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THE BASIC PETROCHEMICAL INDUSTRY IN LATIN AMERICA ^{1/}

Economic Commission for Latin America
(ECLA)

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TABLES OF CONTENTS

	<u>Pages</u>
1. Preliminary comments: methodology	3
2. Summary and conclusions	5
3. Trends in 1959-67	7
3.1. The establishment of the petrochemical industry	7
3.2. Production	10
3.3. Prices	19
3.4. Installed capacity and its expansion	19
3.5. Imports	28
3.6. Apparent consumption	32
4. Evaluation of development in 1959-67	39
5. Prospects for the petrochemical industry in Latin America ..	40

1. Preliminary comments: methodology

The Economic Commission for Latin America (ECLA) has drawn up a classification of chemical products ^{1/} with a view to establishing methodological criteria for defining the scope of its studies of the chemical industry in Latin America.

In this classification, organically-based chemicals are listed under: group II (principal organic chemicals); group IV (plastics and synthetic resins); group V (synthetic and artificial fibres); group VI (synthetic rubber and related products, including carbon black); group XV (organic compounds for non-specified uses, excluding those listed in group II). They are also found in subgroups III-A₂ (nitrogenous fertilizers) and III-B (pesticides) of group III (chemicals for agriculture); subgroup VIII-B (detergents) of group VIII (tenso-active and bleaching agents); subgroup XII-A (additives for the petroleum industry) of group XII (products for other specific uses) and subgroup IX-A (industrial explosives) of group IX (explosives, matches and products for fireworks), and they include, in addition, some of the products in group XVI (pharmaceutical products).

In this classification, the petroleum derivatives used as a base for many of the organic products mentioned do not come under a specific sub-sector of the chemical industry, and therefore it is necessary to define the chemicals that can be considered to be petrochemicals, i.e., those products which, given the present state of technology, can be economically produced in the light of market conditions, from fractions and/or complete hydrocarbons of petroleum or natural gas. One of the problems in analysing the development of the Latin American petrochemical industry is the fact that many basic and intermediate organic chemicals are still being produced from raw materials that do not necessarily come from petroleum or natural gas. Such materials include the aromatics (benzene, toluene and xylene), methanol, ammonia, carbon disulphide, vinyl chloride, polybutadiene rubber, butanol, etc.

^{1/} La industria química en América Latina, (United Nations publication, Sales No.: 64.II.G.7), annex I.

ECLA has adopted the following definitions for chemicals derived from petroleum.^{2/}

(a) Basic petrochemical raw materials

Under this heading are fractions of petroleum or natural gas that can be obtained using conventional techniques in standard installations in the petroleum industry. They include the following:

Natural gas: methane

Liquid petroleum gas (LPG)

Refinery gas

Naphtha

Kerosene

Paraffins

Refining residues

(b) Petrochemicals proper

These include pure hydrocarbons, and chemical elements and compounds that can be obtained directly through physico-chemical processes from petrochemical raw materials.^{3/}

Petrochemicals can be used as chemical reagents to obtain intermediate and final petrochemical products, other chemical products in general, and also solvents, or others for direct use.

(c) Intermediate chemical products

These include all chemicals that can be obtained from petrochemicals proper, or from compounds derived entirely from petrochemicals or petrochemicals and other chemicals of non-petrochemical origin. Besides being used directly, such intermediate chemicals may be used to obtain final products.

(d) Final chemical products

These include all chemicals obtained from intermediate and/or basic chemicals, either pure petrochemicals or petrochemical and non-petrochemical

^{2/} See La industria petroquímica en América Latina, op. cit.

^{3/} Products such as ammonia, benzene, toluene, xylene, methanol, ethylene, etc., are only considered to be petrochemicals if they are obtained directly from petroleum or natural gas hydrocarbons.

compounds. They may be used by the chemical and para-chemical manufacturing industries, or be destined for the general market.

Accordingly, in view of the local conditions of the Latin American chemical industry and the data available on it, this paper will consider petrochemicals proper those defined in point (b) above and will refer to intermediate chemicals only if necessary for purposes of clarification.

ECLA has carried out a number of studies on the chemical industry,^{4/} including a recent analysis 1959-67;^{5/} summing up previous studies and expanding their coverage and adding details on different products and countries in Latin America, and a report^{6/} which gives a historical account of the situation and makes suggestions for a development strategy. All these studies complement the present analysis of the basic petrochemical industry.

