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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

FONDO DE INVERSIONES DE VENEZUELA (FIV)
THE REPUBLIC OF VENEZUELA

THE FEASIBILITY STUDY OF THE ESTABLISHMENT OF THE COKE PLANT IN THE REPUBLIC OF VENEZUELA

SEPTEMBER 1994

UNICO INTERNATIONAL CORPORATION
MITSUI MINING ENGINEERING

Preface

In response to a request from the Government of the Republic of Venezuela, the Government of Japan decided to conduct a study on the Establishment of the Coke Plant in the Republic of Venezuela and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Venezuela a study team headed by Mr. Yoshiyasu Mikami, Unico International Corporation, three times between July 1993 and July 1994.
The team held discussions with the officials concerned of the Government of the Republic of Venezuela, and conducted field surveys in the study area. After the study team returned to Japan, further studies were conducted and the present report was prepared.

I hope that this report will contribute to the Construction of the Coke Plant in Venezuela and to the enhancement of friendly relations between our two countries.
I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Venezuela for their close cooperation extended to the study team.

September 1994

Kimio Fujita
President
Japan International Cooperation Agency

September 1994

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Mr. Fujita

Letter of Transmittal

We are pleased to submit you the final report on the Feasibility Study of the Establishment of the Coke Plant in the Republic of Venezuela.

The report analyzes financial and economic feasibility of the Coke Plant on the basis of relevant data and information obtained through field surveys, including availability of coking coal in Tachira - only one state having coking coal deposits in the country; properties of coking coal and possible coal blending design required for coke production; domestic and foreign markets for blast furnace coke and by-products; selection of the coke plant site, the type and size of the coke oven; and environmental impacts.

In the report, market study revealed that, while Venezuela has no market for blast furnace coke, the United States would import large amounts of blast furnace coke in the future due to the shutdown of existing coke ovens. On the other hand, availability of coking coal in Tachira is not sufficient to meet demand at the present stage of development, necessitating imports of foreign coal, particularly U.S. coal, to produce coke with marketable quality. In overall consideration to the above factors, we have to conclude that construction of the proposed coke plant is not feasible at present. The report also pointed out that project feasibility will improve if the development of coal resources in Tachira is progressed to produce a sufficient amount of coking coal to replace import requirements. The Venezuelan counterpart will conduct a feasibility study when commercial exploitation of coal deposits in the state starts.

The report also examined the possible use of weak coking coal available in the State of Zulia who wishes to promote volume exports of coal and use it for coke production as well.

The report provides in-depth examination and analysis of potential utilization of coal resources, including potential markets for blast furnace coke and required coke properties, coke production technologies and its environmental impacts, thus fulfilling the objective of technology transfer to the Venezuelan industry.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs, and the Ministry of International Trade and Industry for the valuable advices and supports extended to this study team. We also wish to express deep gratitude to FIV and other authorities concerned of the Republic of Venezuela for the close cooperation and substantial assistance provided to us during our activities.

Very truly yours,

Mikami Yoshiyasu
Team Leader, the Feasibility
Study of the Establishment of
the Coke Plant in the Republic
of Venezuela

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Chapter 1 Background Study

1.1 National and Regional Development Policies

The Republic of Venezuela (Venezuela) is endowed with abundant petroleum, mineral, and hydro–energy resources. It became the world largest oil exporting country in 1928 and continued its position over the ensuing three decades. Although taken over by Saudi Arabia later, the country still boasts crude oil production capacity of 2.7 million barrels per day and maintains daily production of 2 million – 2.5 million barrels, most of which are exported.

Since 1960, the government of Venezuela has been implementing 8 times of 5–year national development plans through the Central Coordination and Planning Agency (Oficina Central de Coordinación y Planificación de la República – CORDIPLAN). The latest plan, the 8th National Development Plan (1990 – 1994) with the subtitle "Great Turning Point (El Gran Viraje)" was announced in January, 1990, and was approved by the Congress in September.
Major objectives of the until 7th development plans were first aimed, politically, to establish democracy and to prevent the emergence of military dictatorship and communism, with economic goals focusing on nationalization of oil industry to allow the government to obtain gigantic revenues from oil exports. Then, the priority was shifted to investment of oil revenues in domestic sectors to redirect national economy from overdependence on oil exports by fostering growth of non–oil sectors and building economic and social infrastructure. To this end, the government established a variety of state enterprises, through which industrialization based on import substitution and development of value–added products using locally available mineral resources have been promoted, and social infrastructure has been constructed.

In contrast, the 8th National Development Plan has proclaimed major changes in development strategy, primarily focusing on the following 5 areas:

1) Shift from controlled economy to market economy
2) Promotion of private investment
3) Reduction of overdependence on oil exports
4) Decentralization and regional development
5) Development of human resources

Compared to the previous development plans, items 1) and 2) mark major changes, almost opposite in direction. To achieve these objectives, the plan envisages the opening of the domestic market, the privatization of state enterprises, and the promotion of foreign investment.

While 3) is the objective continued from the past, 4) represents a major change because it involves a major shift of authority and responsibility for public service to local governments.

Previously, Venezuela pursued inward-looking attitude in its economic development strategy. The government has been protecting all the industrial sectors except for the oil industry, which have thus failed to gain international competitiveness.
The 8th National Development Plan is the first to emphasize the development of international competitiveness of the Venezuelan economy, which is to be accomplished through the opening of the domestic market to spur the restructuring of domestic sectors under competitive pressure from foreign industries. For this purpose, the plan sets forth various institutional reforms.
The first target is the rationalization of state enterprises which have overgrown in size and have lost efficiency and productivity. The second target is the opening of the domestic market by abolishing or relieving import regulations, reducing tariff rates, and abolishing price control. Transfer of state enterprises to local government control and privatization through sales to the private sector is the third pillar of the reform. Fourth, foreign capital is attracted to help domestic industries develop international competitiveness through the introduction of capital and technology. Finally, the improvement of government finance is contemplated by increasing government revenues through tax reforms and reappraising public investment projects.

Major policy targets in the previous development plans, namely industrialization through import substitution and utilization of mineral resources to develop value-added products, have been promoted by regional development corporations which have been established for this purpose. The oldest one is Guayana Development Corporation (Corporación Venezolana de Guayana: CVG) which has more than 30 years of history. Other major regional development corporations include Zuliana Development Corporation (Corporación de Desarrollo de la Región Zuliana: CORPOZULIA), Southwest Region Development Corporation (Corporación Venezolana del Suroeste: CORPOSUROESTE or CVS), Andes Development Corporation (Corporación de los Andes: CORPOANDES), Northeast Region Development Corporation (Corporación de Desarrollo de la Región Nororiental: CORPORIENTE), and Central West Region Development Corporation (Corporación de Desarrollo de la Región Centrooccidental: CORPOCCIDENTE), which are under direct supervision of the president. These development corporations have been funded by Venezuela Investment Fund (Fondo de Inversiones de Venezuela: FIV), which is now playing an important role in promoting the privatization of state enterprises.
Each of the regional development corporations, in addition to the development of its own region, participates in national projects covering different regions, such as railroad construction in the suburbs of Caracas, a liquefied natural gas project called "Cristóbal Colón Project," and PROA (Proyecto Orinoco-Apure) project to develop a watershed area along the Orinoco River (Río

Orinoco) and its branch, Apure River (Río Apure).

Politically, Venezuela consists of a federal district including the state capital, 22 states, and a federal territory consisting of islands. The governor of the federal district is a cabinet member and a minister. Governors of the states are appointed by the President.

In 1989, with the increasing demand for decentralization, public election was introduced for 22 state governors. At the same time, regional development corporations such as CORPOZULIA and CORPOSUROESTE have been delegated more power and authority, and their transfer to local government control is contemplated as part of government-wide efforts. For instance, National Ports Corporation (Instituto Nacional de Puertos: INP) under the Ministry of Transportation and Communication is now supervised by local governments, and Southwest Region Coal Development Corporation (Carbones del Suroeste: CARBOSUROESTE) under Venezuela Investment Fund is now under control of CORPOSUROESTE.

Today, a variety of organizations are implementing development projects according to needs and characteristics of each region, which include the following:

- CORPOSUROESTE (Tachira State) leads projects to promote production of local specialties, including cacao, coffee, palm tree, and other temperate products. Also, it plans to induce industrial development by using undeveloped coal and phosphate resources. However, the state is situated inland inaccessible from the major economic region, and the lack of railroad, road, and river transport networks impedes its development.
- CORPOZULIA (Zulia State) is involved in development of the livestock industry – the major economic activity in the state – including the improvement of milk quality, and the improvement of market access for agricultural and livestock products. Also, it is promoting projects to foster dry land farming. Market expansion for coal abundant in the state is also an important activity of the corporation.
- CVG is engaged in promotion and expansion of heavy industries by utilizing rich reserves of iron ores, bauxite, hydroelectric power available in Guayana. It also starts a paper and pulp production project to exploit forest resources developed over vast land.

1.2 Industrial Development Policy and Measures

Venezuela still earns 80% of its exports from petroleum, which forms a unrivaled basis of the country's economy. The country has been attempting to shift its economic structure from overdependence on oil exports by investing oil revenues in industrial sectors, particularly manufacturing industries. Nevertheless, the attempt is far from its accomplishment.

In the past, Venezuela has enjoyed several oil-driven economic booms, the late 1920s, the 1950s, and the 1970s. The first boom was mainly brought by revenues from concessions for exploration and drilling of oil wells granted to foreign companies, which helped the country modernize its military force, improve government finance, and develop government institutions. However, no particular effort for industrialization was initiated during the period.

In the 1950s, the government began to pursue industrialization policy through import substitution designed to protect and nurture domestic industries, including financial assistance and import restriction on competing foreign products. Then, in the 1960s, the government curtailed the granting of concession for development of petroleum resources to foreign companies, while fostering domestic industries actively through various measures.

The initial target was manufacturers of consumer goods to substitute imports, then production of intermediate goods including metal and chemical was started. A state oil company was established and moved into oil drilling and refinery operations.

In the 1970s, while oil production declined from its peak level, the rapid rise in oil prices increased government revenues dramatically. Under the favorable wind for oil producing countries, the government has successfully nationalized the country's oil industry. Then, state enterprises have started production of iron and steel, and aluminum by using abundant reserves of iron ores, bauxite, and hydroelectric power in Bolívar State in Guayana region. Many state enterprises were established during the period to follow suite in other areas.
At that time, domestic industries obtained the ability to mostly satisfy domestic demand for consumer goods. Foreign capital, particularly the U.S., played a critical role. Construction of infrastructure, including power supply, road, and communication, was progressed considerably. At the same time, however, heated investment and consumption eroded foreign currency reserves and increased foreign debts.

In the 1980s, the rise in oil prices caused repercussions in the form of worldwide recession, which led to the decline in oil prices and the decrease in the country's oil revenues. The government's financial condition deteriorated rapidly.
Meanwhile, many state enterprises were poorly managed and recorded operating loss due to various reasons, including small domestic markets, low levels of production technology, poor product quality, and inept management. A primary example was seamless pipes that lacked competitiveness because of unstable delivery schedule, poor quality, and high price.
External debts accumulated rapidly, accompanied by the depreciation of Bolívar (Bs) and high inflation.

One of measures taken by the government to counter the situation was to boost exports of local resources in order to earn foreign currencies. Such measures include:

- Re-expansion of iron ore exports
- Development of coal mines and promotion of coal exports
- Export of oil-related resources not subject to OPEC's ceiling, such as the increase in production and export of natural gas, and export of heavy oil.
- Increase in gold production

In addition, the increase in value added to iron ore production is considered, including increased production of reduced iron briquettes, and production of coke from coal.

After 1989, the country's industrial development policy made a sharp turn from previous ones, partly because of pressure from IMF.
The government led by President Perez, and his successor, acting President Velasquez who took over in the middle of Perez's term, is currently engaged in liberalization of domestic economy and market. This is an austerity policy opposed to the previous protection of domestic industries. The current policy intends to restructure domestic industries, particularly manufacturing industries, through competition with foreign companies, helping them to obtain international competitiveness. To this end, a variety of measures are being taken, including liberalization of foreign trade and currency exchange, promotion of foreign investment, privatization of state enterprises, and liberalization of prices and interest rates.

In accordance with the policy, the opening of domestic markets to foreign products, phased reduction of tariff rates, and acceptance of foreign investment have been initiated. Also, foreign companies can participate in purchase of state enterprises in the process of privatization. In fact, they are encouraged to form joint ventures which are considered as effective means of introducing capital and technology, while creating employment and market opportunities.
The liberalization initiatives have increased imports. However, manufacturing industries share the belief that the participation in a wider regional market is the only way to improve international competitiveness, which is reflected in their committed efforts. They are pleased to see that the liberalization process is now extended to regional economic integration efforts through bilateral and trilateral agreements. Trade negotiations with various countries, including Colombia, Chile, and Mexico, are in progress, and exports are reportedly on the steady rise.

Beside the move toward economic liberalization, the government's industrial promotion policy includes the increase in localization rate and decentralization of factories. Tax incentives are provided for manufacturing industries. Localization is emphasized for the auto industry by setting specific target rates of localization. Similarly, decentralization of factories is promoted through restriction on factory locations and public assistance.

The target localization rates of the auto industry are set for different types of automobiles in each year between 1986 and 1995. The maximum localization rate for 4.6–ton trucks in 1955 is set at 50%, 46% for less than 2,200 cc passenger cars, and 44% for 2,200 cc or larger cars. On the other hand, the minimum localization rate for diesel mini–buses and 12.5–ton or larger trucks is set at 18%. Also, automakers are required to reimburse the amount equivalent to a certain portion of imported automotive parts by exports of finished products or parts.
For other industries, localization of parts and raw materials is sometimes reviewed and required at the time of establishment of a new company or application for approval of a new production project.

The restriction on factory location and public assistance is designed to prevent factories from being concentrated in a limited area, thereby to ensure balanced land development. For this purpose, the entire country is zoned to 4 areas: Caracas metropolitan area – Area A; Valencia and Puerto Cabello – Area B; Barcelona, Barquisimeto, Maracaibo and other major cities – Area C; and the rest of the country – Area D. On the other hand, industries are grouped to 4 categories. Basically, industries are restricted to locate in Area A, while tax and other incentives are offered for factories who locate in Area C or D.

Finally, certain types of industries which meet the government's industrial policy can enjoy corporate tax incentives ranging from 50% to 100% for 5 years from the start of production. Eligible industries are the smelting of iron ores, production and processing of aluminum, production of cement, pulp and paper, and sheet glass, production of raw materials for the above, and development of phosphate minerals.
As for new fixed investment, the corporate tax for the year of investment is subject to exemption.

1.3 Socioeconomic Indicators

Population in Venezuela totaled 14,516,735 in 1981 when the 11th census was taken. (not including unregistered Indians which total estimated 53,350 persons) There were 36 cities with 50,000 or more population, and 84.1% of population resided in urban areas with 1,000 or more population.
Population grew to 18,871,905 in 1989, 19,325,222 in 1990, and 19,786,504 in 1991. The largest city is Caracas, followed by Maracaibo, Valencia, Maracay, and Barquisimeto.

15 years or older population totaled 12,184,103 in 1990. Working population amounted to 7,245,782, of which 6,528,937 were employed and 716,845 unemployed (9.9%). Employment by industry type at the end of 1990 is summarized in Table 1-1.

Table 1-1 EMPLOYMENT BY INDUSTRY TYPE (END OF 1990)

		Persons	Composition (%)
A)	Agricultural sector	808,624	12.4
B)	Non-agricultural sector	5,720,313	87.6
	Oil and mining	(64,446)	(1.0)
	Manufacturing	(1,032,406)	(15.8)
	Electricity, gas, water supply	(65,605)	(1.0)
	Construction	(503,314)	(7.7)
	Commerce, restaurant, hotel	(1,382,888)	(21.2)
	Transportation, warehouse, communication	(395,892)	(6.1)
	Financial, insurance, real estate, personal service	(385,963)	(5.9)
	Public service	(1,881,457)	(28.8)
	Other	(8,342)	(0.1)
	Total	6,528,937	100.0

Source: Department of Statistics and Information

Venezuelans consist of aboriginal Indian, European and other descent immigrated from various parts of world, and those of mixed descent.
In 1800 when population was around 900,000, Indian accounted for 18.4%, European descent 20.3%, and black descent 61.3% (mainly mixed European and black descent).
Since then, Venezuela has been attracting many immigrants, peaked by European immigrants before and after the Second World War, and those from Caribbeans and Latin American countries after then. With a relatively high rate of natural increase in population, Venezuela's

total population grew from around 5 million in 1950 to 20 million at present.

While freedom of religion is guaranteed in Venezuela, 96.2% of population are Christians. In particular, 94.8% are Roman Catholics. Other religions include Islam, Judaism, and indigenous creeds.

Compulsory education is provided throughout the country. Elementary education consists of 6 years, junior high schools 3 years, and high schools 2 years. In 1980, the compulsory education system was extended from 6 years in elementary schools to 9 years in elementary and junior high schools. High schools are divided into general and vocational courses. Post-secondary education is offered at teacher's colleges (3 to 4 years), colleges (2 to 3 years), and universities (5 years). In addition, there are kindergartens for 3 years old.
There are 25 universities, of which 15 are national and 10 are private.

In Venezuela, the president directly elected by popular vote is responsible for administration. The president organizes a cabinet which consists of 16 ministers, heads of 6 government organizations, and a few ministers specially appointed by the president. The president's term is 5 years, and not eligible for re-election until 10 years after the end of his term.
The coming presidential election will be held in December, 1993, and a new president will take office in February, 1994.
There is a bicameral Congress consisting of the Senate and the Chamber of Deputies. Except for ex-presidents becoming permanent members of the Senate, all the members are elected to five-year terms, under the proportional representation system using a fixed candidate list. The judicial system consists of three levels of courts.

Venezuela's administrative divisions are the Federal District including the national capital, Caracas, 22 states, and one territory. The Federal District and states have governors. State governors and mayors are elected by popular vote since 1989. The governor of the Federal District is appointed by the president and is a minister.

Major political parties in Venezuela are relatively new in history and cover a wide range from left to right. After the 1970s, however, two parties - the Democratic Action party (Partido Acción Democrática: AD) and the Christian Socialist party (Partido Social Crstiano: COPEI) - advocating social democracy have been dominating the political system.

The country's economy is generally described by major economic indicators shown in Table 1-2 and Table 1-3.

Table 1-2 shows sectorial breakdown and growth rates of GDP, and Table 1-3 summarizes recent changes in major economic indicators.

The decrease in the value of oil exports, combined with the increase in imports, has caused a deficit in the international balance of payments. Given the weight of oil exports (accounting for 80% of total) on government revenues, the decline in oil exports has directly affected government finance to turn into the red. In addition, inflation is under way and the local currency – Bolívar – has been depreciated significantly.

Table 1-2 SECTORIAL BREAKDOWN AND GROWTH RATES OF GROSS DOMESTIC PRODUCTS (GDP)

(Unit: million, Bolívares, %)

Industrial Sector	1990		1991		1992	
		(%)		(%)		(%)
Total	478,320	6.5	527,927	10.4	566,562	7.3
Agriculture	25,483	-1.8	26,303	3.2	26,931	2.4
Hydrocarbons	106,564	13.9	117,541	10.3	115,355	-1.9
Manufacturing	79,816	7.4	88,449	10.8	99,110	12.1
Electricity and water	8,123	5.1	8,854	9.0	9,551	7.9
Construction	23,576	7.7	30,826	30.8	36,006	16.8
Commerce, restaurant, hotel	60,013	3.8	70,931	7.5	82,540	16.4
Other	168,745	4.0	185,023	9.6	197,069	6.5

Source: 1993 President's Message

Table 1-3 MAJOR ECONOMIC INDICATORS (1990-92)

(million dollars, %)

Year	1990 (Growth)		1991 (Growth)		1992 (Growth)	
Trade balance	10,735	–	5,026	–	1,779	–
Export	17,278	33.8	15,127	–12.4	14,049	–5.7
Oil	13,780	39.7	12,233	–11.2	11,443	–6.5
Non–oil	3,498	14.6	2,894	–17.3	2,606	–10.0
Import	6,543	–10.2	10,101	54.4	12,270	21.5
Current account	8,279	–	1,663	–	–3,727	–
International balance of payments	3,225	–	3,183	–	–1,507	–
External debt	26,671	–1.8	26,518	–0.6	27,240	2.7
Foreign currency reserve	11,759	55.8	14,105	20.0	12,728	–9.8
Average exchange rate ($/Bs)	47.2	48.3	56.9	20.5	68.4	20.2
Unemployment rate (%)	9.9	–	9.0	–	8.0	–
Inflation rate (%)	36.5	–	31.0	–	32.0	–
Commercial bank lending rate (%)	34.9	–	37.7	–	41.4	–

Source: Central bank's monthly reports, 1993 President's Message, and the January 7, 1993 issue of "Economia Hoy" magazine

1.4 Natural Condition, Geography and Geology

Venezuela is located in the northern part of the South American Continent, between 0'45" and 12'12" N.L. and between 59'48" and 73'12" W.L. It faces the Caribbean Sea (Mar de Caribe) on north, and is bounded by Guyana on the east side, Brazil on the south side, and Colombia on the west side. It has land area of 912,000 km^2, equivalent to 2.4 times that of Japan.
When its territory is added by the Esequibo region under the subject of the territorial dispute with Guyana, Venezuela is shaped like an elephant which faces west and is about to raise its nose.

