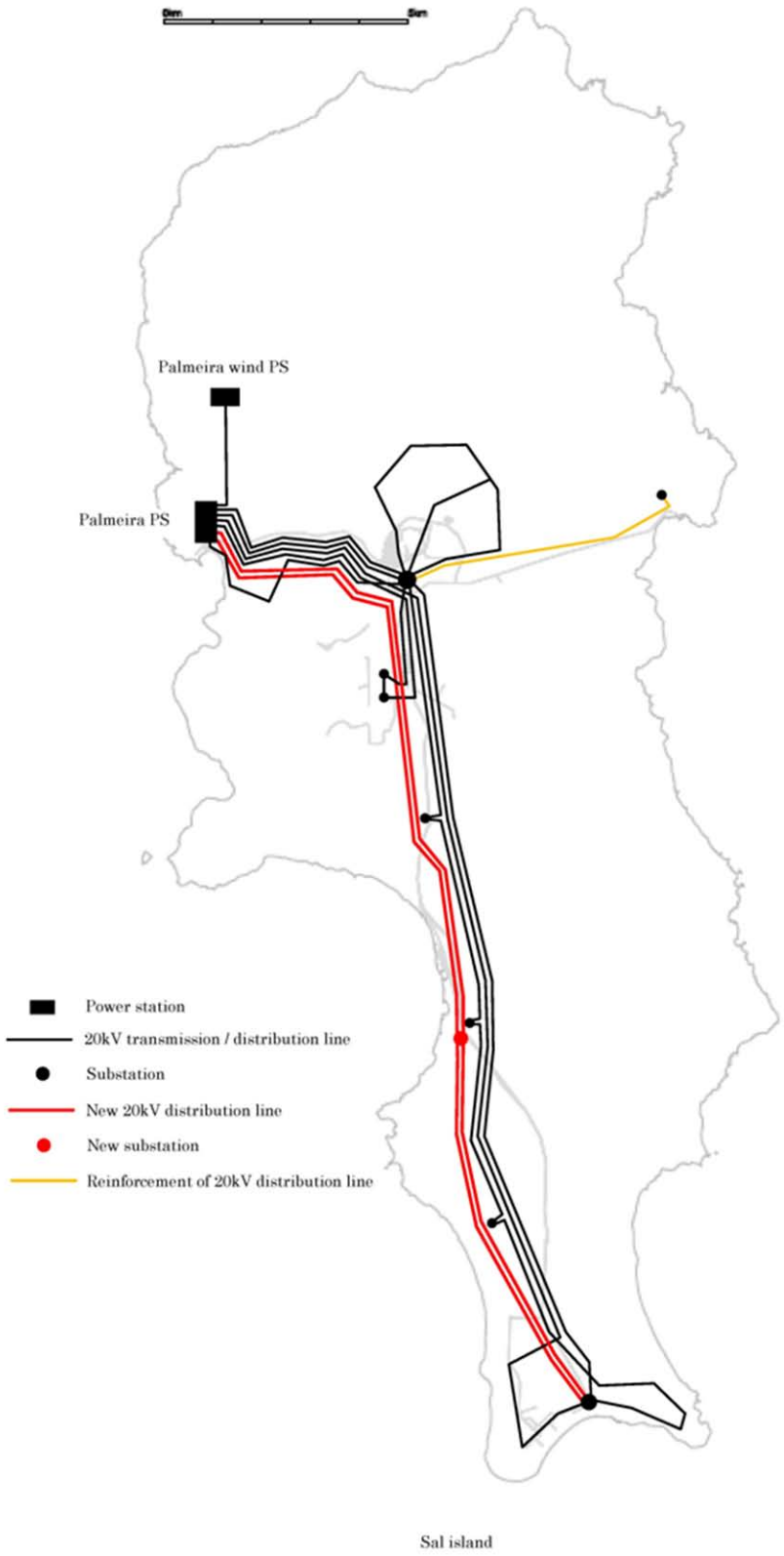


Figure A- 1.3 System Planning Map for Sal Islands

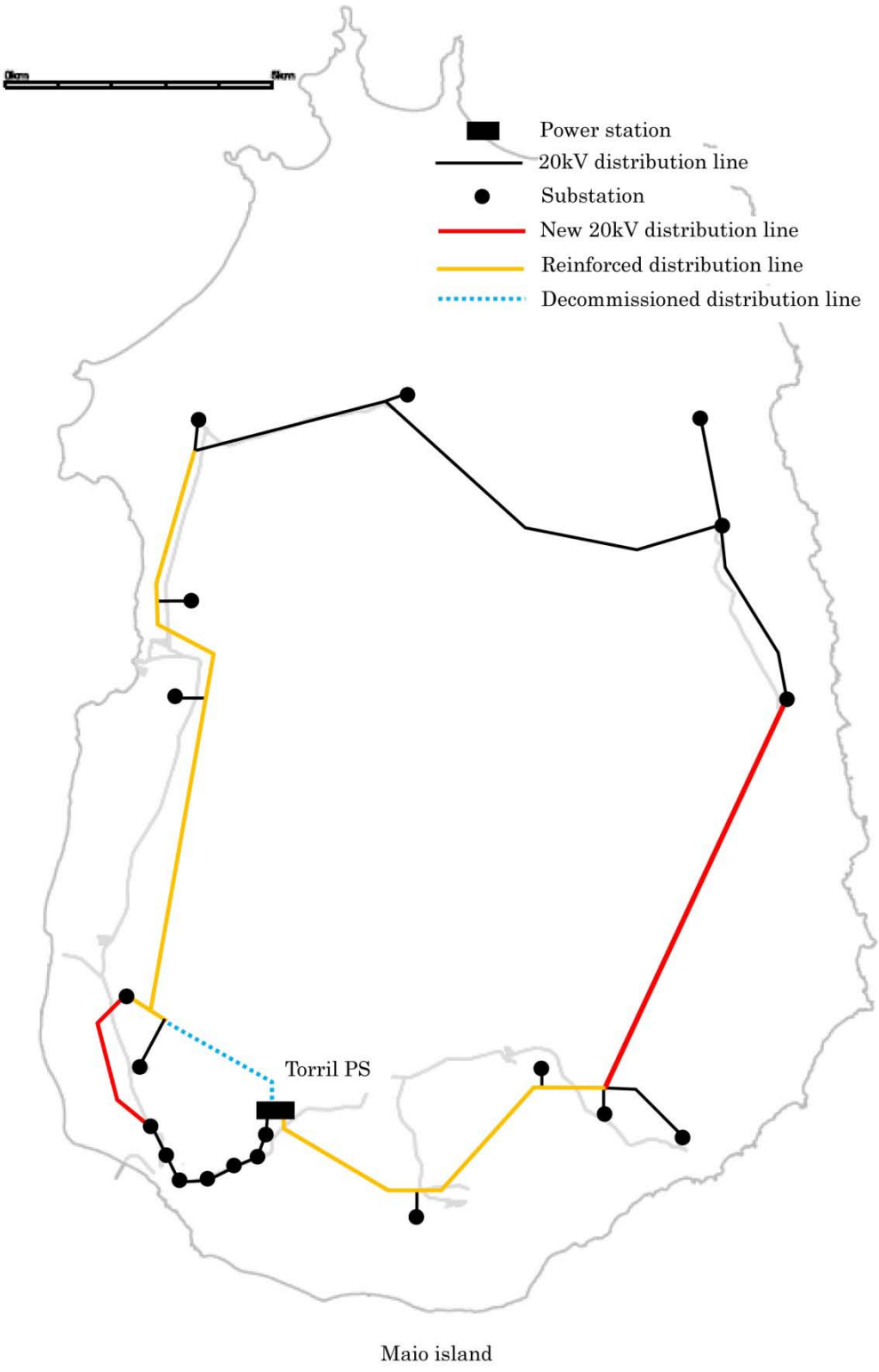


Figure A- 1.4 System Planning Map for Maio Islands

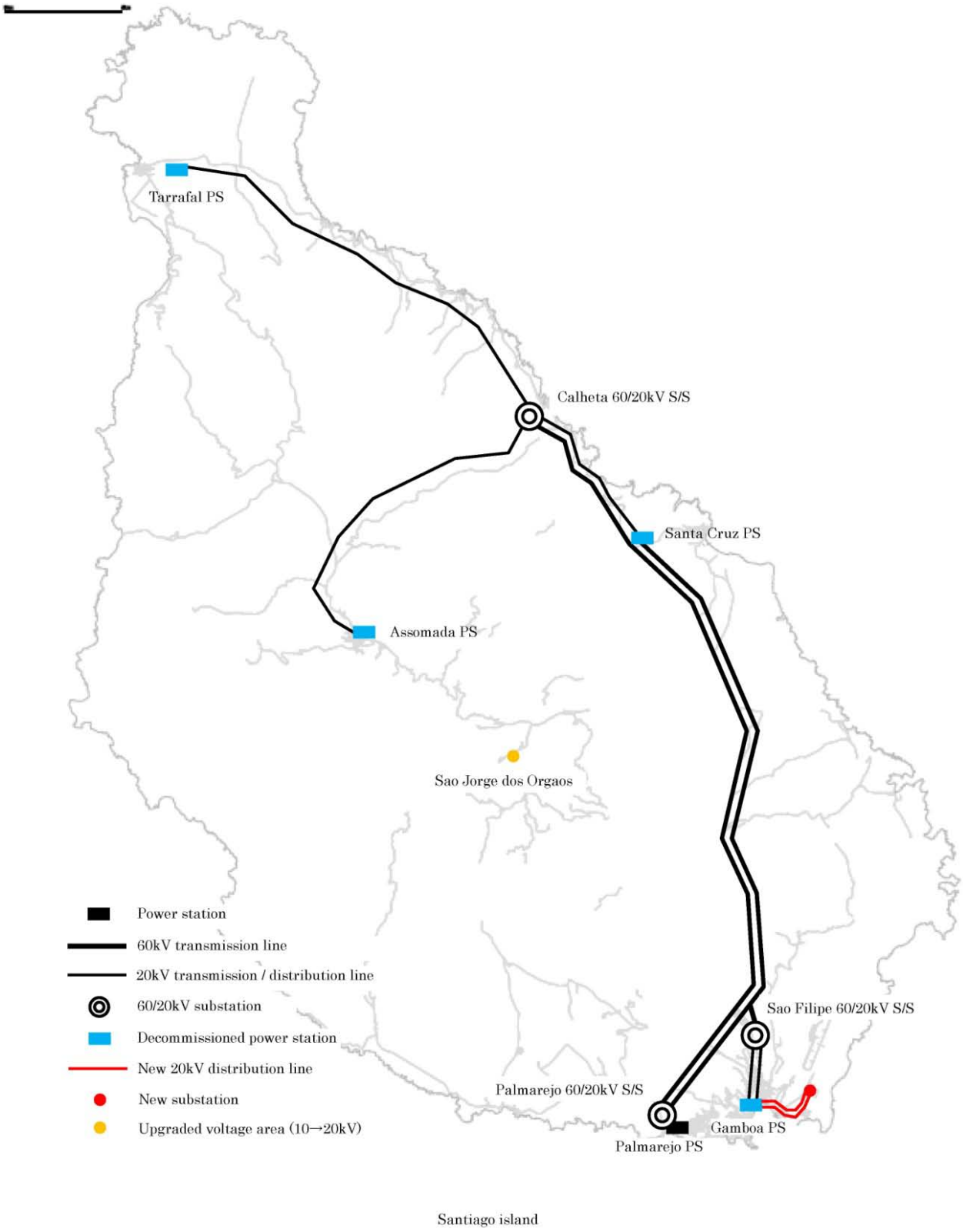


Figure A- 1.5 System Planning Map for Santiago Islands

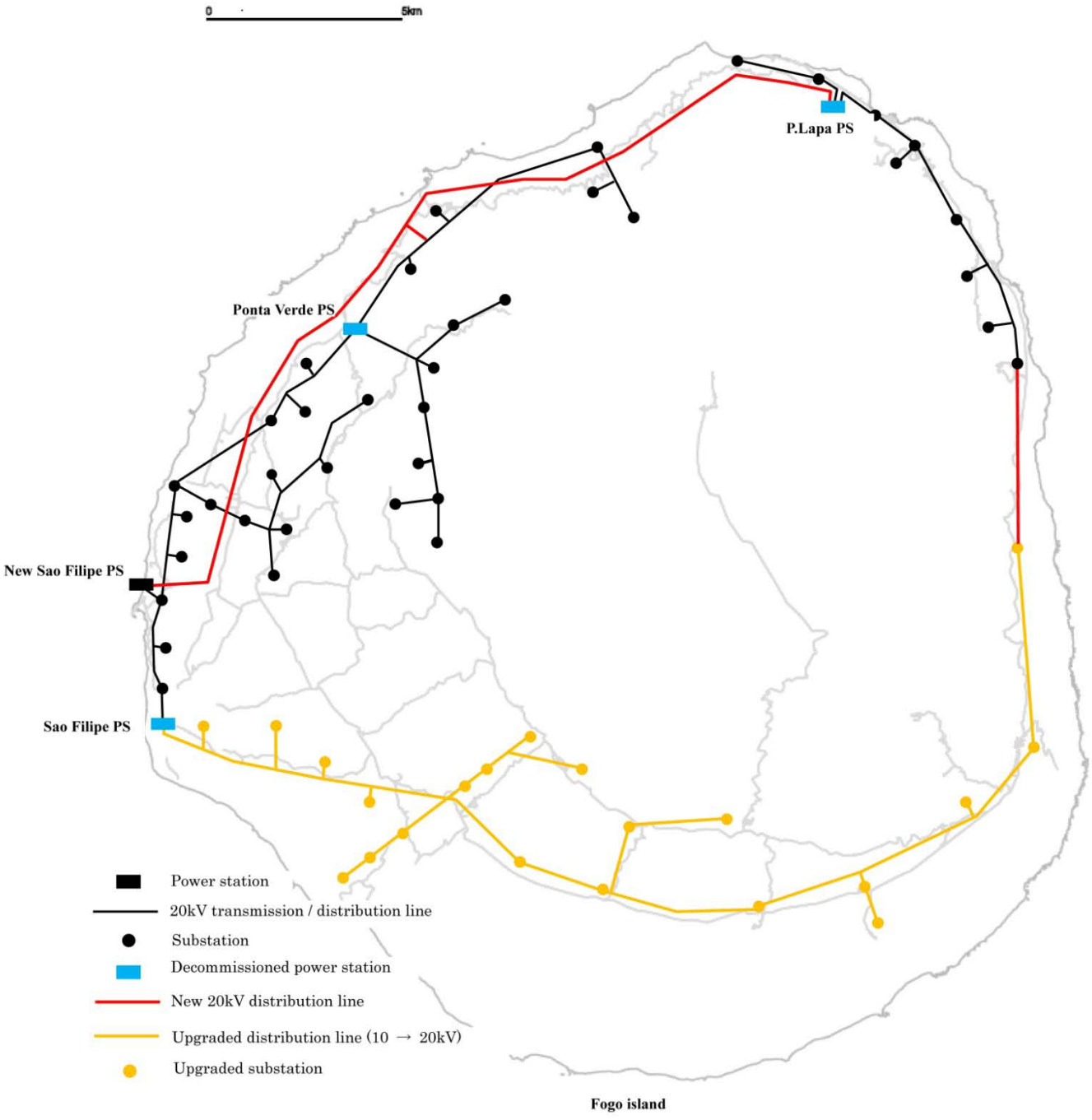


Figure A- 1.6 System Planning Map for Fogo Islands

Appendix 2. Economic and Financial Analysis

Table A- 2.1 Economic analysis (cost to benefit)

Islad of Santiago

(Unit: thousands of 2009 CVE)

Years		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Item	Initial amount																						
A. Investment schedule																							
Land Preparation	-																						
Construction																							
Works #1 & #2	1,672,641	836,320	836,320																				
I. Total	1,672,641	836,320	836,320																				
B. Working capital																							
II. Working capital	6,272		6,272																				
C. Annual costs	Annual amount																						
Power Generation (Fuel)																							
Works #1 & #2				199,282	255,852	343,316	407,918	476,825	550,946	630,763	716,795	809,499	909,468	1,017,348	1,133,841	1,259,708	1,395,779	1,542,952	1,702,208	1,874,609	2,061,314	2,263,581	2,482,779
O&M																							
Works #1 & #2	3%			50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179
	of construction cost																						
III. Total				249,461	306,031	393,495	458,097	527,004	601,126	680,942	766,975	859,678	959,647	1,067,527	1,184,020	1,309,888	1,445,958	1,593,132	1,752,387	1,924,789	2,111,493	2,313,760	2,532,958
D. Benefits	Annual amount																						
Works #1 & #2				222,739	290,610	396,186	478,138	567,558	665,781	773,678	892,209	1,022,287	1,165,037	1,321,692	1,493,607	1,682,269	1,889,309	2,116,517	2,365,859	2,639,490	2,939,776	3,269,314	3,630,953
IV. Incremental output				222,739	290,610	396,186	478,138	567,558	665,781	773,678	892,209	1,022,287	1,165,037	1,321,692	1,493,607	1,682,269	1,889,309	2,116,517	2,365,859	2,639,490	2,939,776	3,269,314	3,630,953
E. Net benefits																							
IV-I-II-III		-836,320	-842,593	-26,722	-15,421	2,690	20,040	40,554	64,655	92,736	125,235	162,609	205,390	254,164	309,587	372,381	443,351	523,386	613,472	714,701	828,283	955,554	1,097,995
Discount rate	12%																						
Net present value	-506,121	-836,320	-752,315	-21,303	-10,977	1,710	11,371	20,546	29,247	37,455	45,161	52,356	59,045	65,238	70,949	76,197	80,999	85,376	89,349	92,939	96,169	99,059	101,630
Internal rate of return	9.2%	-836,320	-771,655	-22,412	-11,845	1,893	12,910	23,926	34,933	45,887	56,751	67,484	78,062	88,466	98,685	108,708	118,530	128,147	137,558	146,764	155,769	164,574	173,186

Source: Prepared by the JICA Study Team.