2. Summary and conclusions

The present brief analysis of the development of the basic petrochemical industry in Latin America covers the period 1959-67, examining a group of chemicals known as "petrochemicals proper", which are defined as "pure hydrocarbons, chemical elements and compounds that can be obtained directly through physico-chemical processes from fractions of natural gas or petroleum" (petrochemical raw materials).^{7/}

Its main purpose is to identify the main features of production, foreign trade, apparent consumption, installed and/or projected capacity, and prices, both regionally and in terms of products, to the extent allowed by the data available.

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- 4/ La industria química en América Latina, op. cit.: La industria química en América Latina, 1952-64 (E/CN.12/756); La industria de alcalis sódicos en América Latina (E/CN.12/804); El caucho en América Latina (E/CN.12/792) La oferta de fertilizantes en América Latina (E/CN.12/761).
 - 5/ Las industrias químicas en América Latina y su evolución en los años 1959-1967 (to be issued).
 - 6/ El desarrollo industrial de América Latina (E/CN.12/830), a document submitted to the Economic Commission for Latin America at its thirteenth session (Lima, April 1969).
 - 7/ Following the ECLA definition given in La industria petroquímica en América Latina, op. cit.

The present analysis is complemented by the series of ECLA studies mentioned above on the chemical industry in Latin America.^{8/} It should be noted that the fact that products are dealt with in particular groups should not be considered an attempt to divide the sub-sector up into separate compartments or to ignore its interrelationships with the vast chemical industry as a whole. This approach is used simply as a methodological tool to facilitate the study of an inherently complex industry whose pattern of development in the region is very varied.

In brief, the development of the petrochemical industry has been dynamic, with production in the region growing at a yearly average of 41 per cent over the period 1959-67, with differences between countries; in 1967 it had an installed capacity of over 1.3 million tons per year and produced almost 800 000 tons.

These figures indicate a process of import substitution which reduces the share of imports from 52 to 28.4 per cent between 1959 and 1967. In addition, they show, on the one hand, considerable technological progress, together with heavy dependence on the external sector for want of a clear-cut regional development policy in this field, and, on the other hand, a change in the structure of production which is tending to become vertically integrated from the final product down to the basic materials. This process is more far-reaching in some countries, such as Argentina, Brazil and Mexico, but the rest of the countries intend to follow the same course.

The analysis also reveals that regional development has depended on the greater or lesser momentum of demand for specific groups of finished products in the domestic markets. Thus the production of ammonia was developed - particularly in Mexico and Colombia - in response to the growth of demand for fertilizers; and the production of aromatic and olefin hydrocarbons, which rank next in importance, in response to the demand for plastics, textiles and paints. It should, however, be noted first, that installed capacity consists of a considerable number of small plants manufacturing the

^{8/} See footnotes 4-6.

same products, often in the same country, and, secondly, that intra-regional trade is a comparatively new departure, conducted on a small scale and generally involving marginal percentages of production.

It is considered that development of the petrochemical industry has failed to reach the levels envisaged in the national industrial development plans, since it has not had the expected effect on the economy (as it had in Europe and the United States), in spite of Latin America's natural resources and the specially enacted legislation for promoting this branch of industry.

In the light of recent events, it may be assumed that Latin America's petrochemical industry is reaching a somewhat critical stage of its development, inasmuch as it is beginning to be affected by national and regional circumstances connected with integration and competition. The industrial development policies adopted in each country in relation to the domestic, regional or world markets and the characteristics of the existing petrochemical industry will determine whether Latin America will be able to reach exceptionally high levels in the production of petrochemicals. Organizations have already been set up for the integration of markets, at least at the subregional level, and for some products market integration has been going for many years. The integration of production is indubitably a rational method of developing certain industries - particularly petrochemicals - on a scale which would today be technologically and economically justified. From the characteristics of some plants now under construction, it may be assumed that the petrochemical industry has already reached this critical stage of development.

3. Trends in 1959-67

3.1. The establishment of the petrochemical industry

Latin America possesses vast natural resources (petroleum and natural gas) for the petrochemical industry, and since the nineteen-forties or thereabouts, it has had the capacity to process them (petroleum industry), at least in the relatively more developed countries of the region. In those early years the first projects for the establishment of petrochemical plants were also prepared, but very few materialized; those that did were mostly in

countries with State petroleum enterprises, such as Argentina, Mexico and Venezuela.