Topographically, the country can be divided into several regions.
The Andes (Los Andes) runs from the international border in the southeast area to northeast and reaches a coastal area in the middle of the country. Then it extends along the coast from the central to the eastern part and disappears into the Caribbean Sea near the Paria peninsula (Península de Paria). Along the western border, the Perija mountain range (Sierra de Perija) – a branch of the Andes – runs in a roughly north–south direction. Between the Perija mountains and the Andes there are Lake Maracaibo (Lago de Maracaibo), a salt lake, and surrounding plains, as well as Venezuela Bay.
In the southern part, there are many table mountains, generally called the Guayana Plateau or the Roraima Plateau, forming watersheds along international borders with Brazil and Guyana. Mountains gradually become lower toward north. Between the Andes and the Guayana plateau is a vast prairie called Los Llanos, through which the Orinoco River, the third largest river in South America, together its numerous branches including Apure and Caroni, flows down to the Atlantic while forming a large delta. The western part of Los Llanos forms a relatively wet plain, and the central and eastern parts a dry plateau.
There are islands in the Caribbean that belong to Venezuela.

Geographically, the main part of the country is located within the northeast trade wind zone, and dominant wind is east or northeast. The Guayana Plateau in the southern part is situated in the tropical rain forest climate zone, with the annual maximum precipitation reaching nearly 4,000mm. On the other hand, the Paraguana peninsula (Península de Paraguana) and its surroundings are characterized by near the desert climate, with the annual average precipitation of around 400mm, and less than 100mm some year. Other areas are mostly situated in the savanna climate zone marked by dry and rainy seasons. Annual precipitation ranges between slightly less than 1,000mm and 2,000mm, depending upon local topography.
Highlands in the Andes offer a unique climate zone in the country. With the highest peak at around 5,000m above the sea level, several peaks of Andes are covered by permanent snow and ice. At the same time, there are strips of temperate and frigid climate zones at certain altitudes.

Highlands in the Andes have much precipitation, with the annual maximum precipitation exceeding 3,000mm.

The highland areas, as well as flat areas or basins in the mountains at altitudes around 500m – 1,500m are characterized by mild temperature, with the daily average temperature and the annual average temperature being around 20 degrees centigrade, and are suitable for human settlement. As a result, Venezuela's major cities are developed in relatively highland areas, including Caracas, Maracay, Valencia, Barquisimeto, Mérida, and San Cristóbal.
At the same time, there are many cities developed around ports and harbors and other strategic locations, including Maracaibo, Coro, Puerto Cabello, La Guaira, Barcelona, Puerto la Cruz, Cumaná, Ciudad Guayana, and Ciudad Bolívar.

The Guayana Plateau is covered by the Precambrian formation, the world oldest geological formation, and is quite stable. The Andes and the Perija mountains are also made up of the Paleozoic formation in part. At the same time, most portions of the Andes are active in orogeny, as known by the Caracas earthquake in 1967. They are also very unstable and often flow out soils during torrential rain.
Venezuela produces coals from the relatively young Mesozoic and Cenozoic Tertiary formations, rather than the Paleozoic Carboniferous formation.

1.5 Laws and Regulations Related to Environmental Control, Labor and Tax

Environment-related laws and regulations are summarized as follows.
As for pollution control, major laws are the Environmental Organization Law (Ley Orgánica del Ambiente) established in July, 1976, and the Environmental Penal Code (Ley Penal del Ambiente) established in January, 1992.
There are various decrees issued under the Environmental Penal Code. Important decrees are listed in Table 1-4.

Table 1-4 IMPORTANT DECREES RELATED TO ENVIRONMENT CONTROL

Decree No. 2213	Environmental impact assessment
Decree No. 2217	Noise control
Decree No. 2221	Discharge control on Lake Valencia and its surrounding waters
Decree No. 2223	Discharge control on Lake Maracaibo and its surrounding waters
Decree No. 2224	Discharge control on general waters
Decree No. 2225	Air pollution control (exhaust gas control)

Among them, regulations related to noise, water discharge to Lake Maracaibo and its surrounding waters, water discharge to general waters, and exhaust gas are summarized in Table 1-5, Table 1-6, and Table 1-7.

The decrees were promulgated on April 23, 1992. Regulations related to water quality are provided with a 2-year grace period, and those related to air quality with a 3-year grace period.

As for regulations related to business location, the Land Planning Law (Ley Orgánica para la Ordenación del Territorio) established in August, 1983, and the City Planning Law (Ley Orgánica de Ordenación Urbanísta) established in December, 1987, in addition to the Environmental Organization Law, restricts unplanned factory siting. In particular, coke furnaces and similar facilities are allowed to be constructed only in industrial areas under the Land Planning Law.
On the other hand, the Local Decentralization Law (Ley Orgánica de la Administración Central) of December, 1987, and the Amended Local Decentralization Law (Ley Orgánica de Decentralización, Delimitación y Transferencia de Competencias del Poder Público) of December, 1989, set forth restrictions on factory location and public assistance to promote decentralization.

The Labor Law (Ley de Trabajo) was established in 1936 and has been amended several times since then. The recent amendment was made in 1990 and was enacted in May, 1991. Partly because social democratic parties have been in power for a long period of time, the law reportedly provides for relatively favorable conditions for workers.

For instance, the original law had the provisions covering 8 working hours per day, retirement allowance, profit sharing by workers, and annual vacation.

The present law requires a certain percentage of Venezuelans in the total number of employment and payroll at each business establishment, and has the provisions prohibiting sexual discrimination, the provisions related to the minimum wages, allowances for overtime and nighttime work, protection of workers against dismissal, and the advance borrowing of retirement allowance.

The country's taxation system is founded upon oil-related taxes, followed by business income tax collected from the mining sector. Also, corporate income tax on non-oil and non-mining sectors, personal income tax (resident and non-resident), commodity tax, technical training tax, business tax, and import and export duties are imposed. Business tax is collected by local governments.

Oil companies are required to pay exploration tax, drilling tax, area tax, production tax, consumption tax, transportation tax, and oil business income tax. Business income tax on the mining sector other than the oil industry is imposed at a uniform 60%. Also, oil and mining companies are required to pay tax on dividend earned.

As mentioned earlier, the Venezuelan government has been earning most of its revenues from oil sales. The slump in oil prices since the late 1980s has therefore caused government revenues to reduce and fluctuate significantly. In particular, overestimation of oil prices during annual budget compilation has created huge budget deficits in recent years. To solve the problem by securing stable revenue sources, thereby reducing the overdependence on oil revenues, the Perez government which took power in 1989 proposed tax reforms as part of its economic reform policy. However, it faced a strong opposition from the Congress, and the implementation of tax reforms was postponed to delay appropriate actions to reduce budget deficits, which prolonged inflationary pressure.

At present, Ramon Velasquez is serving as the acting president until February, 1994, but the Delegation of Powers Law (Ley habilitante) has granted to President Velasquez the authority to approve important bills by presidential decrees without passing the Congress. In addition to tax reforms, the amendment of the Privatization Law, and a large project in the oil sector are considered under the Delegation of Powers Law. The above project and value-added tax have been approved under the law, and the value-added tax has been imposed since October 1, 1993.

Table 1-5 REGULATORY STANDARDS FOR NOISE FROM FACTORIES IN VENEZUELA

(Unit: dB(A))

Zone \ Time	Daytime 6:30 - 9:30pm	Nighttime 9:31pm - 6:29am	Applicable Areas
I	55	45	Areas where quiet is particularly needed to preserve a good living environment
II	60	50	Areas where quiet is needed for as they are used for residential purposes.
III	65	55	Areas used for commercial and industrial as well as residential purposes where there is a need to preserve the living environment.
IV	70	60	Areas mainly serving industrial purposes which are in need of measures to prevent the living environment of local residents from deteriorating.
V	75	65	Areas where go along the edge of highways and airports.

Source: Ley Penal Ambiente

Table 1-6 EMISSION STANDARDS OF DISCHARGED WATER IN VENEZUELA

(Unit: mg/l, excluding pH, temp., color)

Item	Lake Maracaibo & Related		Others (excluding Lake Valencia)		
	(Direct)	(Sewer)	(River & Lake)	(Marine)	(Sewer)
pH	6 – 9	6 – 9	6 – 9	6 – 9	6 – 9
SS	50	400	60	60	400
Total solid	–	–	1,500	–	1,600
Solublues	3,000	1,200	–	–	–
BOD	40	400	60	60	350
COD(Mn)	150	1,000	350	600	900
Hydro Carbon & Mineral Oil	20	30	20	20	20
Oil	30	100	20	20	150
As	0.1	0.5	0.5	0.5	0.5
Alkyl-Hg	non	non	non	non	non
Hg	0.01	0.01	0.01	0.01	0.01
Cd	0.1	0.2	0.2	0.2	0.2
Phenol	0.05	0.5	0.5	0.5	0.5
CN(–)	0.1	0.2	0.2	0.2	0.2
Cr(+6)	0.1	0.5	0.5	0.5	0.5
Pb	0.5	0.5	0.5	0.5	0.5
Org-P	0.05	–	0.25	0.25	–
Org-Cl	0.02	–	0.05	0.05	–
Total Cr	2.0	3.0	2.0	2.0	3.0
F	0.5	10	10	10	10
Total Al	1.0	20	5.0	5.0	10
Ba	5.0	0.1	5.0	5.0	10
Br	–	3.0	–	–	–
Co	0.5	0.5	0.5	0.5	0.5
Cu	0.5	3.0	1.0	1.0	1.5
Detergent	2.0	8.0	2.0	2.0	8.0
P	1	3	1	3	20
Total Fe	10	25	10	–	25
Mn	2.0	10.0	2.0	–	10.0
Ni	2.0	0.5	2.0	2.0	2.0
Total N	10	40	10	10	80
Ag	0.1	0.1	0.1	0.5	0.1
Se	0.05	0.2	0.05	0.2	0.2
SO4	–	400	–	–	400
S	0.5	2.0	0.5	2.0	2.0
V	–	2.5	–	–	5.0
Zn	2.0	2.0	5.0	10	10
Biocide	–	0.05	–	–	0.05
Temp ( )	30	40	–	–	40
Color (Pt-Co)	under 500	–	under 500	under 500	–

Note: Exclude Radio Isotope, Floating Solid, Bubble
Source: Ley Penal Ambiente

Table 1-7 EMISSION STANDARDS OF AMBIENT AIR IN VENEZUELA

Examples for coke plant

Item	Type of Facility	Type of Fuel	Capacity	Emission Standard (mg/m3)
SO2	Power plant	Coal		
		(bituminous)		2,400
		(Lignite)		9,000
		Fuel oil		4,500
	Process Furnace	Coal		
		(bituminous)		2,400
		(Lignite)		6,000
		Fuel oil		5,000
	H2SO4 plant	(cat. contact)		2,850
	Coke plant*			500
NO2				300 **
Soot & Dust	Power plant	Coal	less than 50MW	400
			50 – 200MW	300
			more than 200MW	200
		Fuel oil	less than 50 MW	250
			50 – 200MW	175
			more than 200MW	150
	Incinerator	Coal	less than 500MW	350
			more than 500MW	250
		Residual solid	less then 1t/h	350
			1 – 3t/h	250
			3 – 7t/h	200
			more than 7t/h	150
	Coke plant*			150
	Refinery Process furnace			120
H2S	Coke plant			2,000
	Refinery			7.5
H2SO4	H2SO4 plant	(cat. contact)		300

Note: * Include sub–products recovery
** ppm

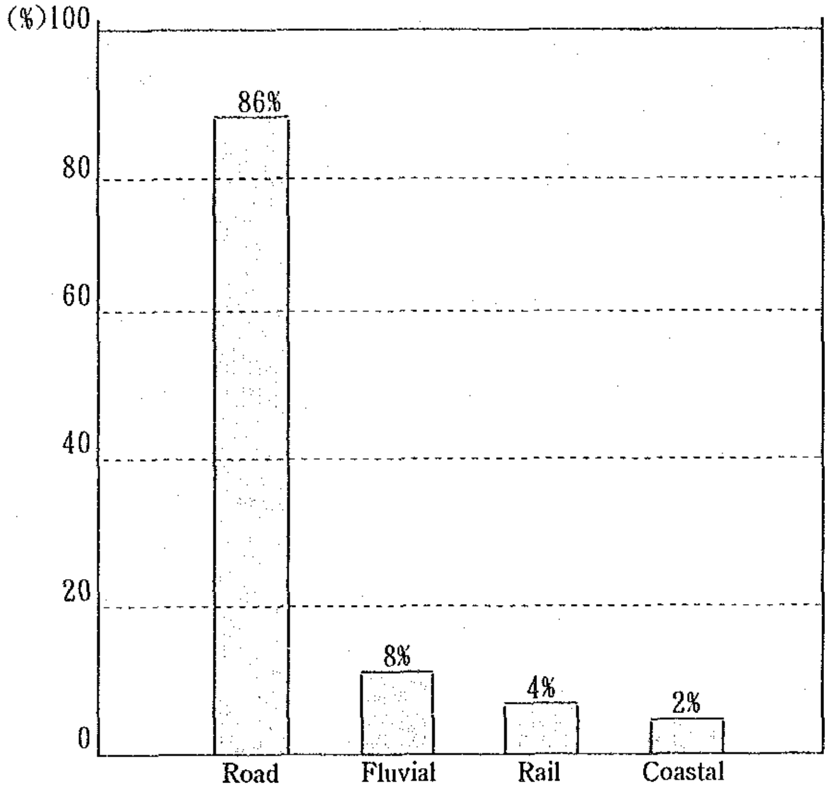
Source: Ley Penal Ambiente

Chapter 2 Existing Infrastructure

Chapter 2 Existing Infrastructure

2.1 Modes of Transportation

Major modes of transportation in Venezuela are road, fluvial transport, railroad and coastal transport. Among them, road transport accounts for 86% of total traffic volumes and thus plays a critical role in the country's transportation sector.



Source: PROA

Fig.2-1 MODAL SHARE IN VENEZUELA'S TRANSPORTATION MODES

2.1.1 Road Transport

Fig.2-2 shows a general view of road networks in Venezuela. As major industrial and commercial activities in the country are distributed roughly in an east-west direction (new industrial areas in the east, in and around Cumaná and Barcelona, Caracas metropolitan area in the center, and Maracaibo – the oil production center – and San Cristóbal – a strategic point in trade with Colombia – in the west), the trunk of nationwide road networks is formed along the Pan-American Highway between San Cristóbal and Caracas, from which arterial roads are

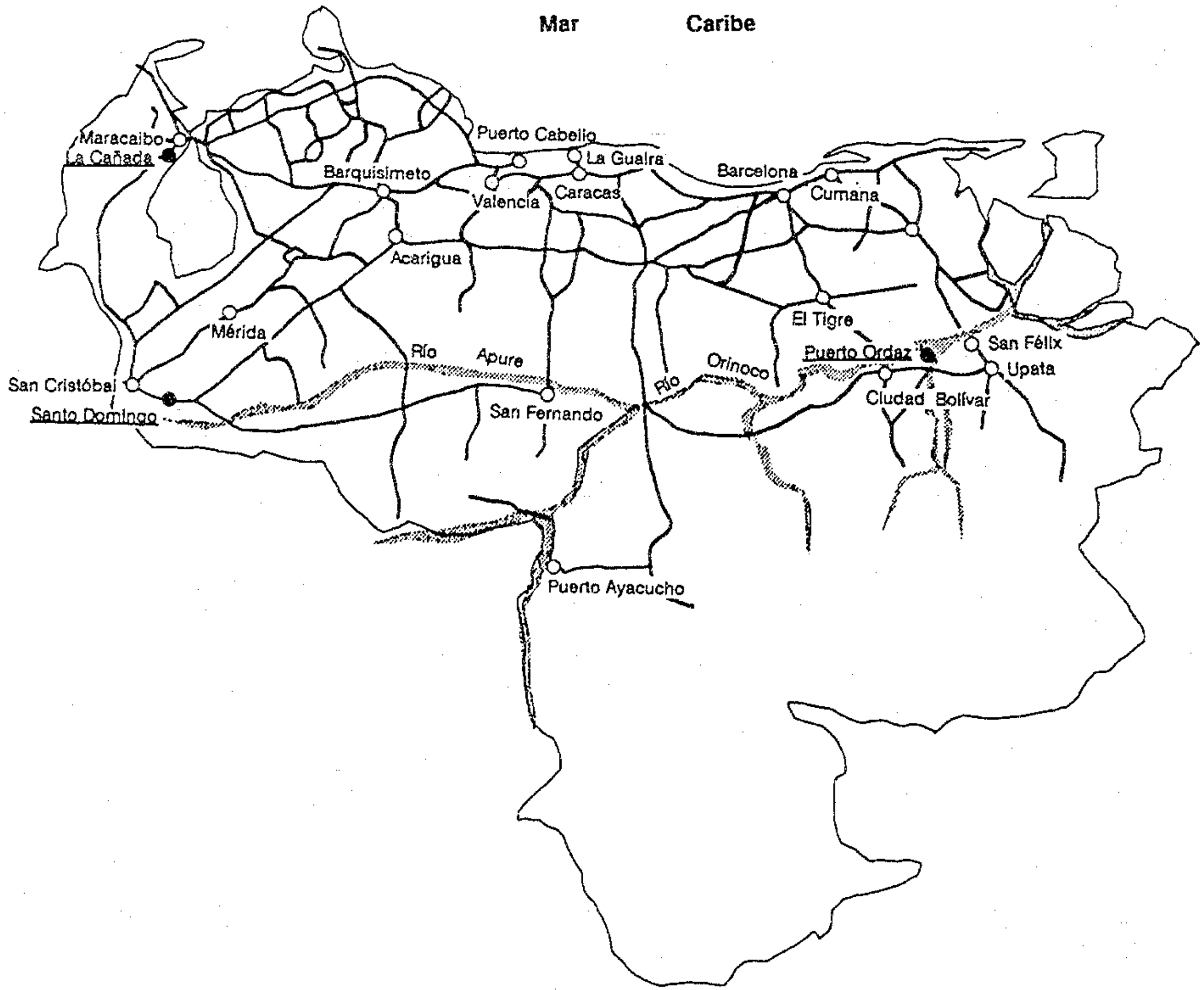


Fig.2-2 OUTLINE OF MAJOR ROAD

extended to major cities in the north. In contrast, industrial and commercial activities are much less intensive in the area along the Orinoco River which flows the central part of the country in an east–west direction, and in the south thereof. Accordingly, road networks are not so much developed as those in the northern part. Note that most of roads in the country, including major highways, have only two lanes.

According to 1986 World Road Statistics of International Road Federation (IRF), the total road length in Venezuela is 100,571km.

(1) Road conditions

Table 2–1 summarizes total road length by type of road, the percentage of pavement, and automobile ownership in selected countries in North and South America.

Table 2–1 ROAD CONDITIONS IN SELECTED COUNTRIES

	Year of investigation	Road length (km)	National/ arterial road (km)	Regional road (km)	Other (km)	Pavement rate (%)	Automobile ownership (1,000 vehicles)
U.S.	1989	6,237,290	654,773	701,820	4,880,697	58.2	187,261
Canada	1989	879,530	145,724	134,054	599,752	31.8	16,270
Mexico	1989	237,057	46,610	57,894	132,553	34.6	8,923
Argentina	1986	211,369	37,306	174,063	-	27.1	5,497
Chile	1987	79,223	10,320	32,780	36,185	13.0	886
Brazil	1990	1,670,148	114,908	219,735	1,355,734	9.7	13,070
Venezuela	1986	100,571	36,307	37,886	26,377	33.1	2,086

Source: IRF, World Road Statistics 1988, 1989, 1991

The pavement rate of 33% in Venezuela is the highest among South American countries, indicating that road networks are relatively well developed in the country. The number of automobiles per 1km of road is 20 in Venezuela, compared to 30 in the U.S., 18 in Canada, 37 in Mexico, 26 in Argentina, 11 in Chile, 7.8 in Brazil, and 50 in Japan (as of 1990).

(2) Road features

1) Design speed

Standard design speeds are regulated according to types of road and local topographic conditions, as shown in Table 2–2.

Table 2-2 STANDARD DESIGN SPEEDS FOR ROADS IN VENEZUELA

Type of road/topography		Design speed(km/h)
Expressways	Flat	90 - 120
	Mountain	80 - 110
Arterial roads	Flat	90 - 120
	Hill	80 - 100
	Mountain	50 - 80

2) Sectional design features

The maximum car width and height are specified as 2.6m and 3.9m respectively by a decree issued under the Land Transportation Law. The standard width of each lane is set at 3.6m by adding safety allowance of 0.5m on each side to the 2.6m width.

2.1.2 Fluvial Transport

Venezuela has a major river system consisting of the Orinoco River and its branches, which basin area covers around 80% of the entire country, as shown in Fig.2-3.
The Orinoco River is 2,060km long, joined by branch rivers of Ventuari, Caura, Caroni, and Aro from the right side, and Guaviare, Meta, Arauca, Apure, Vichada, Portuguesa, and Guarico from the left side.

There are two navigation channels from the Atlantic to the Orinoco River. One passes the north side of the Orinoco delta, and the other runs the south side. The north channel is assessable to shallow-draft ships. On the other hand, the south channel is navigational by large freight ships from Boca Grande at the mouth of the bay to Puerto Ordaz located 343km upstream, and further 18km to the Matanzas iron ore loading port. It is always dredged to depths of 9.7m in the dry season and 13.4m in the rainy season.

A publication by Institute Nacional de Canalizaciones in 1991 indicates features of the Orinoco River, as shown in Table 2-3.