Island of San Vicente

(Unit: thousands of 2009 CVE)

Years		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Item	Initial amount																						
A. Investment schedule																							
Land Preparation	-																						
Construction																							
Works #1 & #2	1,133,591	566,795	566,795																				
I. Total	1,133,591	566,795	566,795																				
B. Working capital																							
II. Working capital	4,251		4,251																				
C. Annual costs	Annual amount																						
Power Generation (Fuel)																							
Works #1 & #2				114,888	227,074	338,759	449,365	568,632	673,829	783,686	896,677	1,010,462	1,069,901	1,132,312	1,151,609	1,171,871	1,193,145	1,215,484	1,238,939	1,263,568	1,289,427	1,316,580	1,345,090
O&M																							
Works #1 & #2	3%			34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008
	of construction cost																						
III. Total				148,895	261,082	372,766	483,373	602,640	707,836	817,693	930,685	1,044,469	1,103,909	1,166,320	1,185,617	1,205,878	1,227,153	1,249,492	1,272,947	1,297,575	1,323,435	1,350,588	1,379,098
D. Benefits	Annual amount																						
Works #1 & #2				198,617	397,489	600,340	806,101	1,032,384	1,237,991	1,444,926	1,653,254	1,863,046	1,972,637	2,087,708	2,123,286	2,160,644	2,199,870	2,241,057	2,284,303	2,329,711	2,377,390	2,427,453	2,480,019
IV. Incremental output				198,617	397,489	600,340	806,101	1,032,384	1,237,991	1,444,926	1,653,254	1,863,046	1,972,637	2,087,708	2,123,286	2,160,644	2,199,870	2,241,057	2,284,303	2,329,711	2,377,390	2,427,453	2,480,019
E. Net benefits																							
IV-I-II-III		-566,795	-571,046	49,722	136,408	227,573	322,728	429,745	530,155	627,232	722,569	818,576	868,728	921,388	937,670	954,766	972,717	991,565	1,011,356	1,032,136	1,053,955	1,076,866	1,100,921
Discount rate	12%																						
Net present value	2,476,186	-566,795	-509,863	39,638	97,092	144,627	183,125	217,722	239,815	253,329	260,566	263,560	249,739	236,497	214,890	195,364	177,712	161,746	147,298	134,219	122,371	111,635	101,901
Internal rate of return	27.3%	-566,795	-448,673	30,695	66,163	86,727	96,634	101,102	97,997	91,095	82,453	73,391	61,196	50,997	40,776	32,622	26,113	20,915	16,761	13,440	10,783	8,656	6,953

Source: Prepared by the JICA Study Team.

Island of Sal

(Unit: thousands of 2009 CVE)

Years		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Item	Initial amount																						
A. Investment schedule																							
Land Preparation	-																						
Construction																							
Works #1 & #2	1,149,675	574,838	574,838																				
I. Total	1,149,675	574,838	574,838																				
B. Working capital																							
II. Working capital	4,311		4,311																				
C. Annual costs	Annual amount																						
Power Generation (Fuel)																							
Works #1 & #2				676,475	689,108	704,139	722,164	733,049	1,772,016	1,785,089	1,799,465	1,815,274	1,832,653	1,851,760	1,872,766	1,895,859	1,921,247	1,949,158	1,979,843	2,013,578	2,050,664	2,091,436	2,136,261
O&M																							
Works #1 & #2	3%			34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490
	of construction cost																						
III. Total				710,965	723,598	738,629	756,654	767,539	1,806,506	1,819,579	1,833,955	1,849,764	1,867,144	1,886,251	1,907,256	1,930,349	1,955,738	1,983,649	2,014,334	2,048,068	2,085,154	2,125,927	2,170,751
D. Benefits	Annual amount																						
Works #1 & #2				1,186,175	1,208,327	1,234,684	1,266,289	1,285,377	3,107,170	3,130,093	3,155,301	3,183,021	3,213,496	3,246,999	3,283,832	3,324,325	3,368,842	3,417,783	3,471,588	3,530,740	3,595,770	3,667,263	3,745,860
IV. Incremental output				1,186,175	1,208,327	1,234,684	1,266,289	1,285,377	3,107,170	3,130,093	3,155,301	3,183,021	3,213,496	3,246,999	3,283,832	3,324,325	3,368,842	3,417,783	3,471,588	3,530,740	3,595,770	3,667,263	3,745,860
E. Net benefits																							
IV-I-II-III		-574,838	-579,149	475,210	484,729	496,055	509,636	517,837	1,300,664	1,310,514	1,321,346	1,333,257	1,346,352	1,360,748	1,376,575	1,393,975	1,413,104	1,434,134	1,457,254	1,482,672	1,510,616	1,541,336	1,575,109
Discount rate	12%																						
Net present value	5,237,266	-574,838	-517,097	378,835	345,021	315,252	289,181	262,353	588,354	529,295	476,490	429,273	387,044	349,270	315,476	285,235	258,169	233,938	212,241	192,806	175,393	159,785	145,792
Internal rate of return	44.2%	-574,838	-401,584	228,486	161,606	114,677	81,694	57,559	100,247	70,038	48,966	34,259	23,989	16,812	11,793	8,281	5,821	4,096	2,886	2,036	1,438	1,018	721

Source: Prepared by the JICA Study Team.

Island of Sant Antão

(Unit: thousands of 2009 CVE)

Years		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Item	Initial amount																						
A. Investment schedule																							
Land Preparation	-																						
Construction																							
Works #1 & #2	862,010	431,005	431,005																				
I. Total	862,010	431,005	431,005																				
B. Working capital																							
II. Working capital	3,233		3,233																				
C. Annual costs	Annual amount																						
Power Generation (Fuel)																							
Works #1 & #2				15,456	19,366	26,065	33,263	41,006	45,068	49,254	53,572	58,027	62,628	67,381	72,380	78,377	84,674	91,286	98,228	105,518	113,172	121,209	129,648
O&M																							
Works #1 & #2	3%			25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860
	of construction cost																						
III. Total				41,316	45,226	51,925	59,123	66,866	70,928	75,114	79,432	83,888	88,489	93,242	98,240	104,237	110,534	117,146	124,089	131,378	139,033	147,069	155,508
D. Benefits	Annual amount																						
Works #1 & #2				23,158	29,408	40,107	51,855	64,756	72,081	79,773	87,849	96,329	105,233	114,582	124,399	134,706	145,529	156,893	168,825	181,354	194,509	208,322	222,826
IV. Incremental output				23,158	29,408	40,107	51,855	64,756	72,081	79,773	87,849	96,329	105,233	114,582	124,399	134,706	145,529	156,893	168,825	181,354	194,509	208,322	222,826
E. Net benefits																							
IV-I-II-III		-431,005	-434,237	-18,159	-15,819	-11,818	-7,268	-2,110	1,153	4,659	8,417	12,441	16,745	21,341	26,159	30,469	34,995	39,747	44,737	49,976	55,477	61,253	67,318
Discount rate	12%																						
Net present value	-780,277	-431,005	-387,712	-14,476	-11,259	-7,511	-4,124	-1,069	522	1,882	3,035	4,006	4,814	5,478	5,995	6,235	6,393	6,484	6,516	6,499	6,441	6,350	6,231
Internal rate of return	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

Source: Prepared by the JICA Study Team.

Island of Maio

(Unit: thousands of 2009 CVE)

Years		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Item	Initial amount																						
A. Investment schedule																							
Land Preparation	-																						
Construction																							
Works #1 & #2	178,184	89,092	89,092																				
I. Total	178,184	89,092	89,092																				
B. Working capital																							
II. Working capital	668		668																				
C. Annual costs	Annual amount																						
Power Generation (Fuel)																							
Works #1 & #2				1,803	2,804	3,698	4,592	5,467	6,392	7,371	8,286	9,241	10,340	11,513	12,752	14,061	15,444	16,904	18,447	20,078	21,800	23,619	25,540
O&M																							
Works #1 & #2	3%			5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346
	of construction cost																						
III. Total				7,148	8,150	9,044	9,938	10,813	11,737	12,717	13,631	14,586	15,686	16,858	18,098	19,406	20,789	22,250	23,793	25,423	27,145	28,964	30,886
D. Benefits	Annual amount																						
Works #1 & #2				1,904	3,000	4,008	5,039	6,075	7,190	8,393	9,548	10,775	12,071	13,441	14,887	16,415	18,030	19,735	21,536	23,439	25,450	27,573	29,817
IV. Incremental output				1,904	3,000	4,008	5,039	6,075	7,190	8,393	9,548	10,775	12,071	13,441	14,887	16,415	18,030	19,735	21,536	23,439	25,450	27,573	29,817
E. Net benefits																							
IV-I-II-III		-89,092	-89,760	-5,244	-5,149	-5,036	-4,898	-4,738	-4,547	-4,324	-4,083	-3,811	-3,614	-3,418	-3,210	-2,991	-2,760	-2,515	-2,257	-1,984	-1,695	-1,391	-1,069
Discount rate	12%																						
Net present value	-197,169	-89,092	-80,143	-4,181	-3,665	-3,201	-2,779	-2,400	-2,057	-1,746	-1,472	-1,227	-1,039	-877	-736	-612	-504	-410	-329	-258	-197	-144	-99
Internal rate of return	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Source: Prepared by the JICA Study Team.

Island of Fogo

(Unit: thousands of 2009 CVE)

Years		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Item	Initial amount																						
A. Investment schedule																							
Land Preparation	-																						
Construction																							
Works #1 & #2	622,054	311,027	311,027																				
I. Total	622,054	311,027	311,027																				
B. Working capital																							
II. Working capital	2,333		2,333																				
C. Annual costs	Annual amount																						
Power Generation (Fuel)																							
Works #1 & #2				22,268	28,555	35,840	42,634	49,965	53,599	60,955	64,962	69,105	73,390	77,823	82,413	87,166	92,091	97,881	104,415	111,276	118,480	126,044	133,987
O&M																							
Works #1 & #2	3%			18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662
	of construction cost																						
III. Total				40,929	47,216	54,502	61,295	68,627	72,260	79,616	83,624	87,766	92,051	96,485	101,075	105,828	110,752	116,542	123,076	129,937	137,141	144,706	152,648
D. Benefits	Annual amount																						
Works #1 & #2				28,060	36,484	46,424	55,974	66,478	72,256	83,246	89,862	96,808	104,102	111,761	119,803	128,247	137,113	146,422	156,197	166,461	177,237	188,553	200,434
IV. Incremental output				28,060	36,484	46,424	55,974	66,478	72,256	83,246	89,862	96,808	104,102	111,761	119,803	128,247	137,113	146,422	156,197	166,461	177,237	188,553	200,434
E. Net benefits																							
IV-I-II-III		-311,027	-313,360	-12,870	-10,732	-8,078	-5,322	-2,148	-4	3,629	6,238	9,042	12,051	15,276	18,728	22,419	26,360	29,880	33,121	36,523	40,096	43,847	47,786
Discount rate	12%																						
Net present value	-562,176	-311,027	-279,785	-10,260	-7,639	-5,134	-3,020	-1,088	-2	1,466	2,249	2,911	3,464	3,921	4,292	4,587	4,816	4,874	4,824	4,749	4,655	4,545	4,423
Internal rate of return	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

Source: Prepared by JICA Study Team.

Whole Islands

(Unit: thousands of 2009 CVE)

Years		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Item	Initial amount																						
A. Investment schedule																							
Land Preparation	-																						
Construction																							
Santiago	1,672,641	836,320	836,320																				
S. Vicente	1,133,591	566,795	566,795																				
Sal	1,149,675	574,838	574,838																				
Sant Antão	862,010	431,005	431,005																				
Maio	178,184	89,092	89,092																				
Fogo	622,054	311,027	311,027																				
I. Total	5,618,154	2,809,077	2,809,077																				
B. Working capital																							
II. Working capital	21,068		21,068																				
C. Annual costs	Annual amount																						
Power Generation (Fuel)																							
Santiago				199,282	255,852	343,316	407,918	476,825	550,946	630,763	716,795	809,499	909,468	1,017,348	1,133,841	1,259,708	1,395,779	1,542,952	1,702,208	1,874,609	2,061,314	2,263,581	2,482,779
S. Vicente				114,888	227,074	338,759	449,365	568,632	673,829	783,686	896,677	1,010,462	1,069,901	1,132,312	1,151,609	1,171,871	1,193,145	1,215,484	1,238,939	1,263,568	1,289,427	1,316,580	1,345,090
Sal				676,475	689,108	704,139	722,164	733,049	1,772,016	1,785,089	1,799,465	1,815,274	1,832,653	1,851,760	1,872,766	1,895,859	1,921,247	1,949,158	1,979,843	2,013,578	2,050,664	2,091,436	2,136,261
Sant Antão				15,456	19,366	26,065	33,263	41,006	45,068	49,254	53,572	58,027	62,628	67,381	72,380	78,377	84,674	91,286	98,228	105,518	113,172	121,209	129,648
Maio				1,803	2,804	3,698	4,592	5,467	6,392	7,371	8,286	9,241	10,340	11,513	12,752	14,061	15,444	16,904	18,447	20,078	21,800	23,619	25,540
Fogo				22,268	28,555	35,840	42,634	49,965	53,599	60,955	64,962	69,105	73,390	77,823	82,413	87,166	92,091	97,881	104,415	111,276	118,480	126,044	133,987
O&M																							
Santiago	3%			50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179	50,179
S. Vicente	of construction cost			34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008	34,008
Sal				34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490	34,490
Sant Antão				25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860	25,860
Maio				5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346	5,346
Fogo				18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662	18,662
III. Total				1,198,715	1,391,303	1,620,362	1,828,480	2,043,489	3,270,394	3,485,662	3,708,301	3,940,152	4,126,925	4,326,683	4,494,305	4,675,587	4,870,925	5,082,210	5,310,626	5,557,171	5,823,402	6,111,014	6,421,849
D. Benefits	Annual amount																						
Santiago				222,739	290,610	396,186	478,138	567,558	665,781	773,678	892,209	1,022,287	1,165,037	1,321,692	1,493,607	1,682,269	1,889,309	2,116,517	2,365,859	2,639,490	2,939,776	3,269,314	3,630,953
S. Vicente				198,617	397,489	600,340	806,101	1,032,384	1,237,991	1,444,926	1,653,254	1,863,046	1,972,637	2,087,708	2,123,286	2,160,644	2,199,870	2,241,057	2,284,303	2,329,711	2,377,390	2,427,453	2,480,019
Sal				1,186,175	1,208,327	1,234,684	1,266,289	1,285,377	3,107,170	3,130,093	3,155,301	3,183,021	3,213,496	3,246,999	3,283,832	3,324,325	3,368,842	3,417,783	3,471,588	3,530,740	3,595,770	3,667,263	3,745,860
Sant Antão				23,158	29,408	40,107	51,855	64,756	72,081	79,773	87,849	96,329	105,233	114,582	124,399	134,706	145,529	156,893	168,825	181,354	194,509	208,322	222,826
Maio				1,904	3,000	4,008	5,039	6,075	7,190	8,393	9,548	10,775	12,071	13,441	14,887	16,415	18,030	19,735	21,536	23,439	25,450	27,573	29,817
Fogo				28,060	36,484	46,424	55,974	66,478	72,256	83,246	89,862	96,808	104,102	111,761	119,803	128,247	137,113	146,422	156,197	166,461	177,237	188,553	200,434
IV. Incremental output				1,660,652	1,965,319	2,321,748	2,663,397	3,022,628	5,162,469	5,520,108	5,888,023	6,272,266	6,572,576	6,896,182	7,159,814	7,446,606	7,758,692	8,098,407	8,468,309	8,871,195	9,310,133	9,788,478	#######
E. Net benefits																							
IV-I-II-III		-2,809,077	-2,830,145	461,937	574,015	701,386	834,917	979,139	1,892,075	2,034,446	2,179,721	2,332,115	2,445,651	2,569,500	2,665,509	2,771,019	2,887,768	3,016,197	3,157,683	3,314,024	3,486,731	3,677,464	3,888,060
Discount rate	12%																						
Net present value	5,667,709	-2,809,077	-2,526,915	368,253	408,573	445,744	473,754	496,062	855,879	821,679	786,029	750,878	703,066	659,527	610,866	567,005	527,584	492,007	459,899	430,954	404,833	381,231	359,877
Internal rate of return	20.7%	-2,809,077	-2,344,548	317,018	326,344	330,338	325,758	316,481	506,631	451,284	400,549	355,021	308,425	268,444	230,694	198,676	171,522	148,411	128,714	111,909	97,539	85,223	74,644

Source: Prepared by the JICA Study Team.

