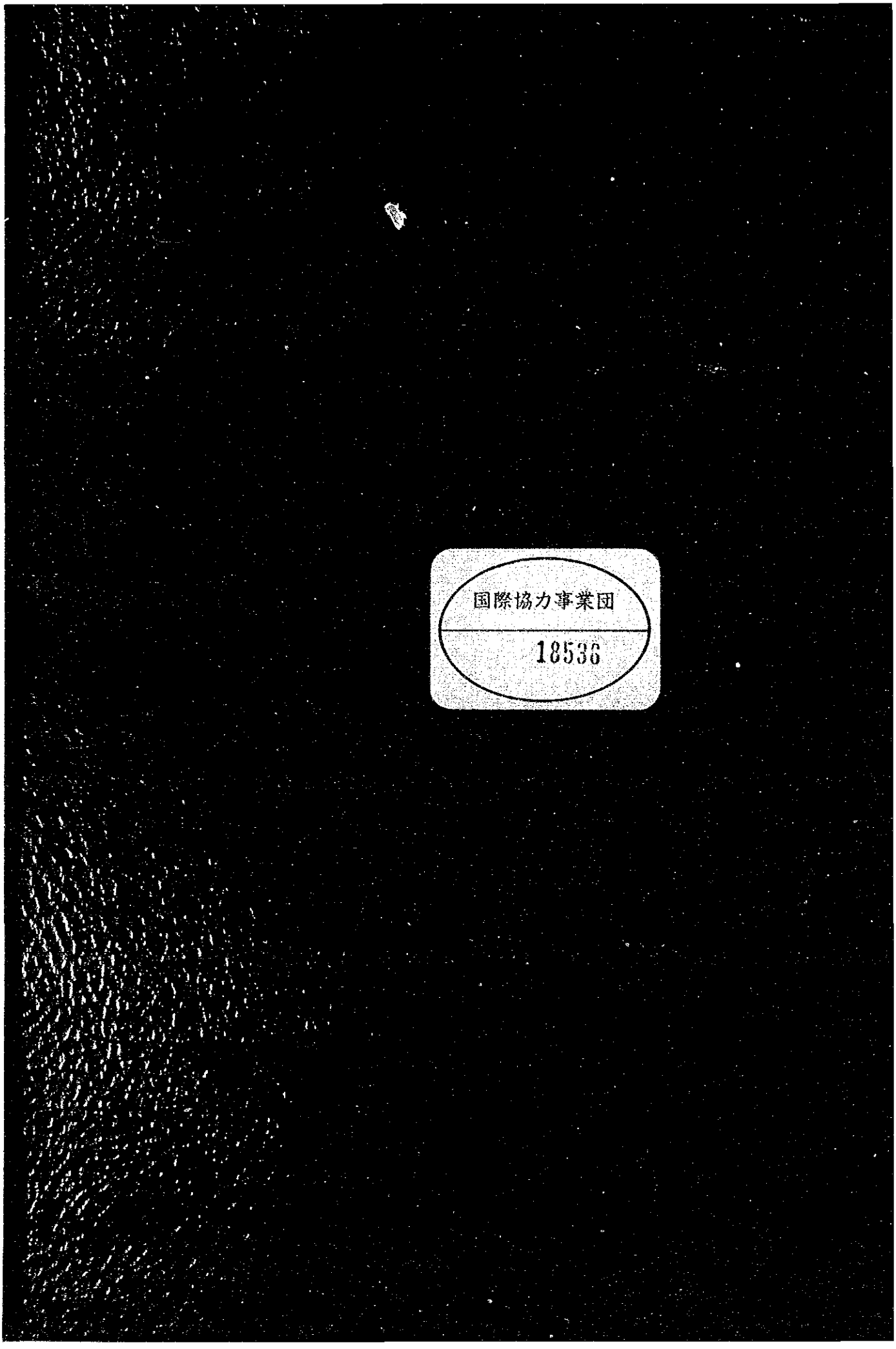
THE STUDY
ON
MASTER PLAN ON SUPPLY AND MARKETING SYSTEM
OF PETROLEUM PRODUCTS
IN
THE REPUBLIC OF PARAGUAY

NOVEMBER 1988

JAPAN INTERNATIONAL COOPERATION AGENCY



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PREFACE

In response to a request from the Government of the Republic of Paraguay, the Government of Japan has decided to conduct a study on a master plan on supply and marketing system of petroleum products in the Republic of Paraguay and has entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Paraguay a study team headed by Mr. Mizuho Kitamura, JGC Corporation, from March 5 to March 29, 1988.

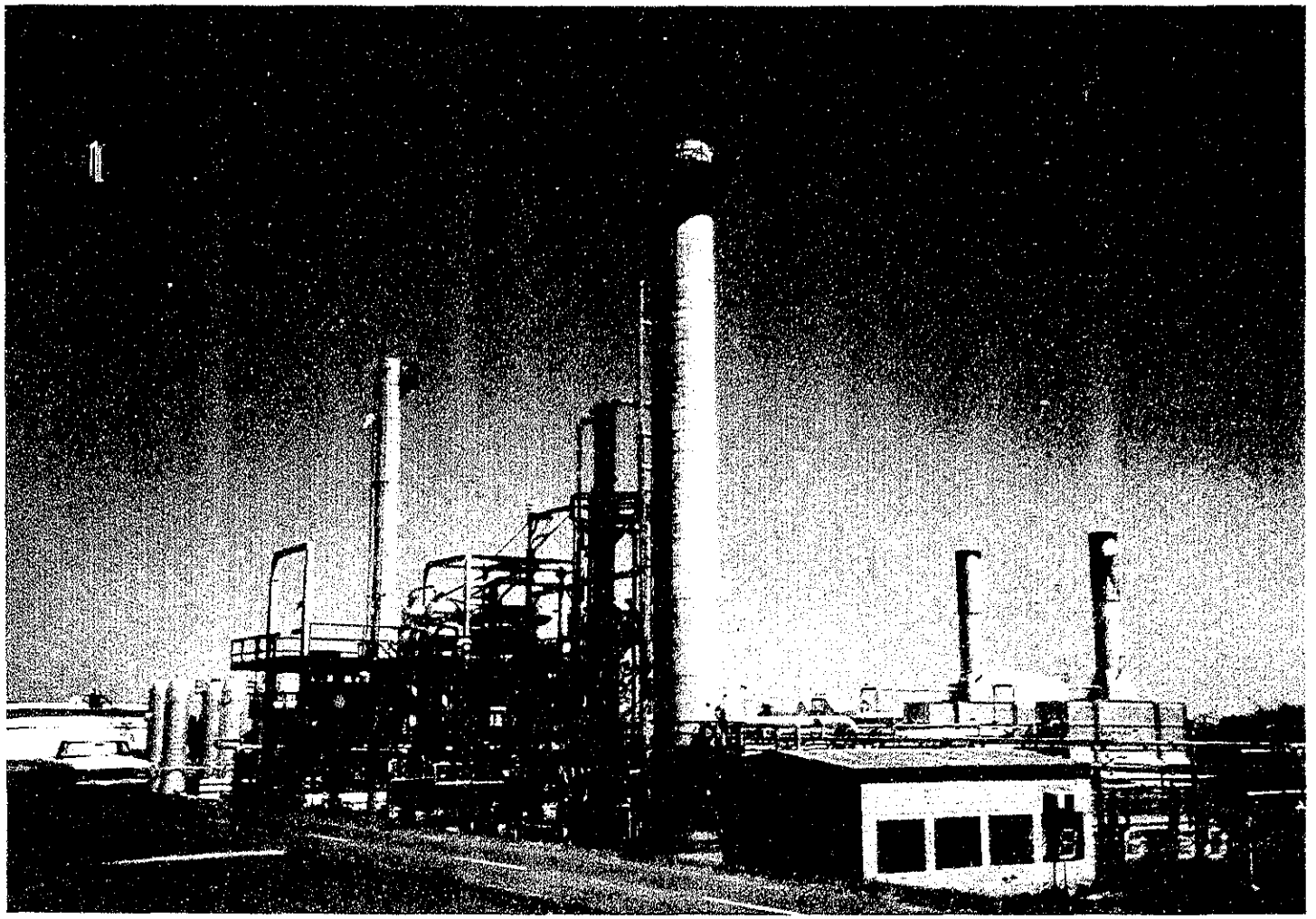
The team held discussions on the study with concerned officials of the Government of Paraguay and conducted field surveys in the study-related areas. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve to improve the present system of supply and marketing of petroleum products and will contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Republic of Paraguay for their close cooperation extended to the team.

November 1988

Kensuke Yanagiya
President
JAPAN INTERNATIONAL COOPERATION AGENCY



VILLA ELISA REFINERY

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ABBREVIATIONS

ASC	:	average supply cost
EIRR	:	economic internal rate of return
FIRR	:	financial internal rate of return
NPV	:	net present value
BBL	:	barrel
bn	:	billion
BPCD	:	barrel per calendar day
BPSD	:	barrel per stream day
°C	:	degree centigrade
cst	:	centistokes
gal.	:	gallon
GDP	:	gross domestic product
Gs	:	guaranis
GSP	:	government selling price
ha	:	hectare
hr	:	hour
kℓ	:	kiloliter
kWh	:	kilowatt hour
ℓ	:	liter
lb	:	pound
MM	:	million
m^2	:	square meter
MW	:	megawatt
%	:	percent
% wt.	:	weight percent
% vol.	:	volume percent
ppm	:	parts per million
RON	:	research octane number
t	:	metric ton
TOE	:	tons of oil equivalent
US$	:	US dollar
yr	:	year

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INTRODUCTION

1. Background and Progress of the Study

In 1987, the Government of the Republic of Paraguay requested the Government of Japan, based on a technical cooperation agreement between the two countries, to carry out a master plan study to facilitate the establishment of a plan for the future supply of petroleum products in Paraguay.

The Japanese Government, in response to the request, sent a preliminary survey mission headed by Mr. Kazuo Ishii, the head of the Industry Division, Mining and Industrial Planning and Survey Department of the Japan International Cooperation Agency (JICA) to Paraguay from 26 October to 3 November, 1987.

The mission, during its stay in Paraguay, briefly studied the petroleum products market in the country which lies as the background of the request of the Paraguayan Government, and discussed and agreed on the extent and content of the study to be carried out, with Petroleos Paraguayos (PETROPAR), the national oil company who represented Paraguay.

The "SCOPE OF WORK", upon which the both parties agreed, was signed by Dr. Julio C. Gutierrez, President of PETROPAR, and Mr. K. Ishii, the head of the JICA Mission, in Asuncion, the capital of Paraguay, on 2 November, 1987.

In accordance with the "SCOPE OF WORK", JICA dispatched an eight(8) person study team headed by Mr. Mizuho Kitamura from 6 through 27 March, 1988.

Paraguay is an inland country located in the southern central part of the South American Continent. The country depends wholly on imports for the supply of petroleum products consumed in the country, and demand for refined petroleum products in 1987 corresponded to about 11,000 b/d, and is forecasted to reach to around 20,000 b/d in the year 2000. Of the present demand, about 5,000 b/d is supplied by PETROPAR's Villa Elisa Refinery (designed capacity: 7,500 b/d) which refines the Saharan Blend crude imported from Algeria. The balance of about 5,000 b/d is supplied by imported refined products from the two neighboring countries, Argentina and Brazil. Since Paraguay is an inland country, both imported crude oil and refined products must be transported a long way, so that their costs are rather high.

The Paraguayan economy basically depends on the export of agricultural, forestry and livestock products and her balance of trade presently running a deficit. Therefore, it is extremely important that Paraguay works out a system for the supply of petroleum products that would satisfy the country's future long-term requirements in the most economical way. It is assumed that the situation abovementioned forms the basis behind the request for the master plan study by the Paraguayan Government.

With this understanding in mind, the JICA study team, during its stay in Paraguay, visited

PETROPAR and other government agencies and state-run companies to learn about the present situation surrounding industry and the economy of Paraguay and to collect relevant information. From PETROPAR, the study team learned and collected information on the history and present activities of the company and the situation prevailing in the petroleum products market in Paraguay. Also the study team travelled around the country for about one week and tried to enhance their understanding on the actual situation in Paraguay.

PETROPAR assigned a study team led by Ing. Mario Jose Romanach to render the JICA study team full support and cooperation.

The JICA study team prepared a "progress report" which describes the progress and outcome of the field survey in Paraguay as well as the basic framework and presuppositions for the studies to be undertaken after the team's return to Japan. The report was based on extensive discussions with PETROPAR's study team and on the consensus of the both parties. The JICA study team submitted the progress report to PETROPAR on 25 March, 1988 which was subsequently accepted. A memorandum which records the above situation was signed on the same day by Dr. Gutierrez, the President of PETROPAR, and Mr. Kitamura, the leader of the JICA study team.

After coming back to Japan, the JICA study team examined and analyzed the information and materials collected during its stay in Paraguay as well as those brought back by the preliminary survey mission in accordance with the aforementioned progress report, and worked out an analysis of the present status of the petroleum products market in Paraguay, future demand forecasts for petroleum products, and plans for future petroleum products supply systems in Paraguay, and examined and evaluated them.

The result of both the field study in Paraguay and the work in Japan were summarized in a "Draft Final Report" which was sent to the Government of Paraguay through JICA in early September 1988. JICA sent Mr. Kitamura, the leader of the study team, accompanied by one other member of the study team to Paraguay from 25 September to 3 October, 1988 to explain and discuss the above report with the Paraguayan parties concerned. The result of the discussion is described in a minute of meeting dated 30 September, 1988 and signed by Dr. Gutierrez and Mr. Kitamura.

After Mr. Kitamura returned to Japan, the study team made revisions and additions to the report in accordance with the results of the above discussion in Paraguay so that a final report of the study could be completed.

The above is a brief description on how the present final report is prepared.

2. Purpose of the Study

The purpose of the study was to research the demand/supply and distribution of petroleum products in Paraguay, to examine and compare the advantages and disadvantages to the nation of Paraguay of domestic refining versus imports of petroleum products, to establish petroleum products supply plans so as to fulfil the demand for petroleum products at the minimum possible cost from the viewpoints of national economy, and to fully evaluate such plans from both technical and economic aspects.

3. Study Team

(1) Field Study

Team Leader: Mr. Mizuho KITAMURA

Members: Mr. Akio IWAKI
Mr. Hiroshi OTANI
Mr. Hiroaki AIKAWA
Mr. Hiroshi MAEDA
Mr. Kouhei KOMIYAMA
Mr. Natsuo TASHIRO
Ms. Motoko IWAMI

(2) Work in Japan

(in addition to the above field study members)

Mr. Hidekatsu TANAKA
Mr. Yoichi SAGOSHI
Mr. Akio SHINAGAWA

(3) Explanation and Discussion on the Draft Final Report

Mr. Mizuho KITAMURA
Mr. Hiroshi OTANI

4. Field Study

The following is the itinerary of the study team for the field study carried out in March 1988.

SURVEY ITINERARY (1)

DATE	HOUR	SUB GROUP	PLACE OF VISITS	SUBJECT
March 7	8:00	all	JICA Asuncion Office	Courtesy call
(Mon.)	9:00	all	PETROPAR Head Office	Courtesy call
	14:00	all	Villa Elisa Ref.	Survey schedule
	17:00	all	ditto	Plant observation
March 8	8:30	E	Villa Elisa Ref.	General Economy & Energy
(Tues.)	to			Economy
	16:30	T-1	ditto	Transportation & Distribution
		T-2	ditto	Existing Refinery
March 9	7:30	E	Ministerio de Industria y Comercio	Industry & Industrial Policy
(Wed.)	10:00	E	Banco Central del Paraguay	Macroeconomy, Monetary Policy
	16:00	E	Secretaria Tecnica de Planificacion	Energy Economy
	8:30	T-1	Villa Elisa Ref.	Existing Refinery
	to			
	16:30	T-2	ditto	Transportation & Distribution
March 10	7:30	E	Ministerio de Obras Publicas y	Transportation Sector and Energy
(Thur.)			Comunicaciones	
	9:00	E	Ministerio de Hacienda	Taxation System
	14:30	E	Villa Elisa Ref.	Petroleum Product Market
	8:30	T-1	Villa Elisa Ref.	Existing Refinery
	to			
	16:30	T-2	ditto	Transportation & Distribution
March 11	7:30	E	Servicio Forestal Nacional	Forest as Energy Resources
(Fri.)	9:00	E	Administracion Paraguaya de	Production & Supply of Power
			Alcoholes	Alcohol
	11:00	E	Embassy of Japan	Courtesy call
	14:30	E	Villa Elisa Ref.	Petroleum Product Market
	8:30	T-1	ditto	Existing Refinery
	to			
	16:30	T-2	ditto	Transportation & Distribution
March 14	7:30	all	Leave Asuncion	
(Mon.)	11:30	all	APAL Plant (Troche)	Observation
	over night	all	Ciudad Presidente Stroessner	

SURVEY ITINERARY (2)

DATE	HOUR	SUB GROUP	PLACE OF VISITS	SUBJECT
March 15	8:00	all	ITAIPU Power Plant	Observation
(Tues.)	12:00	all	PETROPAR Hernandarias Depots	Observation of Facilities and Operations
	over night	all	Ciudad Presidente Stroessner	
March 16	8:00	all	Acaray Power Plant	Observation
(Wed.)	over night	all	Ciudad Presidente Stroessner	
March 17	9:00	all	JICA Yguazu Office	Courtesy call
(Thur.)	14:00	all	Centro de Mecanizacion Agricola (CEMA)	Mechanization and Resulting Demand for Gas oil
	over night	all	Encarnacion	
March 18	9:00	all	JICA Encarnacion Office	Courtesy call
(Fri.)	14:00	all	Yacyreta Dam	Observation
	20:00	all	Arrived at Asuncion	
March 21	8:30	E	Villa Elisa Ref.	Petroleum Product Market
(Mon.)	to	T-1	ditto	Existing Refinery
	16:30	T-2		Transportation & Observation
March 22	10:00	E	ANDE	Energy Economy
(Tues.)	14:00	E	Villa Elisa Ref.	Concept of Alternative Supply
	8:30 to 16:30	T	ditto	Scheme
March 23	8:30	all	Villa Elisa Ref.	Basis for Financial & Economic
(Wed.)	to 16:30			Evaluation
March 24	8:30	all	Villa Elisa Ref.	Progress Report
(Thur.)	to 16:30			
March 25	16:00	all	PETROPAR Head Office	Submission of Progress Report
(Fri.)				