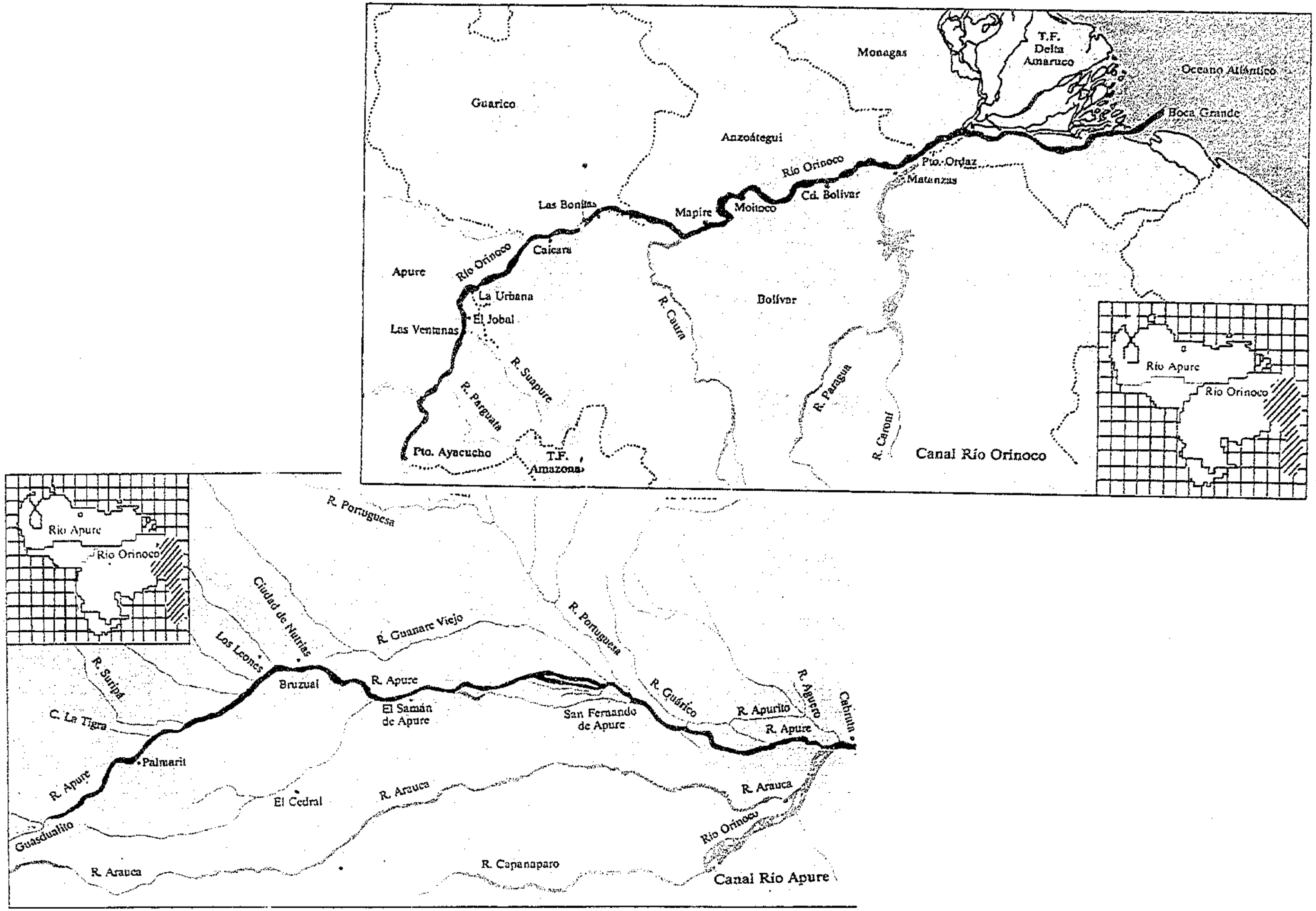


Fig.2-3 FLUVIAL SYSTEM OF ORINOCO

Table 2-3 MAJOR FEATURES OF ORINOCO RIVER LENGTH

Distance	Matanzas–Boca Grande 361 km Constantly dredges	El Jobal–Matanzas 645 km
Width	91.8 to 183 m	100 m
Water depth	Minimum 9.7 m Maximum 13.4 m	Minimum 2.5 m
Navigational tonnage	80,000 MT (ship)	3,500 MT (barge)

Major items carried on the river include iron ores, bauxite, heavy oil, and general cargo. Table 2–4 shows recent changes in tonnage carried by type of cargo. According to a report of Institute Nacional de Canalizaciones in 1991, approximately 21 million tons of cargo were carried by 857 ships. Of total, iron ore accounted for 67%, general cargo 26%, heavy oil 5.1%, and bauxite 1.9%.

Table 2-4 RECENT CHANGES IN CARGO CARRIED ON ORINOCO RIVER, BY TYPE OF CARGO (1,000 TONS)

Year	1985	1986	1987	1988	1989	1990	1991
Total	19,085	18,899	20,425	22,290	23,311	22,368	21,517
–Heavy oil (Petroleo)	3,293	2,813	2,307	1,753	1,110	1,020	1,099
–Iron ore (Hierro)	10,121	10,657	12,311	14,076	15,155	15,163	14,468
–General cargo (Cargo general)	5,389	5,222	5,582	6,248	6,779	5,923	5,635
–Bauxite (Aluminio)	282	207	225	213	267	262	315

Source: Institute Nacional de Canalizaciones

Major features of ports along the Orinoco River, based on information obtained from CVG Rio Orinoco Authority, are summarized in Table 2–5.

For industrial development and promotion in the Guayana area, CVG is contemplating a construction plan for an industrial port in Ciudad Guayana. The plan consists of a 920m dock for small ships and barges and a 4,230m dock for large ships, capable of loading 2 million tons of cargo annually.

Table 2-5 PORT CHARACTERISTICS OF THE REGION GUAYANA

Port	Docks	Capacity (ton)	Berths	Length (M)	Equipment	Equipment	Storage Facilities
VENALUM	Marginal, steel structure with paved slabs	500,000	2	384	Mixed	Two 35 mt portal crane each one suction system and conveyor belt. One transfer system.	Two 25,500 mt silos. 15,000 mt yard.
SIDOR	Fixed with concrete structure	Section I 1,300,000	2	332	Bulk	Two 22 mt unloaders, 3.5 m^3 clam sheels. 10 m^3 arm clamps.	68,000 m^2 yard. Ten 3,000 m^2(30x100)
		Section II 600,000	2	387	General	Six semi–portal cranes with two 25 mt hooks each.	warehouses each, of which 4 are covered.
		Section III 900,000	2	319	Mixed	One 400 mt roating crane Three 25 mt portal cranes each.	
CEMENTOS GUAYANA	Floating	258,000	1	128	Bulk	Pumping equipment and pipes.	Storage silos.
OIL TERMINALS		10,000	2	200	Bulk		Storage tnaks.
SAN FELIX	Floating	200,000	1	120	General Bulk	Two 10 mt cranes each.	21,000 m^2 yard. Two covered storehouses. (355 and 179 square meters) Silos for cereals.
PALVA MINERALERO	Floating	8,000,000	1	122	Bulk General	One 45 mt crane. One 4,000 mt/h loader.	One million mt yard. 1,000 mt yard.
	Marginal		1	241.2		One 2,500 mt/h conveyor band system.	
FEROMINERA	Marginal, steel structure and piles	Sections I and II 24,000,000	1	575	Bulk	One 4,000 mt/h loader.	7,200,000 mt yard.
		Section III 360,000	2		General	One 118 mt movable crane. Two 35 mt movable crane. One 15 mt movable crane. Two 4 mt hoists each.	500 m^2 storehouse. 1,000 m^2 yard.
INTERALUMINA	Fixed marginal steel structure and piles	5,000,000	2	365	Bulk	Two 25 mt unloaders each. One 1,220 mt/h conveyor band. One 528 mt/h unloader band. One 1,000 mt/h loader	295,000 mt yard. 221,050 mt yard. 48,000 mt yard.
ALCASA	Floating two barges fixed in pile dolphines	500,000	1	91	Bulk	Two hoppers. One conveyor band.	7,000 mt and 35,000 mt storehouses. Two 2,400 mt silos each. Two 4,000 mt silos each

Development of the Orinoco/Apure river basin

(Project of Orinoco & Apure: PROA)

The PROA will cover total length of 1,800km. A master plan is currently prepared to secure navigational channels on the Orinoco/Apure river system in order to develop resources in the central and southwestern parts of the country, particularly Tachira State. As the first step, various plans are being considered to secure navigability for 8 months between the mouth of the Apure River and the confluence in Portuguesa.

2.1.3 Railroad

(1) Current situation

There are only two rail lines in Venezuela; a 170km line connecting Acarigua and Puerto Cabello, via Barquisimeto and Morón; and a 197km government-owned line for transportation of iron ores in Bolívar State.

There is an abandoned 120km line between San Félix in Tachira State and Uraca near Maracaibo, which was operated between 1896 and 1950.

As a result, railroad transport accounts for a meager 2% of total traffic volumes carried in Venezuela. Recent changes in rail traffic volumes in Venezuela and the U.S. are shown in Table 2-6.

Table 2-6 RECENT CHANGES IN RAIL TRAFFIC VOLUMES IN VENEZUELA (COMPARED TO THE U.S.)

(Unit: Million)

Year	United States		Venezuela	
	Passenger (Million passenger·km)	Freight (Million ton·km)	Passenger (Million passenger·km)	Freight (Million ton·km)
1982	16,966	1,191,844	19	29
1983	17,606	1,237,428	22	22
1984	16,564	1,345,480	12	11
1985	17,649	1,280,394	8	14
1986	8,069	1,283,736	17	12
1987	8,639	1,388,388	22	18
1988	9,156	1,467,672	29	40
1989	9,396	1,482,024	38	39

Source: U.N., Transportation Statistics

(2) Railroad construction projects

According to "Short-, Medium-, and Long-Term National Railroad Plans 1992 (Plan Ferroviario Nacional, a Corto, Mediano y Largo Plazo, 1992)" published by Railways Corporation (Ferrocar), construction of an arterial railroad network totaling 3,073km is planned between 1990 and 2020. As shown in Fig.2-4, the planned network will link major cities and production bases in consideration to interface with road, water, and air transport networks.

A railroad construction project, which is also designated in the 8th National Development Plan as the short-term project, is called the south-west system. It will connect the north side of the Andes and Maracaibo and will be used to transport coal and phosphate produced in Tachira State to the Maracaibo port for export. The plan also envisages that the system will be able to attract Colombian coals which are currently carried on road.

The system will consist of the following two lines:

Line 1 : La Fria - Maracaibo (365km)

Line 2 : La Fria - La Ceiba - Barquisimeto (501km)
A La Fria - La Concha section (110km) will be constructed in phase 1.

The La Fria - La Concha section will be given the highest priority for development of coal and phosphate mines in northern Tachira.

A feasibility study on the section was conducted by Lavalin International of Canada and a report was submitted in September, 1991. The study compares the proposed railroad transport service with existing roads of 400km, under the following assumptions:

a) 3 million tons of coal and phosphate will be exported through the Maracaibo port.
b) The proposed railroad will be used as part of the following intermodal system:

Mines - La Fria industrial park	(40km)	: Truck
La Fria - La Concha	(110km)	: Rail
La Concha - Maracaibo port	(200km)	: Barge

The study compared operation costs for road transport and the proposed intermodal system, and concluded that the latter would be more cost effective than the former. (Table 2-7)

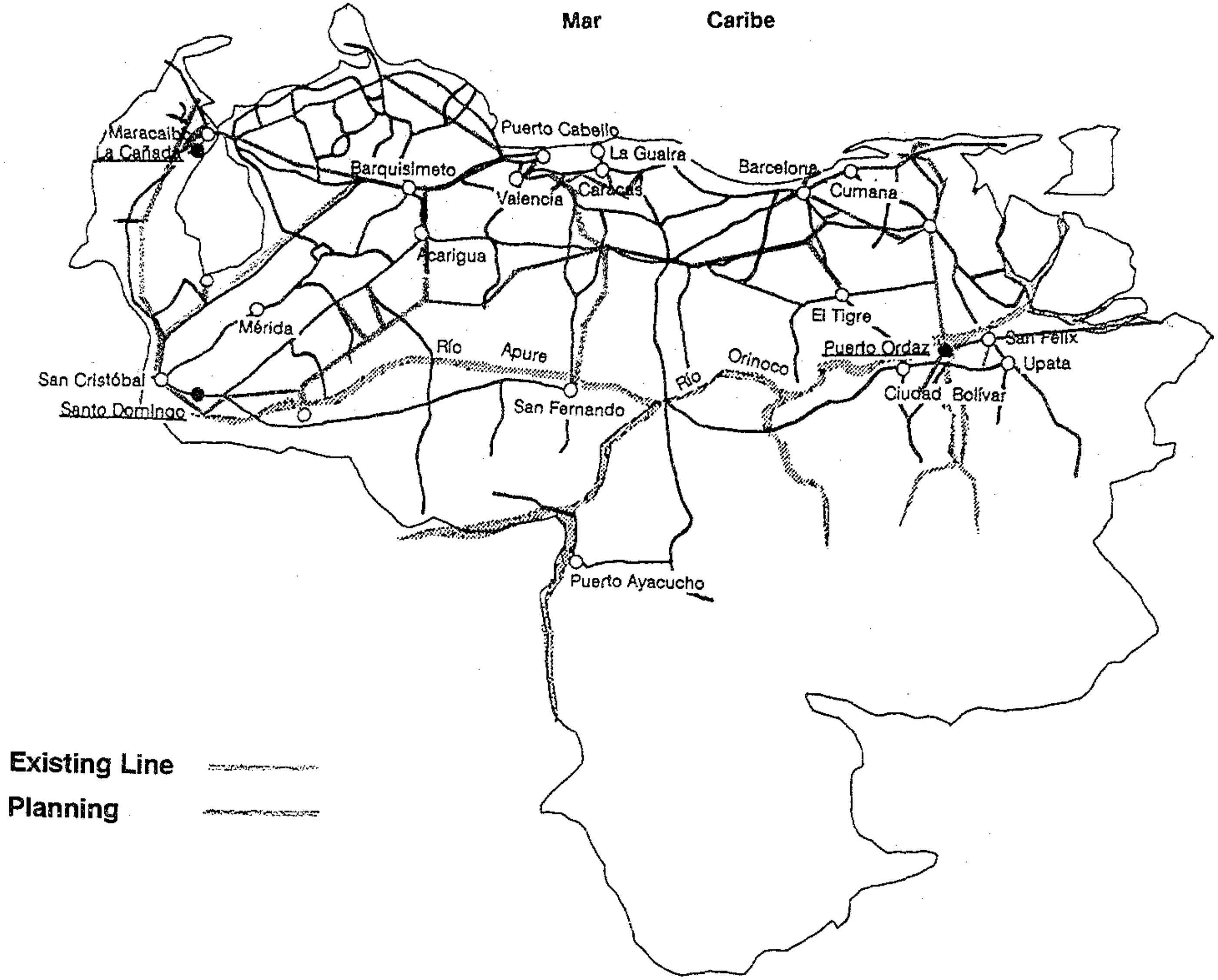


Fig.2-4 EXISTING & FUTURE RAIL ROAD LINE

Table 2-7 COMPARISON OF OPERATION COSTS

	400 km road	Intermodal system
Maintenance/operation cost total (Million US$/year)	8.40[1]	7.24[2]
Government subsidy for road repair (Million US$/year)	5.00	
Loading cost at Maracaibo Port (Million US$/year)	15.00	Included in operation cost
Total (Million US$/year)	28.40	7.24
– per ton (US$/ton)	9.46	2.40
Depreciation	11.50	7.26
– per ton (US$/ton)	3.83	2.43

NOTE: 1991 base

1) Including the purchase of 500 42–ton trucks.

2) Including the purchase of 60 42–ton trucks.
Including required fleet of rolling stock and transshipping equipment.

2.2 Port and Harbor

Major ports in Venezuela have been operated by the port authority INP, but President's Message 1993 has indicated that their management would be transferred to local governments. At present, there are 8 international ports in Venezuela(Fig.2–5). Table 2–8 shows freight tonnages (general cargo + bulk) handled at each port.

Table 2-8 FREIGHT VOLUMES HANDLED AT INTERNATIONAL PORTS (GENERAL CARGO - BULK)

Port Name	1987	1988	1989	1990	1991
Total	7,807,541	9,707,866	6,641,941	6,573,235	8,386,523
La Guaira	1,616,428	2,110,698	1,396,420	1,640,033	1,938,138
Maracaibo	772,217	1,117,057	746,292	639,021	840,952
Puerto Cabello	4,929,594	6,766,867	3,833,576	3,641,060	4,455,823
Guanta	329,277	437,534	468,184	445,503	838,333
Puerto Scure	58,778	111,708	47,795	32,526	65,683
Carupano	–	22,445	18,268	15,070	31,398
Guaranao	86,296	115,884	106,552	129,143	175,823
El Gamache	14,951	25,673	27,854	30,879	40,373

Source: INP

According to 1991 statistics, Maracaibo is the third largest port handling general cargo, next to Puerto Cabello and La Guaira. It handled 840,952 tons of cargo in 1991, of which general cargo amounted to 485,509 tons and bulk cargo 355,443 tons. Bulk cargo is mostly coal, while coffee accounts for significant portions.

The Maracaibo port has 11 wharves, which lengths and depths are shown in Table 2–9.

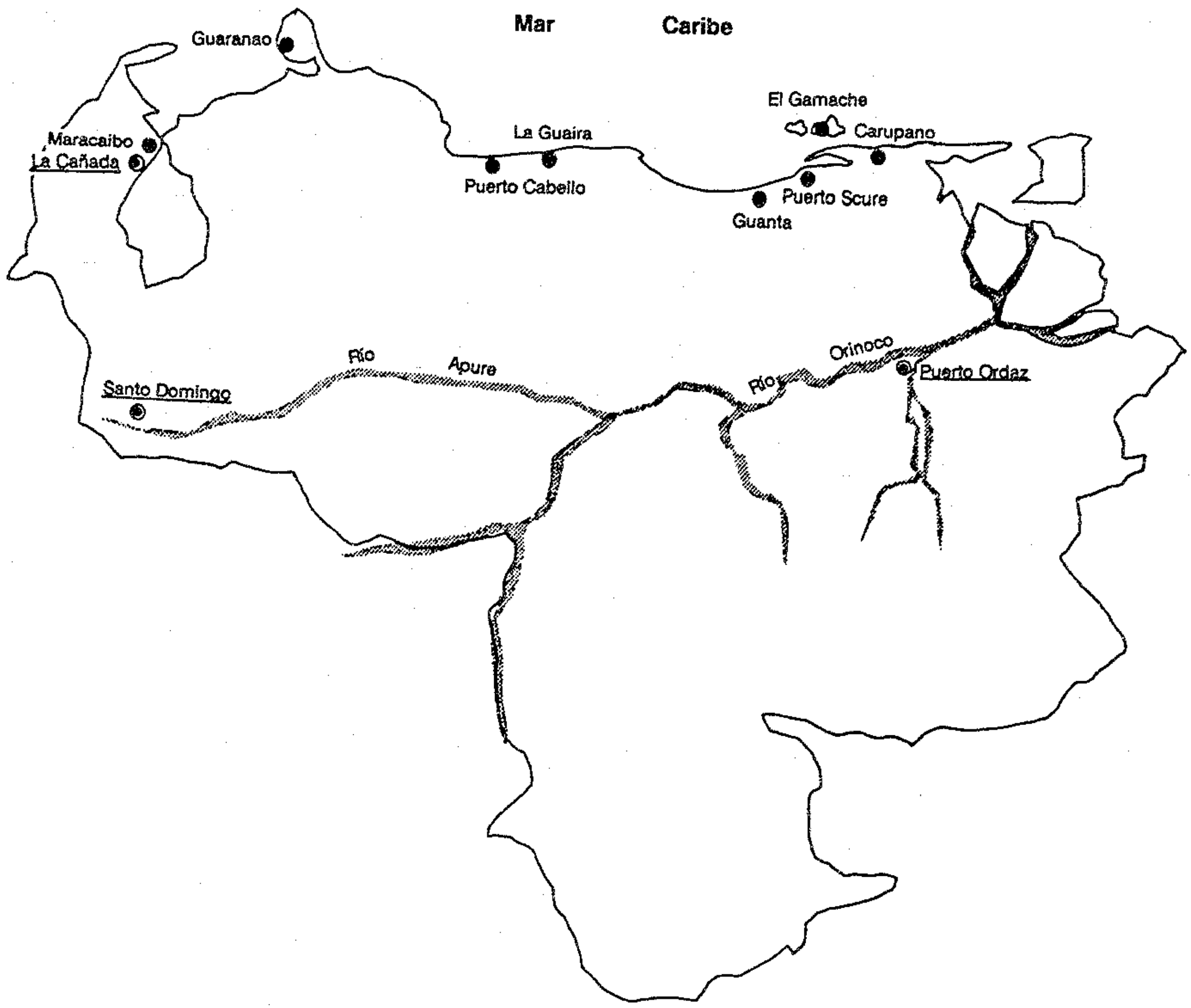


Fig.2-5 INTERNATIONAL PORT IN VENEZUELA

Table 2-9 WHARVES AT MARACAIBO PORT

Wharf No.	Length (m)	Depth (ft)
1	106	19
2	106	19
3	159	20
4	159	22
5	135	22
6	135	22
7	135	22
8	135	22
9	120	22
10	120	22
11	120	22

In addition to the Maracaibo general cargo port, there are large company–operated oil terminals on the east bank of Lake Maracaibo, including Puerto Miranda, Cabimas, La Salina, Bachaquero, and San Lorenzo. (Fig.2–6)

Each terminal is accessible through navigation channels outside the lake and inner channels within the lake. Outer channels are dredged to – 12.8m. Inner channels are said to be 30m or deeper in the middle of the lake, but they are dredged according to loading capacities of visiting ships. Note that a 5–knot speed limit, together with height restriction of 45.0m, is imposed on ships passing under the El Puente General Urdaneta bridge which crosses a strait south of Punta Piedras situated on the opposite side of Maracaibo City.