However, the Second World War gave rise to a world-wide demand for the basic organic chemicals produced by the synthesis of organic materials in general, and this opened up markets for petroleum products, to the detriment of the by-products of coal and the fermentation of agricultural residues. Latin America, with its petroleum and natural gas resources, was then emerging as one of the regions with the brightest prospects in this field.

It was only in the second half of the nineteen-fifties, however, that a start was made on the construction of petrochemical plants (in Argentina, Brazil, Colombia, Mexico and Venezuela), which were small, as they were intended to supply only small domestic markets and protected by high customs tariffs. Most of these plants were designed and built by well-known international firms and belonged to large-scale world chemical enterprises,^{9/} except in Mexico, where the State enterprise^{10/} held a monopoly of the production of all basic petrochemicals, and even of some intermediate products.

This was not an isolated venture; it formed part of a whole process of industrialization. At that time, industrial development laws were approved in several Latin American countries; they established priorities for industrial development plans, including those for the petrochemical industry, on the basis of the import substitution to be achieved through the processing of their plentiful natural resources (petroleum and natural gas) by up-to-date techniques.

In the case of the petrochemical industry, this development legislation has serious flaws, since through either omissions or over-specification it aims at promoting this industry without considering inter-sectoral conditions which have a marked impact on the petrochemical industry itself. Thus, no account was taken of some intermediate and finished products of the chemical industry (and even of the basic inorganic chemical industry) which step up

^{9/} Dupont de Nemours, Monsanto Company, Koppers, Borden Company, Dow Chemical Company, Imperial Chemical Industries, Montecatini, etc.

^{10/} Petróleos Mexicanos (PEMEX)

and accelerate the growth of demand for basic petrochemical products.

A brief examination of the structure of the petroleum industry in the Latin American countries at the time the petrochemical industry came into being is in order here, since the technical and economic interdependence between the two industries, and the institutional system for petroleum development in each country, obviously affected the institutional structure and development of the petrochemical industry.

In countries which follow the system of granting long-term oil concessions to private enterprises (Peru, Venezuela and Colombia), the possibilities of utilizing natural gas as a raw material for petrochemicals depend on whether the companies holding the concessions intend to expand their activities and increase their investment in the country. Since the concessions are generally held by companies operating on an international scale, which have petrochemical plants producing exclusively for export operating in their own countries or in other more suitable places, their interest in developing the petrochemical industry in Latin America has gone no further than the exploratory stage, mainly because of the small domestic markets and the dim prospects for intra-regional trade.

The petrochemical processes used are the result of recent technological progress, which usually entails a high level of technical know-how and huge financial resources. The companies holding concessions for the region's main oilfields have an abundance of both these important elements. This is not the case with public or private enterprises in countries which have not adopted the system of concessions and where the petroleum industry is in the hands of the State.

The financial resources required by these countries for the development of their petroleum industry are so great that only a small proportion of them can be used to promote petrochemical projects. Moreover, the negotiations undertaken by national institutions to obtain external loans for investment in the petrochemical industry scarcely ever yield satisfactory results unless they are backed by prior agreements on the use of patents and the provision of technical assistance.

To sum up, Argentina and Colombia follow the system of oil concessions, while in Mexico and Brazil petroleum development is mainly State-controlled;

as a result, in some countries the petrochemical industry is mostly in the hands of the private sector, and in others it is controlled by a strong government monopoly.

In 1965, of the total installed capacity in operation in Argentina and Colombia, 95.9 and 86.5 per cent, respectively, belonged to the private sector, compared with only 51.8 per cent in Brazil, 16.2 per cent in Venezuela and 8.2 per cent in Mexico.

About 1960, a great many petrochemical projects with varying technical and economic characteristics were proposed, some of which were carried out and put into operation, but quite a number of projects failed to materialize, for reasons which include inadequate development laws and deficiencies in the public authorities responsible for enforcing them.