NOTE: E: Economics group T-1: Technical group-1 T-2: Technical group-2

ATTENDEES/PERSON INTERVIEWED (1)

1.	PETROPAR	
	Dr. Julio C. Gutierrez	(Presidente)
	Dr. Desiderio M. Enciso	(Miembro Titular)
	Lic. Fabio Cabrera	(Gerente General)
	Ing. Mario Romanach	(Gerente, Gerencia Tecnologica Gerencia)
	Dr. Roberto Jimenez Rueda	(Gerente, Gerencia Industrial Gerencia)
	Dr. Carlos Rodriguez Baez	(Jefe, Seccion Estadistica)
	Lic. Antonio Turro	(Sub Gerente, Gerencia Administrativa Gerencia)
	Ing. Juan C. De Giacomi	(Sub Gerente, Gerencia Tecnologica Gerencia)
	Ing. Ernesto Ayala B.	(Vice Superintendente, Superintendencia de Obras y Mantenimiento)
	Lic. Felix Valenzuela	(Sub Jefe, Seccion Comercial)
	Ing. Claudio A. Corrales	(Seccion Operaciones y Proceso)
	Ing. Francisco K. Terashima	(Seccion Operaciones y Proceso)
2.	Ministerio de Industria y Comercio	
	Dr. Emilio A. Ramirez Russo	(Director del Gabinete Tecnico.)
3.	Banco Central del Paraguay	
	Sr. Ovidio C. Otazu Gimenez	(Jefe del Departamento de Estudio Economicos Division Est. Monetarios y Financieros)
4.	Secretaria Tecnica de Planificacion, Presidencia de la Republica	
	Lic. Mirna Chamorro de Ojeda	(Div. Prog. Energetica)
5.	Oficina de Coordinacion y Planificacion Integral del Transporte	
	Ministerio de Obras Publicas y Comunicaciones	
	Dr. Isidro Nunez Gomez	(Director General)
6.	Ministerio de Hacienda	
	Dr. Jose Serra Cuevas	(Secretario Tecnico)
	Dr. Miguel Angel Butes	
7.	Servicio Forestal Nacional Ministerio de Agricultura y Ganaderia	
	Ing. Pedro H. Calabrese	(Director)
8.	APAL	
	Dr. Ramon Jimenez Leguizamon	(Gerente Administrativo y Financiero)
	Dra. Ernesta Ikuko Oka	
9.	APAL Plant (Troche)	
	Ing. Artemio Anibal Cardose	(Jefe de Personal, Planta)
10.	ITAIPU Power Plant	
	RR.PP.	
11.	Hernandarias Depots	
	Sr. Julio Cesar Cristaldo	(Jefe de la Planta Hernandarias)
12.	ACARAY Power Plant	(Jefe Dpto. Central Acaray)
	Ing. Pedro Chudykl	
13.	CEMA	
	Ing. Cayo Franco	(Director)
	Sr. Villordo	

ATTENDEES/PERSON INTERVIEWED (2)

14. YACYRETA Dam

Ing. Freddy Cardozo	(Director Adjunto de Ingenieria Consultores Internacionales de Yacyreta; CIDY)
Ing. Ascencio Lara	(CIDY)

15. ADMINISTRACION NACIONAL DE ELECTRICIDAD (ANDE)

Ing. Enzo Debernardi	(Presidente)

16. MUNICIPALIDAD DE ASUNCION PROYECTO CETA

Arq. Josefina Romero

CHAPTER 1 ECONOMY OF PARAGUAY

1.1 General Economy

1.1.1 Overview of the Macroeconomy

Paraguay recorded an annual economic growth rate of 8.8% during the 1970s, the highest among all Latin American countries. However, the rate dropped to 2.2% from 1980 through 1987. The main reason for the high growth rate in the 1970s was the construction of the world's largest dam, Itaipú Dam, which increased demands in both domestic and neighboring markets. The construction of the huge project was almost finished in the early 1980s, and when capital inflow related to the project ceased, the Paraguayan economy went into recession (Table 1.1-1).

Paraguay is basically an agricultural country; 45% of the economically active population (1982), about a fourth of GDP, and more than 98% of exports are dominated by agriculture, forestry and livestock industries. Agricultural production is greatly influenced by weather conditions and by changes in international commodity prices. Therefore, production fluctuates every year; it dropped by 3% in 1983 because of heavy rain, but recovered in the following years, to 7% in 1984 and 6% in 1985, and then dropped sharply by 12% in 1986 due to a flood and again recovered in 1987 with a 9.7% growth rate (Table 1.1-2).

Manufacturing production is also influenced by agriculture, since about 70% of manufacturing production involves the processing of agricultural products. Accordingly, it decreased by 1.4% in 1986 and recovered by 3.5% in 1987.

Likewise, most export commodities are agriculture-based products, thus, fluctuating exports. However, exports are also influenced by exchange rates. The present exchange rate in Paraguay is multi-tiered; Gs 550 per US$ is applied to special export products (or to a certain portion of exports) and a free market rate is applied to other products. The main reason that the export figure increased by 38% in 1985 was a change in the exchange rate policy: A free market exchange rate was applied to 50% of the exports of two major export commodities – cotton and soybeans. A 30% increase in exports in 1987 was mainly caused by rising international commodity prices.

The recent inflation rate of 20% level is lower than those in other Latin American countries. This inflation can be explained by the change in the exchange rate policy. As some strategic commodities are imported under a lower exchange rate, but with limited quantity, imports using the free market rate increase and prices rise as a result. Moreover, as government subsidies for the imports increase, financial deficits become bigger, resulting in more inflation.

Paraguay has a balance of payments structure typical of developing countries: Trade

deficits are financed by capital surplus. This trade deficit is due to the international trade structure of exporting agricultural products and importing resources, including petroleum and all kinds of manufacturing goods.

Paraguay is one of the few countries that have never rescheduled their repayment of foreign debts. However, repayment became burdensome after the completion of Itaipú Dam, because capital inflow almost ceased.

Table 1.1-1 Major Economic Indicators

	1970 – 1980	1980 – 1987	1985	1986	1987
Population (thousand)	2,358 [1]	3,030 [2]	3,681	3,788	n.a.
Pop. growth rate (%)	2.54 [3]	2.99 [4]	2.94	2.90	n.a.
Economic growth rate (%) [5]	8.8	2.2	4.0	0.0	4.3
Price rises					
Consumer price (%)	–	20.4	25.2	31.7	21.8
Wholesale price (%)	16.6	28.2	23.5	45.1	11.9
Growth of exports (%) [5]	10.1	4.9 [4]	37.7	–3.2	30.0
Growth of imports (%) [5]	13.0	5.2 [4]	13.2	5.7	24.9
Trade balance (MM US$)	–6 [6]	–262 [7]	–192	–162	n.a.

1) 1972, census.
2) 1982, census.
3) Annual average of 1972 – 1982.
4) Annual average of 1980 – 1986.
5) Real growth rate.
6) Average value of 1970 – 1980.
7) Average value of 1980 – 1986.

Source: Banco Central del Paraguay, "Cuentas Nacionales 1976/1986."
Secretaria Tecnica de Planificacion, "Plan Nacional de Desarrollo Economico y Social 1985 – 1989."
IMF, "International Financial Statistics."

1.1.2 Industrial Structure

As mentioned above, Paraguay is basically an agricultural country. Agriculture shared 16% of GDP in 1987, of which the entire primary industries together with livestock, forestry and fishing accounted for 26%. The manufacturing industry was 16% of GDP, of which the secondary industries together with mining and construction accounted for 22%. The tertiary industry accounted for 52% of GDP, of which 27% was dominated by commerce.

Paraguay covers about 400,000 km² which is almost the same size as Japan, but has a small population of less than 4 million, about one thirtieth of Japan. Therefore, the domestic

market is very small and it takes time and much financing to provide an essential infrastructure. Accordingly, when the big projects like the construction of Itaipú Dam and Yacyreta Dam started, their economic and social effects extended across the country. The construction of the Itaipú Dam, in particular, caused high economic growth called the "Paraguayan miracle."

This resulted in a 9% annual economic growth rate during the 1970s, thus increasing per capita income from 984 dollars in 1970 to 1,589 dollars in 1980. The area around the dam construction site, adjacent to the border with Brazil, prospered with many workers and consumption goods brought in not only from Brazil but from many other countries. A new town was built there for the workers, and public facilities such as a hospital and school and infrastructures such as roads and a port (Pto. Pte. Franco) were constructed. About 38,000 people worked there at the peak of the construction in the middle of 1979.

The investment capital of the two big binational projects totalled 2.5 billion dollars, which accounted for 9 to 10 per cent of GDP at the peak of the construction, from 1978 to 1980.[1] The two big projects not only promoted direct investment but induced other investment, for example, investment in construction materials such as cement and foreign investment mainly in agro-industries.

Thus, the economy of Paraguay changed greatly thanks to the Itaipú project. Paraguay's relationship with Brazil solidified; many Brazilians settled in bordering departments such as Amambay, Canindeyú, Alto Paraná and Itapúa and introduced the cultivation of soybeans. Soybeans are now one of the major export commodities of Paraguay.

Table 1.1-3 shows the production of major agricultural products. Production increased in cotton, soybean, wheat and yerba mate.

The production of other products changed greatly year by year because increases in agricultural production were caused by the expansion of cultivated land and farmers easily switched crops with the changes in prices.

Seventy percent of the manufacturing industry is the processing sector of agricultural products. The manufacturing industry accounts for 17% of GDP and 16% of the economically active population. Most of the industry is comprised of small- and medium-sized industries and cottage industries of less than 4 employees. The production trend in the major manufacturing products is shown in Table 1.1-4. Production changes yearly. The cause may be that the market is too small to make the most of the scale of the economy and the local infrastructures are too underdeveloped to have access to the market. Accordingly, the development of the manufacturing industry is impeded.

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1) Secretariá Técnica de Planificatión, "Plan Nacional de Desarrollo Economico y Social 1985 – 1989" Primera Parte, p.63.

The present industry in Paraguay, both agriculture and manufacturing, is basically structured to satisfy domestic demand. Therefore, it centers around consumption goods and most of the capital and intermediate goods must be imported, except for a few products like steel.

Table 1.1-2 GDP by Industrial Sector (Share and Growth Rate)

(Unit: %)

	Percentage share by industry				Annual Growth Rate				
	1970	1975	1980	1987	1970 – 1980	1980 – 1985	1985	1986	1987[1]
GDP	100.0	100.0	100.0	100.0	8.8	2.3	4.0	0.0	4.3
Primary industry	30.4	30.8	25.2	26.0	6.7	3.6	4.6	−6.1	7.0
Agriculture	16.1	16.7	14.5	16.2	7.7	5.0	6.0	−12.6	9.7
Secondary industry	20.9	20.2	24.6	22.5	10.6	4.2	3.4	−0.6	3.1
Manufacturing	18.5	17.0	17.9	16.2	8.3	1.1	5.0	−1.4	3.5
Construction	2.4	3.2	6.6	5.8	20.3	0.0	−1.0	1.0	2.0
Tertiary industry	48.7	49.0	50.2	51.5	9.1	11.9	3.9	3.5	3.5

1) Provisional.

Source: Banco Central del Paraguay, "Cuentas Nacionales 1976/1986."
Secretaria Tecnica de Planificacion, "Plan Nacional de Desarrollo Economico y Social 1985–1989."

Table 1.1-3 Production of Major Agricultural Products

(Unit: 1,000 ton)

	1976	1978	1980	1982	1984	1986
Cotton	105	285	235	254	320	312
Rice	52	36	61	65	39	60
Maiz	344	368	506	520	414	450
Manioc	867	867	911	948	870	791
Soybean	280	330	650	750	745	700
Tobacco	40	20	17	18	21	7
Wheat	25	30	44	70	130	233
Coffee	4	7	7	8	7	6
Sugarcane	1,440	1,786	2,357	2,333	2,541	2,100
Tung	131	96	95	105	147	145
Mate	20	25	27	31	35	37

Source: Banco Central del Paraguay, "Cuentas Nacionales 1976/86."

Table 1.1-4 Production of Major Manufacturing Products

		1980	1981	1982	1983	1984	1985	1986
Textile								
Cotton fabric	(10^6 m)	17	13	9	6	6	9	12
Cotton fiber	(1,000 ton)	75	106	91	77	105	160	100
Oil for industrial use								
Tung	(1,000 ton)	10	12	13	17	9	9	7
Edible Oil								
Soybean oil	(1,000 ton)	2	3	6	6	5	6	11
Cottonseed oil	(1,000 ton)	2	13	7	4	5	11	11
Construction Materials								
Lime	(1,000 ton)	49	57	54	74	72	71	79
Cement	(1,000 ton)	177	156	111	153	109	46	179
Tobacco	(10^6 packet)	32	38	38	47	44	42	38
Beverages								
Beer	(1,000 kℓ)	62	63	70	72	75	77	89
Foods								
Sugar	(1,000 ton)	89	76	81	98	85	73	69
Flour	(1,000 ton)	82	101	97	100	90	99	108

Source: Banco Central del Paraguay, "Boletin Estadistico", Noviembre 1987.

1.1.3 Fiscal and Monetary Conditions

The central government's financial operations generated deficits in the early 1980s but these turned into a surplus after 1986, as shown in Table 1.1-5. This was due to the tight fiscal policy of the government since 1983 and the strong rise in revenues, especially income taxes and sales tax revenues.

Public revenues are derived mainly from indirect taxes, such as customs duties, internal taxes and sales taxes, and income taxes (see Table 1.1-5). On the other hand, of expenditures, distributed among the ministries, the largest allotment is to the Ministry of Defense, 15% of total expenditure in 1986. Next comes the Ministry of Education, Ministry of Interior and Ministry of Public Health. Repayment of public debt has been increasing since 1984. It especially jumped by 136% in 1987 (Jan. to Nov.), perhaps due to the repayment of the financing of the deficits, mainly to the Central Bank, during the early 1980s.

The public sector accounts for about 10% of the Paraguayan economy, comprised mainly of the central government and public enterprises. Public enterprises in Paraguay carry out such works as telecommunications, transportation, energy, cement and steel. The current

accounts of these public enterprises show deficits in recent years which have furthered the increase in foreign debt.

The recent monetary policy is of tight monetary control. The purpose of this policy is to prevent inflation. During the 1970s, it was requisite to prevent inflation caused by the strong inflow of foreign capital that financed the construction of Itaipú Dam. In the 1980s, the primary factor for inflation was public deficits caused by the cease in capital inflow.

Table 1.1-5 Central Government Financial Operations

(Unit: bn Gs)

	1983	1984	1985	1986	1987[1)]
Total Revenue	60.2	79.6	102.8	134.0	195.4
Customs duties	6.1	7.9	11.0	15.3	19.2
Internal taxes	19.0	29.2	42.2	51.0	69.9
Taxes on alcohol	2.1	3.0	4.3	6.8	7.7
Income taxes	9.6	10.0	15.7	20.3	35.0
Property taxes	3.3	3.6	4.8	5.9	7.1
Sales taxes	2.9	6.0	9.1	13.5	20.3
Pension funds	4.6	4.5	5.7	6.5	9.3
Other	12.6	15.4	10.0	14.7	26.9
Total Expenditure	81.1	82.6	103.8	131.2	189.1
Ministry of Defense	11.7	12.8	15.9	20.1	26.9
Ministry of Education	11.5	11.8	14.6	17.5	23.8
Ministry of Interior	7.6	8.0	10.6	12.9	17.1
Ministry of Public Health	2.8	3.1	3.7	4.9	6.9
Ministry of Public Works	3.8	2.7	2.7	3.6	5.7
Ministry of Finance	1.8	1.8	2.2	2.7	3.5
Ministry of Agriculture and Livestock	1.8	1.9	2.3	3.0	3.9
Other ministries	1.6	1.9	2.5	3.3	4.1
Public debt	6.1	11.2	11.7	17.4	41.1
Other	32.4	27.4	37.8	45.8	56.1
Balance	−20.9	−3.0	−1.0	2.8	6.3

1) Jan. to Nov.

Source: Banco Central del Paraguay, "Boletin Estadistico", Nov. 1987.

The Central Bank of Paraguay executes all monetary policies and has all the functions of a Central Bank, such as issuing notes, supervising interest rates and legal reserves of the commercial banks and, in the international sphere, controlling the foreign exchange system.

The present foreign exchange system is a multi-tiered system. Official rates are applied to the exports and imports of some special commodities and services, and the free market rate is applied to the rest. This system was executed in 1982, and the sphere in which the free rate is applicable has been widening since then. The free rate is now applied to 75% of total trade. Table 1.1-6 shows the present exchange rate system.

The application of preferential exchange rates for the special commodities and services burdens the government and the Central Bank to fill up the gap. The burden amounted to 43 billion Gs in 1985, almost 3% of the GDP (Table 1.1-7). The Central Bank is reluctant to devalue the currency for fear of inflation. Therefore, it gradually increases the application of free market rates, which actually devalues the currency.

1.1.4 International Trade and Balance of Payments

The degree of dependance upon foreign trade in 1986 was 37% for imports and 30% for exports, almost the same as Korea which is famous for its high dependance on trade. However, Paraguay's high dependance upon foreign trade is only a recent trend; it was low until 1980. Its dependance on trade, both imports and exports, was 31% in 1970 and 34% in 1980.

The most significant characteristic of trade in Paraguay is the well known contraband, with its huge volume and extensiveness. Although it is impossible to get accurate figures, the gap between the statistics of Brazil and Paraguay in 1982 was 255 million dollars, more than the registered trade figure of 238 million dollars in Paraguay.[1)]

Major export products are shown in Table 1.1-8. Almost all export products are agricultural products and their processed goods. The largest export is cotton fiber, and the second largest is soybeans, which began being cultivated in the 1970s. However, the export value of these products fluctuates every year because their prices are subject to sharp fluctuations in the international market. Therefore, it is very difficult for Paraguay to secure a stable income from such exports.

With regards to imports, machinery imports are increasing and the share of foods is decreasing (Table 1.1-9). The share of petroleum and its products is decreasing due to the recent fall in petroleum prices.

Paraguay's trade structure by country is quite different from other Latin American countries. The major trade partner of Paraguay's neighboring countries is the United States,

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1) Miranda, A., "Paraguay y las Obras Hidroeletricas Binacionales", 1988., p.113

Table 1.1-6 Exchange Rates[1)]

Item	Exchange rate Gs./US$
– Repayment of public foreign debt	240 – 320[2)]
– Binational organizations	240[3)]
– Importations (FOB) of ANDE, FME, CORPOSANA and ANTELCO[4)]	240
– Importations (FOB) of petroleum and combustible petroleum products	400
– Importations (CIF) of the Central Government	400
– Importations of the rest of the public sector and the maintenance payment of airplanes and other services of LAP	400
– Importations of argicultural input	550[5)]
– Disbursement of external loans	550[6)]
– Exportations of goods by the private sector and public enterprises	550
– Exportations of services by the private sector and public enterprises	Free rate
– General services	Free rate
– Capital transactions of private sector	Free rate
– External loan of private sector	Free rate
– Supplyer's credit	Free rate
– Private sector's short- and long-term capital repayment	Free rate

1) Subjects to the Resolución del Consejo Nacional de Coordinación Economica nos. 28 (3/28/86): 6 and 7 (26/01/87).
2) Exchange rate of Gs. 320 corresponds to the repayment of the external debt with the maturity from 01/07/87.
3) This kind of exchange rate has not been considered in any other resolution.
4) ANTELCO is included in this group by Resolution no. 6 of 26/01/87 of CNCE.
5) Up to the total amount of the foreign currency reserves of the Central Bank.
6) Applicable to the loans of the World Bank and Inter-American Development Bank, from January, 1987. Resolution no. 12 of 28/01/87, of CNCE.