Weather conditions in the area is described in "Sailing Directions" published by Defense Mapping Agency Hydrographic/Topographic Center, as follows:

Weather: Weather is very unstable. The annual average temperature is 28 °C. Strong northeast wind blows in the outer area between November through April. 10 to 55 knot strong wind blows in the evening between February and April. There are squalls accompanying strong east wind which occasionally reaches 50MPH, lasting half an hour to one hour. The rainy season is between May through October. The annual average precipitation ranges between 400mm and 500mm, including short strong rains.

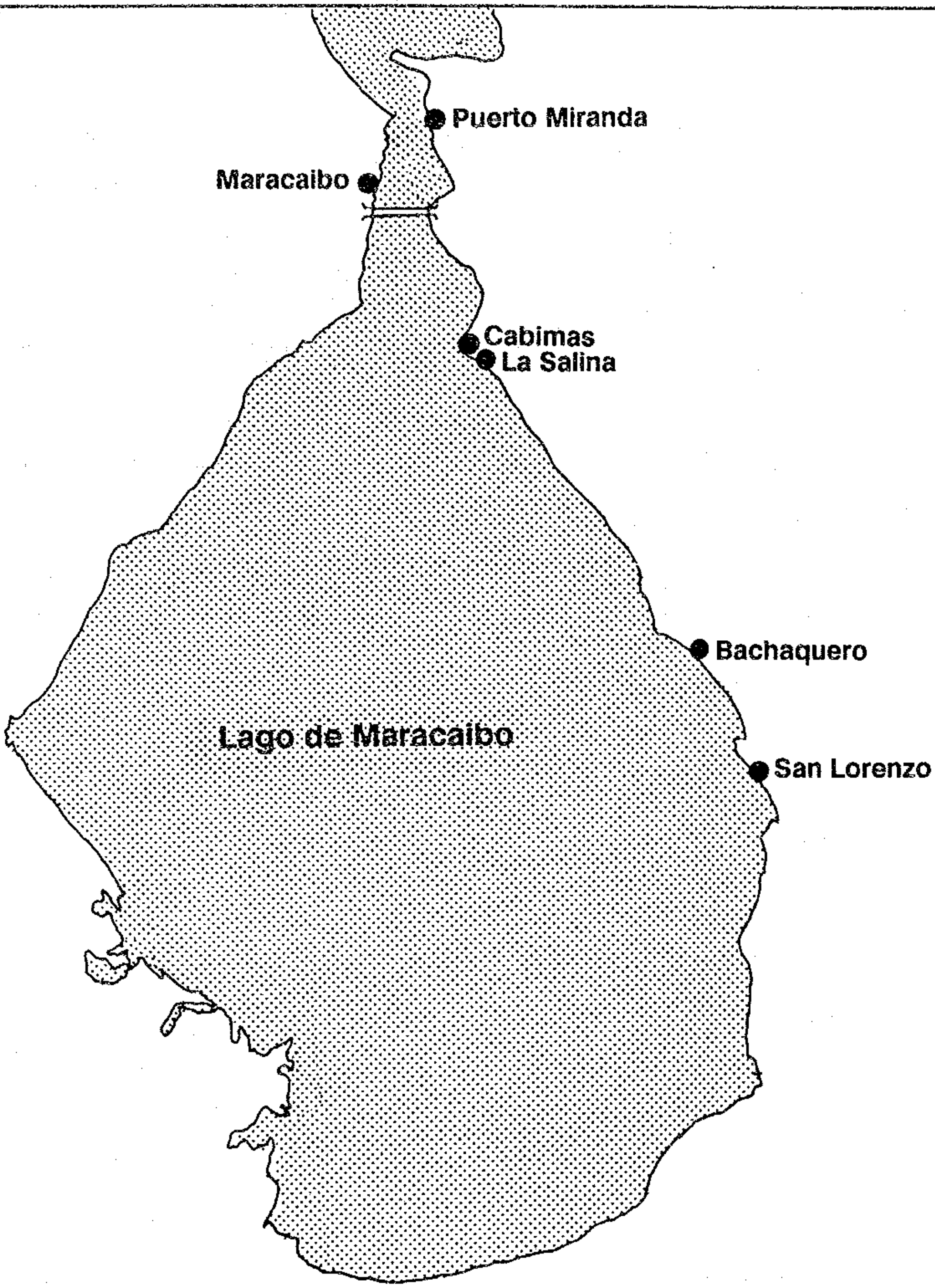


Fig.2-6 PRIVATE PORT IN LAKE MARACAIBO

2.3 Public Utilities

2.3.1 Electricity

In Venezuela, 12 power companies including 5 state-owned companies are operated. 5 state-owned power companies, C.V.G. Electrificación del Caroni (EDELCA), C.A. de Administración y Fomento Eléctrico (CADAFE), C.A. Energía Eléctrica de Venezuela (ENELVEN), C.A. Energía Eléctrica de Barquisimeto (ENERBAR), and C.A. Energía Eléctrica de la Costa Oriente (ENELCO), supply 80% of electricity requirements in the country. The largest private power company is Electricidad de Caracas (EdeC or ELECAR) based in Caracas metropolitan area.

The total installed capacity as of 1991 was 17,763MW, of which EDELCA's Guri power plant accounted for 10,000MW. Total power generation in 1991 was 60,304GWH. Power consumption by power companies in 1991 is summarized in Table 2-10.

Table 2-10 POWER CONSUMPTION BY POWER COMPANIES

Company Name	Power Consumption (GWH)
Total	47,500
State enterprises	37,760
* EDELCA - C.V.G. Electrificación del Caroni	17,100
* CADAFE - C.A. de Administración y Foment eléctrico	13,980
* ENELVEN Note 1) - C.A. Energía Eléctrica de Venezuela	4,600
* ENELBAR Note 2) - C.A. Energía Eléctrica de Barquisimeto	1,100
* ENELCO - C.A. Energía Eléctrica de la Costa Oriente	980
Private enterprises	9,740
* EdeC or ELECAR - C.A. Electricidad de Caracas	5,650
* CALEV - C.A. Luz Eléctrica de Venezuela	2,380
* ELEGGUA - C.A. Electricidad de Guarenas-Guatire	400
* CALEY - C.A. Luz Eléctrica de Yaracuy	130
* ELEBOL - C.A. Electricidad de Ciudad Bolívar	280
* CALIFE - C.A. Luz y Fuerza Eléctrica de Puerto Cabello	240
* ELEVAR - C.A. Electricidad de Valencia	660

Source : Camara Venezolana de la Industria Eléctrica (CAVEINEL)
Note : 1) includes C.A. Luz Eléctrica de Perija (LEPCA).
2) includes C.A. Planta Eléctrica de Carora (CAPEC).

EDELCA, which is under supervision of CVG, is responsible for power generation and transmission using abundant water resources of the Caroni River and supplies electricity to major companies in the Puerto Ordaz district. It has the largest generation capacity among other power companies, which are responsible for power generation, transmission, and distribution in each service area. Among them, CADAFE distributes electricity to 94% of the entire area and is said to be the largest power company in the country. On the other hand, ENELVEN serves the west side of Lake Maracaibo in Zulia State, ENELCO the east side, and ENELBAR the entire Lara State including Barquisimeto.

As shown in Fig.2–7, a nationwide power transmission network is developed to distribute electricity produced at EDELCA's Guri and Macagua hydropower stations and EdeC's Tacoa thermal power plant, and CADAFE's Planta Centro thermal power plant.

The power transmission grid, completed a decade ago, has virtually eliminated electricity shortage, except for instantaneous and local voltage drop and outage due to lightning, and has the ability to meet increasing demand.
At present, Venezuela sells electricity to Colombia.

As part of restructuring of state enterprises, FIV is reorganizing CADAFE, ENELVEN, and ENELBAR. In fact, the area on the east bank of Lake Maracaibo, in Zulia State, previously served by CADAFE, has been separated as ENELCO. CADAFE may be divided into several holding companies which will operate power distribution and generation companies in the Andes, west, central, and east areas. Also, privatization of ENELVEN, ENELBAR, and ENELCO is being considered.

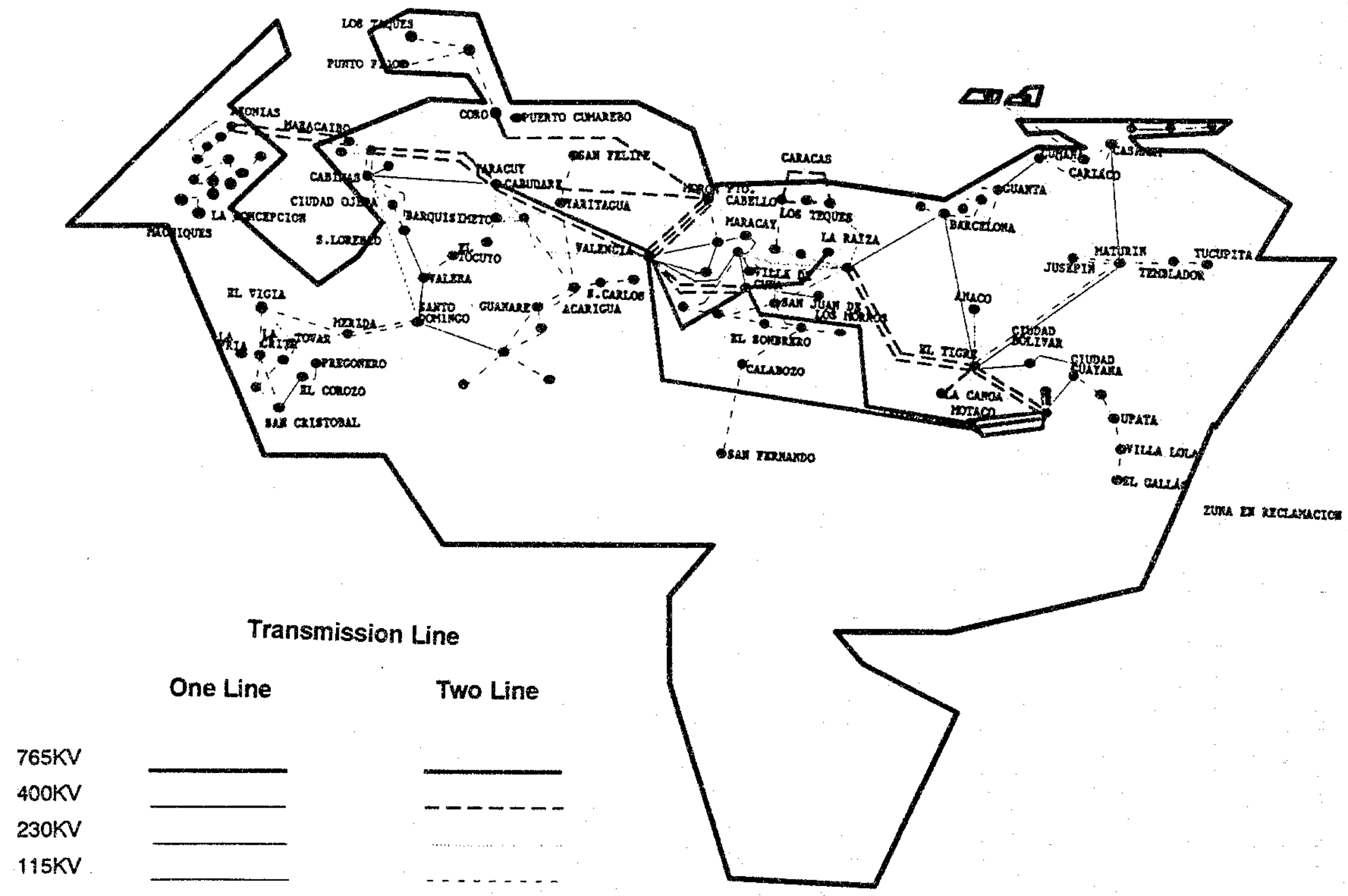


Fig.2-7 OUTLINE OF TRANSMISSION LINE

2.3.2 Fuel Gases

In Venezuela, development and management of petroleum and natural gas resources are monopolized by the state under a special law. Drilling, distribution, and sales of oil and natural gas are handled by 3 companies under a state-owned Petroleum Campany, Petroleos de Venezuela, S.A. (PDVSA), namely LAGOVEN S.A., MARAVEN S.A., and CORPOVEN S.A.

According to PDVSA's 1992 annual report, 116.3 x 10^6m^3/day of natural gas were produced and used for the following purposes:

Re-injection	: 37.3 x 10^6m^3/day
Consumption by Petroleum Institute subsidiaries	: 31.3 x 10^6m^3/day
Sales to the domestic market	: 38.5 x 10^6m^3/day

Re-injection means the returning of natural gas into a well in order to maintain pressure in the well and to maximize the duration of oil drilling in and around the well.

In addition, 112,600bbl/day of liquefied natural gas (LNG) and ethane were produced in 1992.

LAGOVEN and MARAVEN are mainly responsible for drilling of oil and natural gas in Zulia State in the west, while CORPOVEN is active in Monagas State and Anzoategui State in the east.
Natural gas produced in Zulia State is collected and transported by MARAVEN to Ulé on the west bank of Lake Maracaibo and by CORPOVEN to El Tablazo on the west bank of a strait connecting Venezuela Bay and Lake Maracaibo, for separation of gas constituents. Propane and butane so separated are used for LPG and high-grade gasoline, ethane and propane as raw materials for petrochemical products (ethylene plant), methane gas for urea production, fuel for thermal power generation, for Amuay and Cardón refineries, and for urban gas in Maracaibo and its surrounding communities.
LPG contained in cylinders is supplied to Tachira State.

On the other hand, natural gas produced in Anzoategui State is collected and transported by CORPOVEN to Anaco for separation of gas constituents. Gas mainly consists of methane is sent through pipelines to the Puerto Ordaz district, the Puerto La Cruz district, Caracas, Valencia, and Moron and Barquisimeto. Propane and butane residues are used as LPG fuel which is supplied to both the domestic and export markets.

Methane is used as a reducing agent for steel making and boiler fuel in the Puerto Ordas district, raw materials for petrochemical products (ammonia and urea) and thermal power generation in Moron, and urban gas in other cities. Recently, it is also used as a raw material for petrochemical products in José near Puerto La Cruz. A pipeline network transporting natural gas in the country is shown in Fig.2-8, and LPG's supply and distribution networks in Fig.2-9.

At the time of hearing in August, 1993, the average price of fuel gases mainly consisting of methane was 3.5Bs/m^3 in La Cañada, and 1.4Bs/m^3 in Puerto Ordaz. This price differential reflects the fact that natural gas resources are being fully exploited in the west, while still abundant in the east.

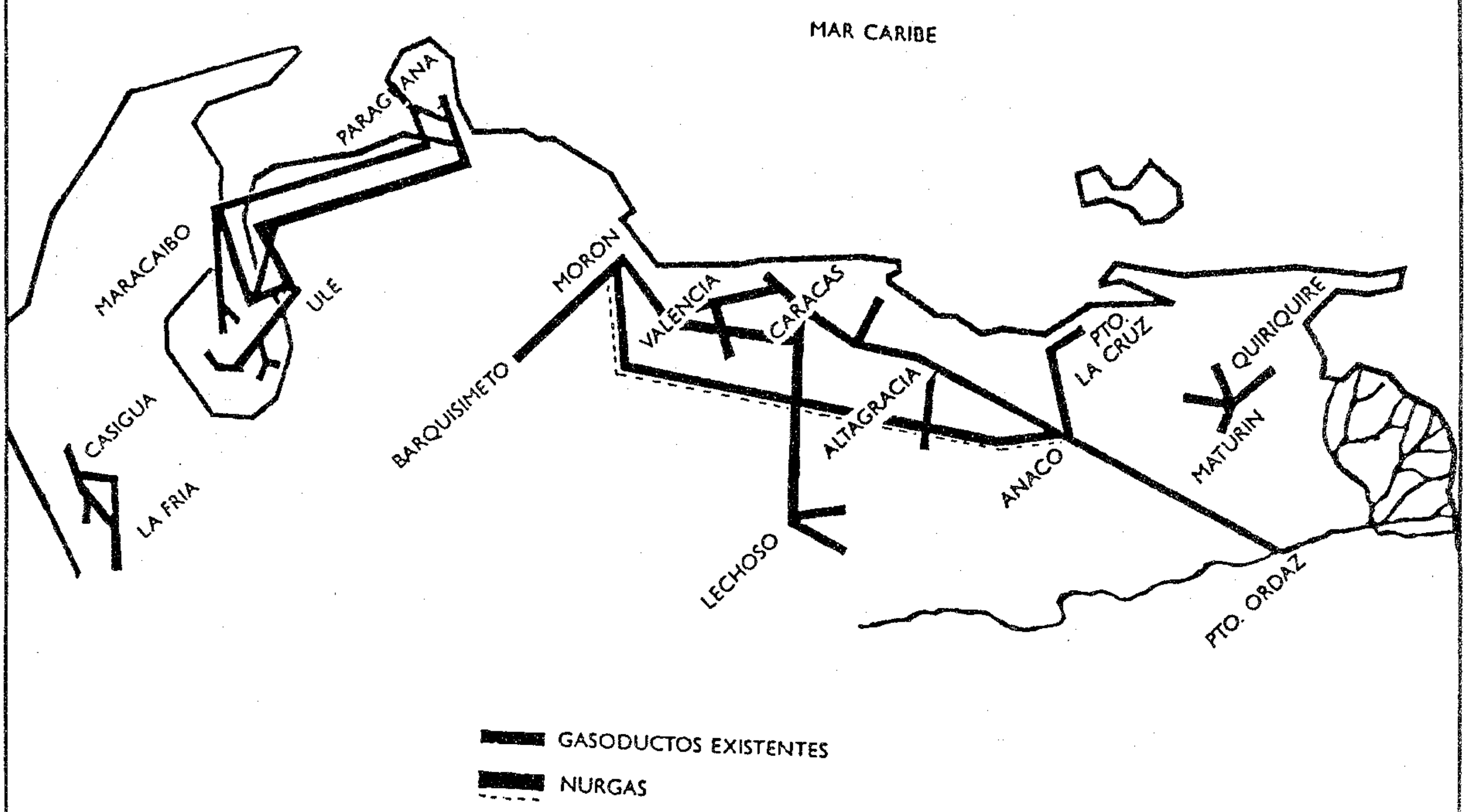


Fig.2-8 NATURAL GAS PIPELINE NETWORK

Source: MEM

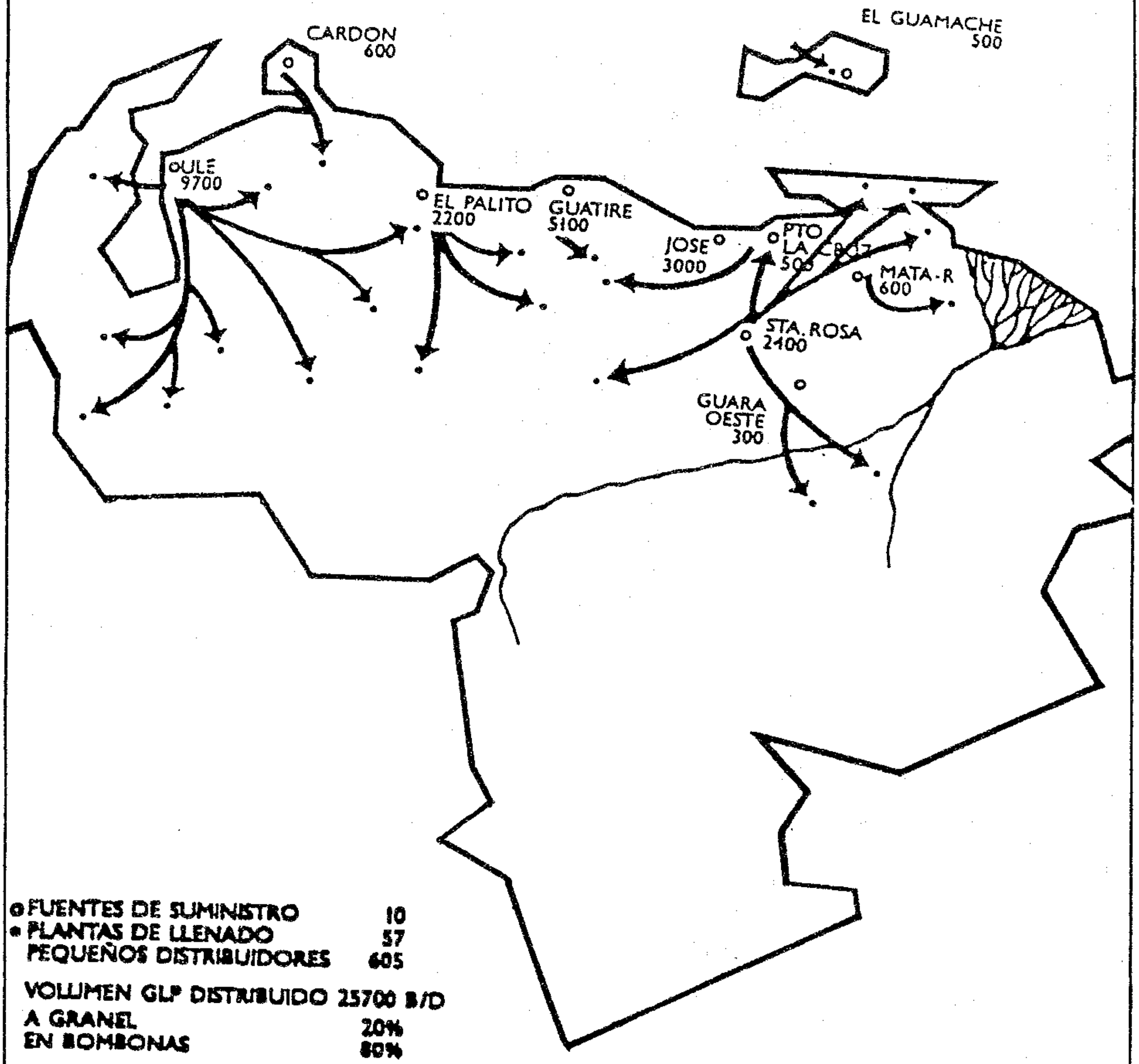


Fig.2-9 LPG SUPPLY AND DISTRIBUTION

Source: MEM

2.3.3 Public Water

In Venezuela, water resource management is handled by various authorities, which are summarized as follows.