Table A- 2.2 Financial analysis (income statement and operating efficiency indicators)

Island of Santiago

		Year																				
	(Unit)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Fund requirement	CVE mil	840.7	851.6																				
Construction cost		836.3	836.3																				
Working capital			6.5																				
Interest		4.4	8.8																				
Fund procurement		840.7	851.6																				
Equity		168.1	170.3																				
Loan		672.6	681.3																				
Residual value			1,672.6	1,589.0	1,505.4	1,421.7	1,338.1	1,254.5	1,170.8	1,087.2	1,003.6	920.0	836.3	752.7	669.1	585.4	501.8	418.2	334.5	250.9	167.3	83.6	0.0
Remaining debt (loan)		668.2	1,340.7	1,340.7	1,340.7	1,340.7	1,340.7	1,340.7	1,340.7	1,340.7	1,340.7	1,296.0	1,251.3	1,206.6	1,161.9	1,117.2	1,072.6	1,027.9	983.2	938.5	893.8	849.1	0.0
Energy demand	MWh			8,922	11,640	15,869	19,152	22,734	26,668	30,990	35,738	40,948	46,666	52,941	59,827	67,384	75,677	84,777	94,765	105,725	117,753	130,953	145,438
Energy supply	MWh			14,483	18,595	24,952	29,647	34,655	40,042	45,843	52,096	58,833	66,099	73,939	82,406	91,554	101,443	112,140	123,714	136,244	149,813	164,514	180,445
Total sales	CVE mil			231.7	308.4	428.8	527.9	639.2	764.8	906.5	1,066.3	1,246.2	1,448.6	1,676.2	1,932.1	2,219.7	2,542.8	2,905.5	3,312.8	3,769.8	4,282.7	4,858.0	5,503.3
Unit rate	CVE/kWh	25.0	25.5	26.0	26.5	27.0	27.6	28.1	28.7	29.3	29.8	30.4	31.0	31.7	32.3	32.9	33.6	34.3	35.0	35.7	36.4	37.1	37.8
Variable cost	CVE mil			207.3	271.5	371.6	450.4	537.0	632.9	739.0	856.6	986.8	1,130.8	1,290.2	1,466.7	1,662.2	1,878.5	2,118.1	2,383.5	2,677.4	3,002.9	3,363.6	3,763.1
Fuel cost of power generation	CVE mil			207.3	271.5	371.6	450.4	537.0	632.9	739.0	856.6	986.8	1,130.8	1,290.2	1,466.7	1,662.2	1,878.5	2,118.1	2,383.5	2,677.4	3,002.9	3,363.6	3,763.1
Fuel unit cost	CVE/kWh	13.8	14.0	14.3	14.6	14.9	15.2	15.5	15.8	16.1	16.4	16.8	17.1	17.5	17.8	18.2	18.5	18.9	19.3	19.7	20.0	20.4	20.9
Fixed cost	CVE mil			135.8	136.9	137.9	139.0	140.1	141.3	142.4	143.6	144.8	146.0	147.3	148.5	149.8	151.2	152.5	153.9	155.3	156.7	158.2	159.7
Depreciation		83.6	83.6	83.6	83.6	83.6	83.6	83.6	83.6	83.6	83.6	83.6	83.6	83.6	83.6	83.6	83.6	83.6	83.6	83.6	83.6	83.6	83.6
O&M		52.2	53.3	54.3	55.4	56.5	57.6	58.8	60.0	61.2	62.4	63.6	64.9	66.2	67.5	68.9	70.3	71.7	73.1	74.6	76.1		
Interest		8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.4	8.1	7.8	7.6	7.3	7.0	6.7	6.4	6.1	5.8	5.5	
Profit before tax				-120.1	-108.7	-89.4	-70.2	-46.7	-18.1	16.3	57.3	105.9	163.3	230.6	309.0	400.2	505.8	627.9	768.7	930.7	1,116.9	1,330.5	1,575.0
Tax	CVE mil			0.0	0.0	0.0	0.0	0.0	0.0	4.1	14.3	26.5	40.8	57.6	77.3	100.0	126.4	157.0	192.2	232.7	279.2	332.6	393.8
Profit after tax	CVE mil			-120.1	-108.7	-89.4	-70.2	-46.7	-18.1	12.2	43.0	79.4	122.5	172.9	231.8	300.1	379.3	470.9	576.5	698.1	837.7	997.8	1,181.3
Repayment of principal	CVE mil			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	44.7	849.1
Cash flow	CVE mil	-168.1	-170.3	-36.5	-25.1	-5.8	13.4	37.0	65.6	95.9	126.6	118.3	161.4	211.9	270.7	339.1	418.3	509.9	615.5	737.0	876.6	1,036.8	422.3
Equity IRR	20.5%																						
In the case of 100% equity financing																							
Profit before tax	CVE mil			-111.4	-100.0	-80.7	-61.5	-38.0	-9.4	25.0	66.0	114.6	171.7	238.7	316.9	407.7	513.1	634.9	775.4	937.1	1,123.0	1,336.3	1,580.6
tax	CVE mil			0.0	0.0	0.0	0.0	0.0	0.0	6.3	16.5	28.6	42.9	59.7	79.2	101.9	128.3	158.7	193.8	234.3	280.8	334.1	395.1
Profit after tax	CVE mil			-111.4	-100.0	-80.7	-61.5	-38.0	-9.4	18.8	49.5	85.9	128.8	179.0	237.6	305.8	384.8	476.1	581.5	702.9	842.3	1,002.2	1,185.4
Cash flow	CVE mil	-836.3	-842.8	-27.8	-16.4	2.9	22.1	45.7	74.3	102.4	133.2	169.6	212.4	262.7	321.3	389.4	468.4	559.8	665.2	786.5	925.9	1,085.8	1,275.6
Project IRR	9.8%																						

Fund procurement			
Equity		20.0%	
Loan		80.0%	
Interest rate		0.65%	
Grace period	year	10	
Amortization	year	30	

Project life	year	20	
Construction cost	CVE mil	1,672.6	as of 2009
Working capital	O&M cost of	1.5	months
Depreciation (straight line)		5.0%	p.a.
Tax rate		25%	

Fuel cost	CVE/kWh	13.8	as of 2009
O&M cost		3.0%	of the construction cost
Cost escalation:			
Fuel cost		2.0%	p.a.
Other costs		2.0%	p.a.

Energy demand	MWh/year	(As projected)	
Demand increase		(As projected)	
T&D loss		(As projected)	
Average retail price	CVE/kWh	25.0	as of 2009
Tariff increase		2.0%	p.a.

Source: Prepared by the JICA Study Team.

Island of Santiago

		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Debt Service Coverage Ratio	DSCR			-3.2	-1.9	0.3	2.5	5.2	8.5	12.5	17.2	3.7	4.8	6.1	7.6	9.4	11.5	13.9	16.7	20.0	23.8	28.1	1.9
Return on Asset	ROA			-7.7%	-7.5%	-6.6%	-5.4%	-3.8%	-1.5%	1.0%	3.4%	6.0%	8.8%	11.4%	13.6%	15.3%	16.5%	17.3%	17.7%	17.9%	17.8%	17.6%	19.7%
Return on Rate Base	RRB			-51.8%	-35.3%	-20.9%	-13.3%	-7.3%	-2.4%	1.3%	4.0%	6.4%	8.5%	10.3%	12.0%	13.5%	14.9%	16.2%	17.4%	18.5%	19.6%	20.5%	21.5%

Balance sheet

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Current assets (Cash)	0.0	6.5	-30.0	-55.1	-60.9	-47.5	-10.5	55.0	150.9	277.5	395.9	557.3	769.2	1,039.9	1,379.0	1,797.2	2,307.1	2,922.6	3,659.6	4,536.2	5,573.0	5,988.8
Properties and equipment (T&D facilities)	836.3	1,672.6	1,589.0	1,505.4	1,421.7	1,338.1	1,254.5	1,170.8	1,087.2	1,003.6	920.0	836.3	752.7	669.1	585.4	501.8	418.2	334.5	250.9	167.3	83.6	0.0
Total Assets	836.3	1,679.2	1,559.0	1,450.3	1,360.9	1,290.7	1,244.0	1,225.9	1,238.1	1,281.1	1,315.8	1,393.6	1,521.9	1,708.9	1,964.4	2,299.0	2,725.3	3,257.1	3,910.5	4,703.5	5,656.6	5,988.8
Liabilities	668.2	1,340.7	1,340.7	1,340.7	1,340.7	1,340.7	1,340.7	1,340.7	1,340.7	1,340.7	1,296.0	1,251.3	1,206.6	1,161.9	1,117.2	1,072.6	1,027.9	983.2	938.5	893.8	849.1	0.0
Net assets	168.1	338.5	218.3	109.6	20.2	-50.0	-96.7	-114.8	-102.6	-59.6	19.8	142.3	315.2	547.0	847.1	1,226.5	1,697.4	2,273.9	2,972.0	3,809.7	4,807.5	5,988.8
Paid in capital	168.1	338.5	338.5	338.5	338.5	338.5	338.5	338.5	338.5	338.5	338.5	338.5	338.5	338.5	338.5	338.5	338.5	338.5	338.5	338.5	338.5	338.5
Retained earnings	0.0	0.0	-120.1	-228.9	-318.3	-388.5	-435.2	-453.3	-441.0	-398.0	-318.6	-196.2	-23.2	208.5	508.7	888.0	1,358.9	1,935.4	2,633.5	3,471.2	4,469.0	5,650.3
Total liabilities and net assets	836.3	1,679.2	1,559.0	1,450.3	1,360.9	1,290.7	1,244.0	1,225.9	1,238.1	1,281.1	1,315.8	1,393.6	1,521.9	1,708.9	1,964.4	2,299.0	2,725.3	3,257.1	3,910.5	4,703.5	5,656.6	5,988.8

Source: Prepared by the JICA Study Team.

Island of S. Vicente

		Year																				
	(Unit)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Fund requirement	CVE mil	569.8	577.2																				
Construction cost		566.8	566.8																				
Working capital			4.4																				
Interest		3.0	6.0																				
Fund procurement		569.8	577.2																				
Equity		114.0	115.4																				
Loan		455.8	461.7																				
Residual value			1,133.6	1,076.9	1,020.2	963.6	906.9	850.2	793.5	736.8	680.2	623.5	566.8	510.1	453.4	396.8	340.1	283.4	226.7	170.0	113.4	56.7	0.0
Remaining debt (loan)		452.8	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	878.3	848.1	817.8	787.5	757.2	726.9	696.6	666.3	636.0	605.8	575.5	0.0
Energy demand	MWh			8,016	16,043	24,231	32,535	41,668	49,967	58,319	66,728	75,195	79,618	84,263	85,699	87,207	88,790	90,452	92,198	94,030	95,955	97,975	100,097
Energy supply	MWh			10,058	19,880	29,658	39,341	49,783	58,993	68,611	78,503	88,465	93,669	99,133	100,822	102,596	104,458	106,414	108,468	110,624	112,888	115,265	117,761
Total sales	CVE mil			206.6	421.8	649.8	890.0	1,162.6	1,422.1	1,693.0	1,975.8	2,271.0	2,452.7	2,647.7	2,746.7	2,850.9	2,960.7	3,076.5	3,198.6	3,327.4	3,463.4	3,607.1	3,758.9
Unit rate	CVE/kWh	24.8	25.3	25.8	26.3	26.8	27.4	27.9	28.5	29.0	29.6	30.2	30.8	31.4	32.1	32.7	33.3	34.0	34.7	35.4	36.1	36.8	37.6
Variable cost	CVE mil			119.5	241.0	366.7	496.1	640.4	774.0	918.2	1,071.6	1,231.7	1,330.3	1,436.0	1,489.7	1,546.3	1,605.8	1,668.6	1,734.8	1,804.7	1,878.5	1,956.4	2,038.7
Fuel cost of power generation	CVE mil			119.5	241.0	366.7	496.1	640.4	774.0	918.2	1,071.6	1,231.7	1,330.3	1,436.0	1,489.7	1,546.3	1,605.8	1,668.6	1,734.8	1,804.7	1,878.5	1,956.4	2,038.7
Fuel unit cost	CVE/kWh	11.4	11.7	11.9	12.1	12.4	12.6	12.9	13.1	13.4	13.7	13.9	14.2	14.5	14.8	15.1	15.4	15.7	16.0	16.3	16.6	17.0	17.3
Fixed cost	CVE mil			92.1	92.8	93.5	94.2	95.0	95.7	96.5	97.3	98.1	99.0	99.8	100.7	101.6	102.4	103.4	104.3	105.3	106.2	107.2	108.2
Depreciation		56.7	56.7	56.7	56.7	56.7	56.7	56.7	56.7	56.7	56.7	56.7	56.7	56.7	56.7	56.7	56.7	56.7	56.7	56.7	56.7	56.7	56.7
O&M		35.4	36.1	36.8	37.5	38.3	39.1	39.8	40.6	41.5	42.3	43.1	44.0	44.9	45.8	46.7	47.6	48.6	49.5	50.5	51.5		
Interest		5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.7	5.5	5.3	5.1	4.9	4.7	4.5	4.3	4.1	3.9	3.7	
Profit before tax				-10.9	82.2	183.7	293.7	421.4	546.4	672.3	801.0	935.3	1,017.8	1,106.4	1,151.0	1,198.0	1,247.5	1,299.8	1,354.9	1,413.1	1,474.6	1,539.5	1,608.2
Tax	CVE mil			0.0	20.5	45.9	73.4	105.3	136.6	168.1	200.2	233.8	254.4	276.6	287.7	299.5	311.9	325.0	338.7	353.3	368.7	384.9	402.1
Profit after tax	CVE mil			-10.9	61.6	137.8	220.3	316.0	409.8	504.2	600.7	701.4	763.3	829.8	863.2	898.5	935.7	974.9	1,016.2	1,059.9	1,106.0	1,154.7	1,206.2
Repayment of principal	CVE mil			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3	575.5
Cash flow	CVE mil	-114.0	-115.4	45.8	118.3	194.5	277.0	372.7	466.5	560.9	657.4	727.8	789.7	856.2	889.6	924.9	962.1	1,001.2	1,042.6	1,086.2	1,132.3	1,181.1	691.8
Equity IRR	59.8%																						
In the case of 100% equity financing																							
Profit before tax	CVE mil			-4.9	88.1	189.7	299.6	427.3	552.3	678.2	806.9	941.2	1,023.5	1,111.9	1,156.3	1,203.1	1,252.5	1,304.5	1,359.5	1,417.5	1,478.7	1,543.5	1,611.9
tax	CVE mil			0.0	22.0	47.4	74.9	106.8	138.1	169.6	201.7	235.3	255.9	278.0	289.1	300.8	313.1	326.1	339.9	354.4	369.7	385.9	403.0
Profit after tax	CVE mil			-4.9	66.1	142.2	224.7	320.5	414.2	508.7	605.1	705.9	767.6	833.9	867.2	902.3	939.4	978.4	1,019.6	1,063.1	1,109.1	1,157.6	1,209.0
Cash flow	CVE mil	-566.8	-571.2	51.7	122.7	198.9	281.4	377.1	470.9	565.3	661.8	762.5	824.3	890.6	923.9	959.0	996.0	1,035.1	1,076.3	1,119.8	1,165.7	1,214.3	1,270.1
Project IRR	26.2%																						

Fund procurement			
Equity		20.0%	
Loan		80.0%	
Interest rate		0.65%	
Grace period	year	10	
Amortization	year	30	

Project life	year	20	
Construction cost	CVE mil	1,133.6	as of 2009
Working capital	O&M cost of	1.5	months
Depreciation (straight line)		5.0%	p.a.
Tax rate		25%	

Fuel cost	CVE/kWh	11.4	as of 2009
O&M cost		3.0%	of the construction cost
Cost escalation:			
Fuel cost		2.0%	p.a.
Other costs		2.0%	p.a.

Energy demand	MWh/year	(As projected)	
Demand increase		(As projected)	
T&D loss		(As projected)	
Average retail price	CVE/kWh	24.8	as of 2009
Tariff increase		2.0%	p.a.

Source: Prepared by the JICA Study Team.

Island of S. Vicente

		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Debt Service Coverage Ratio	DSCR			8.8	24.5	41.7	60.3	81.9	103.1	124.4	146.2	27.6	30.0	32.6	34.1	35.6	37.2	38.9	40.7	42.6	44.6	46.8	2.9
Return on Asset	ROA			-1.0%	5.2%	10.4%	14.2%	17.0%	18.0%	18.2%	17.8%	17.3%	16.0%	14.9%	13.5%	12.3%	11.4%	10.7%	10.0%	9.5%	9.0%	8.7%	8.6%
Return on Rate Base	RRB			-5.3%	14.6%	21.2%	24.8%	27.2%	28.8%	29.8%	30.4%	30.9%	31.1%	31.3%	31.4%	31.5%	31.6%	31.7%	31.8%	31.9%	31.9%	32.0%	32.1%

Balance sheet

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Current assets (Cash)	0.0	4.4	50.2	168.6	363.0	640.0	1,012.7	1,479.2	2,040.1	2,697.5	3,425.4	4,215.1	5,071.2	5,960.9	6,885.7	7,847.8	8,849.0	9,891.6	10,977.9	12,110.2	13,291.3	13,978.6
Properties and equipment (T&D facilities)	566.8	1,133.6	1,076.9	1,020.2	963.6	906.9	850.2	793.5	736.8	680.2	623.5	566.8	510.1	453.4	396.8	340.1	283.4	226.7	170.0	113.4	56.7	0.0
Total Assets	566.8	1,138.0	1,127.2	1,188.8	1,326.6	1,546.9	1,862.9	2,272.7	2,777.0	3,377.7	4,048.8	4,781.9	5,581.3	6,414.3	7,282.5	8,187.9	9,132.4	10,118.3	11,147.9	12,223.6	13,347.9	13,978.6
Liabilities	452.8	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	878.3	848.1	817.8	787.5	757.2	726.9	696.6	666.3	636.0	605.8	575.5	0.0
Net assets	114.0	229.4	218.5	280.2	418.0	638.3	954.3	1,364.1	1,868.3	2,469.1	3,170.5	3,933.8	4,763.6	5,626.8	6,525.3	7,461.0	8,435.8	9,452.0	10,511.9	11,617.8	12,772.5	13,978.6
Paid in capital	114.0	229.4	229.4	229.4	229.4	229.4	229.4	229.4	229.4	229.4	229.4	229.4	229.4	229.4	229.4	229.4	229.4	229.4	229.4	229.4	229.4	229.4
Retained earnings	0.0	0.0	-10.9	50.8	188.6	408.9	724.9	1,134.7	1,638.9	2,239.7	2,941.1	3,704.4	4,534.2	5,397.4	6,295.9	7,231.6	8,206.4	9,222.6	10,282.5	11,388.4	12,543.1	13,749.3
Total liabilities and net assets	566.8	1,138.0	1,127.2	1,188.8	1,326.6	1,546.9	1,862.9	2,272.7	2,777.0	3,377.7	4,048.8	4,781.9	5,581.3	6,414.3	7,282.5	8,187.9	9,132.4	10,118.3	11,147.9	12,223.6	13,347.9	13,978.6

Source: Prepared by the JICA Study Team.