Source: Banco Central del Paraguay

References:

ANDE: Administración Nacional de Electricidad.
FME: Flota Mercante del Estado.
CORPOSANA: Corporacion de Obras Sanitarias de Asunción.
ANTELCO: Administración Nacional de Telecomunicaciones.
LAP: Lineas Aereas Paraguayas.
CNCE: Consejo Nacional de Coordinacion Economica.

Table 1.1-7 Subsidies to the Public Sector[1]

	Millions of guaranies			Growth rates			Percentage of GDP		
	1983	1984	1985	1983	1984	1985	1983	1984	1985
Exchange subsidy									
1. For servicing the external public debt[2]	2,725	9,511	27,801[3]	68.0	149.0	192.3[3]	0.3	0.9	2.0[3]
2. For imports by public institutions[4]	4,117	16,791	15,592	50.9	307.8	−7.1	0.5	1.6	1.1
3. Total (1+2)	6,842	26,302	43,393	57.3	299.6	54.9	0.8	2.5	3.1
Credit subsidy									
4. At the rate of interest of the minimum portfolio[5]	1,476	2,777	4,159	500.3	88.1	49.8	0.2	0.3	0.3
5. At the rate of inflation[6]	1,476	4,998	8,196	2,380.7	238.6	64.0	0.2	0.5	0.6
Total subsidy									
(3+4)	8,318	29,079	47,552	74.3	249.6	63.5	1.0	2.7	3.4
(3+5)	8,318	31,300	51,589	87.3	276.3	64.8	1.0	2.9	3.7

1) Provisional figures.

2) Includes only the exchange subsidies identified in the Central Bank's monetary program and which originate from the gap between the exchange rate paid by the Central Bank to acquire foreign currency and the exchange rate at which it sells to the public sector for servicing its external debt.

3) Estimated figures.

4) Equals the gap between the rate of exchange paid by the Central Bank for foreign currency and the average rate of exchange at which it sells to the public sector for its imports.

5) Equals the gap between the rate of interest paid by the non-financial public sector for net Central Bank credit and that paid by the non-financial private sector for credit with a term of less than 240 days under the minimum portfolio system.

6) Equals the gap between the rate of interest paid by the non-financial public sector for net Central Bank credit, and the rate of inflation.

Source: UN ECLA, "Economic survey of Latin America and the Caribbean 1985"

Table 1.1-8 Exports by Products

	Value in Million US$				Share (%)			
	1980	1982	1984	1986	1970	1975	1980	1986
Agricultural Products	70.5	106.6	121.6	56.7	15.0	26.3	22.7	24.4
Soybean	42.1	89.6	99.3	43.9	--	9.9	13.6	18.9
Tobacco	10.1	5.9	15.3	5.4	9.0	6.8	3.3	2.3
Fruits and vegetables	8.4	8.6	3.8	5.3	0.5	3.3	2.7	2.3
Coffee	2.3	0.3	0.1	--	1.4	4.9	0.7	--
Yerba Maté	1.9	0.2	0.2	0.1	0.8	0.2	0.6	0.0
Other	5.7	2.0	2.9	2.0	3.3	1.2	1.8	0.9
Timber	66.3	43.8	22.2	17.7	19.7	15.8	21.4	7.6
Livestock Products	4.2	8.8	11.7	43.9	26.7	19.5	1.4	18.9
Industrial Products	168.8	170.1	178.5	113.6	38.4	38.2	54.4	48.9
Cotton fiber	105.8	122.4	131.2	80.7	6.3	11.4	34.1	34.7
Sugar	3.1	3.9	4.2	3.6	0.0	3.8	1.0	1.5
Oil	17.1	18.8	19.0	9.2	10.9	6.0	5.5	4.0
Coconut oil	4.3	6.4	3.8	1.9	4.5	2.5	1.4	0.8
Tung oil	9.5	10.2	9.4	3.0	5.5	2.7	3.1	1.3
Essential oil	9.1	3.5	3.2	4.0	3.2	5.5	2.9	1.7
Hides and skins	0.8	0.4	--	--	0.8	0.6	0.3	--
Quebracho extract	4.4	5.0	5.6	3.8	3.1	1.4	1.4	1.6
Other	28.5	16.1	15.3	12.3	14.1	9.5	9.2	5.3
Other	1.0	0.3	0.4	0.7	0.2	0.3	0.1	0.2
Total	310.2	329.8	334.5	232.5	100.0	100.0	100.0	100.0

Source: Banco Central del Paraquay, "Boletin Estadistico", Noviembre 1987

while that of Paraguay is Brazil and Argentina. This might be due to the geographical position of Paraguay, an inland country surrounded by these two big countries, and to a lack of any particular export product. Trade with Brazil has been increasing rapidly these past years while that of Argentina, who had been a major trading partner, has been decreasing (Table 1.1-10). The reversal of roles between Brazil and Argentina has made Brazil Paraguay's major exporting partner in 1982 and its major importing partner in 1977. This might be the result of the relative change in the position of these two countries as economic powers in Latin America and because of the stronger relationship between Brazil and Paraguay due to the construction of Itaipú Dam.

Paraguay's exports to Brazil mainly consist of soybeans and timber; that to Argentina, timber and foodstuff such as vegetables, palmetto and vegetable oils. Japan's imports from Paraguay consists of a small amount of soy beans, vegetable oils, hides and skins.

Although Paraguay is a member country of ALADI (Asociación Latinoamericana de Integración), which aims at free trade and economic integration, it does not seem that Paraguay benefits from this system because trade with member countries remains at the same level.

The balance of payment structure in Paraguay is, as mentioned before, that in which deficits in trade balance resulting in deficits in current accounts, are balanced with the surplus in capital accounts, the typical pattern of developing countries. Recent increases in deficits in current accounts are caused by the increase in deficits in invisible trade, while deficits in merchandise trade is decreasing (Table 1.1-11). The major reasons for the increase in deficits in invisible trade are the decrease in transactions relating to the construction of Itaipú Dam and Yacyretá Dam, and increase in deficits in insurances and income from direct investments. However, income from tourists have been increasing.

The surplus in capital accounts has been decreasing since 1983 when the construction of Itaipú Dam was almost finished. Sources of capital inflow are mainly international financial institutions such as the World Bank and Inter-American Development Bank, and bilateral loans from developed countries. The decreasing surplus of this long-term capital accounts resulted in the sharp decrease of the overall balance, which turned into a deficit in 1982. As a result, foreign reserves are decreasing.

According to the World Bank statistics, foreign debt outstanding at the end of 1986 was 1.96 billion dollars, including short-term debts (Table 1.1-12). Two thirds of the public and public guaranteed long-term debt (disbursed) outstanding is comprised of the debt to official creditors such as multinational institutions and government financial institutions, the rest to private financial institutions, most of which are export finances.

Debt outstanding increased by 27% annually from 1975 to 1980. This figure decreased to

Table 1.1-9 Imports by Products

	Value (Million US$)				Share (%)		
	1980	1982	1984	1986	1970	1980	1986
Foodstuffs	24.0	23.9	14.3	17.0	7.8	4.6	3.3
Beverages & tobacco	39.7	38.2	25.5	33.9	8.3	7.7	6.7
Fuels & lubricants	129.5	154.2	137.6	96.9	21.0	25.0	19.0
Paper products	12.3	13.4	7.8	8.8	2.7	2.4	1.7
Chemicals	31.8	32.7	29.4	29.6	5.0	6.1	5.8
Vehicles & parts	93.3	47.6	102.6	30.7	12.8	18.0	6.0
Textiles	9.8	9.8	6.0	10.3	2.1	1.9	2.0
Agricultural equipment	9.5	9.4	11.8	6.9	2.3	1.8	1.4
Iron & steel products	20.0	39.5	23.5	28.8	7.0	3.9	5.7
Metal & metal products	6.4	14.5	5.7	8.9	1.7	1.2	1.7
Machinery	79.3	105.4	92.2	163.3	19.2	15.3	32.1
Other	61.1	92.2	56.8	74.6	10.2	11.8	14.6
Total	517.1	581.5	513.0	509.4	100.0	100.0	100.0

Source: Same as Table 1.1-8.

Table 1.1-10 Trade by Country (Share in trade expressed in US$)

Exports to:	1976	1980	1986
Brazil	6.0	13.0	39.5
Argentine	9.9	23.9	15.1
Netherlands	14.9	6.4	9.7
Switzerland	11.8	10.2	5.8
U.S.A.	11.7	5.4	4.0
West Germany	11.2	12.4	3.3
Uruguay	4.8	3.3	2.8
Italy	1.6	1.9	1.8
France	5.7	1.6	0.8
Japan	3.5	3.6	0.8
Spain	1.5	1.5	0.8
U. K.	6.0	0.6	0.4
Other	11.4	16.2	15.2
Total	100.0	100.0	100.0

Imports from: (FOB)	1976	1980	1986
Brazil	17.3	27.2	31.6
Argentine	20.9	20.6	13.6
Algeria	12.8	7.2	6.6
U.S.A.	10.2	9.9	13.7
West Germany	8.5	6.5	6.5
Japan	4.7	8.1	5.7
U. K.	7.6	5.6	6.4
Spain	1.6	1.1	0.9
France	1.4	2.3	2.5
Netherlands	0.6	0.4	0.4
Other	14.4	11.1	12.1
Total	100.0	100.0	100.0

Source: Same as Table 1.1-8.

Table 1.1-11 Balance of Payments

(Unit: MM US$)

	1981	1982	1983	1984	1985	1986	1987[1)]
Balance on current account	−373.5	−374.8	−247.9	−317.4	−225.5	−358.9	−350.0
Trade balance	−373.9	−315.1	−225.4	−287.8	−191.5	−162.4	−134.8
Merchandise exports, FOB	398.5	396.2	326.0	361.3	324.4	573.4	800.0
Merchandise imports, FOB	−772.4	−711.3	−551.4	−649.1	−515.9	−735.8	−934.8
Services' balance	−5.4	−64.7	−28.7	−38.9	−41.5	−207.5	−226.7
Net transfers	5.8	5.0	6.2	9.3	7.5	11.0	11.5
Balance of capital account	425.9	344.2	290.0	283.9	53.7	237.2	–
Direct investment	31.9	36.6	4.9	5.2	0.7	31.5	–
Portfolio investment	5.9	−7.5	3.3	–	8.3	–	–
Other long-term capital	130.6	236.3	281.0	214.2	112.3	180.5	–
Short-term capital	257.5	78.8	0.8	64.8	−67.6	25.2	–
Errors and omissions	−12.9	−25.8	−92.3	17.6	56.6	28.6	–
Total balance	39.5	−56.4	−50.2	−15.6	−115.2	−93.1	–
Counterpart items	−0.3	−2.4	−3.2	−4.3	8.3	8.6	–
Liabilities constituting foreign authorities' reserves	4.2	−6.0	−2.7	1.8	6.1	−10.0	–
Changes in reserves (− indicate increase)	−43.4	64.8	56.1	18.1	100.8	94.5	–

1) Estimates by BCP.

Source: IMF, "International Financial Statistics."
Banco Central del Paraguay, "Boletin Estadistico."

Table 1.1-12 External Debt

(Unit: MM US$)

	1981	1982	1983	1984	1985	1986
Total external debt	1,150.0	1,297.5	1,407.1	1,495.0	1,779.4	1,960.4
Long-term debt	842.0	1,071.5	1,274.1	1,397.0	1,628.4	1,838.4
Short-term debt	308.0	226.0	133.0	98.0	151.0	122.0
Public & public guaranteed long-term debt	709.2	940.0	1,144.5	1,286.7	1,524.6	1,752.3
Multilateral official creditors	252.9	321.3	369.6	450.3	527.0	601.3
Bilateral official creditors	205.7	237.8	338.0	373.8	506.3	592.6
Private creditors	250.6	380.9	436.9	462.6	491.3	558.4
Total debt service	70.7	80.7	84.4	116.2	155.3	197.3
Principle payments	38.8	39.5	39.1	58.3	75.9	109.3
Interest payments	31.9	41.2	45.3	57.9	79.4	88.0
Debt service ratio (%)	9.8	10.4	15.1	13.4	13.2	19.2

Source: World Bank, "World Debt Tables 1987/1988."

18% in the 1980s mainly due to the decrease in capital inflow relating to the Itaipú project. However, debt service payment of the accumulated debt during the 1970s is increasing, so is the debt service ratio; 9.8% in 1981 increased to 19% in 1986. This 19% is not so high compared with other Latin American countries, but it is the highest level for Paraguay in recent history. There is some fear that Paraguay, together with other Latin American countries, will have difficulty in repaying its debt.

1.2 Future Prospects

1.2.1 Population and Regional Distribution

Population is a basic variable when determining the future demand of petroleum and petroleum products. The assumption here is as follows;

Year	Annual average growth rate
1976 – 1980	3.3% (actual) [1]
1980 – 1985	3.0 (")
1985 – 1986	2.9 (")
1987 – 1990	2.9 (forecast)
1990 – 1995	2.7 (")
1995 – 2000	2.5 (")

1) Actual growth rate is based on statistics from the Central Bank of Paraguay.

The population growth rate is gradually decreasing. The forecasted growth rate from 1987 to 1990 is 2.9%, the same as in 1986, then decreases to 2.7% from 1990 to 1995, and to 2.5% from 1995 to 2000. The World Bank estimates the annual population growth rate of Paraguay from 1985 to 2000 to be 2.5%.[1)]

The results of forecasting the population are; 3.8 million in 1986 (actual), 4.2 million in 1990, 4.8 million in 1995 and 5.5 million in 2000.

The estimation of urban population is based on the census taken in 1982 that urban population was 42% of the total population. Because of rapid urbanization, the urban population will increase by 4% annually until 1990, when urban population will be 46% of the total population. Then the annual growth rate will decrease to 3.9% until 2000, at which time the urban population will be 52% of the total population. This 52% share is smaller than the

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1) World Bank, "World Development Report, 1987."

present situation of other Latin American countries; for example, 52% for Ecuador, 67% for Colombia, 85% for Uruguay, 73% for Brazil and 84% for Argentina. Paraguay is basically an agricultural country, and urbanization will not proceed like other countries.

Estimation of the regional distribution of the population is based on a 1982 census (Table 1.2-1). The regional distribution of the population will not change drastically until 2000, although the population of Centro-Sur, which includes the metropolitan area of Asunción, will increase a little. That is, urbanization will proceed mainly within the region, not trans-regionally. However, the small increase in the Centro-Sur region will be offset by a decrease in the North region.

1.2.2 Outlook of Macroeconomy

It is very difficult to forecast the future economy of Paraguay because annual fluctuation is big, as mentioned in the previous section. The rapid economic growth rate in the 1970s was due to a special factor; the construction of Itaipú Dam. Such a high growth rate cannot be expected in the near future. The growth rate of 2.2% from 1980 to 1987 was too low, however, because it included negative growth rates during the recession period from 1982 to 1983. The annual growth rate, excluding the recession years, from 1983 to 1987 was 2.8%.

It is envisaged, therefore, that the economy of Paraguay will grow by 3% annually from 1988 to 1995, exceeding the estimated population growth rate by only a little. From 1995 to 2000, the economic growth rate may be higher because it is expected that the economy of Brazil, which has a great influence on the economy of Paraguay, will recover in the late 1990s. The outlook of economic growth rate from 1995 to 2000 is 3.5%.

The outlook of the sectoral growth rates are as follows. The annual growth rate of the secondary industry in the latter half of the 1990s is 3.5%, while that of the tertiary industry is 3.7%.

	1988 – 1995	1995 – 2000
Annual economic growth rate	3.0%	3.5%
Primary industry	3.0	3.0
Secondary industry	3.0	3.5
Tertiary industry	3.0	3.7

Table 1.2-1 Population by Region

	1982 [1]		2000	
	(1,000)	(share, %)	(1,000)	(share, %)
Centro Sur	1,951	57.9	3,172	58.0
Este	913	27.1	1,482	27.1
Norte	441	13.1	712	13.0
Occidental	64	1.9	104	1.9
Total	3,370	100.0	5,469	100.0

1) Data for 1982 is census.

CHAPTER 2 ENERGY ECONOMY

Energy economy of a country is largely influenced by various factors such as: economic activity, population, living style of the people, industrial structure, mode of transportation and traffic, endowment of primary energies, energy supply system and related costs. Therefore, to analyze structural changes and features of energy economy of Paraguay, the influence of the above factors should be taken into account.

In this chapter, firstly under paragraph 2.1, changes in the demand/supply structure of energy and its characteristics over the past 15 years from 1970 through 1985 are outlined mainly with the use of statistics, "Balance Energetico Nacional" compiled and issued by Secretaria Tecnica de Planificacion. Then, the major trends of each energy consuming sector are examined. In paragraph 2.2, the future demand/supply pattern of each energy is discussed and, in conclusion, the forecasted energy consumption in Paraguay in the year 2000 is presented.

2.1 Past Trends in Energy Economy

2.1.1 Overview of Past Energy Demand/Supply

(1) Features of Energy Demand Pattern

Past records of energy finally consumed in Paraguay (final energy consumption) during the 15 years from 1970 through 1985 are shown in Table 2.1-1 in terms of TOE (tons of oil equivalent). A conversion table of TOE is given in Appendix 1.

The final energy consumption in Paraguay increased to 2,180,000 TOE from 1,220,000 TOE over the above period at the averaged annual growth rate of 3.9%. However, most of the growth was achieved during the 1970's, and the annual growth rate dropped to 1.9% in the first half of 1980's due to the stagnant economy.

Among consuming sectors, the Residential and Commercial sector consumed 1,075,000 TOE of final energy in 1985, which represents nearly half of the total consumption of the country. However, this share slightly decreased over the 1970-1985 period.

The final energy consumption by the Transportation sector grew remarkably during the 1970's and the share held by this sector in the total energy consumption increased to 19% in 1980 from 11% in 1970. However, in the first half of the 1980's, the energy consumption of this sector stagnated and the annual growth rate fell to as low as 1.7%.

The Industry sector comes next to the Residential and Commercial sector, having consumed 650,000 TOE of energy in 1985. This sector also recorded a high growth in

energy consumption during the 1970's, but since 1980 the annual growth rate amounted to only 1%, with a peak consumption in 1983.

The Public sector (including other sectors) marked the highest growth rate of 8.7% among all energy consuming sectors during the period of 1970 to 1985. However, the influence of this sector on the final energy consumption of Paraguay is a marginal one since the sector consumed less than 2% of the total energy consumption of the country in 1985.

To sum up, the trend in the final energy consumption in Paraguay during the period of 1970 to 1985 is characterized by a slight reduction in the share of the Residential and Commercial sector which accounts for almost one half of the total energy consumption. Instead, the Transportation and the Industry sectors played major roles in the expansion of the total energy consumption of the country.

Past trends in the final energy consumption by the Transportation and the Industry sectors reflect the trend in overall economic activity, i.e. a slow down in response to the stagnation in economic growth. In contrast, the rate of growth in the final energy consumption by the Residential and Commercial sector, though relatively low, was stable during the period of 1970 to 1985, showing the resistant characteristics of this sector to fluctuations in the economy.