Water resource in general	Ministerio del Ambiente y de los Recursos Renovables – MARNR
City sewerage	Instituto Nacional de Obras Sanitarias – INOS
Rural sewerage	Local sanitary corporation
City water	C.A. Hidrológia Venezolana – HIDROVEN
Rural water	Local water supply corporation
Water source and watershed management	MARNR
Hydropower generation	CVG, EDELCA, others

Ministerio del Ambiente y de los Rcursos Renovables (MARNR) is primarily responsible for management of water resources in Venezuela, covering almost all the aspects of water resources including facility operation, utilization, control, administration, and planning. Furthermore, MARNR manages projects for construction and maintenance of hydrographic structures, irrigation channels, urban water supply, hydropower generation, flood and erosion control, and inland water transport.

Water supply and sewerage in urban areas has previously been managed by Instituto Nacional de Obras Sanitarias (INOS). INOS has been divided into local self-accounting public corporations which are under supervision of newly established Venezuela Waterworks Corporation, which is responsible for planning, public relations, and financial matters. The local public corporations are moving toward privatization.
On the other hand, local water supply and sewerage services are under supervision of Ministerio de Sanidad y Asisténcia Social (MSAS).

As of 1992, estimated 72% of households in Venezuela are served by public water supply service, and 56% by public sewerage. Since large cities in Venezuela are mostly located in mountain areas and it is critical for them to secure water sources for their residents. On the other hand, there are few final sewage treatment plants and water contamination is presenting a serious problem in recent years.

Chapter 3 Demand Forecast for Cokes and By-Products

Chapter 3 Demand Forecast for Coke and By-Products

3.1 General

3.1.1 Domestic Markets

Since there is no blast-furnace steel mill in Venezuela, nor plan for construction, all blast-furnace coke to be produced by the proposed coke oven will have to be exported. On the other hand, there is domestic demand for coke breeze, and 30,000 tons produced annually at beehive ovens in Tachira State are sold at Bs 6,300 per ton (July - August, 1993). As for by-products, domestic markets for crude tar and benzene are relatively small, and all of them produced in the proposed project will be exported in unrefined forms. Finally, ammonium sulfate is already produced at other sources and can be sold to the domestic market, or to the international market.

3.1.2 Export Markets

(1) Blast-furnace coke

When demand forecast is examined for the next two decades, there are potential markets in the U.S., Brazil, and Europe for blast-furnace coke to be produced by the proposed plant at a rate of 1 million tons annually.

In the U.S., crude steel production is expected to remain unchanged or decrease slightly in future. Coke demand will decrease due to an increasing use of the Pulverized Coal Injection (PCI) method, and proliferation of the mini-mill or the direct reduction method. Furthermore, steel making methods which do not use coke, such as fused reduction, have been developed and can be widely accepted in the future. However, they are not likely to proliferate to an extent which significantly affects coke demand, in consideration to the need for amortizing massive investment in existing blast furnaces. Coke supply will decrease at a pace exceeding the anticipated decrease in coke demand, partly due to the aging of existing coke ovens, the accelerated closing of old plants and the difficulty in construction of new ovens due to increasingly strict environmental regulations. In 1992, the U.S. imported 2 million tons of coke. In the future, however, an annual deficit of 6 million tons is anticipated to necessitate imports of 1 million to 3 million tons of coke produced by newly constructed ovens. At present, the U.S. is mainly importing coke from Japan, Australia, and Canada. Industry analysts expect China to boost its export. Thus, Venezuela can expect the U.S. to be the most prospective market for its coke exports, but has to carefully examine its competitive position against the other exporting countries.

In Brazil, there are more than 80 steel mills using charcoal in the state of Minas Gerais, which produce a combined total of 7.2 million tons of crude steel. Assuming that the coke ratio is slightly over 45% and the whole amount of charcoal currently used is replaced by coke, annual coke demand amounts to 3.3 million tons. At present, the steel mills are evaluating two alternatives to the current use of charcoal which causes extensive forest destruction, namely increased reforestation to boost charcoal supply sources or conversion to coke. If the latter is selected, coke demand will reach the above amount at maximum. Brazil does not produce much coking coal and has to import suitable coal if coke is to be produced locally.

Finally, crude steel production in the EC is on the declining trend, and coke demand will decline accordingly. At the same time, many coke ovens are aging and are expected to be shut down in the near future. The closing of existing coke ovens will result in decrease in coke supply by 11 million tons in the next decade. New coking capacity to be constructed in the future is estimated at 2 million tons annually. The PCI method is widely used in comparison to Japan and the U.S. and further proliferation is not likely, thus not working as a major factor in decreasing coke demand. Overall, coke will become short supply in the EC as a whole. However, strong competition is expected from nearby exporting countries, such as Russia and Poland, so that the EC may not be an attractive market compared to the U.S.

(2) Coke breeze

From the 1 million ton coke plant, 850,000 tons of blast-furnace coke and 150,000 tons of coke breeze will be produced. Venezuela consumes approximately 30,000 tons of coke breeze, which is supplied by existing beehive ovens. Thus, the entire amount of coke breeze will be exported. Major users include integrated steel plants which consume coke breeze in the sintering process before the blast furnace, in amount equivalent to 10% of total coke demand for blast furnaces.

Coke breeze prices in the U.S. were averaged at US$40 per ton between 1985 and 1989, 40% of US$100 for blast-furnace coke.

(3) By-products

Since there is small demand for products derived from crude tar and benzene in Venezuela, and the amounts of crude tar and benzene produced from the proposed coke oven will be below the minimum economic capacity of a refining plant, namely 30,000 tons and 10,000 tons respectively, it is not economical to construct a new refining facility for the project, and it is desirable to export crude tar and benzene without refining. In fact, there are enough refining facilities and markets for the products in the U.S. and Western Europe, and various companies such as ATOCHEM in France and RUETGERS in Germany are ready to buy these products.
Ammonium sulfate is already produced by PEQUIVEN in the country. Estimated 20,000 tons can be sold to the domestic market by using the existing distribution network. Any surplus can be sold to the international market.

3.2 Demand Forecast

3.2.1 Blast-Furnace coke

Worldwide production of blast-furnace coke ranged between 300 million and 320 million tons between 1984 and 1988. In 1988, 310 million tons were produced, of which 36 million tons originated in North America, 2.4 million tons in South America, 150 million tons in Western Europe, USSR and Eastern Europe, 1.5 million tons in Africa, 120 million tons in Asia, and 3.8 million tons in Oceania. As for international trade, the U.S. imports a total of 2 million tons annually during the same period, the EC 1 million – 1.5 million tons, and other areas 1 million tons, totaling 3.5 million tons, equivalent to 1% of total production.

Blast-furnace coke, in principle, is produced at each steel mill to meet its own demand. It is sometimes purchased from outside sources, mainly coal companies or specialized coke makers which mainly produce coke for casting, urban gas, and by-products recovery.

Thus, coke users meet increasing demand firstly by increasing internal production, then purchase from outside supply sources on a long-term contract basis, and finally other makers and foreign sources. On the other hand, if demand decreases, procurement from outside sources, particularly imports, is to be cut back first. That means, purchasing coke from foreign suppliers is rather used as a means of adjusting temporary supply and demand imbalance, and although it is usually made in the form of long-term contract, in which quantities and prices are revised on an annual basis, making it very unreliable for suppliers. In particular, prices vary greatly with supply and demand, often below long-term production costs of suppliers as well as above affordable prices for buyers. While coking coal and coke prices are theoretically correlated, their prices on the international market are subject to significant fluctuation. Fig.3-1 shows yearly changes in prices of coking coal and blast-furnace coke in the U.S.

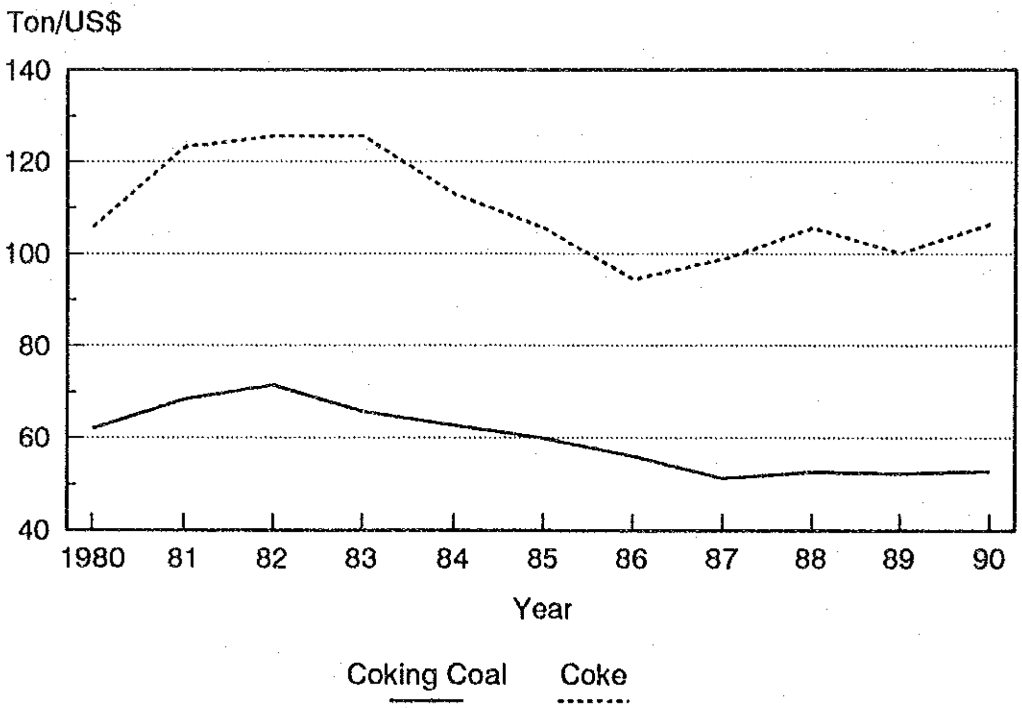


Fig.3-1 RECENT CHANGES IN PRICES OF COKING COAL AND COKE IN THE U.S.

(1) United States

Coke demand is governed by crude steel production. Crude steel production in the U.S. has been continuing flat and gradual decline trends, which are expected to prevail over the next decade according to the forecast of Department of Energy (DOE). Crude steel is produced either at integrated steel plants which process pig iron from the blast furnace by using a conversion or open-hearth furnace, or at electric furnace makers which use pig iron, scraps, or iron produced by the direct reduction.

Recent coke supply and demand trends in the U.S. are summarized in Table 3-1.

Table 3-1 COKE SUPPLY AND DEMAND TRENDS IN THE U.S.

(Unit: Million Ton)

	1985	1986	1987	1988	1989
Pig iron production	45.4	39.6	43.6	50.1	50.3
Consumption of blast-furnace coke (a)	23.4	20.1	23.0	26.5	26.3
Coke ratio	0.508	0.507	0.527	0.528	0.52
Coke consumption for other uses, and inventory changes (b)	-0.1	0.3	0.2	1.4	1.9
Coke exports (c)	1.0	0.9	0.5	1.0	1.0
Total demand (a+b+c)	23.9	21.3	23.7	28.9	29.2
Coke production	23.4	21.0	22.9	26.5	27.1
Imports	0.5	0.3	0.8	2.4	2.1
Total supply	23.9	21.3	23.7	28.9	29.2

Source: United States Department of Interior; Mineral Issues, Sept. 1991

As mentioned earlier, pig iron and crude steel production in the U.S. will remain flat or decline slightly in the future. In particular, pig iron production by blast furnaces will decrease due to proliferation of DR(Direct Reduction) and electric furnaces. Furthermore, an increasing use of the PCI method for blast furnaces will result in decrease in coke consumption required for pig iron production.

Demand forecast for blast-furnace coke in the U.S. is shown in Table 3-2.

Table 3-2 DEMAND FORECAST FOR BLAST-FURNACE COKE IN THE U.S.

(Unit: Million Tons)

	1995	1998	2003
Iron and steel production	54	54	54
- Production at mini-mills	2.7	4.5	4.5
- Production at non-blast furnace facilities	0	0.9	1.8
- Production at blast furnaces	51.3	48.6	47.7
Pig iron demand at steel/pig iron ratio of 0.9	46.2	43.7	42.9
- 0.5-ton coke/pig iron ratio (using coke)	37.1	22.3	14.3
- 0.4-ton coke/pig iron (including PCI)	9.1	21.4	28.6
Coke demand			
- For 0.5 ton coke/pig iron	18.5	11.2	7.2
- For 0.4 ton coke/pig iron	3.6	8.6	11.4
Total coke demand	22.1	19.8	18.6

Source: United States Department of Interior; Mineral Issue, Sept. 1991

On the other hand, major factors leading to the decrease in coke supply in the U.S. are the deterioration of coke ovens due to aging and the influence of the Clean Air Act. In total, the decline in coke production will exceed that in demand. Service years of existing coke ovens in the U.S., at present and in future, are tabulated below. In particular, the Clean Air Act is expected to play a critical role, and its strict regulation will make it difficult to operate 21 years or older plants in 1993 and 1994, and 11 years or older plants in 1998.

Table 3-3 CLOSING OF COKE OVENS

(Unit: Capacity-Million Tons)

	1991			1993-1995 or after			1998 or after		
	No. of ovens	Capacity	%	No. of ovens	Capacity	%	No. of ovens	Capacity	%
5 years or less	2	0.5	2.4	2	1.1	7.1	8[1]	4.5	38.5
6 - 10 years	9	4.5	19.9	2	0.5	3.6	12[2]	7.2	61.5
11 - 15 years	14	7.7	33.9	9	4.5	29.6			
16 - 20 years	3	1.4	6.4	14	7.7	50.2			
21 - 25 years	2	0.5	2.0	3	1.4	9.5			
26 - 30 years	4	1.4	6.4						
30 - 35 years	12	2.8	12.3						
36 years or less	19	3.8	16.7						
Total	65	22.6	100.0	30	15.2	100.0	20	11.7	100.0

Source: United States Department of the Interior; Mineral issues, Sept. 1991

In consideration to the above factors, coke supply and demand situations in the U.S. are forecast as follows.

1) New Plant

2) New non-polluting plant plus upgraded plant

Table 3-4 COKE DEMAND FORECAST

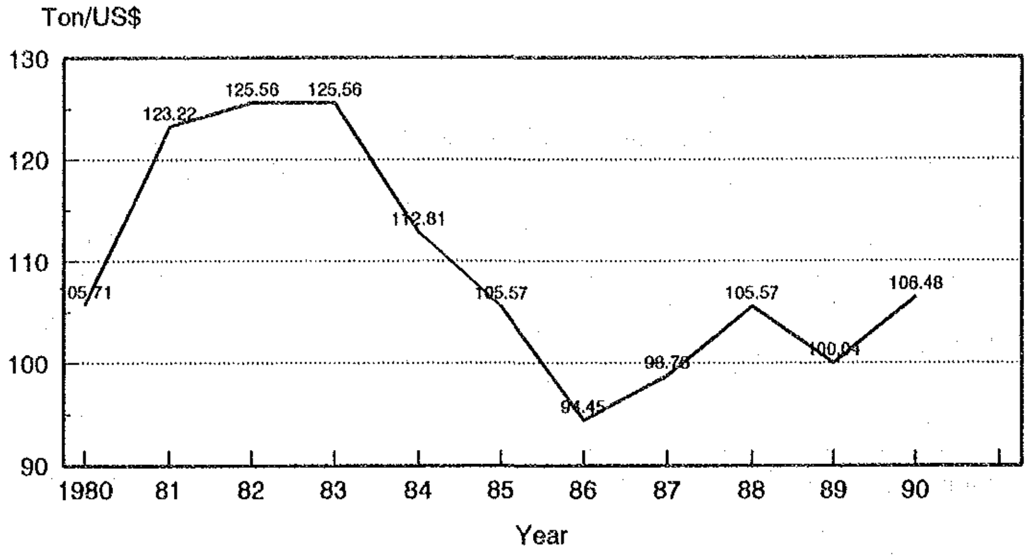
(Unit: Million Tons)

	1993-5	1998	2003
Coke demand	22.2	19.8	18.6
Coke supply	15.2	11.7	11.7
Difference	7.0	8.1	6.9
Supply from Independent Producer	1.8	1.8	1.8
Total Shortage	5.2	6.3	5.1

As shown in the previous page, coke supply shortage at the order of a few million tons is expected. By taking into account forecast errors and imports from other countries, particularly Japan and China, the coke market for new coke ovens including the proposed one in Venezuela is estimated in the range between 1 and 3 million tons, according to opinions by U.S. industries, including consumers such as USX and traders.

Blast-furnace coke prices in the U.S. as of 1993 range between US$85 - US$100, which represent a 10% - 25% decrease from a US$110 level in 1991. The increase in coke imports seems to be a major cause of the price decline. In fact, imports soared from 1.1 million tons in 1991 to 2 million tons in 1992.

The DOE previously forecast that coke prices would surge to US$150 in 1995 on the basis of the 1991 prices and in anticipation of future coke shortage, However, the 1993 prices indicate that the forecast will be above actual levels. Nevertheless, the U.S. coke industry analysts believe that the present price range of US$85 - US$100 is too low compared to production costs of Japanese and other leading coke makers and will rise to around US$135 in 1995. Coke price trends in the U.S. are shown in Fig.3-2.



Coke

Fig.3-2 RECENT TRENDS IN PRICES OF COKE IN THE U.S. (US$ PER TON)

The U.S. imposes no tariff on imported coke. Transportation cost from Venezuela to the Gulf area is estimated at around US$13 per ton, on the basis of freight charge applied to the Japan - U.S. route. The cost can be further reduced by using barges for transportation on the Caribbean, or by using U.S. coal for coke production in Venezuela and transporting coal and coke by coal carriers on the route.

(2) Brazil

In 1989, 6.8 million tons of charcoal were consumed in Minas Gerais for pig iron production, accounting for 91% of charcoal consumption in the state and 66% of wood consumption. Of 38.2 million tons of wood consumed, 9.3 million tons were produced from planted forests, and 22.2 million tons were cut from controlled natural forests. A deficit of 6.7 million tons was obtained from uncontrolled cutting of natural forest, which destroyed 205,000 ha of natural forest in 1989.

At present, construction of a coke oven with annual production capacity of 650,000 tons is estimated to reduce the cutting of natural forest by 100,000 ha annually and is being considered in comparison to the continuation of wood supply by increasing reforestation. The plan envisages the coke production capacity to be 650,000 tons in 1996 as the first phase and additional 650,000 tons in 1998 as the second phase. Even if the plan is successfully implemented, a shortage of coke supply will continue until the plant is completed, and the cutting of natural forest will continue until 1997. On the other hand, reforestation has to continue at a rate of an average 54,000 ha between 1991 and 1995, 10,000 ha between 1996 and 1999, and 63,000 ha between 2000 and 2003.

Assuming that the charcoal production cost using woods from planted forests is the same as the coke production cost, and the average charcoal price at factory, US$113 per ton, is converted at the coke/charcoal replacement ratio of 1.3, the coke price is estimated at US$147 per ton. Further, assuming that the average difference in distance between inland charcoal production plants or ports and steel mills is 200km, US$15 needs to be deducted as the difference in transportation cost. If no Brazilian import duty is imposed on coke exported from Venezuela, the CIF price is estimated at US$132 per ton. Deducting the ocean transportation cost of US$10, the FOB price in Venezuela is US$122 per ton. Thus, if a sum of the production cost and storage and other costs is equal to the FOB price, it is feasible to export coke to Brazil.

(3) European Community

Crude steel production in the EC is estimated at 130 million tons. The EC estimates a surplus production capacity to be 30 million tons and will scrap it in the future. Future production will remain flat or decrease gradually, as seen in the U.S.

Coke supply and demand situation in the EC countries in 1992 is shown in Table 3-5. Blast-furnace coke demand totaled 42 million tons for 12 EC countries, compared to production of 45.8 million tons, with 4.4 million tons used for purposes other than blast furnace.