The Latin American countries can be divided into the following groups, according to the development of the installed capacity of their petrochemical industries in 1965/66:

(a) Countries whose output of petrochemicals satisfied a high proportion of the domestic demand for basic chemical products (Argentina, Brazil and Mexico);^{11/} (b) countries which had a small output and/or a considerable number of projects under study or in process of execution (Venezuela, Colombia, Peru and Chile); (c) countries which produced no petrochemicals, and had no projects or only small-scale projects under study (the remainder of the countries in the region, particularly those at a relatively less advanced stage of development).

3.2. Production

When the petrochemical industry was first launched, some of the basic organic chemicals were produced from raw materials different from petroleum derivatives and natural gas, i.e., through the fermentation of agricultural residues and the chemical processing of coal, ect. Some non-petrochemical processing still continues, so an attempt has been made in this paper to

^{11/} Although Trinidad and Tobago could be included in this group, it is in a different and almost unique position in the region, since its petrochemical industry produces mainly for export, and its chemical industry still manufactures intermediate products on a very small scale.

present the figures separately (tables 1,2 and 3, and figure I); although some margin of error is bound to have crept in, it is unlikely to have affected the bases of the present analysis to any significant extent. The products that continue to be processed partly from non-petrochemical raw materials include ammonia, butadiene, benzene, toluene, xylene, carbon sulphide and methanol. The raw materials from which they are made come from coal and agricultural residues.

The market prices for these products in Latin America hold out little hope for their future production by non-petrochemical means although the domestic prices for petrochemical products are much higher than international prices,^{12/} and the survival of these plants and processes can be put down to the industry's wide range of location and heavy national protection. In the more developed countries, such as Argentina, Brazil and Mexico, there is usually a logical substitution of processes as petrochemical production moves forward. This has not occurred in the other countries, however, either because the industry is still in its infancy there or because no petrochemical plants have been set up.

Some non-petrochemical plants have survived in the former mainly because they are State-owned (by State petroleum companies and army companies, etc.), and their products are normally used for their own purposes (explosives, solvents and so forth).

To judge by the figures in table 1 (figure I), non-petrochemical processes were replaced by petrochemical processes to a considerable extent between 1959 and 1967, over which period the relative importance of petrochemicals (as a percentage of physical output) rose from 52.1 to 84.6 per cent.

Apart from this, the output of petrochemical products proper between those years was genuinely dynamic, achieving an annual growth rate of nearly 41 per cent, with two periods during which it soared up to as much as 71.8 and 63.9 per cent in 1961-62 and 1962-63 respectively (see table 1).

Its dynamic growth was due to its incipient state of development at a time when there was considerable demand for primary commodities and intermediate goods in the region, or at least in some of the relatively more

^{12/} See a study undertaken in the LAFTA countries, entitled La industria petroquímica en la ALALC (ALALC/GG.PQ/I/dt.1), 16 April 1969.

Table 1

LATIN AMERICA: PRODUCTION TRENDS IN THE BASIC PETROCHEMICAL INDUSTRY

Year	Petrochemical		Non-petrochemical ^{a/}		Total Thousands of tons
	Thousands of tons	Percentages	Thousands of tons	Percentages	
1959	53.8	52.1	49.5	47.9	103.3
1960	75.1	54.7	62.2	45.3	137.3
1961	98.8	59.9	66.2	40.1	165.0
1962	169.7	70.0	76.3	30.0	246.0
1963	278.2	76.5	85.4	23.5	363.6
1964	392.9	78.8	105.8	21.2	498.7
1965	555.8	83.0	114.2	17.0	670.0
1966	680.3	95.2	34.6	4.8	714.9
1967	810.4	87.4	116.6	12.6	927.0

Source: ECLA.

^{a/} Based on raw materials other than petroleum (cracked products) and natural gas.

Table 2
LATIN AMERICA:^{a/} OUTPUT OF BASIC PETROCHEMICAL PRODUCTS MADE FROM PETROLEUM RESID
(Thousands of tons)

Products	1959	1960	1961	1962	1963	1964	1965	1966	1967	Installed capacity 1967-68
Ammonia	21.1	31.0	54.6	120.7	196.8	256.6	278.3	295.8 ^{b/}	288.4	489.5
Butadiene	-	-	-	-	-	-	3.0	12.3	28.9	30.0 ^{e/}
Benzene	3.7	5.7	5.2	5.6	6.3	6.9	46.9	57.7	78.0	229.0 ^{e/}
Toluene	-	-	-	-	-	14.0	68.2	96.0	100.8	100.0 ^{d/}
Xylenes	-	-	-	-	-	7.7	...	3.0 ^{e/}	67.9 ^{f/}	59.0 ^{d/}
Naphthalene	2.4	3.2	2.9	3.4	4.3	5.7	4.2 ^{e/}	4.5 ^{e/}	5.0 ^{e/}	10.5
Methanol	10.3	10.0	10.1	10.0	11.7	14.9	19.8	31.6	36.0	55.5
Carbon sulphide ^{g/}	-	-	-	-	7.0	8.3	10.0	7.2	5.1	19.5

Source: ECLA.