Table 2.1-1 Final Energy Consumption in Paraguay by Consuming Sector

(Unit: 10^3 TOE)

Sector / Year	Resident. & Commerce		Transportation		Industry		Public & Others		Total	
	10^3 TOE	%	10^3 TOE	%	10^3 TOE	%	10^3 TOE	%	10^3 TOE	%
1970	788.7	64.5	134.9	11.0	287.0	23.5	11.2	1.0	1221.7	100.0
1975	874.6	62.2	170.2	12.1	346.9	24.6	14.8	1.1	1406.5	100.0
1976	892.4	59.4	193.6	12.9	401.2	26.7	15.0	1.0	1502.2	100.0
1977	913.1	57.5	242.0	15.3	414.5	26.1	17.6	1.1	1587.2	100.0
1978	934.1	53.7	289.7	16.7	495.8	28.5	19.4	1.1	1739.0	100.0
1979	953.7	52.4	325.1	17.9	518.3	28.5	21.9	1.2	1818.9	100.0
1980	970.5	48.9	378.0	19.0	615.6	31.0	21.5	1.1	1985.5	100.0
1981	991.2	49.5	367.8	18.4	621.9	31.0	23.4	1.1	2004.1	100.0
1982	1012.8	48.9	370.9	17.9	655.5	31.6	31.6	1.6	2070.9	100.0
1983	1035.2	48.9	351.5	16.5	701.8	33.1	30.4	1.6	2118.9	100.0
1984	1063.0	49.3	399.6	18.6	649.2	30.2	41.3	1.9	2153.2	100.0
1985	1075.8	49.3	412.8	18.9	653.9	30.0	39.3	1.8	2181.7	100.0
Annual Compound Rate										
1970-1985	2.1%		7.7%		5.6%		8.7%		3.9%	
1970-1980	2.1%		10.8%		7.9%		6.7%		5.0%	
1980-1985	2.1%		1.7%		1.2%		12.8%		1.9%	

Source: Secretaria Tecnica de Planificacion; "Balance Energetico Nacional"

(2) Features of Energy Supply Pattern

Past trends in final energy consumption from 1970 through 1985 and annual growth rates by type of energy in Paraguay are given in Table 2.1-2 as a reference for examination of the features of the energy supply pattern in Paraguay.

As shown in the table, energy supply in Paraguay is divided into two major groups. One is "commercial" energy which consists of petroleum, coal and electricity, and the other is "non-commercial" energy which includes firewood, charcoal and vegetable residue. One of the characteristics of Paraguay's energy economy is the fact that 75% of the total energy consumed is supplied by non-commercial energy, even in 1985. It is also noted that firewood supplied more than half of the country's total energy consumption. The annual growth rate of each type of energy varies from minus 4.5% for coal to 12.2% for electricity. With the exception of coal within the commercial energy group and that of vegetable residue within the non-commercial energy group, consumption of commercial energy increased at a rate more than twice that of non-commercial energy. To look deeper into these differences in the growth rates of various types of energy, calculations were made to separate the contribution of substitution effect and that of the expansion of the consuming sector, to the growth of each particular energy. The results of such calculations are summarized in Fig. 2.1-1 and the methodology used is as described in Appendix 2.

In case of electricity whose consumption increased by as much as 5.6 times during the period of 1970 to 1985, the substitution effect, that is, the increase in its share in the Residential and Commercial sector, contributed to 2.4 times growth of the energy. And expansion of the Industry sector and increase of electricity's share in the energy consumption of the sector contributed to 1.15 times and 1.0 times, respectively, growth of electricity.

In contrast, 2.7 times increase of petroleum during the period was mainly attributed to the expansion of the Transportation sector. During this period, the substitution effect for petroleum energy was negative because the share of petroleum in the energy consumption by the Industry sector decreased. This illustrates a characteristic feature of petroleum consumption in Paraguay, where the share of petroleum in energy consumption of the Residential and Commercial sector and the Industry sector is still minor and petroleum consumption depends mainly on the Transportation sector.

Consumption of firewood slightly increased by 30% during the period due to the increase in energy consumption in the Residential and Commercial sector and the Industry sector, whereas the substitution effect was negative for the firewood energy because the share of this energy decreased in all consuming sectors.

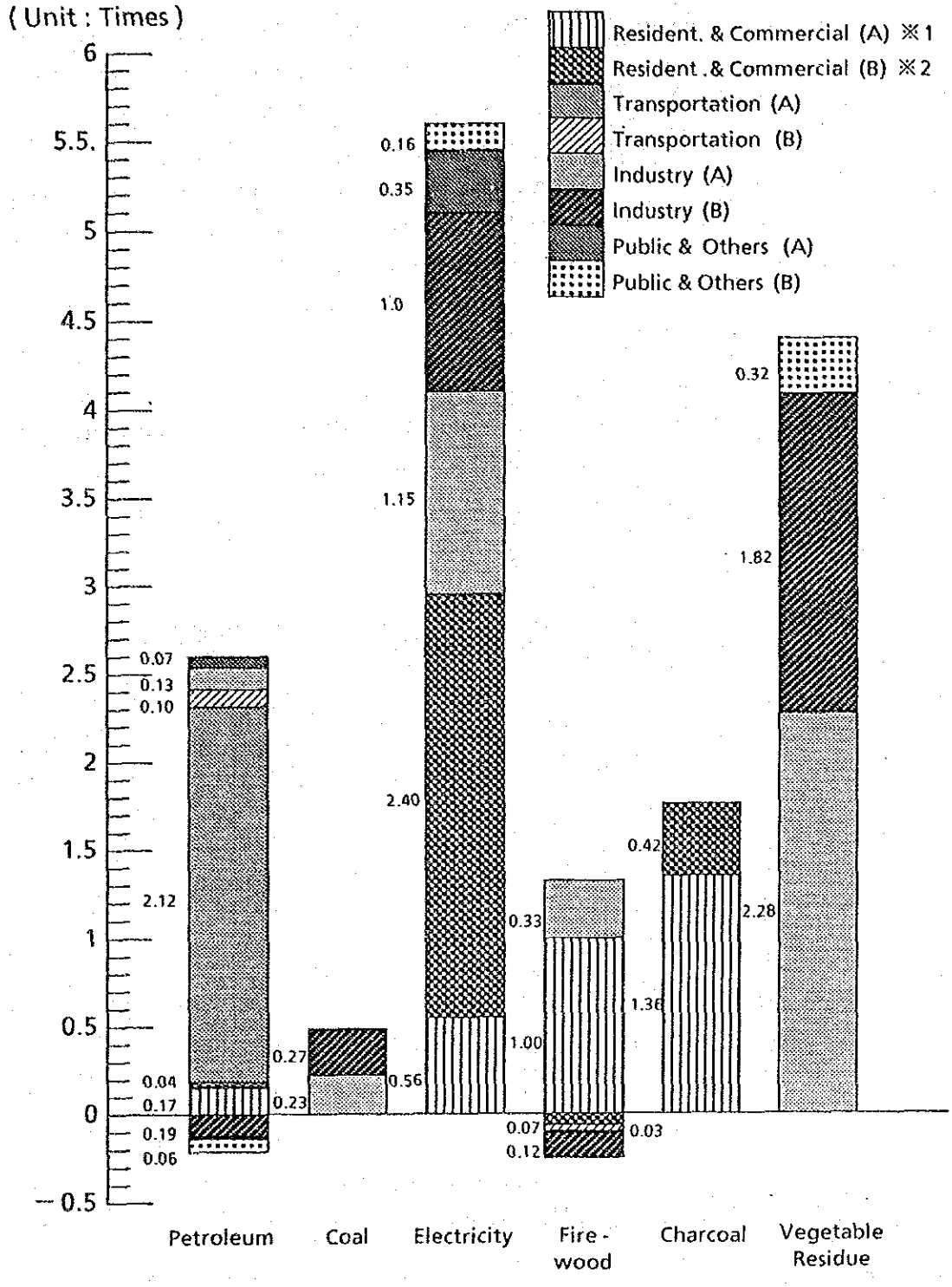
Table 2.1-2 Final Energy Consumption in Paraguay by Type of Energy

(Unit: 10^3 TOE)

	Commercial Energy					Non-Commercial Energy				Grand Total
	Petroleum	Coal	Electricity	Fuel Alcohol	Sub Total	Fire Wood	Charcoal	Veg. Residue	Sub Total	
1970	174.0 (14.2%)	0.04 (–)	16.5 (1.4%)	– –	190.5 (15.6%)	921.3 (75.4%)	40.3 (3.3%)	69.5 (5.7%)	1031.2 (84.4%)	1221.7 (100.0%)
1975	226.1 (16.1%)	– –	28.0 (2.0%)	– –	254.1 (18.1%)	984.5 (70.0%)	49.2 (3.5%)	118.7 (8.4%)	1152.4 (81.9%)	1406.5 (100.0%)
1976	254.6 (17.0%)	– –	32.0 (2.1%)	– –	286.7 (19.1%)	1021.3 (68.0%)	51.2 (3.4%)	143.1 (9.5%)	1215.5 (80.9%)	1502.2 (100.0%)
1977	308.4 (19.4%)	0.01 –	39.7 (2.5%)	– –	348.1 (22.0%)	1028.2 (64.8%)	53.1 (3.3%)	157.8 (10.0%)	1239.1 (78.0%)	1587.2 (100.0%)
1978	359.5 (20.6%)	0.03 –	48.7 (2.8%)	– –	408.2 (23.5%)	1098.6 (63.2%)	55.3 (3.2%)	177.0 (10.2%)	1330.9 (76.5%)	1739.0 (100.0%)
1979	396.8 (21.8%)	0.04 –	57.2 (3.2%)	– –	454.0 (25.0%)	1112.3 (61.2%)	57.4 (3.1%)	195.2 (10.7%)	1364.9 (75.0%)	1818.9 (100.0%)
1980	433.5 (21.8%)	0.04 –	66.2 (3.3%)	– –	499.8 (25.2%)	1192.3 (60.1%)	59.7 (3.0%)	233.8 (11.8%)	1485.8 (74.8%)	1985.5 (100.0%)
1981	418.9 (20.9%)	0.03 –	74.6 (3.7%)	4.2 (0.2%)	497.7 (24.8%)	1207.4 (60.3%)	62.0 (3.1%)	237.1 (11.8%)	1506.4 (75.2%)	2004.1 (100.0%)
1982	430.6 (20.8%)	0.03 –	75.8 (3.7%)	8.8 (0.4%)	515.3 (24.9%)	1228.1 (59.3%)	64.4 (3.1%)	263.2 (12.7%)	1555.6 (75.1%)	2070.9 (100.0%)
1983	407.8 (19.2%)	0.02 –	79.5 (3.8%)	8.6 (0.4%)	496.9 (23.4%)	1244.1 (58.7%)	66.7 (3.2%)	312.3 (14.7%)	1623.0 (76.6%)	2118.9 (100.0%)
1984	457.1 (21.2%)	0.04 –	89.8 (4.2%)	12.0 (0.5%)	558.9 (26.0%)	1235.4 (57.4%)	69.2 (3.2%)	289.7 (13.5%)	1594.3 (74.0%)	2153.2 (100.0%)
1985	457.9 (21.0%)	0.02 –	92.8 (4.2%)	9.2 (0.4%)	559.9 (25.7%)	1243.0 (57.0%)	71.6 (3.3%)	307.2 (14.1%)	1621.8 (75.3%)	2181.7 (100.0%)
Annual Compound Rate 1970-1985	6.7%	Δ4.5%	12.2%	–	7.5%	2.0%	3.9%	10.4%	3.1%	3.9%
1970-1980	9.6%	0%	14.9%	–	10.1%	2.6%	4.0%	12.9%	3.7%	5.0%
1980-1985	1.1%	Δ13.0%	7.0%	('81-'85) 21.6%	2.3%	0.8%	3.7%	5.6%	1.7%	1.9%

Source: "Balance Energetico Nacional"

Fig. 2.1-1 Contribution of Substitution Effect and That of Expansion of Consuming Sector to the Growth of Each Energy Consumption through 1970 to 1985



SOURCE: JICA Mission

NOTE ※1: (A) ; Growth rate of energy consumption attributed to expansion of consuming sector through 1970 to 1985

※2: (B) ; Growth rate of energy consumption attributed to substitution effect through 1970 to 1985

The consumption of charcoal was limited to the Residential and Commercial sector throughout this period and the increase in total energy consumption by this sector was the lowest of all consuming sectors. As a result, consumption of charcoal grew by only 1.7 times during the period, with a 0.42 times contribution of substitution effect.

Use of vegetable residue as an energy in the Industry sector recorded a remarkable increase of 4.4 times due to both the expansion of this sector and the increase in the share held by this energy in the energy consumption of the sector.

2.1.2 Trends in Energy Consuming Sectors

(1) Residential and Commercial Sector

Final energy consumption in this sector is mainly for cooking and lighting in households and service industries in both urban and rural areas. Past trend of final energy consumption by this sector and change of the share of each type of energy in the energy consumption of this sector are shown in Table 2.1-3.

Table 2.1-3 Changes and Shares of Final Energy Consumption in Residential & Commercial Sector by Type of Energy

(Unit: 10^3 TOE)

Year / Energy	1970		1975		1980		1985		Annual Compound Rate	
	Consump.	%	Consump.	%	Consump.	%	Consump.	%	1970-1985 %	1980-1985 %
Petroleum	20.8	(2.6)	30.5	(3.5)	34.2	(3.5)	35.4	(3.3)	3.6	0.6
Coal	–	–	–	–	–	–	–	–	–	–
Electricity	6.8	(0.9)	13.2	(1.5)	29.8	(3.1)	48.9	(4.5)	14.1	10.4
Fuel Alcohol	–	–	–	–	–	–	–	–	–	–
(Commercial Energy)	(27.8)	(3.5)	(43.7)	(5.0)	(64.0)	(6.6)	(84.3)	(7.8)	7.7	5.7
Fire Wood	720.8	(91.4)	781.6	(89.4)	846.7	(87.2)	919.9	(85.5)	1.6	1.6
Charcoal	40.3	(5.1)	49.3	(5.6)	59.7	(6.2)	71.6	(6.7)	3.9	3.7
Vegetable Residue	–	–	–	–	–	–	–	–	–	–
(Non-commercial Energy)	(761.1)	(96.5)	(830.8)	(95.0)	(906.4)	(93.4)	(991.5)	(92.2)	1.8	1.8
Total	788.7	(100.0)	874.6	(100.0)	970.5	(100.0)	1075.8	(100.0)	2.1	2.1
Shares in Total Energy Consumption	64.5%		62.2%		48.9%		49.3%			

Source: "Balance Energetico Nacional"

This sector consumed 1,075,000 TOE of final energy in 1985, consuming nearly one half of final energy consumed in Paraguay. While the Residential and Commercial sector is the largest energy consuming sector of the country, the annual growth rate of the energy consumption was 2.1%, which was far below 3.9% of growth rate of the total final energy comsumption. Share of the Residential and Commercial sector in the total final consumption in Paraguay decreased continuously during the period of 1970 to 1985.

The most important energy for this sector was firewood. In 1985 about 920,000 TOE of firewood was consumed by this sector. This accounts for 85% of the total energy consumption of this sector, down by 6% from 91% in 1970. This remarkably high share of firewood could be explained by the fact that firewood is the most easily available energy source on the market at a price of about one half that of charcoal, needless to say the price comparison with commercial energies which are far more expensive than firewood. However, in recent years, LPG is replacing firewood for use in urban households because of its convenience, resulting in a decrease in the share of firewood in the energy consumption by the Residential and Commercial sector.

Charcoal was used exclusively for cooking in the Residential and Commercial sector and its consumption was steadily increasing and reached 70,000 TOE in 1985, presumably due to its feature to render excellent flavor to the foodstuff.

Consumption of electricity in the Residential and Commercial sector recorded the highest annual growth rate of 14% among various types of energy due to a vigorous electrification. However, the actual amount of consumption was only 49,000 TOE in 1985, which was below that of firewood.

Consumption of petroleum, one of the major commercial energy, showed a small increase in the Residential and Commercial sector during the period between 1970 and 1985, and seemed to become stagnant in the first half of 1980's. This can be explained by the progress in substitution among petroleum products, namely, substitution of kerosene by LPG. Kerosene was once widely used in households for cooking and lighting, and partly to run refrigerators. But recently electricity and LPG was penetrating into such uses.

(2) Transportation Sector

In "Balance Energetico Nacional", the Transportation sector is divided into the following four sub-sectors, and the consumption of each type of energy by sub-sector is indicated.

(a) Road Transportation Sector

This covers energy consumed for transportation of passengers and cargo on roads and highways. Energy consumption by street car in Asuncion City and by agricultural machinery is also included.

(b) Railway Transportation Sector

This accounts for energy used for the operation of the 440 km long national railway between Asuncion and Encarnacion and between San Salvador and Abai. Firewood is the sole energy consumed in this sub-sector .

(c) Air Transportation Sector

This sector consumes the energy for domestic air transportation of passengers and cargo. It should be noted that consumption of jet fuel is excluded from "domestic" consumption because all jet fuel is regarded as being consumed by international airlines.

(d) Water Transportation Sector

This mainly consists of the energy consumed by vessels running on Parana and Paraguay Rivers.

Past records of final energy consumption in the Transportation sector is indicated by energy and sub-sector in Table 2.1-4 and Table 2.1-5, respectively.

Final energy consumption in this sector increased at an annual growth rate of 7% over the period of 1970 to 1985 and reached 410,000 TOE in 1985. This accounts for 18.9% of the total final energy consumed in Paraguay, and represents the third largest energy consuming sector following the Residential and Commercial sector and Industry sector. From the viewpoint of commercial energy consumption, this sector ranks the most important since it alone consumes nearly three fourths of all commercial energy consumed in Paraguay. In particular, more than 80% of petroleum energy is consumed in this sector.