Table 3-5 COKE SUPPLY AND DEMAND IN 12 EC COUNTRIES (1992)

(Unit: Million Tons)

	Production	Imports	Total supply	For steel industry	Other purposes	Exports demand	Total
Belgium	4.95	0.70	5.65	4.78	0.17	0.70	5.65
Denmark	0	0.04	0.04	0	0.04	0	0.04
Germany	14.85	0.65	15.50	13.00	1.34	1.16	15.50
Spain	3.30	0.14	3.44	3.20	0.24	0	3.44
France	6.80	0.60	7.40	6.10	0.87	0.43	7.40
Greece	0	0.04	0.04	0.02	0.02	0	0.04
Ireland	0	0.015	0.015	0.009	0.006	0	0.015
Italy	5.87	0.29	6.16	5.49	0.444	0.226	6.16
Luxembourg	0	1.18	1.18	1.18	0	0	1.18
Netherlands	2.80	0.30	3.10	2.00	0	1.10	3.10
Portugal	0.25	0.005	0.255	0.18	0.075	0	0.255
UK	7.00	0.30	7.30	6.10	0.90	0.30	7.30
12 EC countries in total	45.82	4.26	50.08	42.059	4.105	3.916	50.08

Source: Nippon Steel's Europe Office

Production capacity breakdown (%) of 1 million-ton or larger coke ovens in EC countries by service years (except for Portugal which has production capacity of 250,000 tons), as of 1992, are shown below.

Table 3-6 SERVICE YEARS AND PRODUCTION CAPACITIES (RATIO BY %) OF COKE OVENS IN EC COUNTRIES

(Unit: 10 thousand tons)

	Production capacity	5 years or less	6 to 15 years	16 to 25 years	26 to 30 years	30 years or longer
Belgium	500		100	260	140	
	100%		20%	52%	28%	
France	700		154	364		182
	100%		22%	52%		26%
Germany	1,400	168	686	266		280
	100%	12%	49%	19%		20%
Italy	700		91	350	175	84
	100%		45%	35%	10%	10%
Netherlands	300		135	105	30	30
	100%		45%	35%	10%	10%
Spain	300		90	150	60	
	100%		30%	50%	20%	
UK	700	56	70	406	168	
	100%	8%	10%	58%	24%	
Total	4,600	224	1,326	1,901	573	576
	100%	5%	29%	41%	12%	13%

Source: Nippon Steel's Europe Office

Assuming that 30 years or older plants shown above end their service life in 1995, coke ovens equivalent to 5.76 million tons will be closed. Then in 2000, additional 5.73 million-ton capacities with 25 years or older will be closed. Thus, the EC will lose coke production capacity of 11.5 million tons by 2000, leaving 34.5 million tons. If coke demand remains unchanged and no coke oven is newly constructed, a shortage of 10 million tons will occur in the EC as a whole.

The PCI method is used more widely in the EC than Japan and the U.S., and thus will not work as a major factor in decreasing the future coke demand. Steel produced by electric furnaces accounts for 20% of total production, and a few million tons are imported from Eastern Europe, mainly long products such as reinforcement and wires, with rapid growth expected in the future. As a result, long steel manufacturers in the EC are increasingly converting themselves to electric furnace makers. If all the makers are converted, the share of production by electric furnaces will rise from a present 20% to 36% by 1998. This means, pig iron demand will decrease by 20%, so will coke demand, totaling 8 million tons. However, since scrap supply is limited, conversion to electric furnaces will be limited to one half the expected capacity.

While coke production within the EC will continue at existing coke ovens by using domestic or imported coals, it will decline gradually due to the closing of aged plants.

Environmental regulation is not as strict as in the U.S., but there is relatively strong environmental concern in the public, which tends to make coke oven construction costs relatively high through strict environmental measures, as seen in the U.S. It should be noted, however, that the EC is working with technological innovation to construct larger coke ovens, and some new construction is expected.

All in all, coke supply capacity will decrease by 10 million tons in 2000, while demand will decrease by 4 million tons due to conversion to electric furnaces, resulting in shortage of 6 million tons. Construction of new coke ovens involves uncertainties related to environmental issues. If a capacity of 2 million tons is constructed by 2000, there will be a shortage of 4 million tons, which will be imported. In consideration to strong competition from China and Eastern Europe, it is safe to estimate that a potential market for Venezuelan coke ranges between 1 million and 2 million tons.

Future coke prices, largely depending upon fluctuation of the foreign exchange rate with U.S. dollars, can be assumed at US$135 on average. Deducting the transportation cost of US$17 from Venezuela, the FOB price amounts to US$118. Among EC countries, Germany and the UK require no tariff on imported coke, while France impose some. Recent coke price trends in the EC are shown in Table 3-7.

TABLE 3-7 COKE PRICE TRENDS IN THE EC
(EX-FACTORY AT RUHRKOHLE OF GERMANY)

(Unit: US$ per ton)

October 1981	108.2
May 1982	100.8
October 1982	104.5
January 1984	102.4
May 1984	92.6
January 1985	89.5
May 1985	89.5
January 1986	121.3
July 1987	149.3
August 1988	156.0

Source: SRI

3.2.2 By-Products

(1) Tar

Coal tar is a maritime trade item, exported and imported by the U.S. and Europe, as well as between Japan, China, and Southeast Asia.

Coal tar prices, according to ATOCHEM of France, range between US$80 and US$100 CIF, and US$40 and US$50 FOB, after deducting the transportation cost of US$40 - US$50. Whether coal tar should be sold at these prices or used as fuel needs to be decided on the basis of comparison. Recent trends in exports and imports by the U.S. and the EC are shown in Table 3-8. No tariff is imposed on tar in the U.S.

Table 3-8 RECENT EXPORTS/IMPORTS OF COAL TAR AND COARSE BENZENE

(Unit: 1,000 Tons)

Year	U.S.			EC
	Coal tar		Crude benzene	Coal tar
	Import	Export	Export	Import
1980	28	334	86.7	760.2
81	17	221	36.4	647.5
82	47	334	62.4	595.6
83	119	48	88.4	447.1
84	107	166	53.0	650.9
85	67	85	49.6	577.0
86	66	80	60.4	604.7
87	69	90	3.0	637.1
88	74	104	0.2	670.1
89	87	76	52.0	n.a.

(2) Crude Benzene

Products from crude benzene are mainly benzene, toluene, and xylenes. These products can also be produced from reformate based on naphtha, and the bottom of the naphtha cracker for olefin production. Thus, market opportunities exist when companies producing aromatic compounds, including benzene, toluene and xylene, have surplus capacities or lack raw materials.

In Venezuela, PEQUIVEN plans to construct a styrene plant, which may consume benzene. Even if no sales to PEQUIVEN is made, exports to the U.S. and Europe are feasible. In fact, ATOCHEM of France is interested in buying crude benzene.

Crude benzene prices fluctuate between US$200 and US$400 per ton in the U.S. to reflect large price fluctuation of aromatic chemical products. Assuming that the transportation cost remains at a present US$30, the FOB price will range between US$170 and US$370. A lower price range causes manufacturers to result in below the break-even point, as experienced by many naphtha cracking companies and refineries. The FOB price should be set at US$270 as the average of the above figures.

(3) Ammonium sulfate

In Venezuela, 20,000 tons of ammonium sulfate is produced by PEQUIVEN in 1992. It is a product marketable internationally and the annual production volume of around 20,000 tons can be easily sold to the international market.

3.3 Export Marketing Plan

Based on the result of the above market study, a marketing plan for the proposed coke oven has been developed as follows.

(1) Selection of foreign markets

As discussed above, the U.S. and Brazil are considered to be highly promising markets. On the other hand, the EC has uncertainty about coke imports partly due to policy difference among member countries, and partly due to competition with imports from Eastern Europe. These make the EC less attractive compared to the U.S. and Brazil. Assuming that Brazil will import one fourth of total demand of 650,000 tons from Venezuela, 20% will be exported to Brazil and 80% to the U.S.

As a result, of 850,000 tons of lump coke to be produced annually, 680,000 tons will be exported to the U.S. and 170,000 tons to Brazil. Coke breeze will be entirely exported to the U.S.

Tar and crude benzene will be exported mainly to the U.S. and the EC, and ammonium sulfate which is an international commodity will be marketed in domestic Venezuela market as well as in the international market, depending upon the term of trade for the producer.

(2) Sales quantities and prices of products and by-products

Based on the result of the above market study, export quantities and FOB prices (Venezuela) of products and by-products from the 1 million-ton coke oven are assumed as follows.

TABLE 3-9 EXPORT QUANTITIES AND PRICES OF PRODUCTS AND BY-PRODUCTS

	Annual exports (1,000 tons)	Export prices (US$ per ton)
Blast-furnace lump coke	850	120
Coke breeze	150	40
Tar	40	50
Crude benzene	13	240
Ammonium sulfate	16	100

(3) Sales route

Coke traders include specialized distributors such as STINNES of Germany, and general trade companies (Sogo Shosha) in Japan, who are familiar with market information and export procedures. Since it will be virtually the first experience for Venezuela to produce and export coke, it is advisable to use their expertise as much as possible. In particular, the use of the trader eliminates the need for sales bases in the U.S. and other countries, saving large amounts of cost. Sales commission to these traders is assumed to be 1% of sales price. The same strategy will also be chosen to by-products, including sales commission.

(4) Inventory at factory

Each lot of exports of coke and breeze is estimated at 40,000 tons on the basis of panamax size, and minimum inventories are assumed to be twice the lot. For this study, 1.5 months of production or 106,000 tons inventory is assumed. As for breeze, 1 month of export volume; 12,500 tons is assumed to be a desirable inventory level.

Taking the average export size and frequency of shipment of by-products such as Tar, Crude Benzene and Ammonium Sulfate, into consideration, inventory sizes are assumed as shown in the following table:

(Unit: MT)

Tar	5,000
Crude Benzene	3,300
Ammonium Sulfate	1,300

Chapter 4 Site Evaluation and Selection

Chapter 4 Site Evaluation and Selection

In comparing and evaluating 3 candidate project locations in Santo Domingo, Maracaibo, and Puerto Ordaz, the proposed coke oven is assumed to have annual production capacity of 1 million tons to estimate basic requirements for raw materials, site area, and utilities (energies). These data are used as preliminary criteria to evaluate candidate areas, followed by verification from various aspects. Table 4-1 shows a general outline of the 1 million-ton coke oven construction project, and Fig.4-1 shows relative locations of 3 candidate project sites.

Table 4-1 OUTLINE OF 1 MILLION TON COKE OVEN CONSTRUCTION PROJECT

Product	Blast-furnace coke
Specification	Compliance American specification
Market	Export
Production	1 million tons/year at maximum
Candidate sites	1. Santo Domingo in Tachira State (South-east of the Airport)
	2. La Cañada in Zulia State (South of Maracaibo in Puerto Siderurgico)
	3. SIDOR West Industrial Zone in Puerto Siderurgico
Mining location	Franja Nororiental (FNO)
	Las Adjuntas (LAS)
	Hato de la Virgen (HAT)
Coking coal requirement	1.5 million tons/year
Site area	600,000m^2 (including 80,000m^2 of loading facilities)
Utilities requirements	
Potable water	200m^3/day
Industrial water	8,000m^3/day
Cooling water	100,000m^3/day
Steam	400ton/day
N2	2,500m^3/day
Compressed air	30,000m^3/day
Power consumption	168,000m^3/day

The study team conducted field survey on the basis of the above outline, and collected relevant data in the form of detailed questionnaire and interview surveys to counterparts.

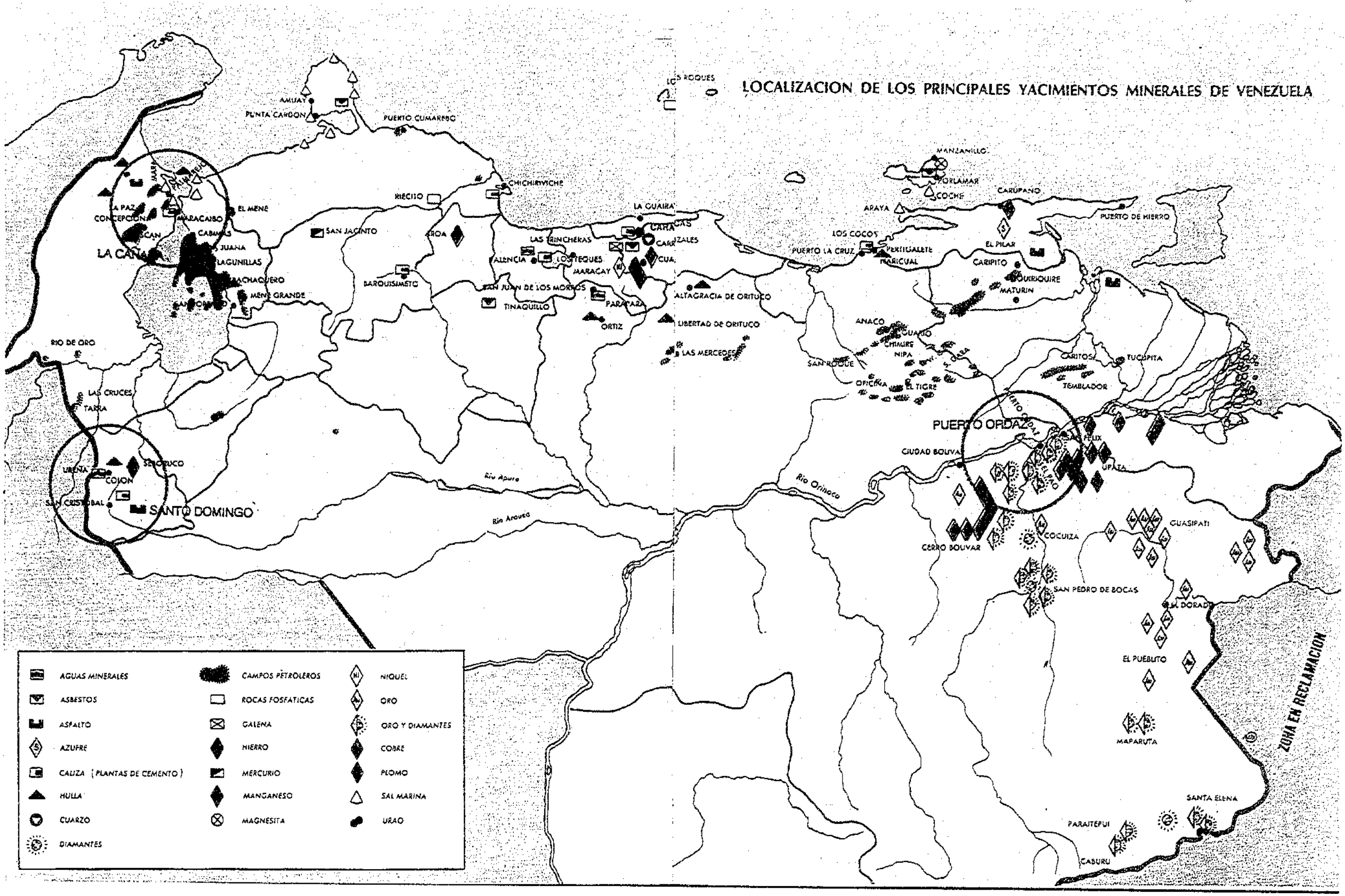


Fig.4-1 RELATIVE LOCATION OF 3 CANDIDATES

4.1 Summary and Evaluation of Survey Results by Relevant Factors

Based on data and information provided by regional development corporations having jurisdiction, and with reference to the results of field tours and interview surveys, and literatures, the candidate areas were analyzed and results are summarized as follows.

4.1.1 Candidate Sites Identified

Figures 4-2, 4-3, and 4-4 show candidate sites for the coke oven proposed by CORPOSUROESTE, CORPOZULIA, and CVG. Their formal names are as follows:

Santo Domingo – Only an area is specified, with no specific site designated.
Maracaibo – Municipio de la Cañada de Urdaneta en la Zona de la Ensenada de Urdanta
Puerto Ordaz – Urbanismo Industrial Cana Veral

These candidate sites are referred to as follows:

Santo Domingo – Santo Domingo
Maracaibo – La Cañada
Puerto Ordaz – Puerto Siderurgico

4.1.2 Applicable Zoning and Other Land Use Regulation

An area in the southernmost part of the City of Maracaibo in Zulia State and its adjacent area in La Cañada are reserved as a steel mill site and are registered as an industrial zone under the Land Planning Law.
The Urbanismo industrial park located on the west side of SIDOR in Puerto Ordaz, Ciudad Guayana in Bolívar State, is also designated as an industrial zone.
On the other hand, the Santo Domingo site and its surroundings in Tachira State are not designed as the industrial zone under the Land Planning Law.