Island of Sal

		Year																				
	(Unit)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Fund requirement	CVE mil	577.8	585.4																				
Construction cost		574.8	574.8																				
Working capital			4.5																				
Interest		3.0	6.0																				
Fund procurement		577.8	585.4																				
Equity		115.6	117.1																				
Loan		462.3	468.3																				
Residual value			1,149.7	1,092.2	1,034.7	977.2	919.7	862.3	804.8	747.3	689.8	632.3	574.8	517.4	459.9	402.4	344.9	287.4	229.9	172.5	115.0	57.5	0.0
Remaining debt (loan)		459.3	921.5	921.5	921.5	921.5	921.5	921.5	921.5	921.5	921.5	890.8	860.1	829.4	798.6	767.9	737.2	706.5	675.8	645.1	614.3	583.6	0.0
Energy demand	MWh			49,042	49,958	51,048	52,355	53,144	128,466	129,413	130,456	131,602	132,862	134,247	135,770	137,444	139,284	141,308	143,532	145,978	148,667	151,623	154,872
Energy supply	MWh			51,623	52,588	53,735	55,110	55,941	135,227	136,225	137,322	138,528	139,854	141,312	142,915	144,678	146,615	148,745	151,087	153,661	156,491	159,603	163,023
Total sales	CVE mil			1,234.1	1,282.3	1,336.5	1,398.1	1,447.5	3,569.2	3,667.4	3,770.9	3,880.1	3,995.6	4,118.0	4,248.0	4,386.4	4,534.0	4,691.9	4,861.1	5,042.8	5,238.4	5,449.4	5,677.5
Unit rate	CVE/kWh	24.2	24.7	25.2	25.7	26.2	26.7	27.2	27.8	28.3	28.9	29.5	30.1	30.7	31.3	31.9	32.6	33.2	33.9	34.5	35.2	35.9	36.7
Variable cost	CVE mil			703.8	731.3	762.2	797.3	825.5	2,035.5	2,091.5	2,150.5	2,212.8	2,278.7	2,348.5	2,422.6	2,501.5	2,585.7	2,675.8	2,772.3	2,875.9	2,987.4	3,107.8	3,237.9
Fuel cost of power generation	CVE mil			703.8	731.3	762.2	797.3	825.5	2,035.5	2,091.5	2,150.5	2,212.8	2,278.7	2,348.5	2,422.6	2,501.5	2,585.7	2,675.8	2,772.3	2,875.9	2,987.4	3,107.8	3,237.9
Fuel unit cost	CVE/kWh	13.1	13.4	13.6	13.9	14.2	14.5	14.8	15.1	15.4	15.7	16.0	16.3	16.6	17.0	17.3	17.6	18.0	18.3	18.7	19.1	19.5	19.9
Fixed cost	CVE mil			93.4	94.1	94.8	95.6	96.3	97.1	97.9	98.7	99.5	100.4	101.2	102.1	103.0	103.9	104.8	105.8	106.7	107.7	108.7	109.8
Depreciation				57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5
O&M				35.9	36.6	37.3	38.1	38.8	39.6	40.4	41.2	42.0	42.9	43.7	44.6	45.5	46.4	47.3	48.3	49.3	50.2	51.3	52.3
Interest				6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.8	5.6	5.4	5.2	5.0	4.8	4.6	4.4	4.2	4.0	3.8
Profit before tax				430.9	450.9	473.5	499.2	519.7	1,430.6	1,472.0	1,515.7	1,561.8	1,610.7	1,662.7	1,717.9	1,776.6	1,839.4	1,906.5	1,978.4	2,055.7	2,139.0	2,228.9	2,326.1
Tax	CVE mil			107.7	112.7	118.4	124.8	129.9	357.6	368.0	378.9	390.4	402.7	415.7	429.5	444.2	459.8	476.6	494.6	513.9	534.8	557.2	581.5
Profit after tax	CVE mil			323.2	338.2	355.1	374.4	389.8	1,072.9	1,104.0	1,136.7	1,171.3	1,208.1	1,247.0	1,288.4	1,332.5	1,379.5	1,429.9	1,483.8	1,541.8	1,604.3	1,671.7	1,744.5
Repayment of principal	CVE mil			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.7	30.7	30.7	30.7	30.7	30.7	30.7	30.7	30.7	30.7	30.7	583.6
Cash flow	CVE mil	-115.6	-117.1	380.7	395.7	412.6	431.9	447.3	1,130.4	1,161.5	1,194.2	1,198.1	1,234.8	1,273.8	1,315.2	1,359.3	1,406.3	1,456.6	1,510.6	1,568.6	1,631.0	1,698.4	1,222.9
Equity IRR	113.0%																						
In the case of 100% equity financing																							
Profit before tax	CVE mil			436.9	456.9	479.5	505.2	525.7	1,436.6	1,478.0	1,521.6	1,567.7	1,616.5	1,668.3	1,723.3	1,781.8	1,844.4	1,911.3	1,983.0	2,060.1	2,143.2	2,232.9	2,329.9
tax	CVE mil			109.2	114.2	119.9	126.3	131.4	359.1	369.5	380.4	391.9	404.1	417.1	430.8	445.5	461.1	477.8	495.8	515.0	535.8	558.2	582.5
Profit after tax	CVE mil			327.7	342.7	359.6	378.9	394.3	1,077.4	1,108.5	1,141.2	1,175.8	1,212.4	1,251.2	1,292.4	1,336.4	1,383.3	1,433.5	1,487.3	1,545.1	1,607.4	1,674.6	1,747.4
Cash flow	CVE mil	-574.8	-579.3	385.2	400.2	417.1	436.4	451.7	1,134.9	1,166.0	1,198.7	1,233.3	1,269.9	1,308.7	1,349.9	1,393.9	1,440.8	1,490.9	1,544.8	1,602.6	1,664.9	1,732.1	1,809.4
Project IRR	40.2%																						

Fund procurement			
Equity		20.0%	
Loan		80.0%	
Interest rate		0.65%	
Grace period	year	10	
Amortization	year	30	

Project life	year	20	
Construction cost	CVE mil	1,149.7	as of 2009
Working capital	O&M cost of	1.5	months
Depreciation (straight line)		5.0%	p.a.
Tax rate		25%	

Fuel cost	CVE/kWh	13.1	as of 2009
O&M cost		3.0%	of the construction cost
Cost escalation:			
Fuel cost		2.0%	p.a.
Other costs		2.0%	p.a.

Energy demand	MWh/year	(As projected)	
Demand increase		(As projected)	
T&D loss		(As projected)	
Average retail price	CVE/kWh	24.2	as of 2009
Tariff increase		2.0%	p.a.

Source: Prepared by the JICA Study Team.

Island of Sal

		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Debt Service Coverage Ratio	DSCR			82.5	85.9	89.6	93.9	97.4	249.4	256.3	263.6	44.3	45.9	47.5	49.3	51.2	53.3	55.4	57.8	60.3	63.0	66.0	4.1
Return on Asset	ROA			21.9%	18.6%	16.4%	14.7%	13.3%	26.8%	21.6%	18.2%	15.9%	14.1%	12.7%	11.7%	10.8%	10.1%	9.5%	9.0%	8.5%	8.2%	7.9%	7.8%
Return on Rate Base	RRB			26.2%	26.4%	26.6%	26.8%	26.9%	30.1%	30.1%	30.1%	30.2%	30.2%	30.3%	30.3%	30.4%	30.4%	30.5%	30.5%	30.6%	30.6%	30.7%	30.7%

Balance sheet

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Current assets (Cash)	0.0	4.5	385.2	780.8	1,193.4	1,625.3	2,072.6	3,203.0	4,364.5	5,558.7	6,756.8	7,991.6	9,265.4	10,580.6	11,939.8	13,346.1	14,802.7	16,313.3	17,881.9	19,512.9	21,211.4	22,429.8
Properties and equipment (T&D facilities)	574.8	1,149.7	1,092.2	1,034.7	977.2	919.7	862.3	804.8	747.3	689.8	632.3	574.8	517.4	459.9	402.4	344.9	287.4	229.9	172.5	115.0	57.5	0.0
Total Assets	574.8	1,154.2	1,477.4	1,815.6	2,170.7	2,545.1	2,934.8	4,007.8	5,111.8	6,248.5	7,389.1	8,566.5	9,782.8	11,040.4	12,342.2	13,691.0	15,090.2	16,543.3	18,054.4	19,627.9	21,268.8	22,429.8
Liabilities	459.3	921.5	921.5	921.5	921.5	921.5	921.5	921.5	921.5	921.5	890.8	860.1	829.4	798.6	767.9	737.2	706.5	675.8	645.1	614.3	583.6	0.0
Net assets	115.6	232.6	555.8	894.0	1,249.1	1,623.5	2,013.3	3,086.3	4,190.3	5,327.0	6,498.3	7,706.4	8,953.4	10,241.8	11,574.3	12,953.8	14,383.7	15,867.5	17,409.3	19,013.6	20,685.2	22,429.8
Paid in capital	115.6	232.6	232.6	232.6	232.6	232.6	232.6	232.6	232.6	232.6	232.6	232.6	232.6	232.6	232.6	232.6	232.6	232.6	232.6	232.6	232.6	232.6
Retained earnings	0.0	0.0	323.2	661.4	1,016.5	1,390.9	1,780.7	2,853.6	3,957.6	5,094.4	6,265.7	7,473.7	8,720.7	10,009.1	11,341.6	12,721.2	14,151.0	15,634.9	17,176.7	18,780.9	20,452.6	22,197.1
Total liabilities and net assets	574.8	1,154.2	1,477.4	1,815.6	2,170.7	2,545.1	2,934.8	4,007.8	5,111.8	6,248.5	7,389.1	8,566.5	9,782.8	11,040.4	12,342.2	13,691.0	15,090.2	16,543.3	18,054.4	19,627.9	21,268.8	22,429.8

Source: Prepared by the JICA Study Team.

Island of Sant Antão

		Year																				
	(Unit)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Fund requirement	CVE mil	433.3	438.9																				
Construction cost		431.0	431.0																				
Working capital			3.4																				
Interest		2.3	4.5																				
Fund procurement		433.3	438.9																				
Equity		86.7	87.8																				
Loan		346.6	351.1																				
Residual value			862.0	818.9	775.8	732.7	689.6	646.5	603.4	560.3	517.2	474.1	431.0	387.9	344.8	301.7	258.6	215.5	172.4	129.3	86.2	43.1	-0.0
Remaining debt (loan)		344.4	690.9	690.9	690.9	690.9	690.9	690.9	690.9	690.9	690.9	667.9	644.9	621.8	598.8	575.8	552.8	529.7	506.7	483.7	460.6	437.6	0.0
Energy demand	MWh			901	1,144	1,561	2,018	2,520	2,805	3,104	3,418	3,748	4,095	4,459	4,841	5,242	5,663	6,105	6,569	7,057	7,569	8,106	8,670
Energy supply	MWh			1,216	1,524	2,051	2,617	3,226	3,546	3,875	4,215	4,566	4,927	5,301	5,695	6,167	6,662	7,182	7,728	8,302	8,904	9,537	10,201
Total sales	CVE mil			24.1	31.2	43.4	57.3	72.9	82.8	93.5	105.0	117.4	130.8	145.3	160.9	177.7	195.9	215.4	236.4	259.0	283.4	309.6	337.7
Unit rate	CVE/kWh	25.7	26.2	26.7	27.3	27.8	28.4	28.9	29.5	30.1	30.7	31.3	32.0	32.6	33.2	33.9	34.6	35.3	36.0	36.7	37.4	38.2	39.0
Variable cost	CVE mil			16.1	20.6	28.2	36.7	46.2	51.8	57.7	64.0	70.7	77.9	85.5	93.6	103.4	114.0	125.3	137.5	150.7	164.9	180.1	196.5
Fuel cost of power generation	CVE mil			16.1	20.6	28.2	36.7	46.2	51.8	57.7	64.0	70.7	77.9	85.5	93.6	103.4	114.0	125.3	137.5	150.7	164.9	180.1	196.5
Fuel unit cost	CVE/kWh	12.7	13.0	13.2	13.5	13.8	14.0	14.3	14.6	14.9	15.2	15.5	15.8	16.1	16.4	16.8	17.1	17.4	17.8	18.2	18.5	18.9	19.3
Fixed cost	CVE mil			70.0	70.5	71.1	71.7	72.2	72.8	73.4	74.0	74.6	75.3	75.9	76.6	77.2	77.9	78.6	79.3	80.0	80.8	81.5	82.3
Depreciation		43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1
O&M		26.9	27.4	28.0	28.6	29.1	29.7	30.3	30.9	31.5	32.2	32.8	33.5	34.1	34.8	35.5	36.2	36.9	37.7	38.4	39.2		
Interest		4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.3	4.2	4.0	3.9	3.7	3.6	3.4	3.3	3.1	3.0	2.8	
Profit before tax		-66.5	-64.4	-60.4	-55.6	-50.0	-46.3	-42.1	-37.5	-32.4	-26.6	-20.2	-13.3	-6.8	0.3	7.9	16.1	25.0	34.6	44.9	56.1		
Tax	CVE mil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.0	4.0	6.2	8.6	11.2	14.0
Profit after tax	CVE mil	-66.5	-64.4	-60.4	-55.6	-50.0	-46.3	-42.1	-37.5	-32.4	-26.6	-20.2	-13.3	-6.8	0.2	5.9	12.1	18.7	25.9	33.7	42.1		
Repayment of principal	CVE mil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	437.6	
Cash flow	CVE mil	-86.7	-87.8	-23.4	-21.3	-17.3	-12.5	-6.9	-3.2	1.0	5.6	-12.4	-6.6	-0.2	6.8	13.3	20.3	26.0	32.1	38.8	46.0	53.8	-349.1
Equity IRR	#DIV/0!																						
In the case of 100% equity financing																							
Profit before tax	CVE mil			-62.0	-59.9	-55.9	-51.1	-45.5	-41.8	-37.6	-33.0	-27.9	-22.3	-16.0	-9.3	-2.9	4.0	11.5	19.5	28.3	37.7	47.9	58.9
tax	CVE mil			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.9	4.9	7.1	9.4	12.0	14.7
Profit after tax	CVE mil			-62.0	-59.9	-55.9	-51.1	-45.5	-41.8	-37.6	-33.0	-27.9	-22.3	-16.0	-9.3	-2.9	3.0	8.6	14.7	21.2	28.3	35.9	44.2
Cash flow	CVE mil	-431.0	-434.4	-18.9	-16.8	-12.8	-8.0	-2.4	1.3	5.5	10.1	15.2	20.8	27.1	33.8	40.2	46.1	51.7	57.8	64.3	71.4	79.0	90.7
Project IRR	#NUM!																						

Fund procurement		
Equity		20.0%
Loan		80.0%
Interest rate		0.65%
Grace period	year	10
Amortization	year	30

Project life	year	20		Fuel cost	CVE/kWh	12.7	as of 2009		Energy demand	MWh/year	(As projected)	
				O&M cost		3.0%	of the construction cost		Demand increase		(As projected)	
Construction cost	CVE mil	862.0	as of 2009						T&D loss		(As projected)	
Working capital	O&M cost of	1.5	months	Cost escalation:								
				Fuel cost		2.0%	p.a.		Average retail price	CVE/kWh	25.7	as of 2009
Depreciation (straight line)		5.0%	p.a.	Other costs		2.0%	p.a.		Tariff increase		2.0%	p.a.
Tax rate		25%										

Source: Prepared by the JICA Study Team.

Island of Sant Antão

		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Debt Service Coverage Ratio	DSCR			-4.2	-3.7	-2.8	-1.8	-0.5	0.3	1.2	2.2	0.6	0.8	1.0	1.2	1.5	1.8	2.0	2.4	2.7	3.1	3.5	0.2
Return on Asset	ROA			-8.3%	-8.8%	-9.0%	-9.0%	-8.8%	-8.9%	-8.8%	-8.5%	-8.4%	-7.9%	-6.9%	-5.2%	-3.0%	0.1%	3.1%	6.8%	10.8%	14.8%	18.1%	-20.1%
Return on Rate Base	RRB			-275.9%	-206.3%	-139.1%	-97.1%	-68.5%	-55.9%	-45.1%	-35.7%	-27.6%	-20.3%	-13.9%	-8.3%	-3.8%	0.1%	2.7%	5.1%	7.2%	9.2%	10.9%	12.5%

Balance sheet

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Current assets (Cash)	0.0	3.4	-20.0	-41.3	-58.6	-71.1	-78.0	-81.1	-80.2	-74.6	-87.0	-93.5	-93.7	-86.9	-73.6	-53.4	-27.4	4.8	43.6	89.6	143.3	-209.1
Properties and equipment (T&D facilities)	431.0	862.0	818.9	775.8	732.7	689.6	646.5	603.4	560.3	517.2	474.1	431.0	387.9	344.8	301.7	258.6	215.5	172.4	129.3	86.2	43.1	-0.0
Total Assets	431.0	865.4	798.9	734.5	674.1	618.5	568.5	522.3	480.1	442.6	387.2	337.5	294.2	257.9	228.1	205.2	188.1	177.2	172.9	175.8	186.4	-209.1
Liabilities	344.4	690.9	690.9	690.9	690.9	690.9	690.9	690.9	690.9	690.9	667.9	644.9	621.8	598.8	575.8	552.8	529.7	506.7	483.7	460.6	437.6	0.0
Net assets	86.7	174.4	107.9	43.6	-16.8	-72.4	-122.4	-168.7	-210.8	-248.3	-280.8	-307.4	-327.6	-340.9	-347.7	-347.5	-341.6	-329.5	-310.8	-284.9	-251.2	-209.1
Paid in capital	86.7	174.4	174.4	174.4	174.4	174.4	174.4	174.4	174.4	174.4	174.4	174.4	174.4	174.4	174.4	174.4	174.4	174.4	174.4	174.4	174.4	174.4
Retained earnings	0.0	0.0	-66.5	-130.9	-191.2	-246.9	-296.8	-343.1	-385.2	-422.8	-455.2	-481.8	-502.0	-515.3	-522.1	-521.9	-516.0	-504.0	-485.2	-459.3	-425.6	-383.5
Total liabilities and net assets	431.0	865.4	798.9	734.5	674.1	618.5	568.5	522.3	480.1	442.6	387.2	337.5	294.2	257.9	228.1	205.2	188.1	177.2	172.9	175.8	186.4	-209.1

Source: Prepared by the JICA Study Team.