In Paraguay, road transportation accounts for the movement of more than 95% of domestic passengers and cargo. Accordingly it consumes, approximately 95% of the total energy consumed by the whole Transportation sector. Energy used for road transportation consists mainly of such petroleum products as gas oil, gasoline and LPG, with electricity and fuel alcohol to a lesser extent. In 1985, 70 TOE of electricity was consumed by the single line street-car in Asuncion, and 9,200 TOE of fuel alcohol, which came into actual use in 1982, was consumed. This fuel alcohol accounted for 2% of the total energy

Table 2.1-4 Changes and Shares of Final Energy Consumption in Transportation Sector by Type of Energy

(Unit: 10^3 TOE)

Year / Energy	1970		1975		1980		1985		Annual Compound Rate	
	Consump.	%	Consump.	%	Consump.	%	Consump.	%	1970-1985 %	1880-1985 %
Petroleum	122.0	(90.4)	158.2	(93.0)	362.4	(95.9)	394.0	(95.5)	8.1	1.7
Coal	–	–	–	–	–	–	–	–	–	–
Electricity	0.03	neg.	0.03	neg.	0.04	neg.	0.07	neg.	5.8	11.8
Fuel Alcohol	–	–	–	–	–	–	9.2	(2.2)	–	–
(Commercial Energy)	(122.0)	(90.4)	(158.2)	(93.0)	(362.4)	(95.9)	(403.2)	(97.7)	8.3	2.2
Wood	12.9	(9.6)	12.0	(7.0)	15.5	(4.1)	9.5	(2.3)	△2.0	△9.4
Charcoal	–	–	–	–	–	–	–	–	–	–
Vegitable Residue	–	–	–	–	–	–	–	–	–	–
(Non-commercial Energy)	(12.9)	(9.6)	(12.0)	(7.0)	(15.5)	(4.1)	(9.5)	(2.3)	△2.0	△9.4
Total	134.9	(100.0)	170.2	(100.0)	377.9	(100.0)	412.8	(100.0)	7.7	1.8
Shares in Total Energy Consumption	11.0%		12.1%		19.0%		18.9%			

Source: "Balance Energetico Nacional"

Table 2.1-5 Changes and Shares of Final Energy Consumption by Sub-Sector of Transportation

(Unit: 10^3 TOE)

Year / Sub-Sector	1970		1975		1980		1985		Annual Compound Rate	
	Consump.	%	Consump.	%	Consump.	%	Consump.	%	1970 –1985 %	1980 –1985 %
Road	107.6	(79.8)	146.9	(86.3)	354.2	(93.7)	395.4	(95.8)	9.1%	2.2%
Railway	12.9	(9.5)	12.0	(7.1)	15.5	(4.1)	9.5	(2.3)	2.0%	Δ9.4%
Air	6.2	(4.6)	7.0	(4.1)	5.3	(1.3)	2.9	(0.7)	Δ4.9%	Δ11.4%
Water	8.2	(6.1)	4.3	(2.5)	3.2	(0.9)	5.0	(1.2)	Δ3.3%	9.3%
Total	134.9	(100.0)	170.2	(100.0)	377.9	(100.0)	412.8	(100.0)	7.7	1.8%

Source: "Balance Energetico Nacional"

consumption of this sub-sector.

The railway transportation sector is run by the National Railway Corporation (FCCAL). The railroads network extents for 440 km in total and mainly carries sugar (21,000 tons in 1985), raw cotton (5,000 tons in 1985), and other agricultural products (8,000 tons in1985). The railway's operation coefficient (cost/revenue ratio) dropped from 0.52 in 1970 to 0.34 in 1985. Due to such financial difficulties, wood-fired locomotives are still in use as well as other vintage railway facilities.

Among nearly 300 airfields and airports of various size in the country, Stroessner Airport in Asuncion is the only one with international status. The recorded number of passengers at this airport was 228,000 in 1985, down 1% on international lines and up 4% on domestic lines, compared with the recorded number in 1976. Lines Aereas Paraguayos (LAP), one of two airlines in Paraguay, operates both international and domestic flights. Another airline, Transporte Aero Militar (TAM) started servicing the routes connecting Asuncion and major cities using planes owned by the country's airforce in 1976.

Table 2.1-6 shows modified figures on energy consumption by the air transportation sub-sector taking into account the consumption of jet fuel, which was regarded as an export and excluded from Table 2.1-5.

Table 2.1-6 Energy Consumption by Air Transportation including Jet Fuel

(Unit: 10^3 TOE)

	1970	1975	1980	1985	Annual Compound Rate 1970-1985	1980-1985
Energy Consumption – Total	12.2	14.3	18.4	21.6	3.9%	3.3%
Energy Consumption – Jet Fuel	(6.0)	(7.3)	(13.4)	(18.7)	7.9%	7.0%

Source: "Balance Energetico Nacional"

(3) Industry Sector

Past records of final energy consumed as fuel and/or source of power by manufacturing industry is shown in Table 2.1-7. "Balance Energetico Nacional" tabulates the energy consumption in this sector by dividing it into two sectors, cement manufacturing and others, so that the figures for these two sectors can be seen separately. However,

Table 2.1-7 shows aggregate figures only. Energy consumption by the Industry sector grew at an annual rate of 5.6% through the period of 1970 to 1985 and reached 653,000 TOE in 1985. This consumption figure comes next largest to that of the Residential and Commercial sector. The share of the Industry sector in the total energy consumption in the country recorded 31% in 1980 and was maintained at more than 30% thereafter.

A characteristic of the energy consumed by the Industry sector in Paraguay is the fact that the share held by non-commercial energy (mainly biomass) is an extremely high of around 90% and shows no sign of declining. The majority of industrial activities in Paraguay consist of the processing of agricultural, forestry and livestock products outside of petroleum refining (PETROPAR), cement manufacturing (INC) and iron and steel manufacturing (ACEPAR). This environment enables the manufacturing industries to use the residue of their raw materials as the most rational source of energy, resulting in a high share of the energy consumed by this sector being provided by means of biomass.

Among petroleum products, only gas oil and fuel oil are used in the Industry sector. Annual consumption of fuel oil fluctuated between 10,000 TOE and 30,000 TOE in response to the operation of the INC's cement factory which is the largest consumer of fuel oil in the country.

Almost all gas oil was used as fuel for in-house electric power generation by factories in non-electrified areas. However, as the power supply network of Administracion Nacional de Electricidad (ANDE) was extended, gas oil consumption decreased.

As a whole, petroleum consumption in 1985 was less than that in 1975, presumably reflecting a stagnant economic growth in the first half of 1980's.

Electricity consumption in the Industry sector grew at an annual rate of 10.3%, the highest among all types of energy consumed by this sector. This was due to the progress in electrification and resultant increase of electricity users.

(4) Public and Others Sector

This includes final energy consumed by government agencies and the armed forces, and energy used by energy sectors in the process of production and distribution of secondary energy. Past records of energy consumption by this sector are shown in Table 2.1-8.

Final energy consumption by this sector increased at an annual rate of 8.7%, but its share of the total energy consumption of the country remained at a relatively low level of less than 2%. An annual growth rate in electricity consumption exceeding 11%, the highest of all type of energy, was mainly due to the progress in electrification efforts by

Table 2.1-7 Changes and Shares of Final Energy Consumption in Industry Sector by Type of Energy

(Unit: 10^3 TOE)

Year / Energy	1970		1975		1980		1985		Annual Compound Rate	
	Consump.	%	Consump.	%	Consump.	%	Consump.	%	1970-1985 %	1980-1985 %
Petroleum	24.9	(8.7)	28.4	(8.2)	23.1	(3.8)	23.7	(3.6)	△0.3	0.5
Coal	0.04	neg.	–	–	0.04	neg.	0.02	neg.	△4.5	△13.0
Electricity	8.0	(2.8)	12.1	(3.5)	32.0	(5.2)	35.1	(5.4)	10.3	1.9
Fuel Alcohol	–	–	–	–	–	–	–	–	–	–
(Commercial Energy)	(32.9)	(11.5)	(40.5)	(11.7)	(55.2)	(9.0)	(58.9)	(9.0)	4.0	1.3
Fire Wood	184.6	(64.3)	187.7	(54.1)	326.6	(53.0)	310.0	(47.4)	3.5	△1.0
Charcoal	–	–	–	–	–	–	–	–	–	–
Vegitable Residue	69.5	(24.2)	118.7	(34.2)	233.8	(38.0)	285.0	(43.6)	9.9	4.0
(Non-commercial Energy)	(254.1)	(88.5)	306.4	(88.3)	(560.4)	(91.0)	(595.0)	(91.0)	5.8	1.2
Total	287.0	(100.0)	346.9	(100.0)	615.6	(100.0)	653.8	(100.0)	5.6	1.2
Shares in Total Energy Consumption	23.5%		24.6%		31.0%		30.0%			

Source: "Balance Energetico Nacional"

Table 2.1-8 Changes and Shares of Final Energy Consumption in Public Sector & Others by Type of Energy

(Unit: 10^3 TOE)

Year / Energy	1970		1975		1980		1985		Annual Compound Rate	
	Consump.	%	Consump.	%	Consump.	%	Consump.	%	1970-1985 %	1980-1985 %
Petroleum	6.4	(57.1)	8.9	(60.5)	13.8	(64.2)	4.8	(12.2)	△1.9	△19.1
Coal	–	–	–	–	–	–	–	–	–	–
Electricity	1.7	(15.1)	2.6	(17.8)	4.3	(20.0)	8.7	(22.1)	11.5	15.1
Fuel Alcohol	–	–	–	–	–	–	–	–	–	–
(Commercial Energy)	(8.1)	(72.2)	(11.5)	(78.3)	(18.1)	(84.2)	(13.5)	(34.3)	3.5	△5.7
Fire Wood	3.1	(27.8)	3.2	(21.7)	3.4	(15.8)	3.6	(9.2)	1.0	1.1
Charcoal	–	–	–	–	–	–	–	–	–	–
Vegitable Residue	–	–	–	–	–	–	22.2	(56.5)	–	–
(Non-commercial Energy)	(3.1)	(27.8)	(3.2)	(21.7)	(3.4)	(15.8)	(25.8)	(65.7)	15.2	50.0
Total	11.2	(100.0)	14.7	(100.0)	21.5	(100.0)	39.3	(100.0)	8.7	12.8
Shares in Total Energy Consumption	1.0%		1.1%		1.1%		1.8%			

Source: "Balance Energetico Nacional"

ANDE.

The consumption of petroleum and vegetable residue as indicated in Table 2.1-8 corresponds to those consumed by PETROPAR and APAL, respectively, during the process of production and distribution. The figures fluctuate considerably reflecting the changes in operation of their plants.

2.2 Future Energy Prospects in Paraguay

2.2.1 Demand/Supply of Each Type of Energy

(1) Petroleum

While the retail price of petroleum products in Paraguay is not very high by international standards, they are several times more expensive than the prices of firewood, charcoal, and vegetable residue in Paraguay. This difference in price may best explain the consumption pattern of petroleum products in Paraguay: The consumption of petroleum products is not so great in the Residential and Commercial sector and the Industry sector where biomass energy is more cheaply available, whereas in the Transportation sector, particularly in road transportation, most petroleum is consumed (Table 2.2-1).

Table 2.2-1 Changes and Shares of Final Consumption of Petroleum

(Unit: 10^3 TOE)

Sector \ Year	1970		1975		1980		1985		Annual Compound Rate	
	Consump.	%	Consump.	%	Consump.	%	Consump.	%	1970–1985 %	1980–1985 %
Resident. & Commercial	20.8	(12.0)	30.5	(13.5)	34.2	(7.9)	35.4	(7.7)	3.6	0.7
Transportation	122.0	(70.0)	158.2	(70.0)	362.4	(83.6)	394.0	(86.1)	8.1	1.7
(Road)	(107.5)		(146.9)		(354.2)		(386.1)		8.9	1.7
(Others)	(14.5)		(11.3)		(8.2)		(7.9)		Δ4.0	0.7
Industry	24.9	(14.3)	28.5	(12.6)	23.1	(5.3)	23.7	(5.2)	Δ0.3	0.5
(Cement)	(17.0)		(18.0)		(23.1)		(10.9)			
Public & Others	6.4	(3.7)	8.9	(3.9)	13.8	(3.2)	4.8	(1.0)	Δ1.9	Δ19.0
Total	174.0	(100.0)	226.1	(100.0)	433.5	(100.0)	457.9	(100.0)	6.7	1.1
Shares in Total Energy Consumption	14.2%		16.1%		21.8%		21.0%			

Source: "Balance Energetico Nacional"

It seems unlikely that this pattern of petroleum consumption will undergo a significant change in the near future in view of the following prospects of the major consuming sectors.

(a) Residential and Commercial Sector

Firewood consumption will reach a ceiling, whereas the use of LPG, as well as electricity, will continue to expand and contribute to a net increase in petroleum consumption by this sector offsetting a decrease in kerosene consumption.

(b) Transportation Sector

There will be a limit in the supply capacity of fuel alcohol, one of the alternative fuels to petroleum. In railway transportation, wood-fired locomotives will eventually be replaced by diesel locomotives if necessary funds can be arranged. Accordingly, it can be said that the position of petroleum products in the Transportation sector may possibly be strengthened and there seems to be little likelihood that petroleum's share in this sector will decrease in near future.

(c) Industry Sector

There is not much possibility that new factories which consume a large amount of petroleum products, especially of fuel oil, are set up within a decade. Further, consumption of gas oil presently used for in-house power generation will decline as the electrical network of ANDE expands.

(2) Electricity

Paraguay in the past relied on thermal power generation for most of its electricity needs. However, at present, hydraulic power supply is more than enough to meet domestic demand with surplus electricity being exported to Brazil.

Hydroelectric generation in Paraguay started in 1964 with the completion of the first power station on the Acaray River, a branch of the Parana River, followed by the second station at the same site. The combined capacity of these two station is 200 MW.

In 1984, Itaipu power station (having a design capacity of 12,600 MW) on the Parana River, a joint project with Brazil, began supplying power to domestic users.

In line with the rapid build-up of the generating capacity, ANDE has made efforts to extend the transmission and distribution network, which now covers about one half of the total population.

Under such circumstances, electricity consumption has increased at an annual rate of more than 10% in each consuming sector with the exception of the Transportation

sector (Table 2.2-2).

As mentioned earlier, the increasing use of electricity had a negative effect on kerosene consumption in the Residential and Commercial sector and gas oil consumption by in-house power generation in the Industry sector. Moreover, the drastic switching from thermal to hydraulic power generation resulted in a decrease in gas oil and fuel oil consumption for electricity generation (Table 2.2-3). In all, it can be said that growth and structural changes in the electric power industry of Paraguay had a remarkable effect on petroleum consumption.

Table 2.2-2 Changes and Shares of Final Consumption of Electricity

(Unit: 10^3 TOE)

Sector \ Year	1970		1975		1980		1985		Annual Compound Rate	
	Consump.	%	Consump.	%	Consump.	%	Consump.	%	1970–1985 %	1980–1985 %
Resident. & Commercial	6.8	(41.2)	13.2	(47.3)	29.8	(45.1)	48.9	(52.7)	14.1	10.0
Transportation	0.03	(neg.)	0.03	(neg.)	0.04	(neg.)	0.07	(neg.)	5.8	11.9
(Road)	–									
(Others)	(0.03)		(0.03)		(0.04)		(0.07)		5.8	11.9
Industry	8.0	(48.5)	12.1	(43.4)	32.0	(48.4)	35.1	(37.9)	10.9	1.9
Public & Others	1.7	(10.3)	2.6	(9.3)	4.3	(6.5)	8.7	(9.4)	11.5	15.1
Total	16.5	(100.0)	27.9	(100.0)	66.2	(100.0)	92.8	(100.0)	12.2	7.0
Shares in Total Energy Consumption	1.4%		2.0%		3.3%		4.2%			

Source: "Balance Energetico Nacional"

Table 2.2-3 Change in Hydrocarbon Consumed for Electric Generation

(Unit: 10^3 ton)

	1980	1981	1982	1983	1984	1985	1986
Gas Oil	4.01	2.45	2.68	3.12	2.55	1.05	1.13
Fuel Oil	2.00	0.30	0.65	0.11	0.22	0.06	–
Total	6.01	2.75	3.33	3.23	2.77	1.11	1.13

Source: ANDE : "Memoria y Balance General"

In addition, construction of the huge Yacyreta dam project has started in 1984 with a scheduled completion of its first phase in 1993. Planned installed capacity of the first phase of this Paraguay-Argentina joint project is 2,700 MW, half of which is destined to be at the disposal of Paraguay. ANDE's electrification plan intends to provide 75% of the population with electricity by the year 2000, from the present coverage of 50%. However, to achieve this target ANDE will have to raise a fund for huge investment required to extend the distribution network into the more sparsely populated regions of the country than in the past. Meanwhile, the Paraguayan government is said to have been studying the possibility of establishing electricity consuming industries such as paper manufacturing, fertilizer manufacturing, and aluminium refining to promote the domestic consumption of electricity. The prospects of these projects are not very favorable since the importation of raw materials will be costly.

To sum up, consumption of electricity in the future will grow steadily, due to the expansion of the power distribution system and to the possible popularization of home electrical appliances, but at a lower rate than in the past.

(3) Fuel Alcohol

In 1976, the Paraguayan government launched a fuel alcohol (fermentation ethanol) development program using sugar cane as a raw material. The program aimed at improving of self-sufficiency in alternative fuel to petroleum, foreign currency savings, creating employment in the agricultural sector, and promoting the development of related technology.

Currently two types of fuel alcohol are produced and in use: anhydrous alcohol of 99.8% purity which is mixed with gasoline and sold under the trade name of ALCONAFTA, and hydrated alcohol of 94 to 96% purity which is used as a sole fuel for specifically designed automobiles. Past consumption records of of these two types of fuel alcohol and the change in the ratio of anhydrous alcohol mixed in ALCONAFTA are shown in Table 2.2-4.

Production of fuel alcohol started in late 1980 at a new plant of APAL located at Mauricio Jose Troche in Guaira Department. In 1981 permission was granted to private concerns to make fuel alcohol and a number of sugar refiners and independent distillers began producting hydrated alcohol. However, anhydrated alcohol is produced exclusively by the Troche plant of APAL. Change in the shares and current production capacities of these three groups of fuel alcohol producers are shown in Table 2.2-5 and Table 2.2-6, respectively.

Table 2.2-4 Consumption of Fuel Alcohol

(Unit: Kℓ)

Year	Anhydrous Consumption	Alcohol Mixed Ratio	Hydrated Alcohol	Total
1981	5,400	(5.8%)	2,600	8,000
1982	12,600	(15.1%)	4,800	17,400
1983	9,200	(12.5%)	7,200	16,400
1984	10,900	(11.8%)	12,100	23,000
1985	3,700	(3.8%)	20,400	24,100
1986	0	(0%)	13,700	13,700

Source: Ministerio de Industria y Comercio

Table 2.2-5 Change in Shares of Fuel Alcohol Production

(Unit: %)

Year	APAL	Sugar Refiner	Independent
1984	54%	45%	1%
1985	69%	29%	2%
1986	72%	26%	2%

Source: Ministerio de Industria y Comercio

Table 2.2-6 Production Capacity of Fuel Alcohol

(Unit: Kℓ/y)

Type of Producer	Number of Factory	Total Capacity	Average Capacity
APAL	1	20,000	20,000
Sugar Refiner	5	7,000	1,400
Independent	6	2,500	400
Total	12	29,500	2,460

Source: Ministerio de Industria y Comercio

To promote the use of fuel alcohol, the government gave a preferential treatment to the import of "alcohol-fueled automobiles" by applying a considerably low import duty of 30% to them as compared with the 130% on ordinary automobiles. In addition, the government regulated the retail price of hydrated alcohol so that it always remained 10~30% lower than that of regular gasoline. These measures took effect in boosting the import of alcohol-fueled cars from Brazil and the registered number of this type of cars approached 10,000 in early 1988. As shown in Table 2.2-4, consumption of hydrated alcohol recorded a peak of 20,000 kℓ in 1985 but sharply decreased in 1986. In the first half of 1986, a considerable amount of fuel alcohol was said to have been illegally imported. However, the fundamental reason for the sharp decline in fuel alcohol consumption in 1986 was a shortage in supply from domestic fuel alcohol producers. Presumably, this supply shortage was caused by reaction of private sector producers to a rise in the purchase cost of sugar cane whereas the sales price of the product alcohol was strictly regulated in relation to the price of gasoline.