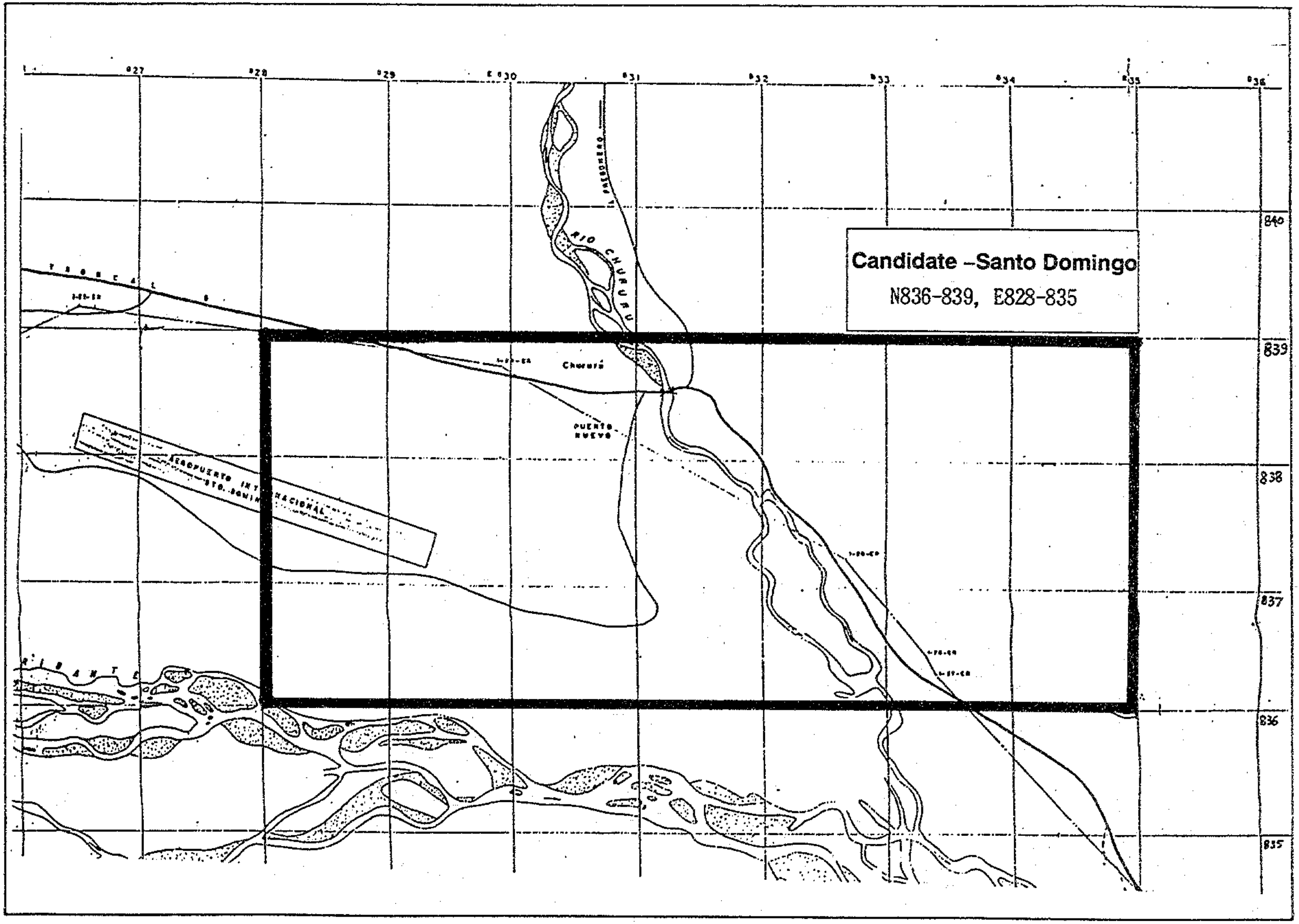


Fig.4-2 CANDIDATE PLACE - SANTO DOMINGO

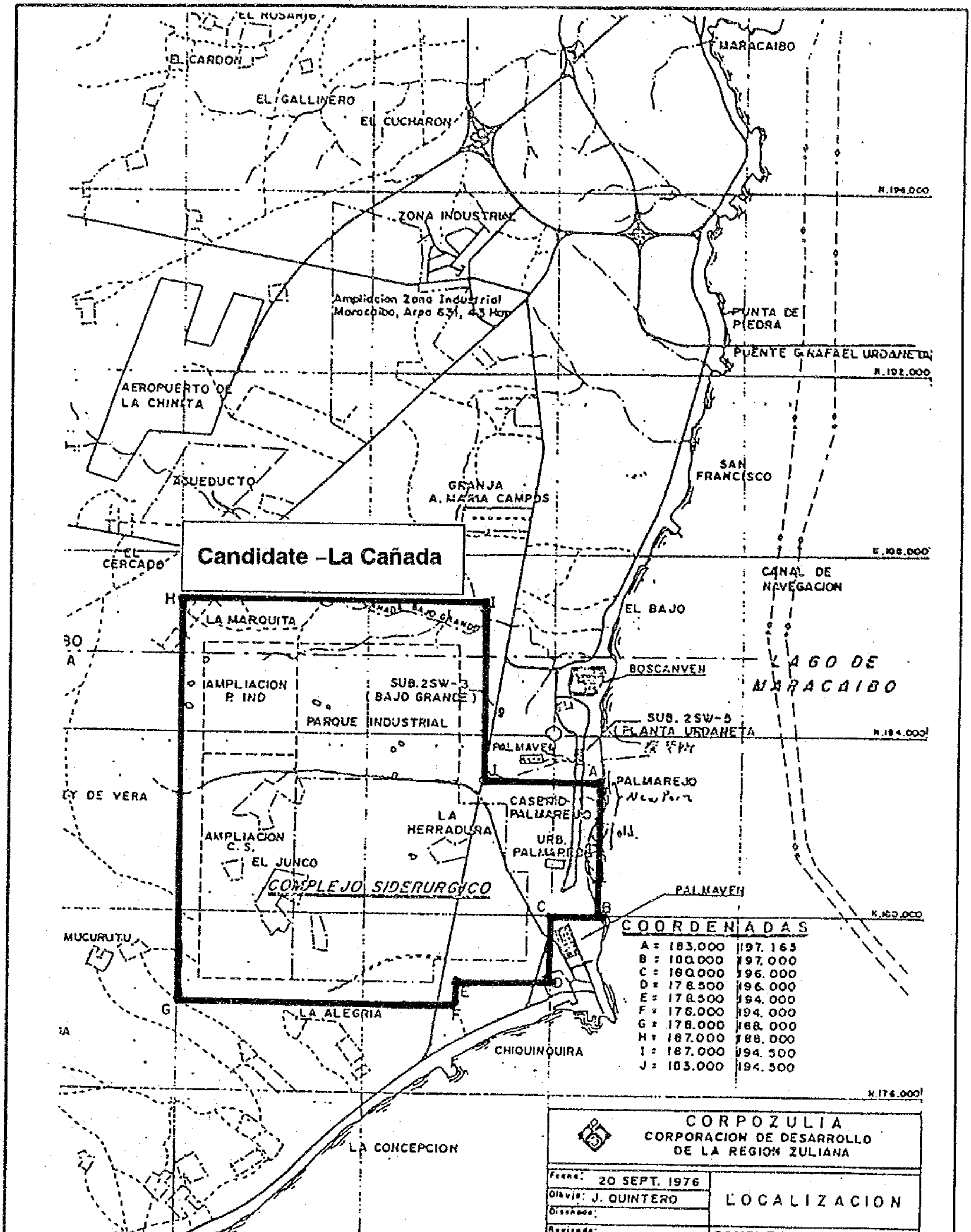


Fig.4-3 CANDIDATE PLACE - LA CAÑADA

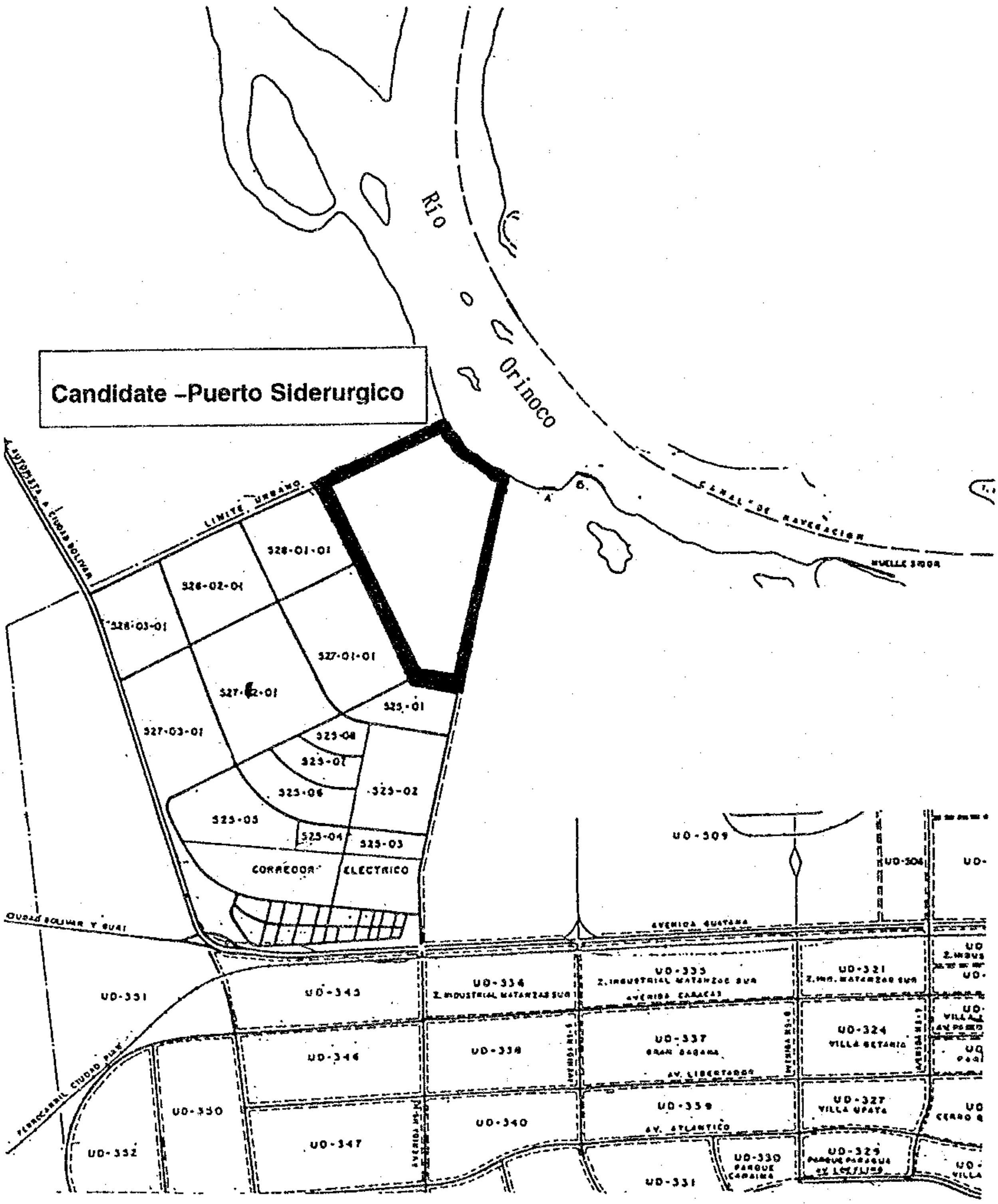


Fig.4-4 CANDIDATE PLACE - PUERTO SIDERURGICO

4.1.3 Current State of Candidate Sites

(1) Santo Domingo

The candidate site indicated by CORPOSUROESTE is described as part of an area bounded by N839–N836 and E828–E835. The vast area includes portions of the Santo Domingo airport and is generally located on the east side of the airport.

On the south side, the Uribante river (Rio Uribante) flows, and on the north side, a motorway which goes to San Cristóbal, Santo Domingo and Guasdualito (Route 113) runs in east–west direction.

From the airport site to the east, a vast flat area extends toward Guasdualito and is mainly used for pasturage and farming.

There is no industrial facility near the site and infrastructure is not developed.

To build a new plant in the site, a number of preparation work including site preparation, construction of access roads, flood control measures (flood occurs every year), and extension of power transmission lines, is required.

(2) La Cañada

The proposed site was reserved by CORPOZULIA in 1982 for construction of a steel mill, which plan was later abandoned. It is located within an industrial zone along the coast of Lake Maracaibo and is currently used as a storage yard for coal produced in Zulia and Colombia and a loading facility to handle shipments of 500,000 tons annually. The site area is 6,800 ha.

The loading facility is capable of accommodating a 3,000–ton barge. Capacity expansion to accommodate a 60,000–ton ocean–going ship was considered during the planning of the steel mill.

A thermal power plant (installed capacity of 1,336KW) is located approximately 2km from the proposed site.

(3) Puerto Siderurgico

The Puerto Siderurgico site is located within an industrial park along the Orinoco river. The industrial park was designated as a heavy industrial zone in May 30, 1989, under Gasette No.3558. Subdivision and site preparation have been completed, and a master plan for infrastructure development has been developed. Acquisition of the site by CVG has been almost completed.

The site area is 562 ha.

4.1.4 Land Cost

CORPOSUROESTE which is responsible for the Santo Domingo site has not completed land acquisition. Land prices indicated by CORPOSUROESTE as current prices range between 2,500Bs and 10,000Bs/ha (July – August, 1993).

Acquisition of the La Cañada site has been completed, and the land price indicated in appraised value is 260Bs/m^2.

Development of the industrial park in which the Puerto Siderurgico site is located has been planned by CVG. Subdivided lots are being sold to private enterprises at 597Bs/m^2.

4.1.5 Coal Supply

The project envisages that coking coals produced in Venezuela will be used for coke making at the proposed plant as far as possible. Coal mines producing coking coals are mostly located in Tachira State, particularly in the following 5 mining areas:

1) Las Adjuntas (LAS)
2) Hato de la Virgen (HAT)
3) Lobatera (LOB)
4) San Félix (SAN)
5) Franja Nororiental (FNO)

Judging from estimated presence of coal seams and qualities, the status of exploration, and other related factors, the following types of coal appear to be suitable for coke making at the proposed plant:

Medium volatile content coal in FNO
Medium to high volatile content coal in LOB (under exploration)
Medium to high volatile content coal in HAT (under exploration)
High volatile content coal in LAS

To produce high-grade coke suitable for export, volatile contents of various types of coals mixed for coal making need to be maintained within an appropriate range.

However, exploration records on the above areas indicate that availability of medium volatile content coal will be limited to an extent which makes it difficult to secure the quality of coke required for export by using Venezuelan coals alone. Thus, it is recommended to conduct a blending test using Venezuelan and foreign coals to find the best mix, in addition to evaluation of coke properties by using domestic coals.

One prospective source is Boyaca coal produced in Colombia, adjacent to Tachira State. Boyaca coal is low to medium volatile content and is currently produced. On the other hand, it may present a problem in terms of stable supply because economically recoverable reserves are still unknown, as well as limited supply due to long distance for transport from the source to the proposed coke making plant. In consideration to these factors, Boyaca coal has been evaluated as one of prospective supply sources.

In addition, two foreign coals have been selected for consideration to supplement domestic and Colombian coals, namely Pinnacle and Blue Creek which are low to medium volatile content coals produced in North America, and which are considered to be competitive in terms of quality, cost, and availability.

Another domestic coal tested was Guasare coal produced in Zulia. It is basically steam coal produced at a rate of 3 million tons annually and is exported for thermal power generation because of relatively small ash and sulfur contents. Although it is not suitable for coke making in terms of coking property and liquidity, it has been included in testing coal property and coke quality in available combinations.

4.1.6 Evaluation of Coal and Coke Transportation Routes and Costs

(1) Estimation of coal and coke transportation costs by different modes

Based on unit costs indicated by CARBOSUROESTE, CORPOZULIA, and CVG, coal and coke transport costs were estimated for different modes. Unit costs provided by the regional development corporations are as follows.

Land transport (20–ton truck)	4.50 Bs/km/ton
(from coal mines to Santo Domingo/La Fria)	
Land transport (50–ton truck)	2.50 Bs/km/ton
(After La Fria and Santo Domingo)	
Barge transport (Maracaibo)	0.40Bs/km/ton
Barge transport (Apure/Orinoco rivers)	1.00Bs/km/ton
Rail transport	1.77Bs/km/ton
Transshipment cost	180Bs/ton

(2) Distance from coal mines to Santo Domingo/La Fria (collection point)

It is assumed that coal will be collected in La Fria for further transportation to the coke making plant. Distance from the mining areas in FNO, LAS and HAT to the collection point is 25km, 81km, and 67km respectively. Among the three areas, the study team was informed that recoverable reserves of FNO would not be sufficient for coke production, merely 1 million tons annually. Between the remaining two areas, distance of 81km was used for cost estimation.

On the other hand, for the Santo Domingo site in Tachira State and for coal transportation via Santo Domingo, distance of 85km was assumed.

(3) Transportation routes and costs

Possible routes and distances of transportation from the mining area to the coke exporting port for each of the alternative project sites were calculated, and based on which transportation costs were estimated. Note that transportation routes considered include those under planning or included in future plans.
_____ shows coal transportation, and ———— coke transportation.

1) For the Santo Domingo site (see Fig.4-5)

Transportation route 1 : Coal will be transported by truck from the mining area to the Santo Domingo site. Produced coke will be transported by truck from the site to Guasdualito located along the upper stream of the Apure river, and after transshipment to barges, will be carried to the Puerto Ordaz port via the Apure/Orinoco rivers. The Apure river is navigational for 7 months each year.

Coal Mine	(20ton) Truck	Santo Domingo	(50ton) Truck	<Guasdualito>	Barge	≪Pto.Ordaz Port≫
Distance	85km		170km		1,200km	
Unit Cost	4.5Bs		2.5Bs		1.0Bs	
Transportation Cost	383Bs/t		425Bs/t		1,200Bs/t	
Transshipment				180Bs/t		

Transportation route 2 : Coal will be transported by truck from the coal mine to the site. Coke will be transported by truck from the site to Puerto Cabello via Acarigua and Valencia.

Coal Mine	Truck	Santo Domingo	Truck	≪Pto.Cabello Port≫
Distance	85km		680km	
Unit Cost	4.5Bs		2.5Bs	
Transportation Cost	383Bs/t		1,700Bs/t	

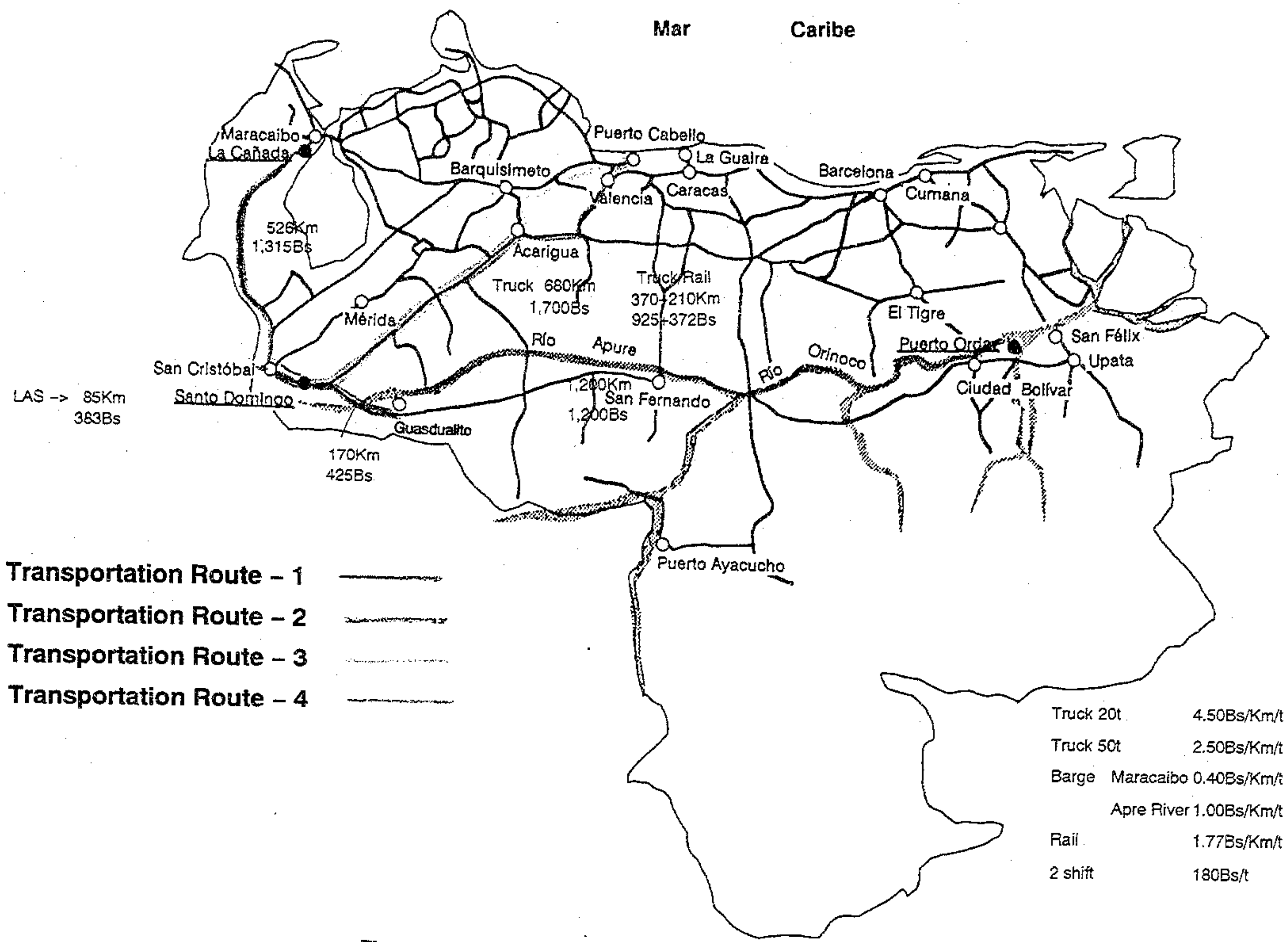


Fig.4-5 TRANSPORTATION ROUTE FOR SANTO DOMINGO

Transportation route 3 : Coal will be carried by truck from the coal mine to the site. Coke will be transported by truck on Route 252 which runs on the west side of Maracaibo to the Maracaibo port.

Coal Mine	Truck	Santo Domingo	Truck	≪Maracaibo Port≫
Distance	85km		526km	
Unit Cost	4.5Bs		2.5Bs	
Transportation Cost	383Bs/t		1,315Bs/t	

Transportation route 4 : Coal will be transported by track from the coal mine to the site. Coke will be transported by truck to Acarigua via Barinas, where transshipped to rail freight cars for further transportation to Puerto Cabello.

Coal Mine	Truck	Santo Domingo	Truck	<Acarigua>	Rail	≪Pto.Cabello Port≫
Distance	85km		370km		210km	
Unit Cost	4.5Bs		2.5Bs		1.77Bs	
Transportation Cost	383Bs/t		925Bs/t		371.7Bs/t	
Transshipment				180Bs/t		

2) For the La Cañada site (see Fig.4–6)

Transportation route 5 : Coal will be transported by truck to La Fria, and after transshipment to 50–ton trucks, it will be further transported to La Cañada.

Coal Mine	Truck	<La Fria>	Truck	La Cañada
Distance	81km		376km	
Unit Cost	4.5Bs		2.5Bs	
Transportation Cost	365Bs/t		940Bs/t	
Transshipment		180Bs/t		

Transportation route 6 : Coal will be transported by truck to La Fria, and after transshipment to 50–ton trucks, will be carried to La Concha, from which barges will be used for coastal transportation to La Cañada.

Coal Mine	Truck	<La Fria>	Truck	<La Concha>	Barge	La Cañada
Distance	81km		140km		200km	
Unit Cost	4.5Bs		2.5Bs		0.4Bs	
Transportation Cost	365Bs/t		350Bs/t		80Bs/t	
Transshipment		180Bs/t		180Bs/t		

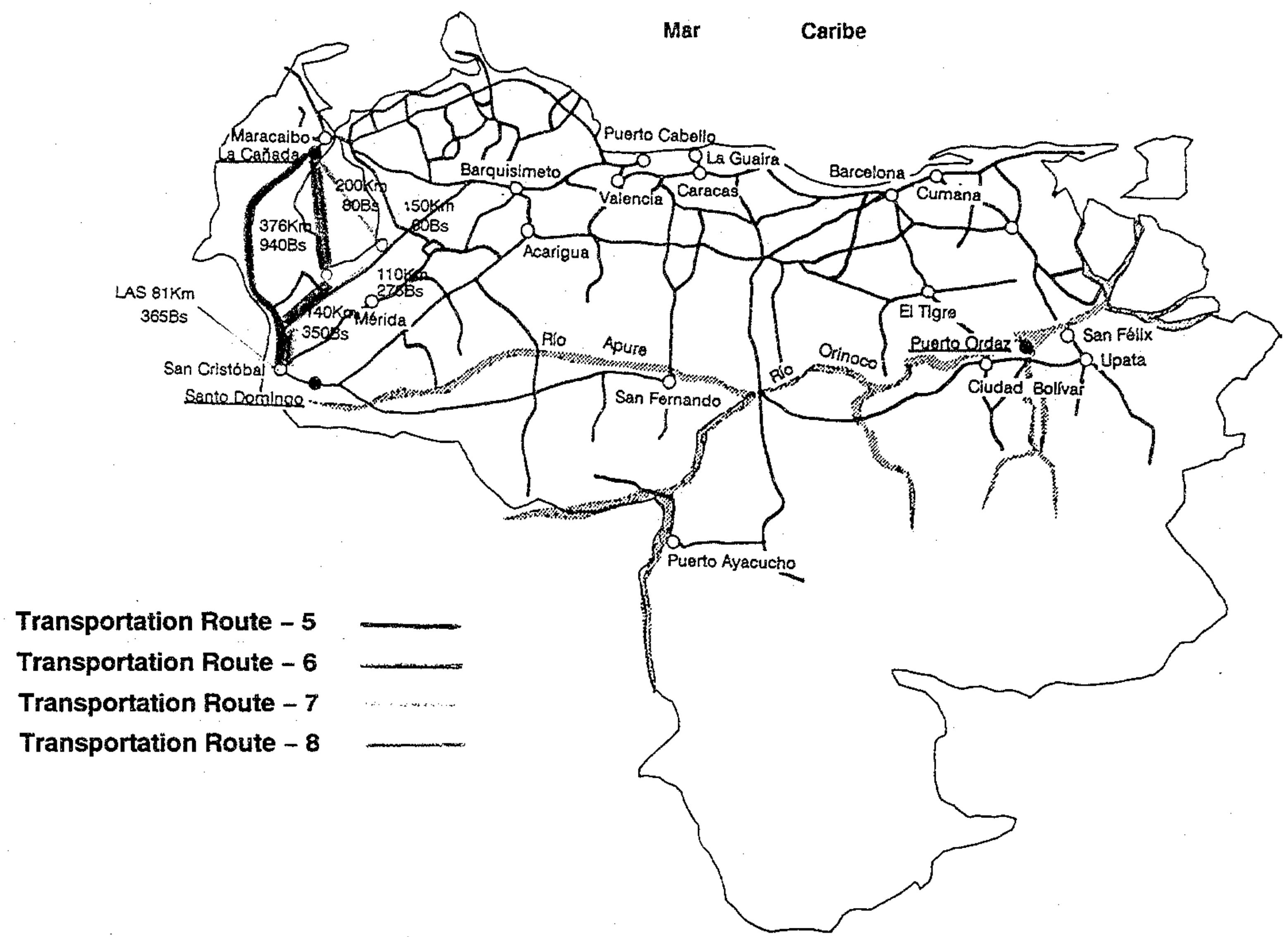


Fig.4–6 TRANSPORTATION ROUTE FOR LA CAÑADA

Transportation route 7 : 20-ton trucks will be used for transport from the coal mine to La Fria, and 50-ton trucks from La Fria to La Ceiba, from where barges will be used for coastal transport to La Cañada.