Island of Maio

		Year																				
	(Unit)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Fund requirement	CVE mil	89.6	90.7																				
Construction cost		89.1	89.1																				
Working capital			0.7																				
Interest		0.5	0.9																				
Fund procurement		89.6	90.7																				
Equity		17.9	18.1																				
Loan		71.6	72.6																				
Residual value			178.2	169.3	160.4	151.5	142.5	133.6	124.7	115.8	106.9	98.0	89.1	80.2	71.3	62.4	53.5	44.5	35.6	26.7	17.8	8.9	-0.0
Remaining debt (loan)		71.2	142.8	142.8	142.8	142.8	142.8	142.8	142.8	142.8	142.8	138.1	133.3	128.5	123.8	119.0	114.3	109.5	104.7	100.0	95.2	90.5	0.0
Energy demand	MWh			74	117	156	196	236	280	326	371	419	470	523	579	638	701	768	838	912	990	1,072	1,160
Energy supply	MWh			96	150	198	245	292	341	394	443	494	552	615	681	751	825	903	985	1,073	1,165	1,262	1,364
Total sales	CVE mil			2.0	3.2	4.3	5.6	6.8	8.3	9.8	11.4	13.1	15.0	17.0	19.3	21.7	24.3	27.1	30.2	33.5	37.1	41.0	45.2
Unit rate	CVE/kWh	25.7	26.2	26.7	27.3	27.8	28.4	29.0	29.5	30.1	30.7	31.3	32.0	32.6	33.3	33.9	34.6	35.3	36.0	36.7	37.5	38.2	39.0
Variable cost	CVE mil			1.9	3.0	4.0	5.1	6.2	7.3	8.6	9.9	11.3	12.9	14.6	16.5	18.6	20.8	23.2	25.8	28.7	31.8	35.1	38.7
Fuel cost of power generation	CVE mil			1.9	3.0	4.0	5.1	6.2	7.3	8.6	9.9	11.3	12.9	14.6	16.5	18.6	20.8	23.2	25.8	28.7	31.8	35.1	38.7
Fuel unit cost	CVE/kWh	18.7	19.1	19.5	19.9	20.3	20.7	21.1	21.5	21.9	22.4	22.8	23.3	23.7	24.2	24.7	25.2	25.7	26.2	26.7	27.3	27.8	28.4
Fixed cost	CVE mil			14.5	14.6	14.7	14.8	14.9	15.0	15.2	15.3	15.4	15.6	15.7	15.8	16.0	16.1	16.2	16.4	16.5	16.7	16.9	17.0
Depreciation				8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9
O&M				5.6	5.7	5.8	5.9	6.0	6.1	6.3	6.4	6.5	6.6	6.8	6.9	7.1	7.2	7.3	7.5	7.6	7.8	7.9	8.1
Interest				0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.7	0.6	0.6	0.6
Profit before tax				-15.3	-15.3	-15.3	-15.2	-15.2	-15.1	-14.9	-14.7	-14.5	-14.3	-14.1	-13.9	-13.7	-13.4	-13.1	-12.8	-12.4	-12.0	-11.6	-11.1
Tax	CVE mil			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Profit after tax	CVE mil			-15.3	-15.3	-15.3	-15.2	-15.2	-15.1	-14.9	-14.7	-14.5	-14.3	-14.1	-13.9	-13.7	-13.4	-13.1	-12.8	-12.4	-12.0	-11.6	-11.1
Repayment of principal	CVE mil			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	90.5
Cash flow	CVE mil	-17.9	-18.1	-6.4	-6.4	-6.4	-6.3	-6.3	-6.2	-6.0	-5.8	-10.3	-10.2	-10.0	-9.7	-9.5	-9.2	-9.0	-8.6	-8.3	-7.9	-7.4	-92.0
Equity IRR	#DIV/0!																						
In the case of 100% equity financing																							
Profit before tax	CVE mil			-14.4	-14.4	-14.4	-14.3	-14.2	-14.1	-14.0	-13.8	-13.6	-13.4	-13.2	-13.1	-12.9	-12.6	-12.4	-12.1	-11.7	-11.4	-11.0	-10.5
tax	CVE mil			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Profit after tax	CVE mil			-14.4	-14.4	-14.4	-14.3	-14.2	-14.1	-14.0	-13.8	-13.6	-13.4	-13.2	-13.1	-12.9	-12.6	-12.4	-12.1	-11.7	-11.4	-11.0	-10.5
Cash flow	CVE mil	-89.1	-89.8	-5.5	-5.5	-5.5	-5.4	-5.3	-5.2	-5.1	-4.9	-4.6	-4.5	-4.3	-4.2	-3.9	-3.7	-3.5	-3.2	-2.8	-2.5	-2.1	-0.9
Project IRR	#DIV/0!																						

Fund procurement			
Equity		20.0%	
Loan		80.0%	
Interest rate		0.65%	
Grace period	year	10	
Amortization	year	30	

Project life	year	20		Fuel cost	CVE/kWh	18.7	as of 2009		Energy demand	MWh/year	(As projected)	
				O&M cost		3.0%	of the construction cost		Demand increase		(As projected)	
Construction cost	CVE mil	178.2	as of 2009						T&D loss		(As projected)	
Working capital	O&M cost of	1.5	months	Cost escalation:								
				Fuel cost		2.0%	p.a.		Average retail price	CVE/kWh	25.7	as of 2009
Depreciation (straight line)		5.0%	p.a.	Other costs		2.0%	p.a.		Tariff increase		2.0%	p.a.
Tax rate		25%										

Source: Prepared by the JICA Study Team.

Island of Maio

		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Debt Service Coverage Ratio	DSCR			-5.9	-5.9	-5.9	-5.8	-5.7	-5.6	-5.5	-5.3	-0.8	-0.8	-0.8	-0.7	-0.7	-0.7	-0.6	-0.6	-0.5	-0.5	-0.4	-0.0
Return on Asset	ROA			-9.3%	-10.3%	-11.5%	-12.9%	-14.8%	-17.2%	-20.5%	-25.4%	-37.5%	-73.0%	-1966.4%	77.5%	37.6%	24.6%	18.1%	14.2%	11.6%	9.7%	8.3%	4.6%
Return on Rate Base	RRB			-772.1%	-480.6%	-352.4%	-274.0%	-221.8%	-182.4%	-151.6%	-129.0%	-110.3%	-95.3%	-82.8%	-72.2%	-63.1%	-55.2%	-48.4%	-42.4%	-37.1%	-32.4%	-28.3%	-24.6%

Balance sheet

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Current assets (Cash)	0.0	0.7	-5.7	-12.1	-18.5	-24.8	-31.1	-37.2	-43.2	-49.0	-59.4	-69.5	-79.5	-89.2	-98.7	-108.0	-116.9	-125.6	-133.8	-141.7	-149.2	-241.8
Properties and equipment (T&D facilities)	89.1	178.2	169.3	160.4	151.5	142.5	133.6	124.7	115.8	106.9	98.0	89.1	80.2	71.3	62.4	53.5	44.5	35.6	26.7	17.8	8.9	-0.0
Total Assets	89.1	178.9	163.6	148.3	133.0	117.7	102.6	87.5	72.6	57.9	38.6	19.6	0.7	-17.9	-36.4	-54.5	-72.4	-89.9	-107.1	-123.9	-140.3	-241.8
Liabilities	71.2	142.8	142.8	142.8	142.8	142.8	142.8	142.8	142.8	142.8	138.1	133.3	128.5	123.8	119.0	114.3	109.5	104.7	100.0	95.2	90.5	0.0
Net assets	17.9	36.1	20.8	5.5	-9.8	-25.1	-40.2	-55.3	-70.2	-84.9	-99.4	-113.7	-127.8	-141.7	-155.4	-168.8	-181.9	-194.7	-207.1	-219.1	-230.7	-241.8
Paid in capital	17.9	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1
Retained earnings	0.0	0.0	-15.3	-30.6	-45.9	-61.1	-76.3	-91.4	-106.3	-121.0	-135.5	-149.8	-163.9	-177.8	-191.4	-204.8	-217.9	-230.7	-243.1	-255.2	-266.8	-277.9
Total liabilities and net assets	89.1	178.9	163.6	148.3	133.0	117.7	102.6	87.5	72.6	57.9	38.6	19.6	0.7	-17.9	-36.4	-54.5	-72.4	-89.9	-107.1	-123.9	-140.3	-241.8

Source: Prepared by the JICA Study Team.

Island of Fogo

		Year																				
	(Unit)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Fund requirement	CVE mil	312.7	316.7																				
Construction cost		311.0	311.0																				
Working capital			2.4																				
Interest		1.6	3.3																				
Fund procurement		312.7	316.7																				
Equity		62.5	63.3																				
Loan		250.1	253.4																				
Residual value			622.1	591.0	559.8	528.7	497.6	466.5	435.4	404.3	373.2	342.1	311.0	279.9	248.8	217.7	186.6	155.5	124.4	93.3	62.2	31.1	-0.0
Remaining debt (loan)		248.5	498.6	498.6	498.6	498.6	482.0	465.4	448.7	432.1	415.5	398.9	382.3	365.6	349.0	332.4	315.8	299.2	282.5	265.9	249.3	232.7	0.0
Energy demand	MWh			1,150	1,495	1,902	2,294	2,724	2,961	3,411	3,682	3,967	4,266	4,580	4,909	5,255	5,619	6,000	6,401	6,821	7,263	7,727	8,214
Energy supply	MWh			1,606	2,059	2,585	3,075	3,603	3,866	4,396	4,685	4,984	5,293	5,613	5,944	6,286	6,642	7,059	7,530	8,025	8,545	9,090	9,663
Total sales	CVE mil			29.2	38.7	50.3	61.8	74.9	83.0	97.5	107.4	118.0	129.4	141.7	155.0	169.2	184.5	201.0	218.7	237.7	258.2	280.2	303.8
Unit rate	CVE/kWh	24.4	24.9	25.4	25.9	26.4	26.9	27.5	28.0	28.6	29.2	29.7	30.3	30.9	31.6	32.2	32.8	33.5	34.2	34.9	35.5	36.3	37.0
Variable cost	CVE mil			23.2	30.3	38.8	47.1	56.3	61.6	71.4	77.6	84.2	91.3	98.7	106.6	115.0	123.9	134.4	146.2	158.9	172.6	187.3	203.1
Fuel cost of power generation	CVE mil			23.2	30.3	38.8	47.1	56.3	61.6	71.4	77.6	84.2	91.3	98.7	106.6	115.0	123.9	134.4	146.2	158.9	172.6	187.3	203.1
Fuel unit cost	CVE/kWh	13.9	14.1	14.4	14.7	15.0	15.3	15.6	15.9	16.2	16.6	16.9	17.2	17.6	17.9	18.3	18.7	19.0	19.4	19.8	20.2	20.6	21.0
Fixed cost	CVE mil			50.5	50.9	51.3	51.7	52.1	52.5	53.0	53.4	53.9	54.3	54.8	55.2	55.7	56.2	56.7	57.2	57.8	58.3	58.8	59.4
Depreciation		31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1
O&M		19.4	19.8	20.2	20.6	21.0	21.4	21.9	22.3	22.7	23.2	23.7	24.1	24.6	25.1	25.6	26.1	26.7	27.2	27.7	28.3		
Interest		3.2	3.2	3.2	3.2	3.1	3.0	2.9	2.8	2.7	2.6	2.5	2.4	2.3	2.2	2.1	1.9	1.8	1.7	1.6	1.5		
Profit before tax		-47.7	-45.7	-43.1	-40.2	-36.7	-34.1	-29.8	-26.5	-22.8	-18.7	-14.2	-9.3	-3.8	2.2	7.9	13.3	19.2	25.6	32.4	39.8		
Tax	CVE mil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	2.0	3.3	4.8	6.4	8.1	10.0
Profit after tax	CVE mil	-47.7	-45.7	-43.1	-40.2	-36.7	-34.1	-29.8	-26.5	-22.8	-18.7	-14.2	-9.3	-3.8	1.7	5.9	10.0	14.4	19.2	24.3	29.9		
Repayment of principal	CVE mil	0.0	0.0	0.0	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	232.7	
Cash flow	CVE mil	-62.5	-63.3	-16.6	-14.6	-12.0	-25.7	-22.2	-19.6	-15.3	-12.0	-8.3	-4.2	0.3	5.2	10.7	16.1	20.4	24.5	28.9	33.7	38.8	-169.3
Equity IRR	#DIV/0!																						
In the case of 100% equity financing																							
Profit before tax	CVE mil			-44.5	-42.5	-39.8	-37.0	-33.5	-31.1	-26.9	-23.6	-20.1	-16.1	-11.7	-6.9	-1.5	4.4	9.9	15.3	21.1	27.3	34.1	41.3
tax	CVE mil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	2.5	3.8	5.3	6.8	8.5	10.3	
Profit after tax	CVE mil	-44.5	-42.5	-39.8	-37.0	-33.5	-31.1	-26.9	-23.6	-20.1	-16.1	-11.7	-6.9	-1.5	3.3	7.4	11.5	15.8	20.5	25.5	31.0		
Cash flow	CVE mil	-311.0	-313.5	-13.4	-11.4	-8.7	-5.9	-2.4	-0.0	4.3	7.5	11.0	15.0	19.4	24.2	29.6	34.4	38.5	42.6	46.9	51.6	56.6	64.5
Project IRR	#NUM!																						

Fund procurement			
Equity		20.0%	
Loan		80.0%	
Interest rate		0.65%	
Grace period	year	5	
Amortization	year	30	

Project life	year	20		Fuel cost	CVE/kWh	13.9	as of 2009		Energy demand	MWh/year	(As projected)		
				O&M cost		3.0%	of the construction cost		Demand increase		(As projected)		
Construction cost	CVE mil	622.1	as of 2009						T&D loss		(As projected)		
Working capital	O&M cost of	1.5	months	Cost escalation:									
				Fuel cost		2.0%	p.a.		Average retail price	CVE/kWh	24.4	as of 2009	
Depreciation (straight line)		5.0%	p.a.	Other costs		2.0%	p.a.		Tariff increase		2.0%	p.a.	
Tax rate		25%											

Source: Prepared by the JICA Study Team.

Island of Fogo

		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Debt Service Coverage Ratio	DSCR			-4.1	-3.5	-2.7	-0.3	-0.1	-0.0	0.2	0.4	0.6	0.8	1.0	1.3	1.6	1.9	2.2	2.5	2.8	3.2	3.6	0.3
Return on Asset	ROA			-8.3%	-8.6%	-8.8%	-9.3%	-9.7%	-10.4%	-10.6%	-11.1%	-11.5%	-11.5%	-10.8%	-8.7%	-4.4%	2.3%	9.8%	18.7%	28.1%	35.7%	39.5%	-21.1%
Return on Rate Base	RRB			-163.5%	-118.1%	-85.7%	-65.1%	-49.0%	-41.1%	-30.5%	-24.6%	-19.3%	-14.5%	-10.0%	-6.0%	-2.2%	0.9%	2.9%	4.6%	6.1%	7.4%	8.7%	9.8%

Balance sheet

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Current assets (Cash)	0.0	2.4	-14.2	-28.8	-40.8	-66.6	-88.7	-108.4	-123.7	-135.6	-143.9	-148.2	-147.9	-142.7	-132.0	-115.8	-95.4	-71.0	-42.1	-8.4	30.4	-141.3
Properties and equipment (T&D facilities)	311.0	622.1	591.0	559.8	528.7	497.6	466.5	435.4	404.3	373.2	342.1	311.0	279.9	248.8	217.7	186.6	155.5	124.4	93.3	62.2	31.1	-0.0
Total Assets	311.0	624.5	576.7	531.0	487.9	431.1	377.8	327.1	280.7	237.6	198.2	162.9	132.0	106.2	85.7	70.8	60.1	53.4	51.2	53.8	61.5	-141.3
Liabilities	248.5	498.6	498.6	498.6	498.6	482.0	465.4	448.7	432.1	415.5	398.9	382.3	365.6	349.0	332.4	315.8	299.2	282.5	265.9	249.3	232.7	0.0
Net assets	62.5	125.9	78.1	32.4	-10.7	-50.9	-87.6	-121.7	-151.5	-177.9	-200.7	-219.4	-233.6	-242.9	-246.7	-245.0	-239.1	-229.1	-214.7	-195.5	-171.2	-141.3
Paid in capital	62.5	125.9	125.9	125.9	125.9	125.9	125.9	125.9	125.9	125.9	125.9	125.9	125.9	125.9	125.9	125.9	125.9	125.9	125.9	125.9	125.9	125.9
Retained earnings	0.0	0.0	-47.7	-93.5	-136.6	-176.8	-213.4	-247.6	-277.3	-303.8	-326.6	-345.3	-359.5	-368.7	-372.5	-370.9	-365.0	-355.0	-340.6	-321.4	-297.0	-267.2
Total liabilities and net assets	311.0	624.5	576.7	531.0	487.9	431.1	377.8	327.1	280.7	237.6	198.2	162.9	132.0	106.2	85.7	70.8	60.1	53.4	51.2	53.8	61.5	-141.3

Source: Prepared by the JICA Study Team.