As this case indicates, the future progress of the fuel alcohol development program will greatly depend on stable sugar cane supplies. Sugar cane farmers have the option of cultivating sugar cane or other cash crops depending on their comparative prices. They also have the choice of selling the sugar cane to alcohol factories or other sugar cane consumers at the time of harvest depending on the purchase price offered. This implies that the market mechanism will not guarantee a sufficient supply of sugar cane for fuel alcohol production to keep stable expansion in future. The government is pushing forward with research and development programs in breeding of sugar cane and in other related agricultural technology, but shows no willingness to stimulate an increase in the supply of fuel alcohol by subsidizing sugar cane farmers and/or fuel alcohol producers. Therefore, the fuel alcohol development program in future will have to proceed on the basis of an in secure raw material supply.

(4) Firewood

The Residential and Commercial sector once consumed three fourths of all firewood in Paraguay mainly as cooking fuel (Table 2.2-7). However, urbanization and changes in living style brought about a decline in the share of the firewood consumption and an increase of the share of LPG and charcoal in this sector.

In the Transportation sector, firewood is used to run locomotives on the railroad between Asuncion and Encarnacion and between El Salvador and Abai. If in the future these locomotives are replaced by diesel locomotives, the consumption of firewood by this sector will cease.

Table 2.2-7 Changes and Shares of Final Consumption of Fire Wood

(Unit: 10^3 TOE)

Year / Sector	1970		1975		1980		1985		Annual Compound Rate	
	Consump.	%	Consump.	%	Consump.	%	Consump.	%	1970–1985 %	1980–1985 %
Resident. & Commercial	720.8	(78.3)	781.6	(79.4)	846.7	(71.0)	919.9	(74.0)	1.6	1.6
Transportation	12.9	(1.4)	12.0	(1.2)	15.5	(1.3)	9.5	(0.8)	Δ2.0	Δ9.3
(Road)	(–)		(–)		(–)		(–)			
(Railway)	(12.9)		(12.0)		(15.5)		(9.5)		Δ2.0	Δ9.3
Industry	184.6	(20.0)	187.7	(19.1)	326.6	(27.4)	310	(24.9)	3.5	Δ1.0
Public & Others	3.1	(0.3)	3.2	(0.3)	3.4	(0.3)	3.6	(0.3)	1.0	1.1
Total	921.3	(100.0)	984.5	(100.0)	1192.3	(100.0)	1243.0	(100.0)	2.0	0.8
Shares in Total Energy Consumption	75.4%		70.0%		60.1%		57.0%			

Source: "Balance Energetico Nacional"

A significant increase in firewood consumption in the Industry sector in the 1970's was the result of efforts to save the energy cost to cope with the skyrocketing price of petroleum. However, after 1980, firewood consumption in the Industry sector leveled off reflecting the stagnation in industrial activities within the country.

The widespread use of firewood in every consuming sector in Paraguay is attributed to its comparatively low price to other energy. This price advantage will be maintained in the future thus making any sharp decrease in firewood consumption unlikely. On the other hand, however, future increases in firewood consumption are not expected since the use of firewood in the households will certainly be affected by LPG along with the progress in urbanization. Penetration of kitchen ranges, which improve the heat efficiency of cooking in the household, will also have saving effect on the use of firewood.

(5) Charcoal

The Residential and Commercial sector is the sole consuming sector of charcoal as is shown in Table 2.2-8. In this sector charcoal is wholly used as cooking fuel and its use is likely to increase in future thanks to its advantages over other cooking fuel such as low price and easy handling. Moreover, the advantage of charcoal in flavoring grilled foodstuff, will also contribute to the growth in charcoal consumption in the future.

One important factor in prospecting future consumption of charcoal in Paraguay is

Table 2.2-8 Changes and Shares of Final Consumption of Charcoal

(Unit: 10^3 TOE)

	1970		1975		1980		1985		Annual Compound Rate	
	Consump.	%	Consump.	%	Consump.	%	Consump.	%	1970–1985 %	1980–1985 %
Resident & Commercial	40.3	(100.0)	49.3	(100.0)	59.7	(100.0)	71.6	(100.0)	3.9	3.7
Other Sector		0		0		0		0	–	–
Total	40.3	(100.0)	49.3	(100.0)	59.7	(100.0)	71.6	(100.0)	3.9	3.7
Shares in Total Energy Consumption	3.3%		3.5%		3.0%		3.3%			

Source: "Balance Energetico Nacional"

ACEPAR's ironworks which started operation in 1987. According to the plan of ACEPAR, the charcoal requirement of the plant is 65,000 tons (45,000 TOE) a year for the operation of one train with a capacity of 75,000 tons of iron, and as the plant attains operation at full capacity (150,000 tons a year) the requirement for charcoal will be doubled. This means that the present market size of charcoal, 71,000 TOE a year, will be more than doubled in the future. Accordingly, it is anticipated that the impact of ACEPAL's requirements will affect the future demand/supply balance of charcoal, resulting in some changes in price level.

(6) Vegetable Residue

Consumption of vegetable residue lead by the Industry sector grew at an annual rate of over 10% (Table 2.2-9). In this sector, residues of cotton, sugar cane, and corn are used as fuel and source of power during the processing of these raw materials. Since processing of agricultural, forestry, and livestock products constitute the majority of manufacturing industries of Paraguay, as mentioned earlier, it is quite natural that use of vegetable residue as energy source is firmly incorporated in the production system of Paraguayan industry. It is unlikely that this situation will change substantially in the near future.

Vegetable residue consumed in the Public and Other sector which appears in the statistics of 1985 corresponds to sugar cane residue used for production of fuel alcohol by APAL. Due to the reasons described in paragraph 2.2.1(3), the consumption of this sort of vegetable residue is not expected to increase greatly in the near future.

Table 2.2-9 Changes and Shares of Final Consumption of Vegitable Residue

(Unit: 10^3 TOE)

	1970		1975		1980		1985		Annual Compound Rate	
	Consump.	%	Consump.	%	Consump.	%	Consump.	%	1970 –1985 %	1980 –1985 %
Industry	69.5	(100.0)	118.7	(100.0)	233.8	(100.0)	285.0	(92.8)	9.9	4.0
Public & Others		–		–		–	22.2	(7.2)	–	–
Total	69.5	(100.0)	118.7	(100.0)	233.8	(100.0)	307.2	(100.0)	10.4	5.6
Shares in Total Energy Consumption	5.7%		8.4%		11.8%		14.1%			

Source: "Balance Energetico Nacional"

2.2.2 Prospects of Energy Consumption in the Year 2000

Based on the future prospects of the macroeconomy of Paraguay described in Chapter 1, and on the features of the demand/supply trend for each type of energy made in paragragh 2.2.1, consumption of each energy in the year 2000 is estimated as shown in Table 2.2-10. The premises for the estimation are summarized below.

(1) Outlook of Macroeconomy

The economy of Paraguay in terms of GDP will grow at an annual rate of 3 to 3.5% from 1988 to 2000, with no drastic change in the industrial structure.

(2) Petroleum

Future consumption of petroleum products will largely depend on the development of the Transportation sector, particularly that of road transportation, which is expected to develop at least in keeping with the growth in GDP. In addition, a further increase in the use of LPG within the Residential and Commercial sector will contribute considerably to the future growth of petroleum consumption.

(3) Electricity

Future consumption of electricity will grow in line with the further expansion of ANDE's distribution network and with the change in living style to more electricity consumption mainly due to the popularization of home electric appliances. However, in consideration of the fact that further expansion of the distribution network will have to cover sparsely populated areas, the rate of increase in electricity users is destined to decline. Consequently, past growth rates of electricity consumption of over 10% will be difficult to maintain.

(4) Fuel Alcohol

To increase the consumption of fuel alcohol, the supply sources including sugar cane production will have to be reinforced. In this regard, however, the initiatives taken by the government do not seem sufficient enought to enhance promotion of this within private sector. Accordingly, no markable expansion in the use of fuel alcohol is expected.

(5) Firewood

While the position of firewood as the most cheaply available energy source in Paraguay will not change in the near future, Paraguay may face a limitations on the supply of firewood because forestry resources are not reproduced spontaneously in a short term. In addition, efforts will be made to avoid the wasteful use of firewood by introducing heat efficient ovens in the households.

Consequently, it is envisaged that the consumption of firewood will not change significantly from the present level.

(6) Charcoal

A key factor that will influence the future demand for charcoal in Paraguay is the extent of ACEPAR requirements. If ACEPAR's plant is operated at full capacity, the country's charcoal consumption will be more than double the level in 1985. However, in this estimation, a more moderate impact by ACEPAR is presupposed.

Table 2.2-10 Estimated Energy Consumption in 2000

(Unit: 10^3 TOE)

Energy	Consumption	Annual Compound Rate (1985--2000)
Petroleum	750	3.3%
Electricity	200	5.2%
Fuel Alcohol	12	1.8%
Firewood	1250	0 %
Charcoal	130	4.1%
Vegitable Residue	480	3.0%
Total	2822	1.7%

Source: JICA Mission

(7) Vegetable Residue

As long as the agro-industry plays a dominant role in the Industry sector of Paraguay, consumption of vegetable residue as energy will continue to grow in line with the development of the sector. In this forecast, however, energy savings through introduction of heat efficient boilers and the possible development of electricity-driven factories in the Industry sector are taken into consideration.

An estimation of energy consumption in year 2000 prepared by Secretaria Tecnica de Planificacion is shown as a reference in Table 2.2-11.

Table 2.2-11 Energy Consumption in 2,000 Estimated by Secretaria Tecnica de Planificacion

(Unit: 10^3 TOE)

Energy	Consumption	Annual Compound Rate (1985–2000)
Petroleum	1807	8.2%
Electricity	516	11.0%
Fuel Alcohol	27	5.0%
Firewood	1204	Δ0.3%
Charcoal	184	6.8%
Vegitable Residue	659	4.8%
Total	4397	4.3%

Source: Secretaria Tecnica de Planificacion

The Secretaria's estimation gives remarkably larger consumption figures, especially those for commercial energy, compared with the estimation adopted by this report (Table 2.2-10).

This difference may be explained primarily by the difference of premises. The Secretaria presupposed that the economy of Paraguay will grow at an annual rate of as high as 6.5%, with the living style as well as the industrial structure shifting rapidly to a more energy consuming one. In contrast, as stated before, this report assumed a more moderate growth and less structural changes to the future Paraguayan economy.

CHAPTER 3 PETROLEUM PRODUCTS MARKET

3.1 Petroleum in Paraguay

3.1.1 Overview of Petroleum Products Market

The size of petroleum products market in Paraguay in 1987 was about 690 thousand kℓ, if it were defined as PETROPAR's sales amount of all petroleum products except for asphalt. The demand for each petroleum product was as follows:

Of all petroleum products, gas oil is in the greatest demand. In 1987, the demand for gas oil was 380 thousand kℓ. The second largest demand was for regular gasoline, 105 thousand kℓ, the third was for LPG, 63 thousand kℓ. Coming next is premium gasoline, 44 thousand kℓ followed by fuel oil, 42 thousand kℓ; jet fuel oil, 40 thousand kℓ; kerosene, 11 thousand kℓ; and aviation gasoline, 4 thousand kℓ. As is seen from these figures it can be noted that in the petroleum products market of Paraguay, demand for transportation fuel such as gas oil and gasoline is very large while demand for industrial fuel oil as well as household LPG and kerosene is relatively small. The reasons for this market propensity are threefold. Firstly, the industry sector of Paraguay is primarily composed of agricultural products processing industries and only few commercial energy-intensive industries exist. Secondly, different from other developing countries, Paraguay has already owned hydroelectric power plants with huge electric power generation capacities. Accordingly, operation of thermal electric power plants which consume petroleum fuel oil is not required. Thirdly, because of availability of large amounts of non-commercial energy sources such as wood, coal and forestry and agricultural residues, petroleum products are not necessarily required to be used in the industrial, residential and commercial sectors of the country.

Regarding the development of the Paraguayan petroleum products market, the demand for all petroleum products excluding asphalt increased 2.4 times for 12 years from 293 thousand kℓ in 1975 to 690 thousand kℓ in 1987. This is equivalent to annual average growth rate of 7.4 percent. In the light of this statistics, it is clearly noted that the Paraguayan petroleum products market has expanded at a relatively high growth rate for the last 12 years.

This, however, does not necessarily mean that the petroleum products market has expanded steadily throughout this period. On an annual basis, the demand for petroleum products increased at a high annual average growth rate from 1975 to 1979. Over four years from 1979 to 1983, however, the demand did not expand as it did before and even declined in certain years. The stagnant demand for this period was caused by a number of negative factors in the Paraguayan economy, such as the second oil crisis, completion of the construction of the world largest Itaipu hydroelectric dam project and so on.

In 1983 and thereafter, the demand for petroleum products recovered to some extent.

Specifically, it is to be noted that the growth rate for demand from 1986 to 1987 reached as high as 10%.

Also, other notable characteristics of the Paraguayan petroleum products market are as follows: Paraguay borders on big Latin American countries such as Brazil and Argentina, and Paraguay is a land-locked country whose population is only a little less than 4 million. Under such geographical and social conditions, the Paraguayan petroleum products market is closely interconnected to the petroleum industries and petroleum products market in neighboring countries, especially Brazil and Argentina.

First of all, PETROPAR, the state-owned petroleum company of Paraguay, imports and refines Algerian light crude oil, and supplies petroleum products through its distributors. However, as PETROPAR's oil refining plant is of a small-scale and simplified type, being not necessarily matched to the demand structure of the country, PETROPAR has to import more than half of the demand for petroleum products from such countries as Brazil and Argentina.

Actually, 441 thousand kℓ of petroleum products, which is equivalent to 61 percent of the 725 thousand kℓ of petroleum products handled by PETROPAR in 1987, were imported from Brazil and Argentina.

Secondly, in Paraguay which borders on many countries and where a small number of people live in a comparatively large area, its government could hardly stop the petroleum products from being smuggled in across its borderlines.

Accordingly, the Paraguayan petroleum market is more or less affected by the petroleum markets in neighboring countries. As a matter of fact, a large number of people living near the border along the Parana river are keenly interested in the prices of petroleum products in Brazil and Argentina on the other side of the river. Thus, if prices on that side are lower, they cross the border to purchase them. In remote territories such as Chaco, it is much easier and clearly less costly to purchase products from neighboring countries rather than to transport them from the oil refining plant of their own country. Also, it is to be noted that due to its high transportation cost of crude oil the retail price of petroleum products in Paraguay tends to be higher than those in neighboring countries. If those became too high, large amount of illegally imported petroleum products would flow into Paraguay, thereby affecting the PETROPAR's petroleum products supply scheme.

Thus, it is necessary for the Paraguayan government to take full account of the situation on the petroleum products market in neighboring countries to make price policy of its own.

Incidentally, it should be worth noting that the handling of illegally imported petroleum products has duely been examined in advance. For a strict analysis, it might be better to take them into account. However, this study report has not included them in its demand supply

analysis.

One of the reasons is that there is no actual method to estimate them properly. Another reason is that in the light of the purpose of this study, i.e., examining the optimum petroleum supply system of PETROPAR, it is apparently inappropriate to include such informally imported petroleum products over which PETROPAR has no control.

Accordingly, in this study, demand-supply situation of petroleum products was analyzed on the basis of volume of petroleum products which PETROPAR directly handled either by delivering to its distributors as well as end users or by self consumption.

Regarding fuel oil, however, PETROPAR's self consumption was not included in the demand figures. This is because the future fuel oil consumption of PETROPAR, which is the second largest consumer of the fuel oil in the country thus having big influence on the national fuel oil consumption, will vary depending on the amount of crude oil to be refined as well as the process scheme of the Villa Elisa Refinery to be adopted in the future.

3.1.2 Petroleum Industry of Paraguay

(1) PETROPAR's History

PETROPAR is the only enterprise which is authorized to import and refine crude oil, and import and sell petroleum products in Paraguay. The development of the Paraguayan petroleum industry started when the construction of a refinery, the installation of the associated facilities and the development of petroleum resources were approved to BOC Internacional under government ordinance No. 847/62 of 1962. Subsequently, BOC Internacional transferred the rights and obligations stipulated under the ordinance to Refineria Paraguay S.A. (REPSA), which started operations in 1966.

However, in 1980 government ordinance 806/80 was submitted and revised to allow the petroleum refining projects to be executed by a joint venture between the government and a private company. Furthermore, by government ordinance No. 22. 165, Petroleo Paraguaityos, namely PETROPAR, was established with the government's capital share of 60 percent and the REPSA's share of 40 percent, and it was decided that PETROPAR would take over REPSA's operations.

The Paraguayan government subsequently purchased the shares of the private shareholders, as a result of the approval of government ordinance No. 12, 267, and PETROPAR became a state-operated company wholly owned by the government and has conducted operations under such a status.

(2) Functions and Activities of PETROPAR

The authorized items of work of PETROPAR, the only petroleum firm of Paraguay,

are petroleum refining, transportation, storage, sales as well as export and import of crude oil and petroleum products, and exploration and development of hydrocarbon resources in Paraguay.

In the Chao region where the possibility of substantial reserves of hydrocarbon resources is considered high, exploratory activities are ongoing. Up to now, however, no striking results of these activities have yet been achieved. Therefore, Paraguay now relies totally on the crude oil import from overseas countries. This crude oil is transported to an area off Buenos Aires Port by ocean tanker, transshipped twice to a small tanker and a barge and then finally transported to Villa Elisa Refinery.

Top priority is given to the use of Paraguayan shipping companies for the river transportation of the crude oil.

Crude oil is refined at a 7,500 BPSD refining plant located in Villa Elisa. However, as this plant incorporates simplified topping units consisting mainly of an atmospheric distillation tower, the operation of the plant is not flexible enough to allow the production of products in a volume suited to the demand pattern in Paraguay. Also, the plant is not equipped with secondary refining facilities capable of producing high-octane gasoline such as aviation gasoline and premium gasoline.

Accordingly, gas oil and LPG which are in great demand, and aviation gasoline and premium gasoline not produced in the said plant, have to be imported by PETROPAR from neighboring countries.

Regarding the distribution of petroleum products, PETROPAR, in some cases, sells them directly to end-users. However, products equivalent to 90 percent or more of the total demand are distributed through distributors. The major distributors are Esso Standard Paraguay, Shell Paraguay Limited, Cooperativas de Petroleo Limitada (COPETROL) and LUBRIPAR. Of these distributors, Esso alone is handling LPG. In addition to the above, there are special distributors who handle only LPG. They are Incogas S.A., Gas Corona S.A., and Lovato Auto Gas Service.