Coal Mine	Truck	<La Fria>	Truck	<La Ceiba>	Barge	La Cañada
Distance	81km		250km		150km	
Unit Cost	4.5Bs		2.5Bs		0.4Bs	
Transportation Cost	365Bs/t		625Bs/t		60Bs/t	
Transshipment		180Bs/t		180Bs/t		

Transportation route 8 : Coal will be carried by truck from the coal mine to La Fria, then by rail to La Concha, and coastal transport to La Cañada.

Coal Mine	Truck	<La Fria>	Rail	<La Concha>	Barge	La Cañada
Distance	81km		110km		200km	
Unit Cost	4.5Bs		1.77Bs		0.4Bs	
Transportation Cost	365Bs/t		195Bs/t		80Bs/t	
Transshipment		180Bs/t		180Bs/t		

3) For the Puerto Siderurgico site (see Fig.4-7)

Transportation route 9 : 20-ton truck transport from the coal mine to Santo Domingo, and 50-ton truck transport to Puerto Siderurgico.

Coal Mine	Truck →	Santo Domingo	Truck →	Pto.Siderurgico
Distance	85km		1,300km	
Unit Cost	4.5Bs		2.5Bs	
Transportation Cost	383Bs/t		3,250Bs/t	
Transshipment		180Bs/t		

Transportation route 10:20-ton truck transport from the coal mine to Santo Domingo, and 50-ton truck transport to Guasdualito, then carried by barge on the Apure/Orinoco rivers to Puerto Siderurgico. The Apure river is navigational for 7 months each year.

Coal Mine	Truck →	<Santo Domingo>	Truck →	<Guasdualito>	Barge →	Pto.Siderurgico
Distance	85km		170km		1,200km	
Unit Cost	4.5Bs		2.5Bs		0.4Bs	
Transportation Cost	383Bs/t		425Bs/t		1,200Bs/t	
Transshipment		180Bs/t		180Bs/t		

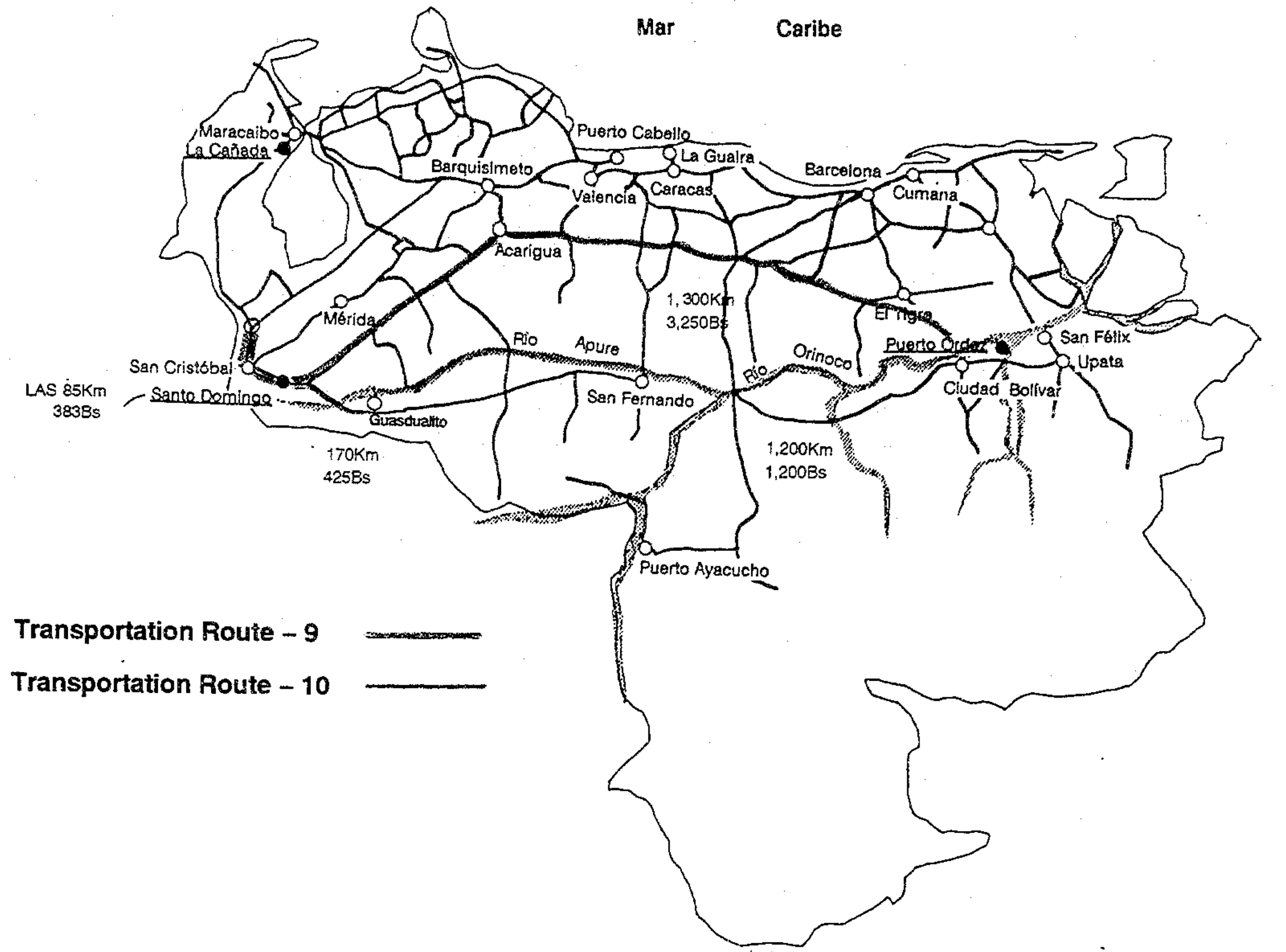


Fig.4–7 TRANSPORTATION ROUTE FOR PUERTO SIDERURGICO

(4) Comparison of transportation costs

Coal and coke transportation costs for each of the above routes are summarized below. Note that the figures are converted to the U.S. dollars at an exchange rate of 1US$ = 90Bs.

Candidate sites for the proposed coke oven	Transportation route (Bs/ton)	Coal transportation (Bs/ton)	Coke transportation (Bs/ton)	Total (BS/ton)	Total (US$/ton)
Santo Domingo	1	383	1,805	2,188	24.3
	2	383	1,700	2,083	23.1
	*3	383	1,315	1,698	18.8
	4	383	1,476.7	1,859.7	20.6
La Cañada	*5	1,485	0	1,485	16.5
	6	1,155	0	1,115	12.3
	7	1,410	0	1,410	15.6
	8	1,000	0	1,000	11.1
Puerto Siderurgico	*9	3,813	0	3,813	42.4
	10	2,368	0	2,368	26.1

Since transportation routes 1, 6, 8, and 10 are not currently available but are under plan and route 7 is not suitable road condition for transporting coal, they are considered as reference data.

3 representative routes to compare the alternative sites are selected at this stage, *3, *5, and *9.

4.1.7 Transportation of Coke to Foreign Markets

(1) The Santo Domingo site

Coke will be transported by barge on the Apure/Orinoco rivers to Puerto Ordaz for exports, or further carried to the Maracaibo port.

(2) The La Cañada site

The wharf planned in the site will be used to load coke to a 60,000-ton ocean-going ship. A ship loader will be installed as part of the coke making plant.

(3) The Puerto Siderurgico site

A port planned to be constructed adjacent to the industrial park will be used for loading. The Orinoco river varies greatly in water flow between rainy and dry seasons, 20,000-ton ocean-going ships will be able to use the facility during the dry season, and 40,000-ton ships during the rainy season.

4.1.8 Domestic Coke Market

As mentioned earlier, there was a plan to build a steel mill in La Cañada, which was abandoned later. At present there is no plan to construct a blast-furnace steel plant in the country. As a result, there is no domestic market to consume coke in large quantities. On the other hand, coke breeze, albeit in small quantities, is used to make electrodes for electrolytic treatment in the aluminum production process.

4.1.9 Use of Coke Oven Gas (COG)

COG can only be used as fuel for home, industrial, or thermal power generation. It can be used as feedstock materials for chemical products, but it cannot compete with abundant natural gas available in the country.

Among the alternative sites, there is a thermal power plant in La Cañada, not in Puerto Ordaz and Santo Domingo. In Puerto Ordaz, industrial fuel is only a possible application. In Santo Domingo, it can be used by a private power generation facility.

4.1.10 Domestic Markets for By-products (Crude Benzene and Tar)

By-products from coke production, in addition to COG, are crude benzene, crude tar, ammonia, and sulfur compounds. Sulfur compounds can be either reduced to sulfur or oxidized to sulfuric acid or sulfuric compounds. It is assumed that the proposed plant will produce sulfuric acid which will be combined with ammonia for production of ammonium sulfate.

(1) Crude benzene

In Venezuela, there is no market which directly consumes crude benzene. There are two potential markets. One is to use as a feedstock material for benzene-toluene-xylene (BTX) - aromatic hydrocarbon compounds. The other is to blend crude benzene in gasoline to boost octane.

In the country, BTX is produced at the El Palito refinery. According to the 1992 report of PDVSA (Petroleo de Venezuela S.A.), BTX production amounts to 97,000 tons per year. If benzene demand grows in future, crude benzene can be used for BTX production. However, crude benzene produced in the coke making process contains large amounts of unsaturated hydrocarbon compounds and needs to be refined by hydrogenation & aromatic extraction or hydro-dealkylation.
Each process requires annual capacity of 100,000 - 300,000 tons for economical operation, and 13,000 tons from the proposed plant is not economically feasible.

Blending crude benzene in gasoline should be limited in amount due to large contents of unsaturated hydrocarbons which produce soot and have to be removed by adding the hydrogenation process.

Thus, regardless of which site is to be selected, crude benzene from the proposed plant needs to be refined for commercial use.
There are many refining facilities in Japan, the U.S., and Europe, so that it is desirable to export crude benzene in an unrefined form.

(2) Crude tar

From crude tar obtained in the coke making process, hard tar, naphthalene oil, anthracene oil, and pitch can be produced by distillation.

However, there is no major market for coal tar proucts in the country, and crude tar needs to be exported regardless of which plant site is selected.

(3) Sulfuric acid

In Venezuela, a sulfuric acid plant having daily capacity of 462,000 tons is operated within the Morón petrochemical complex. The plant produced 254,000 tons in 1992.

The petrochemical complex produces a variety of products such as ammonium sulfate, phosphoric acid, NPK fertilizer in large quantities and ships them to both domestic and export markets. Sulfuric acid is used for numerous purposes as a basic chemical.

In particular, sulfuric acid produced from the coke oven can be used to produce ammonium sulfate through reaction with another by-product, ammonia. Ammonium sulfate can be sold directly or through a marketing channel of PEQUIVEN.

(4) Ammonia

At present, Venezuela produces a large amount of ammonia at petrochemical complexes in Morón and Zulia, which produced 152,000 tons and 468,000 tons in 1992, respectively. Using ammonia as a feedstock material, the both complexes produce urea on a commercial basis, and the Morón plant produces ammonium sulfate, nitric acid, and NPK fertilizer.

It should be noted, however, that a surplus of ammonia is produced when ammonia and sulfuric acid produced in the coke making process are used for ammonium sulfate production. In this case, the surplus has to be sold to the outside market or an appropriate amount of sulfuric acid is purchased.
Regardless of which site is selected for the coke making plant, sulfuric acid has to be purchased from Morón or ammonia should be transported to Morón or Zulia for sales. In this study, it is assumed that the proposed plant will purchase sulfuric acid from outside sources to make up a deficit.

4.1.11 Industrial Water

(1) The Santo Domingo site

At present, there is no industrial water service in and around the Santo Domingo site. Industrial water can be obtained from the Uribante river. However, the river varies in flow rate greatly with seasons, and it produces red muddy water during the rainy season, which needs to be treated before intake, such as the settlement process. Although the use of underground flow of the river seems to be possible, further research and survey is required to collect data and information on underground flow, including flow rate and water quality.

(2) The La Cañada site

There is no industrial water supply service connected to the site.
Instead, well water can be obtained within the site. According to CORPOZULIA's engineers, there are a few dozen wells in the site, which produced drinking water for the city of Maracaibo until Tulé and Socoy dams were completed on the west side of the city in the 1970s and started to supply city water as well as industrial water for petrochemical plants in Zulia.
These wells, not used at present, can produce water at a rate of 1,800 liters/second/well (6,480m^3/hour/well)
The wells have been used for a fairly long period of time without causing land subsidence in and around the site. At the same time, they have been closed down for a while, so that proper maintenance work is necessary. According to CORPOZULIA, well water can be supplied at 2.75Bs/m^3 and piping work will be performed by the water resource corporation at user's expense.

(3) The Puerto Siderurgico site

CVG supplies industrial water to the Puerto Ordaz district. Water is obtained from the Caroni river, which is fairly clear and clean but is slightly acid with pH of 6.0 – 6.6.
The industrial water supply project for the west side of SIDOR, currently under construction, has intake capacity of 5,000 liters/second and plans to distribute water as follows:

Current intake rate	:	900 liters/second
Future intake plan	:	3,000 liters/second
Surplus capacity	:	1,100 liters/second (about 95,000m^3/day)

A 16km–long water distribution channel is planned and 5km has been completed. The entire channel will be completed by the end of 1993. A water tank will be constructed on the west side of the industrial park.

If the proposed site is selected, industrial water can be supplied to the coke making plant from the surplus intake capacity at a price of 1.7Bs/m^3 (as of January, 1993)
Potable water is produced from industrial water at each plant in the industrial park.

4.1.12 Electricity and Fuel Gas

(1) The Santo Domingo site

At present, the area surrounding the site is used as pastureland, with few houses being seen. There is no infrastructure for industrial use, and no industrial plant exists around the site.

As a result, the proposed coke making plant will have to receive electricity supply from CADELCA's substation in El Piñal by constructing power transmission lines. Once the plant starts commercial operation, it may be able to sell surplus electricity to CADELCA. Whichever the case is, negotiation and contract with CADELCA will become necessary.

Tachira State produces little natural gas, thus basically consumes LPG separated from natural gas and crude oil produced in Zulia State,, kerosene, and fuel oil. In and around the site, there is no potential consumer of surplus COG produced from the coke oven.

It is therefore recommended to build a power plant burning COG and to produce electricity for sales.

(2) The La Cañada site

There are ENELVEN's thermal power plant and CORPOVEN's petroleum refinery adjacent to the site. Crude oil pipelines are connected from Boscan oil field to an offshore oil loading terminal. All the facilities are within a few kilometers from the site.

The thermal power plant burns heavy oil and natural gas. According to CORPOZULIA, the coke making plant will be able to receive electricity from the power plant by building dedicated power transmission lines and to sell surplus

COG from the coke oven in return. While COG has a calorific value only a half that of natural gas, it can be effectively burned by modifying burner tips.

(3) The Puerto Siderurgico site

The site is located within easy reach to electricity and fuel gas sources.

There is EDERCA's large power plant near the site, from which electricity can be obtained by installing transmission lines. Natural gas is transported through CORPOVEN's 20-inch and 26-inch pipe lines to SIDOR's steel mill, which are extended from the opposite side of the Orinoco river. It is also used by nearby factories for fuel and steam power sources.

As confirmed by CORPOVEN, it is required by law to buy surplus COG produced from the coke oven. COG is low in calorific value, one half that of natural gas, but it can be used for reduction of iron ores because of rich hydrogen and carbon monoxide contents.

4.1.13 Labor Force

In 1990, the unemployment rate reached 9% in Venezuela. Unemployment rates in the states related to the project are shown in Table 4-2.

Table 4-2 UNEMPLOYMENT RATES IN SELECTED STATES

Tachira	15.1% (108,990 persons)
Zulia	12.0% (31,839 persons)
Bolívar	14.1% (41,188 persons)

Thus, each of these states has abundant labor supply.

Major industries in these states are petroleum and petrochemical in Zulia, and heavy industries such as steelmaking and aluminum smelting in Bolívar, and their related industries. On the other hand, a major economic base in Tachira is agriculture and a small percentage of labor force seems to be engaged in manufacturing industry.

La Cañada is adjacent to Maracaibo with one million population, and Puerto Ordaz is located at the city's margin. If appropriate means of transport are provided, such as regular bus service, therefore, there will be no need for employee housing.
On the other hand, the Santo Domingo site requires employee housing to be constructed near the plant.

4.1.14 Geographical Conditions

(1) The Santo Domingo site

The site is located in a flood plain which is a part of the Los Llanos Plain formed by the Uribante river – the main stream of the Apure river – as it flows out of a ravine in the Andes. It is generally flat and is either unused or pastureland.
The Uribante river and its branch, the Torbes river (Rio Torbes), form valleys which rise westward or northwestward and continue to San Cristóbal, located 30km away in straight distance. A community having 8,000 population, El Piñal, is 5km – 6km east to the site.
A dominant wind direction in the Santo Domingo Airport near the site is easterly during the rainy season between May through August (April through October), and westerly during the dry season. The annual average temperature is 23 – 24°C and annual precipitation ranges between 2,100mm and 3,500mm, the highest in the country.

At present, the site is not designated as industrial land under the POT (Plan de Ordinamient Territorial), and there is no factory or plant around the site.
Water used at the proposed plant can be obtained from the Uribante river or its underground flow. Effluent will also be discharged to the river.
The river varies greatly in flow rate with seasons, and produces red mud water during the rainy season, necessitating settlement and other water treatment facility. Also, flood protection measures will be needed around the coke making plant.

Another important consideration in building the proposed plant in the Santo Domingo site is to avoid any disturbance with air traffic from and to the nearby airport. In particular, production of steam during coke quenching should be avoided. For this reason, as well as for the increase in electricity production, dry quenching is a logical choice. In addition, a smokestack and other high towers may be subject to height restriction. Aesthetic consideration in terms of harmony with surrounding environment is another important factor. Finally, effluent discharged from the plant should be properly treated to prevent any disturbance with fishing and navigation in the Uribante river which is the upper stream of the Apure river flowing through Los Llanos. The same will be applied to exhaust gas which requires adequate treatment to control impacts on the surrounding environment including farming and stock raising.

(2) The La Cañada site

The site is located along the east coast of Lake Maracaibo. It is generally flat with some ups and downs, dotted with bushes which are typically seen in savanna climate. The site is immediately south of Maracaibo, the second largest city in the country, a 20-minute drive from the city center.
The average temperature in the city of Maracaibo is 28°C and the average annual precipitation 600mm. Rainfall mainly occurs between August and October. Northeast wind is generally dominant, with velocity ranging between 5km/h and 15km/h.

The lake has green color to suggest massive growth of planktons and perhaps the progress of eutrophication. Judging from a level of dissolved oxygen which is relatively high at 6ppm - 8ppm, however, contamination may not be as serious as it looks. Nevertheless, water should be treated to remove algae in the intake process. Also, water is very warm, 30°C on surface, and needs to be cooled down through cooling towers, while well water will be used as make-up water.

Water pollution in Lake Maracaibo has reportedly reached a serious level, and special restriction is imposed on discharge of waste water. As mentioned above, however, dissolved oxygen data obtained during the field survey indicates that contamination by organic matters is not serious, equivalent to class A to B waters[1] under Japanese environmental standards.

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1) Japanese environmenta standards (applicable to seawater areas) designate the waters with the cleanest water (dissolved oxygen of 7.5mg/liter or over) as Class A waters, and those with water quality following Class A waters (dissolved oxygen of 5.0mg/liter) as Class B water.