Whole Islands

		Year																				
	(Unit)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Fund requirement	CVE mil	2,823.8	2,860.6																				
Construction cost		2,809.1	2,809.1																				
Working capital			21.9																				
Interest		14.7	29.6																				
Fund procurement		2,823.8	2,860.6																				
Equity		564.8	572.1																				
Loan		2,259.0	2,288.4																				
Residual value			5,618.2	5,337.2	5,056.3	4,775.4	4,494.5	4,213.6	3,932.7	3,651.8	3,370.9	3,090.0	2,809.1	2,528.2	2,247.3	1,966.4	1,685.4	1,404.5	1,123.6	842.7	561.8	280.9	0.0
Remaining debt (loan)		2,244.3	4,503.2	4,503.2	4,503.2	4,503.2	4,503.2	4,503.2	4,503.2	4,503.2	4,503.2	4,353.1	4,203.0	4,052.9	3,902.8	3,752.7	3,602.6	3,452.5	3,302.4	3,152.2	3,002.1	2,852.0	0.0
Energy demand	MWh			68,106	80,398	94,767	108,549	123,026	211,146	225,564	240,393	255,879	267,976	281,011	291,624	303,169	315,733	329,410	344,303	360,523	378,196	397,456	418,451
Santiago				8,922	11,640	15,869	19,152	22,734	26,668	30,990	35,738	40,948	46,666	52,941	59,827	67,384	75,677	84,777	94,765	105,725	117,753	130,953	145,438
S. Vicente				8,016	16,043	24,231	32,535	41,668	49,967	58,319	66,728	75,195	79,618	84,263	85,699	87,207	88,790	90,452	92,198	94,030	95,955	97,975	100,097
Sal				49,042	49,958	51,048	52,355	53,144	128,466	129,413	130,456	131,602	132,862	134,247	135,770	137,444	139,284	141,308	143,532	145,978	148,667	151,623	154,872
Sant Antão				901	1,144	1,561	2,018	2,520	2,805	3,104	3,418	3,748	4,095	4,459	4,841	5,242	5,663	6,105	6,569	7,057	7,569	8,106	8,670
Maio				74	117	156	196	236	280	326	371	419	470	523	579	638	701	768	838	912	990	1,072	1,160
Fogo				1,150	1,495	1,902	2,294	2,724	2,961	3,411	3,682	3,967	4,266	4,580	4,909	5,255	5,619	6,000	6,401	6,821	7,263	7,727	8,214
Energy supply	MWh			79,084	94,795	113,177	130,035	147,501	242,015	259,343	277,263	295,869	310,394	325,914	338,463	352,032	366,645	382,443	399,513	417,929	437,806	459,270	482,457
Santiago				14,483	18,595	24,952	29,647	34,655	40,042	45,843	52,096	58,833	66,099	73,939	82,406	91,554	101,443	112,140	123,714	136,244	149,813	164,514	180,445
S. Vicente				10,058	19,880	29,658	39,341	49,783	58,993	68,611	78,503	88,465	93,669	99,133	100,822	102,596	104,458	106,414	108,468	110,624	112,888	115,265	117,761
Sal				51,623	52,588	53,735	55,110	55,941	135,227	136,225	137,322	138,528	139,854	141,312	142,915	144,678	146,615	148,745	151,087	153,661	156,491	159,603	163,023
Sant Antão				1,216	1,524	2,051	2,617	3,226	3,546	3,875	4,215	4,566	4,927	5,301	5,695	6,167	6,662	7,182	7,728	8,302	8,904	9,537	10,201
Maio				96	150	198	245	292	341	394	443	494	552	615	681	751	825	903	985	1,073	1,165	1,262	1,364
Fogo				1,606	2,059	2,585	3,075	3,603	3,866	4,396	4,685	4,984	5,293	5,613	5,944	6,286	6,642	7,059	7,530	8,025	8,545	9,090	9,663
Total sales	CVE mil			1,727.7	2,085.6	2,513.1	2,940.6	3,404.0	5,930.1	6,467.7	7,036.7	7,645.9	8,172.2	8,746.0	9,262.0	9,825.6	10,442.2	11,117.4	11,857.7	12,670.3	13,563.1	14,545.2	15,626.4
Santiago				231.7	308.4	428.8	527.9	639.2	764.8	906.5	1,066.3	1,246.2	1,448.6	1,676.2	1,932.1	2,219.7	2,542.8	2,905.5	3,312.8	3,769.8	4,282.7	4,858.0	5,503.3
S. Vicente				206.6	421.8	649.8	890.0	1,162.6	1,422.1	1,693.0	1,975.8	2,271.0	2,452.7	2,647.7	2,746.7	2,850.9	2,960.7	3,076.5	3,198.6	3,327.4	3,463.4	3,607.1	3,758.9
Sal				1,234.1	1,282.3	1,336.5	1,398.1	1,447.5	3,569.2	3,667.4	3,770.9	3,880.1	3,995.6	4,118.0	4,248.0	4,386.4	4,534.0	4,691.9	4,861.1	5,042.8	5,238.4	5,449.4	5,677.5
Sant Antão				24.1	31.2	43.4	57.3	72.9	82.8	93.5	105.0	117.4	130.8	145.3	160.9	177.7	195.9	215.4	236.4	259.0	283.4	309.6	337.7
Maio				2.0	3.2	4.3	5.6	6.8	8.3	9.8	11.4	13.1	15.0	17.0	19.3	21.7	24.3	27.1	30.2	33.5	37.1	41.0	45.2
Fogo				29.2	38.7	50.3	61.8	74.9	83.0	97.5	107.4	118.0	129.4	141.7	155.0	169.2	184.5	201.0	218.7	237.7	258.2	280.2	303.8
Variable cost	CVE mil			1,071.8	1,297.6	1,571.5	1,832.7	2,111.5	3,563.0	3,886.5	4,230.3	4,597.6	4,921.7	5,273.5	5,595.8	5,946.9	6,328.8	6,745.4	7,200.2	7,696.3	8,238.1	8,830.2	9,477.9
Fuel cost of power generation	CVE mil			1,071.8	1,297.6	1,571.5	1,832.7	2,111.5	3,563.0	3,886.5	4,230.3	4,597.6	4,921.7	5,273.5	5,595.8	5,946.9	6,328.8	6,745.4	7,200.2	7,696.3	8,238.1	8,830.2	9,477.9
Santiago				207.3	271.5	371.6	450.4	537.0	632.9	739.0	856.6	986.8	1,130.8	1,290.2	1,466.7	1,662.2	1,878.5	2,118.1	2,383.5	2,677.4	3,002.9	3,363.6	3,763.1
S. Vicente				119.5	241.0	366.7	496.1	640.4	774.0	918.2	1,071.6	1,231.7	1,330.3	1,436.0	1,489.7	1,546.3	1,605.8	1,668.6	1,734.8	1,804.7	1,878.5	1,956.4	2,038.7
Sal				703.8	731.3	762.2	797.3	825.5	2,035.5	2,091.5	2,150.5	2,212.8	2,278.7	2,348.5	2,422.6	2,501.5	2,585.7	2,675.8	2,772.3	2,875.9	2,987.4	3,107.8	3,237.9
Sant Antão				16.1	20.6	28.2	36.7	46.2	51.8	57.7	64.0	70.7	77.9	85.5	93.6	103.4	114.0	125.3	137.5	150.7	164.9	180.1	196.5
Maio				1.9	3.0	4.0	5.1	6.2	7.3	8.6	9.9	11.3	12.9	14.6	16.5	18.6	20.8	23.2	25.8	28.7	31.8	35.1	38.7
Fogo				23.2	30.3	38.8	47.1	56.3	61.6	71.4	77.6	84.2	91.3	98.7	106.6	115.0	123.9	134.4	146.2	158.9	172.6	187.3	203.1
Fixed cost	CVE mil			456.3	459.8	463.3	467.0	470.7	474.5	478.4	482.3	486.4	490.5	494.7	498.9	503.3	507.7	512.3	516.9	521.6	526.4	531.4	536.4
Depreciation				280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9
O&M				175.4	178.9	182.4	186.1	189.8	193.6	197.5	201.4	205.5	209.6	213.8	218.0	222.4	226.8	231.4	236.0	240.7	245.5	250.4	255.5
Santiago				52.2	53.3	54.3	55.4	56.5	57.6	58.8	60.0	61.2	62.4	63.6	64.9	66.2	67.5	68.9	70.3	71.7	73.1	74.6	76.1
S. Vicente				35.4	36.1	36.8	37.5	38.3	39.1	39.8	40.6	41.5	42.3	43.1	44.0	44.9	45.8	46.7	47.6	48.6	49.5	50.5	51.5
Sal				35.9	36.6	37.3	38.1	38.8	39.6	40.4	41.2	42.0	42.9	43.7	44.6	45.5	46.4	47.3	48.3	49.3	50.2	51.3	52.3
Sant Antão				26.9	27.4	28.0	28.6	29.1	29.7	30.3	30.9	31.5	32.2	32.8	33.5	34.1	34.8	35.5	36.2	36.9	37.7	38.4	39.2
Maio				5.6	5.7	5.8	5.9	6.0	6.1	6.3	6.4	6.5	6.6	6.8	6.9	7.1	7.2	7.3	7.5	7.6	7.8	7.9	8.1
Fogo				19.4	19.8	20.2	20.6	21.0	21.4	21.9	22.3	22.7	23.2	23.7	24.1	24.6	25.1	25.6	26.1	26.7	27.2	27.7	28.3
Interest				29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	28.3	27.3	26.3	25.4	24.4	23.4	22.4	21.5	20.5	19.5	18.5
Profit before tax				170.4	299.0	449.0	611.6	792.5	1,863.2	2,073.5	2,294.8	2,532.7	2,731.7	2,950.5	3,140.9	3,350.0	3,581.3	3,836.3	4,118.2	4,430.9	4,778.1	5,164.1	5,593.6
Tax	CVE mil			42.6	74.7	112.3	152.9	198.1	465.8	518.4	573.7	633.2	682.9	737.6	785.2	837.5	895.3	959.1	1,029.5	1,107.7	1,194.5	1,291.0	1,398.4
Profit after tax	CVE mil			127.8	224.2	336.8	458.7	594.4	1,397.4	1,555.1	1,721.1	1,899.5	2,048.7	2,212.9	2,355.7	2,512.5	2,685.9	2,877.2	3,088.6	3,323.2	3,583.6	3,873.1	4,195.2
Repayment of principal	CVE mil			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	150.1	150.1	150.1	150.1	150.1	150.1	150.1	150.1	150.1	150.1	150.1	2,852.0
Cash flow	CVE mil	-564.8	-572.1	408.7	505.1	617.7	739.6	875.3	1,678.3	1,836.0	2,002.0	2,030.3	2,179.5	2,343.7	2,486.5	2,643.3	2,816.7	3,008.0	3,219.4	3,454.0	3,714.4	4,003.9	1,646.0

Equity IRR	50.7%																						
In the case of 100% equity financing																							
Profit before tax	CVE mil			199.7	328.2	478.3	640.9	821.8	1,892.5	2,102.8	2,324.1	2,561.9	2,760.0	2,977.8	3,167.2	3,375.4	3,605.6	3,859.7	4,140.6	4,452.3	4,798.6	5,183.6	5,612.1
tax	CVE mil			49.9	82.1	119.6	160.2	205.4	473.1	525.7	581.0	640.5	690.0	744.5	791.8	843.8	901.4	964.9	1,035.2	1,113.1	1,199.7	1,295.9	1,403.0
Profit after tax	CVE mil			149.8	246.2	358.7	480.7	616.3	1,419.4	1,577.1	1,743.0	1,921.4	2,070.0	2,233.4	2,375.4	2,531.5	2,704.2	2,894.8	3,105.5	3,339.3	3,599.0	3,887.7	4,209.1
Cash flow	CVE mil	-2,809.1	-2,831.0	430.7	527.1	639.6	761.6	897.2	1,700.3	1,858.0	2,024.0	2,202.4	2,350.9	2,514.3	2,656.3	2,812.5	2,985.1	3,175.7	3,386.4	3,620.2	3,879.9	4,168.6	4,511.9
Project IRR	20.1%																						

Fund procurement			
Equity		20.0%	
Loan		80.0%	
Interest rate		0.65%	
Grace period	year	10	
Amortization	year	30	

Project life	year	20	
Construction cost	CVE mil	5,618.2	as of 2009
Working capital	O&M cost of	1.5	months
Depreciation (straight line)		5.0%	p.a.
Tax rate		25%	

Fuel cost	CVE/kWh	(aut. cal.)	as of 2009
O&M cost		3.0%	of the construction cost
Cost escalation:			
Fuel cost		2.0%	p.a.
Other costs		2.0%	p.a.

Energy demand	MWh/year	(As projected)	
Demand increase		(As projected)	
T&D loss		(As projected)	
Average retail price	CVE/kWh	(aut. cal.)	as of 2009
Tariff increase		2.0%	p.a.

Source: Prepared by the JICA Study Team.

Whole Islands

		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Debt Service Coverage Ratio	DSCR			16.4	20.8	25.9	31.5	37.7	74.3	81.4	89.0	15.8	17.0	18.4	19.5	20.8	22.3	23.9	25.6	27.6	29.8	32.2	2.1
Return on Asset	ROA			2.2%	3.7%	5.3%	6.8%	8.1%	15.9%	15.0%	14.3%	13.8%	13.0%	12.5%	11.8%	11.2%	10.8%	10.4%	10.1%	9.9%	9.6%	9.5%	9.9%
Return on Rate Base	RRB			7.4%	10.8%	13.4%	15.6%	17.5%	23.6%	24.0%	24.5%	24.8%	25.1%	25.3%	25.4%	25.6%	25.7%	25.9%	26.0%	26.2%	26.4%	26.6%	26.8%

Balance sheet

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Current assets (Cash)	0.0	21.9	430.6	935.8	1,553.5	2,293.1	3,168.4	4,846.7	6,682.7	8,684.7	10,715.0	12,894.6	15,238.2	17,724.7	20,368.0	23,184.8	26,192.8	29,412.2	32,866.1	36,580.5	40,584.4	42,208.4
Properties and equipment (T&D facilities)	2809.1	5,618.2	5,337.2	5,056.3	4,775.4	4,494.5	4,213.6	3,932.7	3,651.8	3,370.9	3,090.0	2,809.1	2,528.2	2,247.3	1,966.4	1,685.4	1,404.5	1,123.6	842.7	561.8	280.9	0.0
Total Assets	2,809.1	5,640.1	5,767.9	5,992.1	6,328.9	6,787.6	7,382.0	8,779.4	10,334.5	12,055.6	13,805.0	15,703.6	17,766.4	19,972.0	22,334.4	24,870.2	27,597.3	30,535.8	33,708.9	37,142.3	40,865.3	42,208.4
Liabilities	2,244.3	4,503.2	4,503.2	4,503.2	4,503.2	4,503.2	4,503.2	4,503.2	4,503.2	4,503.2	4,353.1	4,203.0	4,052.9	3,902.8	3,752.7	3,602.6	3,452.5	3,302.4	3,152.2	3,002.1	2,852.0	0.0
Net assets	564.8	1,136.9	1,264.7	1,488.9	1,825.7	2,284.4	2,878.8	4,276.2	5,831.3	7,552.4	9,451.9	11,500.6	13,713.5	16,069.2	18,581.7	21,267.6	24,144.8	27,233.5	30,556.6	34,140.2	38,013.3	42,208.4
Paid in capital	564.8	1,136.9	1,136.9	1,136.9	1,136.9	1,136.9	1,136.9	1,136.9	1,136.9	1,136.9	1,136.9	1,136.9	1,136.9	1,136.9	1,136.9	1,136.9	1,136.9	1,136.9	1,136.9	1,136.9	1,136.9	1,136.9
Retained earnings	0.0	0.0	127.8	352.0	688.8	1,147.5	1,741.9	3,139.3	4,694.4	6,415.5	8,315.0	10,363.8	12,576.7	14,932.3	17,444.8	20,130.8	23,008.0	26,096.6	29,419.8	33,003.3	36,876.4	41,071.6
Total liabilities and net assets	2,809.1	5,640.1	5,767.9	5,992.1	6,328.9	6,787.6	7,382.0	8,779.4	10,334.5	12,055.6	13,805.0	15,703.6	17,766.4	19,972.0	22,334.4	24,870.2	27,597.3	30,535.8	33,708.9	37,142.3	40,865.3	42,208.4

Source: Prepared by the JICA Study Team.