3.2 Demand and Supply of Petroleum Products

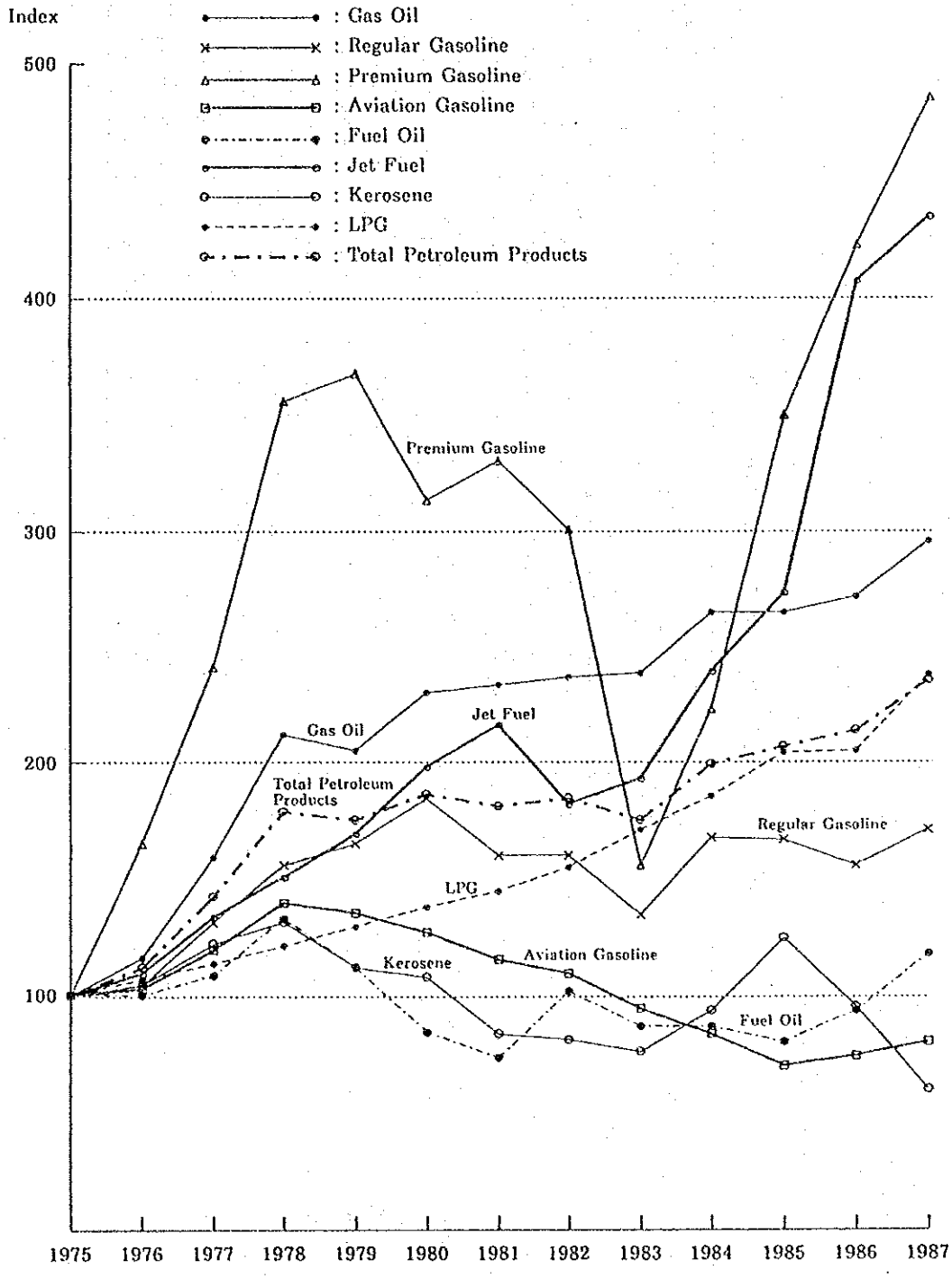
3.2.1 Demand Structure of Petroleum Products

Table 3.2-1 shows the demand and share of each petroleum product in Paraguay over the last 13 years from 1975 to 1987, Table 3.2-2 indicates the annual demand growth rate of each petroleum product, and Fig. 3.2.1 the demand index of each product on the basis of the demand in 1975 being 100. Also, Fig. 3.2-2 shows the 1987 demand structure of petroleum products in Paraguay. Based on such tables and figures, explanation on the demand structure and its development for each petroleum product will be given below.

Table 3.2-1 Demand for Petroleum Products (1975 – 1987)

	Gas Oil		Regular Gasoline		Premium Gasoline		Aviation Gasoline		Kerosene		Jet Fuel		Fuel Oil		LPG		Total		Asphalt
	Kℓ	%	Kℓ	%	Kℓ	%	Kℓ	%	Kℓ	%	Kℓ	%	Kℓ	%	Kℓ	%	Kℓ	%	Ton
1975	128,839	43.9	61,212	20.9	9,134	3.1	5,247	1.8	18,413	6.3	8,298	2.8	35,896	12.2	26,449	9.0	293,488	100.0	N.A.
1976	149,353	45.8	64,069	19.6	15,153	4.6	5,412	1.7	19,239	5.9	9,060	2.8	35,840	11.0	28,234	8.7	326,360	100.0	N.A.
1977	205,611	49.3	80,497	19.3	21,997	5.3	6,275	1.5	22,451	5.4	11,164	2.7	39,065	9.4	30,138	7.2	417,199	100.0	N.A.
1978	273,067	52.0	95,383	18.2	32,498	6.2	7,329	1.4	24,235	4.6	12,524	2.4	47,836	9.1	32,172	6.1	525,045	100.0	N.A.
1979	265,174	51.3	101,300	19.6	33,538	6.5	7,104	1.4	20,682	4.0	14,076	2.7	40,197	7.8	34,342	6.7	516,413	100.0	N.A.
1980	296,269	54.1	113,123	20.7	28,582	5.2	6,686	1.2	19,782	3.6	16,509	3.0	30,112	5.5	36,659	6.7	547,722	100.0	N.A.
1981	301,023	56.4	98,097	18.4	30,161	5.6	6,040	1.1	15,399	2.9	17,959	3.4	26,347	4.9	39,132	7.3	534,158	100.0	100
1982	304,941	56.1	98,250	18.1	27,438	5.0	5,734	1.1	14,876	2.7	15,109	2.8	36,456	6.7	41,124	7.6	543,928	100.0	45
1983	307,414	59.6	82,807	16.1	14,270	2.8	4,930	1.0	13,948	2.7	16,046	3.1	30,961	6.0	45,274	8.8	515,650	100.0	1,390
1984	340,726	58.2	102,782	17.6	20,427	3.5	4,385	0.7	17,124	2.9	19,894	3.4	30,925	5.3	49,067	8.4	585,331	100.0	3,703
1985	341,746	56.2	102,432	16.8	31,601	5.2	3,663	0.6	22,997	3.8	22,669	3.7	28,652	4.7	54,168	8.9	607,928	100.0	8,427
1986	349,607	55.8	95,824	15.3	38,593	6.2	3,875	0.6	17,492	2.8	33,837	5.4	33,543	5.3	54,237	8.7	627,008	100.0	10,249
1987	380,300	55.1	105,073	15.2	44,371	6.4	4,182	0.6	10,908	1.6	40,239	5.8	42,374	6.2	62,775	9.1	690,222	100.0	8,119

Source: PETROPAR



Source : PETROPAR
JICA Mission

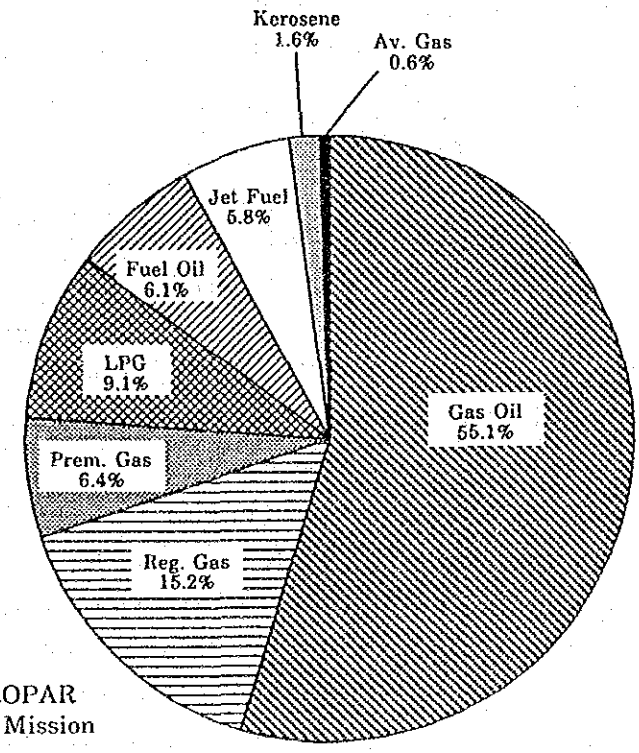
Fig. 3. 2 - 1 Growth Index of Petroleum Products Demand (1975 ~ 1987)

Table 3.2-2 Growth Rate of Petroleum Products Demand

(%/year)

	Gas Oil	Regular Gasoline	Premium Gasoline	Aviation Gasoline	Kerosene	Jet Fuel	Fuel Oil	LPG	Total Petroleum Products
1976	15.9	4.7	65.9	3.1	4.5	9.2	−0.2	6.7	11.2
1977	37.7	25.6	45.2	15.9	16.7	23.2	9.0	6.7	27.8
1978	32.8	18.5	47.7	16.8	7.9	12.2	22.5	6.7	25.8
1979	−2.9	6.2	3.2	−3.1	−14.7	12.4	−16.0	6.7	−1.6
1980	11.7	11.7	−14.8	−5.9	−4.4	17.3	−25.1	6.7	6.1
1981	1.6	−13.3	5.5	−9.7	−22.2	8.8	−12.5	6.7	−2.5
1982	1.3	0.2	−9.0	−5.1	−3.4	−15.9	38.4	5.1	1.8
1983	0.8	−15.7	−48.0	−14.0	−6.2	6.2	−15.1	10.1	−5.2
1984	10.8	24.1	43.1	−11.1	22.8	24.0	−0.1	8.4	13.5
1985	0.3	−0.3	54.7	−16.5	34.3	13.9	−7.4	10.4	3.9
1986	2.3	−6.5	22.1	5.8	−23.9	49.3	17.1	0.1	3.1
1987	8.8	9.7	15.0	7.9	−37.6	18.9	26.3	15.7	10.1

Source: PETROPAR



Source : PETROPAR
JICA Mission

Fig. 3.2-2 Demand Structure of Petroleum Products (1987)

(1) Gas Oil

Of the petroleum products handled by PETROPAR, gas oil is in the greatest demand. The demand for gas oil in 1987 was 380 thousand kℓ – three times that in 1975 – and accounts for 55.1 percent of the demand for all petroleum products except for asphalt. The annual average growth rate of gas oil for 12 years from 1975 to 1987 was 9.4 percent, which is smaller, compared with that of premium gasoline and jet fuel. Nonetheless the growth rate of gas oil up to 1978 was 28.5 percent on an annual basis, which is considered to be very high. Subsequently, the demand rate fell to as low as 2.4 percent on an annual basis up to 1983. Then, from 1983 to 1987 annual growth rate increased again slightly to 5.5 percent, though it is still far below comparing with the growth rate in 1970s.

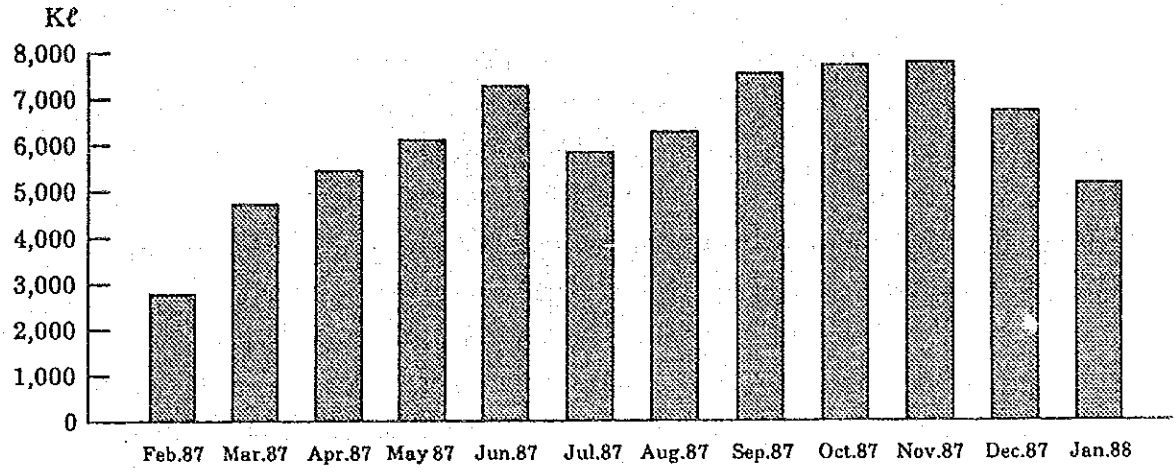
The historical development of demand for gas oil is characterized by its steady growth. Gas oil demand has increased continuously throughout this period, even in 1982 and 1983, when the demand for the other petroleum products fell due to a recession.

Gas oil is used for fuel for onshore transportation measures such as bus, truck and diesel motor vehicles, for agricultural machinery such as tractors, for ships navigating in the Paraguay river and Parana river, for electric power generation for factories in remote locations and also for grain drying in grain silos.

Although detailed data are not available, the onshore transportation sector is supposed to be the largest consumer of gas oil: supposedly, about 70 percent of the national gas oil consumption.

In this regards, the high demand ratio of gas oil on the Paraguayan petroleum market can be attributable to the facts that the most of public buses, trucks and light trucks which are large consumers of petroleum fuel of the country are equipped with diesel engine and that diesel engined passenger cars are very popular among Paraguayan people.

Agricultural sector is supposed to be the second largest consumer of gas oil. Also because of scarcity of data, it is difficult to know the accurate amount of gas oil consumption in this sector. However, according to the report on the analysis of the energy situation in Paraguay which was carried out by the World Bank in 1984, the consumption of gas oil in the agricultural sector is estimated to be around 26 percent of the total national consumption. In recent years, the mechanization in agricultural sector has progressed and agricultural machines such as tractors and combines have been widely introduced in Paraguay. These machines have contributed greatly to increase in agricultural productivity of such harvests as soybeans, raw cotton, and wheat. Fig. 3.2-3 shows PETROPAR's monthly delivery of gas oil from the Hernandalias depot. From this Figure, it is understood that the demand for gas oil is much higher than the average annual



Source : PETROPAR

Fig. 3.2-3 Monthly Sales Amount of Gas Oil at Hernandarias Depot. (Feb.87~Jan.88)

demand rate during the cotton seeding month of June, during the wheat harvest and transportation period from September through November, and also during the soybean harvest month of December.

The amount of gas oil used for ships and plant power generation is not so large. According to the energy balance table prepared by the Secretaria Tecnica de Planificacion, gas oil for ships and power generation accounts for 1.7 percent and 3.0 percent respectively of the total consumption of gas oil in 1985. It is anticipated that gas oil used for captive power generation will be phased out to be replaced by power supplied from the ANDE, as the establishment of a power supply network proceeds in Paraguay. Consequently, the demand for gas oil for the above use will decrease in the future.

(2) Gasoline for Motor Vehicles

Of the petroleum products, gasoline for motor vehicles takes the second place in demand. According to Fig. 3.2-2, regular gasoline accounts for 15.2 percent and premium gasoline, 6.4 percent (a total of 21.6 percent) of the demand for gasoline for motor vehicles.

Here, an examination into the characteristics of motor vehicle gasoline market with an eye on the development of demands for regular gasoline and premium gasoline will be made.

First of all, the demand for premium gasoline in 1987 was 44 thousand kℓ, 4.9 times that in 1975. The annual average demand growth rate for 12 years from 1975 to 1987 was as high as 14.1 percent. However, as clearly shown in Fig. 3.2-1, the demand for premium gasoline greatly changed each year. From 1975 to 1979, premium gasoline showed a high annual growth rate of 38.4 percent but suddenly turned to a sluggish growth, with a minus growth in 1979 and thereafter. Particularly in 1983, the demand for premium gasoline dropped as much as 50 percent as compared with that in the preceding year. After 1984, however, premium gasoline recovered earlier growth, and achieved an annual growth rate of 32.8 percent from 1984 to 1987. Several factors of such large variations in demand for premium gasoline can be pointed out. First of all, it is believed that the drop in demand in 1982 and 1983 was caused by a recession in the Paraguayan economy. In the recession, consumers might have refrained from driving motor vehicles, and purchased less expensive regular gasoline. The price of gasoline which was maintained since 1980 was revised in 1983, and the difference between the price of premium gasoline and that of regular gasoline widened from the past price of 30 Gs per liter to 50 Gs. The demand for regular gasoline also dropped in 1983 by about 16 percent as compared with that in the preceding year. Accordingly, the large variation in demand for premium gasoline can not be attributed to the shift alone from the premium gasoline to regular gasoline. The major factors that affected the gasoline market during such period are considered to be the flow of illegally imported petroleum products and the penetration of fuel alcohol into the market. Certain information obtained from the petroleum market personnel concerned in Paraguay indicates that the greater the difference between the gasoline price in Paraguay and that in the neighboring countries becomes, the larger volume of illegal products flow into Paraguay. The total demand for both the premium and regular gasoline in 1980 was 140 thousand kℓ, which dropped to 97 thousand kℓ in 1983. This drop was considered to be too large to fully attribute to reduction of driving distances of car drivers. Therefore, it is supposed that a large amount of illegally imported products might have flowed into Paraguay.

Regarding the effects of fuel alcohol, motor vehicles fueled by less expensive alcohol suddenly proliferated and the demand for fuel alcohol greatly eroded the demand for gasoline. This was because the National Alcohol Program which was started in 1981 enabled a smooth supply of cheap fuel alcohol at the time when the energy crisis and economic depression occurred.

Regarding the development of demand for regular gasoline, the demand for such gasoline was 105 thousand kℓ in 1987, only 1.7 times that in 1975. The average annual growth rate during this period was 4.6 percent, being much lower than that of premium

gasoline. Regular gasoline showed a comparatively high annual growth rate of 13.1 percent for five years from 1975, and the demand for such gasoline was 113 thousand kℓ in 1980. Subsequently, however, the demand in 1983 dropped to about 73 percent of the demand in 1980. After 1983, the demand slightly increased but had not returned to the level of 1980, in 1987. As in the case of premium gasoline, the stagnant demand for regular gasoline in 1980 and thereafter was attributed possibly to an illegal inflow of petroleum products and also to the effects of introduction of fuel alcohol. Also, the potential demand for regular gasoline was possibly eroded by less expensive motor vehicle fuel such as gas oil, LPG and fuel alcohol.

In Paraguay, two kinds of regular gasoline, a 100 percent petroleum fraction and a gasoline into which absolute alcohol is mixed (called alconafta) are available. Such kinds of gasolines are received into the same tank and sold at the same price. Thus, consumers are unable to buy selectively one of these two kinds. In the last one to two years, the supply volume of absolute alcohol has not been sufficient, so the volume of alconafta available to consumers was rather limited.

As stated above, the situation of the Paraguayan gasoline market are complicated because various factors are involved. In terms of a long-term trend, it is certain that the demand growth rate of premium gasoline will be higher than that of regular gasoline. Accordingly, the ratio of premium gasoline will eventually increase on the gasoline market. This can be assumed because the consumption ratio of the premium gasoline is higher in the capital city of Asuncion, and tends to increase gradually in other cities.

(3) LPG

Of the petroleum products handled by PETROPAR, LPG takes the third place in demand and accounts for 9.1 percent of the total demand for petroleum products. The demand for LPG in 1987 was 63 thousand kℓ, 2.4 times of that in 1975. The annual average growth rate of LPG was 7.5 percent from 1975 through 1987, and demand showed a straight and stable growth. LPG is used mainly as household fuel, and also as motor vehicle fuel. In recent years, household LPG has been used in a large number of households in urban regions. It is said that the LPG was used in about 13 percent of the households in rural regions in 1985. Further, because the price of LPG as fuel for motor vehicle was lower than that of gasoline, the consumption of LPG increased. LPG is said to be used by almost all taxis in Asuncion. It is assumed that about 15 percent of the total LPG consumption is used for motor vehicles.

(4) Fuel Oil

The demand for fuel oil increased by as much as 26 percent from 1986 to 1987. Consequently, the fuel oil accounted for 6.1 percent of the demand for all petroleum products, taking the fourth place. However, the demand for fuel oil amounted only to 42 thousand kℓ in 1987, a 18 percent gain over 1975. The greatest demand for fuel oil from 1975 to 1987 was the 48 thousand kℓ recorded in 1978, and the smallest demand was 26 thousand kℓ in 1981. The big user of fuel oil was a state-owned cement plant where more than 50 percent of the demand for fuel oil was consumed. This cement plant was constructed in the hope that large amounts of cement would be procured from the Paraguayan side at the time of construction of the Itaipu dam. As most of the cement consumption was actually supplied from Brazil, the operating rate of the plant remained low, and the consumption of fuel oil did not increase.

The second largest user of fuel oil was PETROPAR themselves. The amount of fuel oil in Fig. 3.2-2 includes that of sales to outside users, and not PETROPAR's own consumption. In addition to the above two users, there are a few users such as textile plants, but their consumption is small.

(5) Jet Fuel

Jet fuel accounted for 5.8 percent of the demand for petroleum products in 1987, and the demand was 40 thousand kℓ, 4.9 times of that in 1975. The average annual growth rate was as much as 14.1 percent over the past 12 years.

The growth of the increase in the demand for jet fuel was 13.7 percent per year on an average from 1975 to 1981, but the demand dropped in 1982. After 1983, however, demand suddenly increased. Of particular note is the high annual growth rate of 33.2 percent which was achieved from 1985 to 1987. Jet fuel is used mainly for passenger airplanes. In Paraguay, however, the departure and arrival frequencies of the airplanes and the number of foreign passengers who arrived in Paraguay are not necessarily deeply interrelated with the demand for jet fuel. In other words, the frequencies of airplanes of international airlines, and the number of foreign passengers who arrived in Paraguay increased every year, from 1975 to 1981. Subsequently, although both the frequencies and number declined, an increased demand for jet fuel was still observed.

The recent increase in the demand for jet fuel was caused possibly by the larger size of airplanes and also by increase in the loading volume of fuel by foreign airlines in Paraguay.

(6) Kerosene

The demand for kerosene in 1987 amounted to 11 thousand kℓ, a 59 percent drop from 1975, and accounted for 1.6 percent of that of petroleum products. As Paraguay was originally rich in forest resources, wood was extensively used as traditional household fuel. In contrast, kerosene was introduced as a modern household fuel, and thus came to be extensively used for use in lighting and kerosene refrigerators, besides as cooking fuel.

The trend to decrease in demand for kerosene was apparently attributable to the fact that electrification made great progress.

Lighting by electricity spread to wide areas, and LPG gradually came to be used as household fuel. The annual average drop rate of kerosene from 1975 through 1987 was 4.5 percent. However, as clearly shown in Table 3.2-1 and Fig. 3.2-1, the decrease in demand for kerosene did not necessarily occur uniformly on an annual basis. From 1975 to 1978, the demand increased at an annual rate of 9.5 percent. However, after 1978 the demand declined and dropped in 1983 to 58 percent of that in 1978. Then, in 1984 and 1985 demand reincreased but dropped once again in 1986 and 1987.

According to the Paraguayan petroleum industry sources, a substantial amount of kerosene was used to mix it into gas oil when the price of kerosene was cheaper than that of gas oil in the past, and in recent years some gasoline station owners are purchasing kerosene to mix it with gasoline to sell to customers, thus causing sharp fluctuations in the consumption of kerosene.

At the time of this survey at the site, a gasoline station owner who was selling gasoline with kerosene blended therein, was being prosecuted.

(7) Aviation Gasoline

The demand for aviation gasoline in 1987 amounted to 4,200 kℓ, a 20 percent drop from 1975. The historical trend of demand for aviation gasoline was rather straightforward. Up to 1978, the demand increased, but consistently dropped after 1978. Aviation gasoline is used as fuel for airplanes equipped with reciprocating engines, i.e. military airplanes and private small airplanes. In recent years, the nation's road network has been properly established, and the importance of the small type of airplanes as a means of transportation in the private sector dwindled more than ever. In such a situation, the proportion of the demand for aviation gasoline to all petroleum products decreased from 1.8 percent in 1975 to 0.6 percent in 1987. In 1986 and 1987, the percentages were slightly up over the preceding years. The trend of decreases in the demand for aviation gasoline might have changed.

(8) Asphalt

Fig. 3.2-1 and Fig. 3.2-2 do not include asphalt. However, this product was one of the petroleum products sold through PETROPAR. Asphalt is used mainly as material for road construction as well as for building construction.

In these days, when major trunk roads in Paraguay have already been constructed, asphalt is consumed more for roads repairing than for paving new roads.

3.2.2 Regional Demand for Petroleum Products

(1) Overview of Regional Demand

Table 3.2-3 shows the demand for each petroleum product by region and department in Paraguay in 1987, according to the regional division of Paraguay as per Fig. 3.2-4.

Also Fig. 3.2-5 shows a graphical representation of the regional demand for petroleum products. Based on the above table and figures, regional demand characteristics for petroleum products in Paraguay can be stated as follows.

First of all, it is observed that 88 percent of the demand for all the petroleum products throughout Paraguay is concentrated in Region I - "Centro Sur", and Region II - "Este". The demand in Region III - "Norte" accounts for only about 8 percent of the national demand, and that in Region IV - "Occidental" a meager 3.5 percent. Furthermore, demand by departments is as follows: Central Department where Asuncion, the capital of Paraguay, is located accounts for the share of 55.7 percent of the national consumption: Alto Parana where Pto. Pte. Stroessner is located accounts for 10.5 percent; and Itapua where Encarnacion city is located accounts for 7.1 percent.
Demand in the above three departments totals 73.4 percent, i.e., three quarters of the Paraguayan petroleum demand are concentrated. Next, the demand in Concepcion Department and Caaguazu Department account for 6 percent and 4.9 percent, respectively. The demand in other departments is at a level of 1 percent or less.

There is small demand for petroleum products especially in departments within the Chaco region. The rate of this demand is 1 percent or less except in Boqueron Department. The centralized Paraguayan petroleum demand in "Centro Sur" and "Este", and Central Department, Alto Parana Department and Itapua Department is attributable to the concentration of population in such regions and departments, and the active economic activities there. General situation of the Paraguayan petroleum demand can be understood by examining the demand situation in the above regions and departments, although there are a few exceptions to the demand for some petroleum products.

(2) Regional Demand for Petroleum Products

As clearly shown in Table 3.2-3 and Fig. 3.2-5, there are demands for gas oil, regular gasoline, premium gasoline and kerosene in almost all the regions of Paraguay. However, aviation gasoline, jet fuel and fuel oil have demands only in specific regions. The former group of products are used by a wide range of consumers including individual consumers, and the latter by limited users in specific regions. Table 3.2-3 shows as if there were demand for LPG only in Central Department. However, this is because no regional demand statistics is available. It is believed that the LPG is consumed in a wide variety of regions.

(a) Gas Oil

The regional demand structure of gas oil shows that 58.6 percent of the gas oil consumption goes to "Centro Sur", and 30.9 percent to "Este". Consequently, the consumption in these two regions accounts for a total of about 90 percent of the national consumption. The total demand in the major three Departments of Central, Alto Parana and Itapua accounts for 68.9 percent.

(b) Regular Gasoline

The regional demand structure of regular gasoline shows that 56.7 percent of the regular gasoline consumption is recorded in "Centro Sur", and 33.8 percent in "Este". Consequently, the consumption in these two regions accounts for a total of about 91 percent. The degree of concentration in the consumption within these two regions is almost the same as in the case of gas oil. The consumption in the three Departments of Central, Alto Parana and Itapua accounts for a total of 75.7 percent, and the consumption ratio in these three Departments is higher, compared with that of gas oil. This is probably because greater amounts of gasoline is consumed in urban regions.

(c) Premium Gasoline

The regional demand structure of premium gasoline shows that 79.4 percent of the premium gasoline consumption goes to "Centro Sur", and 18.5 percent to "Este". The total consumption ratio in these two regions is 98 percent, and the consumption in the three Departments of Central, Alto Parana, and Itapua accounts for 90.2 percent. The consumption of premium gasoline seems higher in urban regions than that of regular gasoline.

Table 3.2-3 Regional Demand for Petroleum Products (1987)

	Gas Oil Kℓ	(%)	Regular Gasoline Kℓ	(%)	Premium Gasoline Kℓ	(%)	Aviation Gasoline Kℓ	(%)	Kerosene Kℓ	(%)	Jet Fuel Kℓ	(%)	Fuel Oil Kℓ	(%)	LPG Kℓ	(%)	Total Kℓ	(%)
Region I																		
Central	176,535	(46.42)	52,183	(49.66)	32,977	(74.32)	3,907	(93.42)	3,732	(34.20)	40,169	(99.83)	12,439	(29.36)	62,775	(100.00)	384,717	(55.74)
Cordillera	10,458	(2.75)	1,553	(1.48)	545	(1.23)	–	(–)	292	(2.68)	–	(–)	–	(–)	–	(–)	12,848	(1.86)
Paraguari	9,926	(2.61)	1,358	(1.29)	413	(0.93)	–	(–)	558	(5.12)	–	(–)	–	(–)	–	(–)	12,255	(1.78)
Misiones	7,492	(1.97)	1,487	(1.42)	799	(1.80)	–	(–)	328	(3.01)	–	(–)	–	(–)	–	(–)	10,106	(1.46)
Neembucu	5,933	(1.56)	505	(0.48)	44	(0.10)	–	(–)	272	(2.49)	60	(0.15)	1,899	(4.48)	–	(–)	8,713	(1.26)
Guaira	9,926	(2.61)	2,206	(2.10)	439	(0.99)	–	(–)	864	(7.92)	–	(–)	–	(–)	–	(–)	13,435	(1.95)
Caazapa	2,548	(0.67)	294	(0.28)	–	(–)	–	(–)	78	(0.72)	–	(–)	–	(–)	–	(–)	2,920	(0.42)
Sub Total	222,818	(58.59)	59,586	(56.71)	35,217	(79.37)	3,907	(93.42)	6,124	(56.14)	40,229	(99.98)	14,338	(33.84)	62,775	(100.00)	444,994	(64.47)
Region II																		
Canideyu	7,416	(1.95)	1,360	(1.29)	–	(–)	–	(–)	36	(0.33)	–	(–)	–	(–)	–	(–)	8,812	(1.28)
Caaguazu	24,567	(6.46)	6,741	(6.42)	1,167	(2.63)	–	(–)	1,527	(14.00)	–	(–)	–	(–)	–	(–)	34,002	(4.93)
Alto Parana	48,640	(12.79)	18,869	(17.96)	4,828	(10.88)	233		122	(1.12)	–	(–)	–	(–)	–	(–)	72,692	(10.53)
Itapua	36,813	(9.68)	8,504	(8.09)	2,214	(4.99)	–	(–)	1,630	(1.49)	–	(–)	–	(–)	–	(–)	49,161	(7.12)
Sub Total	117,436	(30.88)	35,474	(33.76)	8,209	(18.50)	233	(5.51)	3,315	(30.39)	–	(–)	–	(–)	–	(–)	164,667	(23.86)
Region III																		
Amambay	266	(0.07)	1,563	(1.49)	–	(–)	–	(–)	–	(–)	–	(–)	–	(–)	–	(–)	1,829	(0.26)
Concepcion	10,649	(2.80)	2,399	(2.28)	71	(0.16)	–	(–)	368	(3.37)	–	(–)	28,036	(66.16)	–	(–)	41,523	(6.02)
San Pedro	10,382	(2.73)	1,882	(1.79)	120	(0.27)	–	(–)	724	(6.63)	–	(–)	–	(–)	–	(–)	13,108	(1.90)
Sub Total	21,297	(5.60)	5,844	(5.56)	191	(0.43)	–	(–)	1,092	(10.00)	–	(–)	28,036	(66.16)	–	(–)	56,460	(8.18)
Region IV																		
PDTE Hayes	4,678	(1.23)	930	(0.89)	160	(0.36)	–	(–)	34	(0.31)	–	(–)	–	(–)	–	(–)	5,802	(0.84)
Alto Paraguay	1,445	(0.38)	–	(–)	–	(–)	–	(–)	–	(–)	–	(–)	–	(–)	–	(–)	1,445	(0.21)
Chaco	4,488	(1.18)	1,019	(0.97)	204	(0.46)	28	(0.67)	97	(0.89)	–	(–)	–	(–)	–	(–)	5,836	(0.85)
Boqueron	8,100	(2.13)	2,221	(2.11)	390	(0.88)	14	(0.33)	246	(2.26)	10	(0.02)	–	(–)	–	(–)	10,981	(1.59)
Nueva Asuncion	38	(0.01)	–	(–)	–	(–)	–	(–)	–	(–)	–	(–)	–	(–)	–	(–)	38	(0.01)
Sub Total	18,749	(4.93)	4,169	(3.97)	754	(1.70)	42	(1.00)	377	(3.46)	10	(0.02)	–	(–)	–	(–)	24,101	(3.49)
Total	380,300	(100.00)	105,073	(100.00)	44,371	(100.00)	4,182	(100.00)	10,908	(100.00)	40,239	(100.00)	42,374	(100.00)	62,775	(100.00)	690,222	(100.00)

Source: PETROPAR

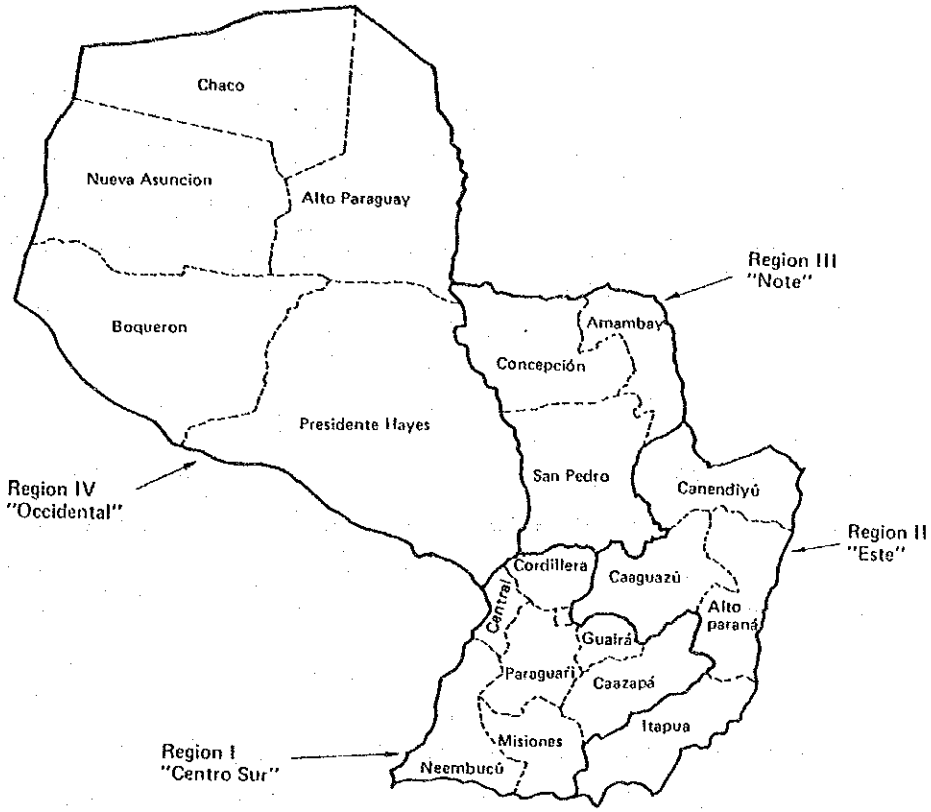


Fig. 3.2-4 Regional Division of Paraguay

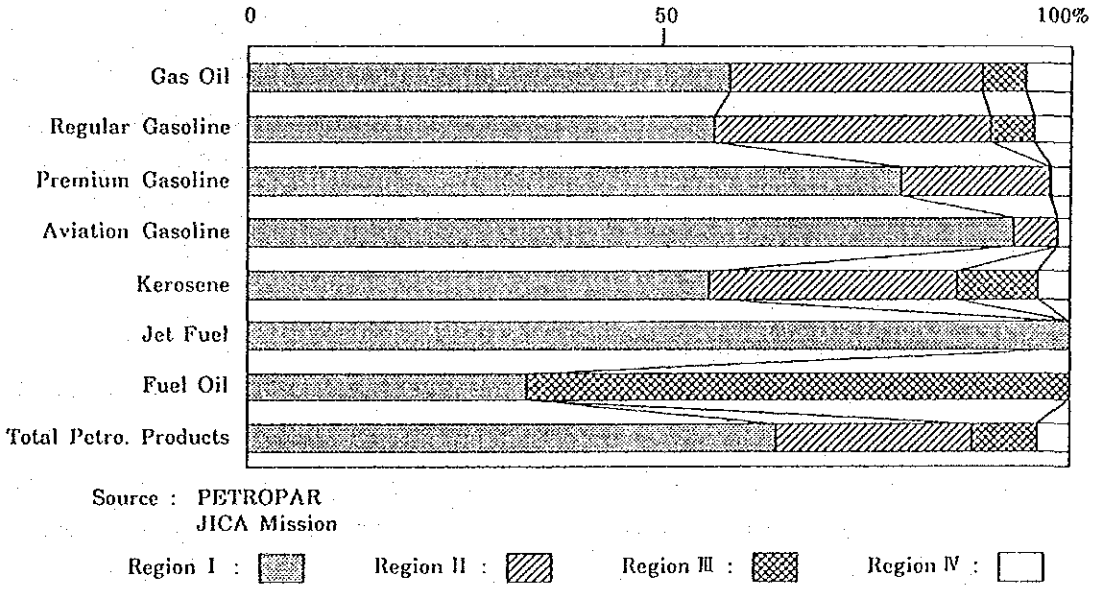


Fig. 3.2-5 Regional Demand for Petroleum Products (1987)