Appendix 3. **List of Project that EIA is mandatory**

Decreto-Lei 29/2006 Annex I

1. Agriculture, livestock industry, hunting and forestry
   a) Poultry: 5,000 or more
   b) Ostrich: 100 or more
   c) Swine: 50 or more
   d) Goat, sheep, and small ruminants: 200 or more
   e) Cattle, large ruminants and horse: 100 or more
   f) Rabbit, related animals, and other rodents: 100 or more
2. Fishery
   a) Fishery and related activities
   b) Aquaculture and related activities
3. Activities related to crude oil and natural gases except for their extraction
   a) Crude oil refineries
   b) Industrial plant for extraction of crude, natural gas and mines products
   c) Plants for storage of crude oil and chemical products
   d) Pipe-lines from gas and oil
   e) Storage of combustion gases
4. Extraction of uranium and thorium
   a) Plants for permanent stock or definitive elimination of radioactive waste
5. Other extraction activities
   a) Extraction of quarry materials
   b) Stone crash
6. Food and drink factory
   a) Industry of dairy products
   b) Plants for slaughter of animals, and process and storage of meat and meat products
   c) Production of fish flour
   d) Production of animal and vegetal conserves
   e) Industry of beer and cooling
   f) Plants for carbornated drink
   g) Production of bottled water
   h) Production of distilled liquor
   i) Production of wine and fruit-fermented drink
   j) Production of fermented ethanol
   k) Production of coffee
   l) Production of sugar
   m) Plants for animal food products
7. Plants for tobacco

8. Textile plants
9. Plants for tanning and finishing leather, and plants for Moroccan leather products, mail-related materials, harnesses and footwear
   a) Tanning manufacturer
10. Plants for coke and refined petroleum products, and plants for process of nuclear fuels
11. Chemical plants
   a) Plants for chemical products
   b) Integrated chemical industry
   c) Pesticides
   d) Pharmaceutical products
   e) Inks and varnishes
12. Plants for rubber and plastic products
13. Plants for non-metal mineral
   a) Plants of glass production
14. Plants for glass and base metal production
   a) Treatment and revetment of metal surfaces
   b) Metal industries
15. Manufacture of vehicles and towing
   a) Production and assembly of motors and cars
16. Other plants for transportation vehicles
   a) Construction and repair of vessels
   b) Naval shipyard
   c) Manufacture of aircrafts
17. Recycling
   a) Storage of used metals
   b) Recycling of used metals, metal and non-metal wastes
18. Storage, purification and distribution of water
   a) Workmanship of canalization and regularization of water courses
   b) Infrastructures for water retention and storage
   c) Storage, purification and distribution of desalinated and non-desalinated water
19. Generation and distribution of electricity, gas, steam and hot water
   a) Thermal plants and other installations of combustion
   b) Transmission and distribution of electricity by aerial and underground cables
20. Construction
   a) Construction of highway, roads, airports and air strips
   b) Construction of commercial and recreational ports
   c) Dam projects
   d) Shipyards
21. Facilities for air transportation
   a) Facilities for repair of aircrafts

22. Hotel complexes
    a) Hotels with 30 beds or more
23. Dredging projects
24. Civil works in the coastal areas for marine erosion prevention
25. Plants for storage, transfer, treatment and final destination of solid industrial and domestic waste
26. Plants of purification
27. Urban and industrial lots
28. Golf fields
29. Plants of disposal of animals inappropriate for food consumption
30. Plants for production and stock of cement products
31. Projects with significant impacts on the natural recourses

Appendix 4. List of Nature Conservation Areas in the target Islands

Name	Category	Island	Brief Description of Location
Serra Malagueta	NP	Santiago	Located in a mountainous bulk at north of the island between Santa Catarina, São Miguel and Tarrafal
Serra do Pico da Antónia	NP	Santiago	Located in mountainous bulk at south of island, at north of Praia between São Domingos and São Lourenço dos Orgãos
Parque Natural do Fogo	NP	Fogo	The Park encloses all areas of the island above 1,500 meters in eastern side and above 1,800 meters in occidental side
Terras Salgadas	NR	Maio	North of the island, is the biggest salt ecosystem at the coastal zone
Casas Velhas	NR	Maio	South of the island with 4.78 km of coastal perimeter
Barreiro e Figueira	NP	Maio	South of the island including little villages of Barreiro, Figueira da horta and Figueira Seca
Lagoa Cimidor	NR	Maio	A salt lagoon at eastern coast of the island
Praia do Morro	NR	Maio	Beach located at western coast of the island
Salinas Porto Ingles	PL	Maio	At north of Porto Ingles village, located at southwest of the island
Monte Penoso e Monte Branco	PL	Maio	Mountainous reliefs in eastern part of the bulk of the island
Monte Santo António	PL	Maio	Mountainous reliefs at northeast of the island
Salinas de Pedra de Lume e Cagarral	PL	Sal	A salt mines inside a round boiler at east of the island
Monte Grande	PL	Sal	Northeast of the Island between Fiura Bay and Monte Grande Beach
Rabo Junco	NR	Sal	At west coast of the Island, and north of Murdeira Bay
Baía da Murdeira	NR marine	Sal	Ample Bay located at west coast of the Island
Costa da Fragata	NR	Sal	Beach of organic sands oriented to the east
Serra Negra	NR	Sal	Parallel way to coastline of southeast of the island of Salt
Buracona-Ragona	PL	Sal	Located at west coast of the island, and north of Palmeira Village
Salinas de Santa Maria	PL	Sal	500 meters east coast, namely Costa da fragata
Morrinho do Filho	NM	Sal	Located in the North of Island at 300 meters from the North coast
Ponta Sinó	NR	Sal	Located in the Southwestern of the Island
Morrhino do Açúcar	NM	Sal	300 meters at South of Morrinho do Filho
Monte Verde	NP	São Vicente	Situated at the northeastern part of the island
Morroços	NP	Santo Antão	At the Centre of the Island in a region denominated East Plateau (Planalto Leste)
Cova/ Ribeiras Paul/ Torre	NP	Santo Antão	Eastern edge of a mountain chain, from a landslide scar to basin of the Ribeiras Paul, in Paúl Municipality
Cruzinha	NR	Santo Antão	Located in the northern coast of the island
Pombas	PL	Santo Antão	A village located at the eastern coast in Paúl Municipality
Tope de Coroa	NP	Santo Antão	Located in a western mountainous bulk with 1979 m height

[Legend] NP: Natural Park, NR: Natural Reserve, PL: Protected Landscape, NM: Natural Monument

(Source) Decreto-lei nº3/2003, www.areasprotegidas.cv, Natura 2000 (identification of protected areas at Sal, Boavista and Maio).

Appendix 5. Environmnetal Monitoring Form

1. Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Timing	Responsible Agency	Monitoring Results during Report Period
• Response/ actions to comments and guidance from DGA • Compliance with conditions if they are imposed on the approval of EIA • Response/ actions to comments from the public	• Before the Loan Agreement	MTIE	

2. Mitigation Measures

- Waste

Monitoring Item	Timing	Responsible Agency	Monitoring Results during Report Period
Construction Phase • Whether construction wastes are properly disposed of • Whether old transformers are properly disposed of or stored	• Continuous monitoring during construction works • Check when all construction works are completed	MTIE	

- Noise / Vibration

Monitoring Item	Timing	Responsible Agency	Monitoring Results during Report Period
Construction Phase • Whether construction works are conducted during daytime hours • Whether local residents are informed of the schedule of works	• Continuous monitoring during construction works	MTIE	

3. Natural Environment

- Ecosystem

Monitoring Item	Timing	Responsible Agency	Monitoring Results during Report Period
Construction Phase • Whether construction works cause large-scale vegetation clearance	• Continuous monitoring during construction works	MTIE	
• Existence/nonexistence of breeding sites and colonies of birds	• Check during line route surveys are conducted	MTIE	
• Whether proposed conservation measures, including the adoption of underground cables, are properly undertaken	• Continuous monitoring during construction works • Check when all construction works are completed	MTIE	

- Soil Erosion

Monitoring Item	Timing	Responsible Agency	Monitoring Results during Report Period
Construction Phase • Whether earthworks are undertaken in the dry season • Whether soil protection measures, such as drainage construction, minimization of vegetation clearance, re-vegetation, and soil compaction are properly undertaken	• Continuous monitoring during construction works • Check when all construction works are completed	MTIE	
Operation Phase • Physical conditions of construction sites to check adequacy of soil protection measures	• Check when all construction works are completed • Check during and after the rainy season (at least once a half year) for three years	MTIE	

4. Social Environment

- Land Acquisition

Monitoring Item	Timing	Responsible Agency	Monitoring Results during Report Period
Construction Phase • Whether the land acquisition procedure is properly undertaken, focusing on consent of affected land owners, proper compensation, and attention to vulnerable persons	• Continuous monitoring during land acquisition process (prior to the construction works)	MTIE	
Operation Phase • Perceptions/ complaints of affected land owners	• Once a year until three years passed from the completion of construction works	MTIE	

- Cultural Heritage

Monitoring Item	Timing	Responsible Agency	Monitoring Results during Report Period
Construction Phase • Whether consultations with local stakeholders are properly undertaken • Investigations if buried cultural properties are discovered during construction works • Whether the proposed mitigation measures are properly undertaken	• Continuous monitoring during construction works	MTIE	

- Landscape

Monitoring Item	Timing	Responsible Agency	Monitoring Results during Report Period
Construction Phase • Whether consultations with local stakeholders are properly undertaken • Whether mitigation measures such as the adoption of underground cables are properly undertaken	• Continuous monitoring during construction works	MTIE	

- Infectious Disease

Monitoring Item	Timing	Responsible Agency	Monitoring Results during Report Period
Construction Phase • Progress and contents of education activities for construction workers and local residents	• Continuous monitoring during construction works	MTIE	

- Accident and Safety

Monitoring Item	Timing	Responsible Agency	Monitoring Results during Report Period
Construction Phase • Whether potential safety hazards are explained to construction workers • Whether the proposed safety measures are undertaken • Perceptions of local residents	• Continuous monitoring during construction works	MTIE	

5. Other

Monitoring Item	Timing	Responsible Agency	Monitoring Results during Report Period
Construction & Operation Phase • Effectiveness of the proposed mitigation measures • Occurrence/ nonoccurrence of unexpected impacts	• Continuous monitoring during construction works • Once a half year until three years passed from the completion of construction works	MTIE	

Appendix 6. Framework of Environmental Checklist

Environmental Checklist for the Power Transmission and Distribution System Development Project in the Republic of Cape Verde

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations at the F/S phase
1 Permits and Explanation	(1) EIA and Environmental Permits	1) Have EIA reports been officially completed? 2) Have EIA reports been approved by DGA (Direcção Geral do Ambiente)? 3) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? 4) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the Government of Cape Verde (GOC)?	1) to 3) Not yet. Some proposed projects involving the construction of transmission lines, EIA will be required as per Decreto-Lei no 29/2006. EIA reports for such proposed projects or the applications of EIA exemption will be prepared and submitted by MTIE. 4) No other environmental permits than the approvals based on Decreto-Lei no 29/2006 are required in Cape Verde.
	(2) Explanation to the Public	1) Are contents of the project and the potential impacts adequately explained to the public based on appropriate procedures, including information disclosure? Is understanding obtained from the public? 2) Are proper responses made to comments from the public and regulatory authorities?	1) Public consultations will be held by MTIE as per Article 22 of Decreto-Lei no 29/2006. 2) MTIE will properly respond to comments from the public and regulatory authorities.
2 Mitigation Measures	(1) Water Quality	1) Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? If water quality degradation is anticipated, are adequate measures considered?	1) There is a possibility of limited soil runoff caused by earthmoving works of the proposed projects, however water quality degradation is expected to be minimal. This is because large-scale earthmoving works, which may cause water quality degradation, are not planned in the projects. In addition, there are no permanent river flows or water bodies in Cape Verde, and therefore water quality degradation is not the matter of a major concern.
3 Natural Environment	(1) Protected Areas	1) Is the project site located in protected areas designated by Cape Verdean laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	1) The following projects may be conducted in protected areas. • Closing of Maio Ring Project: Line passing through a part of Barreiro e Figueira National Park in Maio and along the edge of the Monte Penoso e Monte Branco Protected Landscape • Closing of Santo Antão Ring Project: Pombas Protected Landscape

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations at the F/S phase
			The projects may negatively affect the protected areas. It is necessary for MTIE to undertake mitigation measures.
	(2) Ecosystem	1) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	1) None of the proposed projects is planned in primeval forests, tropical rain forests, ecologically valuable habitats, and the protected habitats of endangered species. All the transmission lines except a part of "Resort Development in Salamansa Area Project" in São Vicente are planned along existing way leaves or existing road reserves.
		2) Does the project site encompass the protected habitats of endangered species designated by Cape Verdean laws or international treaties and conventions?	2) No at present, however, there is a possibility the proposed projects may be in the vicinity of the habitats of endangered species. This should be studied at the D/D phase.
		3) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	3) No significant ecological impacts are anticipated in the proposed projects.
		4) Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife, and livestock? In particular, bird collision should be given due considerations.	4) Habitats of birds are not identified along the proposed project sites at present, but when designing the detail routes of transmission and distribution lines, whether such habitats are around will be confirmed. If there are, mitigation measures to prevent bird collision will be undertaken.
		5) Is there a possibility that improved access by the project will cause impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystem due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered?	5) No.
		6) In cases where the project site is located in undeveloped areas, is there a possibility that the new development will result in extensive loss of natural environments?	6) An underground cable from Salamansa to Baía das Gates of "Resort Development in Salamansa Area Project" in São Vicente Island is planned in the undeveloped area of the northeastern part of the island. However, the possibility of the loss of natural environments is considered low because civil works planned in the project are small-scale.
	(3) Topography and Geology	1) Is there a soft ground on the route of power transmission and distribution lines that may cause slope failures or	1) There may be a soft ground that may cause slope failures or landslides on some routes of the proposed projects. However,

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations at the F/S phase
		landslides? Are adequate measures considered to prevent slope failures or landslides, where needed? 2) Is there a possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? 3) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?	this will be confirmed at the D/D phase. The following measures against slope failures and landslides will be taken. • Civil works shall be avoided during the rainy season. • Adequate compaction of soil shall be conducted. • Re-vegetation of excavated sites shall be conducted. 2) There is a possibility of slope failures or landslides caused by civil works. Measures described in 1) will be properly taken. 3) Most of waste soil generated by civil works will be used for back-filling. For the surplus soil, measures described in 1) will be taken to prevent soil runoff.
4 Social Environment	(1) Resettlement	1) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? 2) Is adequate explanation on relocation and compensation given to affected persons prior to resettlement? 3) Is the resettlement plan, including proper compensation, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? 4) Does the resettlement plan pay particular attention to vulnerable groups or persons, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? 5) Are agreements with the affected persons obtained prior to resettlement? 6) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? 7) Is a plan developed to monitor the impacts of resettlement?	1) to 7) Involuntary resettlement is not expected in the proposed projects. Most of transmission and distribution facilities will be constructed along existing lines, road reserves and/or open areas, and they are small-scale facilities that will not cause involuntary resettlement. If there is a building on the planned route of transmission and distribution, the route can be flexibly diverted from the building depending on the situations in the sites.
	(2) Land	1) Is land acquisition caused by project implementation?	1) Small-scale land acquisition is anticipated in the proposed

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations at the F/S phase
	Acquisition	If land acquisition is caused, are efforts made to minimize the impacts caused by the acquisition?	projects. In most cases, only small plots of land, which is for the construction of wooden poles and secondary substations, will be acquired. Details will be clarified after line route surveys at the D/D phase.
		2) Is adequate explanation on land acquisition and compensation given to affected persons prior to the acquisition?	2) When land acquisition is required, MTIE will give adequate explanation and compensation to persons affected prior to the acquisition.
		3) Is the land acquisition plan, including proper compensation, developed based on line route surveys?	3) & 4) Land acquisition plan will be formulated either as an independent plan or as a part of Environmental Management Plan (EMP). Proper compensation and due considerations to vulnerable groups and persons will be included in the plan.
		4) Does the land acquisition plan pay particular attention to vulnerable groups or persons, including women-headed families, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?	
		5) Are agreements with the affected persons obtained prior to land acquisition?	5) Agreements will be obtained from the affected persons prior to land acquisition.
		6) Is the organizational framework established to properly implement land acquisition? Are the capacity and budget secured to implement the plan?	6) The process of land acquisition will be handled by the Project Implementation Unit to be established in MTIE. MTIE has several experiences in land acquisition for public development projects, and the recent experiences include the AfDB-JICA funded Project for Reinforcement of Generation and Transmission on Santiago. For the AfDB-JICA funded project, MTIE secured the budget for land acquisition. Considering the above, MTIE has the capacity to handle land acquisition process, and the budget will be properly secured.
		7) Is a plan developed to monitor the impacts of land acquisition?	7) The impacts of land acquisition will be monitored, and the monitoring items and methodology will be included in the land acquisition plan.
4 Social Environment	(3) Living and Livelihood	1) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	1) Basically no, but limited scale of land acquisition may affect to some extent. Refer to 4 (2).
		2) Is there a possibility that diseases, including communicable diseases, such as HIV will be introduced due to immigration of workers associated with the	2) The inflow of construction workers may cause sanitation problems or the spread of HIV and other infectious diseases, though the number of the workers is limited. Measures such as

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations at the F/S phase
		project? Are adequate considerations given to public health, if necessary? 3) Is there a possibility that installation of structures, such as power line towers will cause a radio interference? If significant radio interference is anticipated, are adequate measures considered?	health education for construction workers and local communities will be undertaken. 3) Poles to be constructed in the proposed projects are wooden ones, and 12 m high at maximum. There is therefore no concern about a radio interference.
	(4) Heritage	1) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage sites? Are adequate measures considered to protect these sites in accordance with Cape Verdean laws and regulations?	1) Some proposed projects may be planned in the vicinity of cultural properties designated by Lei no 102/III/90, and cultural heritages listed in or submitted to the World Heritage Convention. In addition to these heritages, there may be cultural heritage sites, but details will be identified at the D/D Phase. Consultations with local representatives and the responsible Ministry will be held, and measures such as the diversion of planned routes will be elaborated based on the consultations.
	(5) Landscape	1) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	1) The visual impacts by the proposed projects will be limited since the transmission lines will be wired on wooden poles with 12 m height. However, consultations with local representatives are necessary to avoid unexpected impacts.
4 Social Environment	(5) Ethnic Minorities and Indigenous Peoples	1) Where ethnic minorities and indigenous peoples are living in the rights-of-way, are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? 2) Does the project comply with Cape Verdean laws for rights of ethnic minorities and indigenous peoples?	1) & 2) Ethnic minorities and indigenous peoples are not identified in Cape Verde.
5 Others	(1) Impacts during Construction	1) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	1) Mitigation measures against impacts will be properly undertaken as described below. • Noise and vibration that may disturb livelihood of local people. Mitigation measures will be taken such as prior notification of work schedule to local people and avoidance of civil works during early morning and nighttime. • Although air pollutants will be emitted from construction vehicles, the impacts are negligible since the amount is limited. • Construction waste, waste soil, waste poles replaced by new

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations at the F/S phase
			ones, and old transformers will be generated during construction works. The wastes will be properly disposed of. In terms of PCB contaminant oils, proper storage is necessary.
		2) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?	2) Certain impacts on ecosystem are anticipated by the proposed projects. Details are described in 3 (2).
		3) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	3) Construction activities may affect the social environment as described in 4.
		4) If necessary, is health and safety education (e.g., traffic safety, public health) provided for project personnel, including workers?	4) Health education will be provided to prevent sanitation problems and the spread of HIV and other infectious diseases. Safety education to prevent accidents will also be provided for project personnel.
	(2) Monitoring	1) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?	1) Yes, the Project Implementation Unit (PIU) of MTIE will develop a monitoring plan as a part of the EMP. It is also responsible for the implementation of the monitoring.
		2) Are the items, methods and frequencies included in the monitoring program judged to be appropriate?	2) The PIU of MTIE will set monitoring items, methods, and frequencies, and include them in the monitoring plan. The plan will be formulated based on the consultations with DGA and other authorities.
		3) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?	3) The PIU will establish an adequate monitoring framework.
		4) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	4) Article 25 of Decreto-Lei no 29/2006 stipulates an environmental monitoring. Monitoring format, items, and methodologies will be selected according to the characteristics of planned project components and project site.
6 Note	Note on Using Environmental Checklist	1) If necessary, the impacts to transboundary or global issues should be confirmed, (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	1) There is no need to confirm transboundary and global issues since the Project does not involve such issues.

1) Regarding the term “Country’s Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are made, if necessary. In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan' experience).
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which it is located.

Appendix 7. Qustionnaires for Socioeconomic Survey

Socioeconomic Survey

Questionnaires for Households

Household I.D. Number	
Date of Questionnaire	
Name of Enumerator	Date: / /
Name of Supervisor	Date: / /

Section 1. Respondent's information

1.1	Island Code Santiago =**1**; Fogo =**2**	
1.2	Municipality Code São Salvador do Mundo=**11**; S. Miguel =**12**; Santa Catarina=**21**; Mosteiros =**22**	
1.3	Locality Code Burbur =**111**; Chã de Ponta =**112**; Djeu =**121**; Cabeça Fundão =**211**; Ribeira lhéu=**221**, Queimadinha & Relva =**222**, etc.	
1.4	Number of households in the locality	
1.5	Electrification status of the locality Un-electrified =**1**; Electrified (On-grid) =**2**; Electrified (Stand alone) =**3**	

2.1	Respondent's Name	
2.2	Gender Male =**0**; Female =**1**	
2.3	Age Less than 20 =**1**; 21~30=**2**; 31~40=**3**; 41~50=**4**; 51~60=**5**; Over 61=**6**	
2.4	Number of household members	
2.5	Number of male members	
2.6	Number of female members	
2.7	Type of tenancy Owner=**1**; Rented=**2**; Being occupied for free with consent of owner=**3**; Other=**4**, please specify _____	
2.8	Type of house Brick with tin roof=**1**; Brick with Concrete roof=**2**; Concrete =**3**; Other=**4**, please specify _____	
2.9	Occupation of household head Government official/employee = **1** Private business employee = **2** Private business owner = **3** Farmer = **4** Fisherman = **5** Artisan self employed = **6** Unskilled worker = **7** Unemployed = **8** Other = **9**, please specify _____	

2.10 Is any part of your house used for income generating activity or commercial purposes?

No = **0**; Yes = **1**

2.10.1 If part of your house is used for income generating activity, please indicate the activity. If two or more businesses are carried out, indicate the one that generates the most income for the household.

General goods/drug store = **1**
Restaurant/ Drinking bar = **2**
Bakery = **3**
Furniture making /Carpentry shop = **4**
Handicraft making = **5**
Tailor/ seamstress = **6**
Hair salon or barber shop = **7**
Repair shop = **8**
Grain milling = **9**
Guest house = **10**
Other =**11**, specify_____

3.1 How much is the monthly income do you get from the following sources?

Income sources	Income (CVE/ Month)
3.1.1 Farming	
3.1.2 Livestock	
3.1.3 Fishing	
3.1.4 Non-farm business	
3.1.5 Salary from farm employment	
3.1.6 Salary from non-farm employment	
3.1.7 Remittance	
3.1.8 Other, please specify _____	
3.1.9 TOTAL (summing up of 3.1.1 to 3.1.8)	

3.2 How much is the monthly expenditure on average for the following categories?

Expenditure item	Income (CVE/ Month)
3.2.1 Food items	
3.2.2 Household goods/items	
3.2.3 Clothing	
3.2.4 Transport	
3.2.5 Housing (rental, loan, etc.)	
3.2.6 Energy sources (fuel wood, diesel, kerosene, etc.)	
3.2.7 Education	
3.2.8 Health/ Medicine	
3.2.9 Farming activities (seeds, fertilizers, etc.)	
3.2.10 Business activities	

3.2.11 Remittances	
3.2.12 Saving	
3.2.13 Social activities, leisure	
3.2.14 Other, please specify _____	
3.2.15 TOTAL (summing up of 3.8.1 to 3.8.13)	

3.3 If the Total Expenditure **(3.2.15)** is different from the Total Income (**3.1.9**), please explain the reasons for the difference.

3.4 How much is the monthly energy-related expenditure on average for the following categories?

Energy Source	Income (CVE/ Month)
3.4.1 Gas	
3.4.2 Firewood	
3.4.3 Charcoal	
3.4.4 Candle	
3.4.5 Kerosene	
3.4.6 Personal diesel generator	
3.4.7 Other, please specify _____	
3.4.8 TOTAL (summing up of 3.4.1 to 3.4.7) Please take note that the **total energy cost should be equal to the expenditure on energy sources (3.2.6)**.	

3.5 How much total saving do you have?

CVE

4.1 What time do your household members usually wake up?

Member Categories	Time
4.1.1 Adult and young male (14 years old and above)	
4.1.2 Adult and young female (14 years old and above)	
4.1.3 Children (7-13 years old)	
4.1.4 Infant (less than 7 years old)	

4.2 What time do your household members usually go to bed?

Member Categories	Time
4.2.1 Adult and young male (14 years old and above)	

4.2.2 Adult and young female (14 years old and above)	
4.2.3 Children (7-13 years old)	
4.2.4 Infant (less than 7 years old)	

4.3 How long do your household members work?

Work Categories	Working hours
4.3.1 Farming/ livestock	Hours
4.3.2 Fishing	Hours
4.3.3 Salaried employees	Hours
4.3.4 Business operators	Hours
4.3.5 Housewives	Hours
4.3.6 Others, please specify	Hours

4.4 How long do your household members spend leisure time?

Member Categories	Leisure hours
4.4.1 Adult and young male (14 years old and above)	Hours
4.4.2 Adult and young female (14 years old and above)	Hours
4.4.3 Children (7-13 years old)	Hours
4.4.4 Infant (less than 7 years old)	Hours

4.5 How do your household members spend their leisure time? Please select the most popular three activities.

Leisure Categories	1st	2nd	3rd
4.5.1 Adult and young male (14 years old and above)	4.5.1.1	4.5.1.2	4.5.1.3
4.5.2 Adult and young female (14 years old and above)	4.5.2.1	4.5.2.2	4.5.2.3
4.5.3 Children (7-13 years old)	4.5.3.1	4.5.3.2	4.5.3.3
4.5.4 Infant (less than 7 years old)	4.5.4.1	4.5.4.2	4.5.4.3

1. Talking with household members
2. Talking with friends
3. Strolling outside and visiting
4. Religious activities
5. Watching TV and/or VTR
6. Listening to radio and/or music
7. Reading (books, newspapers, etc.)
8. Studying
9. Playing sports
10. Dancing
11. Drinking
12. Activities for local community, cooperatives, and NGOs
13. Productive activities (hunting, fishing, handcrafting, etc.)
14. Nothing
15. Others, please specify _____

Section 2. Energy related issues

FOR both Electrified and Un-Electrified Households

5.1 What is the main source of energy for lighting? (Rank as 1, 2 and 3, in order of importance)

Energy Source	Rank
5.1.1 Electricity from the ELECTRA grid	
5.1.2 Electricity from the stand-alone generation system	
5.1.3 Candle	
5.1.4 Kerosene lantern	
5.1.5 Gas lantern	
5.1.6 Solar lantern	
5.1.7 Personal diesel generator	
5.1.8 Other, please specify _____	

5.2 How much is the average monthly cost for lighting?

Energy Source	Rank
5.2.1 Electricity from the ELECTRA grid	
5.2.2 Electricity from the stand-alone generation system	
5.2.3 Candle	
5.2.4 Kerosene lantern	
5.2.5 Gas lantern	
5.2.6 Solar lantern	
5.2.7 Personal diesel generator	
5.2.8 Other, please specify _____	

FOR Household Electrified by ELECTRA grid

6.1 When did you connect to the ELECTRA grid?

Within one (1) year =**1**
One (1) to three (3) years ago = **2**
More than 3 years ago = **3**

6.2 How would you rate the quality of service from the ELECTRA? Please rate each of the following.

Category	Rate	Reason
6.2.1 Reliability		
6.2.2 Cost		
6.2.3 Response time to fault		
6.2.4 Billing & collection		
6.2.5 Other, please specify _____		

Very good = **1** Fair = **3**
Good = **2** Poor = **4**

6.3 Has your electricity service ever been disconnected?

No=**0**; Yes=**1**

6.4 If yes, please explain the reason

_____

6.5 Does your household have a meter for electricity?

6.6 How much is the average monthly cost for electricity from the ELECTRA grid? Please answer based on the recent bills of the electricity tariff. CVE

6.7 How much kWh do you use per month on average? Please answer based on the recent bills of the electricity tariff. kWh

6.8 For what purpose does your household use electricity?

Electric appliances	Answer No=0; Yes=1
6.8.1 Lighting	
6.8.2 Cooking and boiling water	
6.8.3 Radio/ Audio players	

6.8.4 TV/ VTR	
6.8.5 Refrigerator	
6.8.6 Fan	
6.8.7 Air conditioner	
6.8.8 Other, please specify _____	

6.9 Which of the following electric appliances does your household have?

Lighting Source	Answer No=0; Yes=1
6.9.1 Light bulb (incandescent)	
6.9.2 Light bulb (fluorescent)	
6.9.3 TV (small)	
6.9.4 TV (big)	
6.9.5 Radio	
6.9.6 Stereo	
6.9.7 Refrigerator (small)	
6.9.8 Refrigerator (big)	
6.9.9 Freezer (small)	
6.9.10 Freezer (big)	
6.9.11 Fan	
6.9.12 Air conditioner	
6.9.13 Electric iron	
6.9.14 Electric cooker	
6.9.15 Other, please specify _____	

FOR Household Electrified by Stand-Alone System

7.1 Has this house been electrified by a stand-alone generation system?
No=**1**; Yes=**2**

7.2 What is the Type(s) of Generation System?

Type	Capacity (kW)	Initial cost (CVE)
7.2.1. Diesel Generator	7.2.1.1	7.2.1.2
7.2.2. Photovoltaic system	7.2.2.1	7.2.2.2
7.2.3. Other, specify _____	7.2.3.1	7.2.3.2

7.3 Why have you decided to install the stand-alone generation system?
To do farming = **1**
To do commercial activities = **2**
To improve quality of life = **3**
Other = **4**, please specify _____

7.4 What are the average generation patterns per day?

	0	1	2	3	4	5	6	7	8	9	10	11
No=0 Yes=1												

	12	13	14	15	16	17	18	19	20	21	22	23
No=0 Yes=1												

7.5 How much is the monthly cost for the generation system?

Type	Cost (CVE)
7.5.1. Monthly running cost (fuel, etc.)	
7.5.2. Maintenance cost	

FOR Un-Electrified Households

8.1 Do you know about the procedure for connecting your house to the ELECTRA grid? No=**1**; Yes=**2** [ ]

8.2 Is your house connected to the ELECTRA grid? No=**1**; Yes=**2** [ ]

8.3 If no, what is the reason for your household not to connect to the ELECTRA grid?

Reason why not to connect to the ELECTRA grid	Answer No=0; Yes=1
8.3.1 Electricity is not necessary	
8.3.2 Connection fee is high	
8.3.3 Electricity tariff is high	
8.3.4 Other, please specify _____	
8.3.5 Other, please specify _____	

8. What time of the day do you think electricity is most needed? Please select the first 4 and second most needed time from each of the following.

8.4.1 1st : [ ]
8.4.2 2nd : [ ]

Whole day (24 hours) = **1**
Daytime only (from 6 a.m. to 6 p.m.) = **2**
Nighttime only (from 6 p.m. to 6 a.m.) = **3**
From 6 p.m. to 10 p.m. = **7**
From 10 p.m. to 2 a.m. = **8**
From 2 a.m. to 6 a.m. = **9**

From 6 a.m. to 10 a.m. = **4**
From 10 a.m. to 2 p.m. = **5**
From 2 pm. to 6 p.m. = **6**

Others =**10**, please specify _____
_____

8.5 For what purpose does your household want to use electricity?

Electric appliances	Answer No=0; Yes=1
8.5.1 Lighting	
8.5.2 Cooking and boiling water	
8.5.3 Radio/ Audio players	
8.5.4 TV/ VTR	
8.5.5 Refrigerator	
8.5.6 Fan	
8.5.7 Air conditioner	
8.5.8 Other, please specify _____	

Section 3: Electricity Tariff and Willingness to Pay

FOR Un-Electrified Household

9.1 Do you want to get electricity from the ELECTRA grid?
No = **0**, **go to 9.1.1**; Yes = **1**, **go to 9.1.2**

9.1.1 If **no**, please tell me the reasons.

9.1.2 If **yes**, please tell me the reasons.

9.2 According to **your answer to Q 5.2,** your household currently spends about CVE _____ per month for lighting. (Note: Sum up all expenditure for lighting fuel **from Q 5.2**) If electricity were available in your area, how much are you willing to pay?
Same as current spending for fuels = **1**
More than current spending for fuels = **2**, **go to 9.3**

Lower than current spending for fuels = **3**, **go to 9.5** ☐

9.3 You said you are willing to pay **more than** the current energy expenditure for lighting, please tell me exactly how much you are willing to pay per month?

CVE

9.4 Please tell me why you are willing to pay **more than** the current energy expenditure.

9.5 You said you are willing to pay **less than** the current energy expenditure for lighting, please tell me exactly how much you are willing to pay per month?

CVE

9.6 Please tell me why you are willing to pay **less than** the current energy expenditure.

9.7 What type of payment mechanism do you think is most convenient?

Through banks = **1**
Pay to a collector = **2**
Pay at customer service counter = **3**
Through pre-paid meters = **4**
Others = **5**, please specify _____

9.8 What type of payment would you prefer?

Quarterly = **1**
Monthly = **2**
Bi-monthly = **3**
Others =**4**, please specify _____

Section 4: Impacts of Electrification

FOR Household Electrified by ELECTRA grid

10.1 What are the significant change have you experienced after the electrification of your villages and household?

Impact	Answer No=0; Yes=1
10.1.1 Nothing has changed	
10.1.2 Village became safer	

10.1.3 Economic activities/ rural industry in the area have been activated	
10.1.4 If yes in 10.1.3, please specify what activities have been activated. _____	Please specify _____
10.1.5 Markets/ shops operating in the night have increased	
10.1.6 Working/business hours per day became longer	
10.1.7 Housewives' work became longer	
10.1.8 Housewives' work became shorter	
10.1.9 Cooking became easier	
10.1.10 Nighttime became more enjoyable	
10.1.11 Leisure time (e.g. TV watching, radio listening) became longer	
10.1.12 Studying/ reading at night became easier	
10.1.13 Sleeping hours became shorter	
10.1.14 Family became lazy	
10.1.15 Neighborhood relationships/ community became loose	
10.1.16 Other, please specify _____	

FOR Un-Electrified Household

10.2 What impacts/ benefits do you expect for the electrification of your household?

Impact	Answer No=0; Yes=1
10.2.1 Nothing will change	
10.2.2 Village will become safer	
10.2.3 Economic activities/ rural industry in the area will be activated	
10.2.4 If yes in 10.2.3, please specify what activities are expected _____	Please specify _____
10.2.5 Markets/ shops operating in the night will increase	
10.2.6 Working/business hours per day will become longer	
10.2.7 Housewives' work will become longer	
10.2.8 Housewives' work will become shorter	
10.2.9 Cooking will become easier	
10.2.10 Nighttime will become more enjoyable	
10.2.11 Leisure time (e.g. TV watching, radio listening) will be longer	
10.2.12 Studying/ reading at night will become easier	
10.2.13 Sleeping hours will become shorter	
10.2.14 Family will become lazy	

10.2.15 Neighborhood relationships/ community will become loose	
10.2.16 Other, please specify _____	

FOR both Electrified and Un-Electrified Household

10.3 Which of the following public services do you think of high importance to improve your livelihood? Please rank 1st, 2nd, and 3rd of the most needed services.

Service	Rank
10.3.1 House supply/ house ownership	
10.3.2 Electricity supply	
10.3.3 Safe water supply	
10.3.4 Roads, bridges, and other infrastructure	
10.3.5 Public transportation	
10.3.6 School/ Educational services	
10.3.7 Hospital/ Health services	
10.3.8 Latrines and other sanitation services	
10.3.9 Irrigation	
10.3.10 Flood control	
10.3.11 Other, please specify _____	

10.4 Please tell me the reasons of the ranking.

Section 5: Other

11.1 Do you have any specific suggestion to ELECTRA?

11.2 In terms of rural electrification, do you have any specific suggestion to the Government?

END of Household Questionnaire

Comments from Interviewee, if any

Comments from Enumerator, if any

Name of Enumerator		Date: / /
Name of Supervisor		Date: / /
Name of Data Entry Clerk		Date: / /