- a/ Excluding Cuba, Jamaica, and Trinidad and Tobago.
- b/ Including a level of output equal to that in 1965 for Colombia.
- c/ Argentina: approximately 105 000 thousand tons of petrochemical production (benzene, toluene, and xylene) altogether.
- d/ Capacity in Mexico only. Argentina included for benzene.
- e/ Excluding Colombia, and the countries listed under a/.
- f/ Excluding Venezuela.
- g/ Argentina only, by petrochemical processes, from about 1963.

Table 2 (Continued)

Products	1959	1960	1961	1962	1963	1964	1965	1966	1967	Installed capacity 1967-68
Ethylene	4.6	4.5	6.2	5.0	9.1	17.2	27.3	37.0	58.4	134.3 ^{h/}
Propylene	1.2	1.2	1.3	1.6	2.6	3.3	34.9	54.3 ^{i/}	61.7 ^{i/}	236.0
Carbon black	10.0	19.5	17.0	21.8	38.3	54.8	60.3	76.9 ^{e/}	75.4 ^{f/}	117.1
Naphthenic acids	0.5	...	1.5	1.6	2.1	2.7	2.9	4.0	4.0	...
Total	53.8	75.1	98.8	169.7	278.2	392.9	555.8	680.3	810.4	1 540.7

Growth rate:

Annual percentage	39.6	31.6	71.8	63.9	41.2	41.5	22.4	33.8
Annual percentage 1959-65	48.0%							
Annual percentage 1959-67	41.0%							

Per capita output (kg/yr) 0.28 0.38 0.48 0.80 1.28 1.75 2.41 2.87 3.32

^{h/} Including 20 000 tons for Colombia, and excluding Brazil, for lack of data.
^{i/} Excluding probable output in Argentina.

Table 3

LATIN AMERICA:^{a/} TOTAL OUTPUT OF BASIC PETROCHEMICAL PRODUCTS INCLUDING SOURCES
OTHERS THAN PETROLEUM
(Thousands of tons)

Product	1959	1960	1961	1962	1963	1964	1965	1966	1967
Ammonia	38.1	53.1	75.3	146.2	234.5	302.1	335.8	345.4 ^{b/}	340.0 ^{f/}
Naphthenic acids	0.5	...	1.5	1.6	2.1	2.7	2.9	4.0	4.0
Butadiene	-	-	-	-	-	-	3.0	12.3	23.9
Benzene	12.3	17.1	17.2	20.4	22.4	28.7	67.2	70.0	101.1
Toluene	2.1	3.3	3.4	3.5	3.9	19.4	72.9	100.5 ^{d/}	105.5 ^{d/}
Xylones	0.6	2.5	3.0	3.1	2.7	10.6	10.0	10.0 ^{f/}	60.0 ^{f/}
Napthalene	2.4	3.2	2.9	3.4	4.3	5.7	4.2 ^{d/}	4.5 ^{d/}	5.8 ^{d/}
Methanol	10.3	10.0	10.1	10.0	11.7	14.9	19.2	31.6	36.0
Carbon sulphide	20.7	22.9	25.6	27.8	29.9	36.5	39.7	38.4 ^{d/}	40.2
Ethylene	4.6	4.5	6.2	5.0	9.1	17.2	29.3	37.0	58.4
Propylene	1.2	1.2	1.3	1.6	2.6	3.3	34.9	54.3	61.7
Carbon black	10.0	19.5	17.0	21.8	38.3	54.8	60.3	76.9 ^{d/}	75.4
Total	102.8	137.3	163.5	244.4	361.5	495.9	680.0	784.9	917.0

Source: ECLA.

- a/ Excluding Cuba, Jamaica, and Trinidad and Tobago.
- b/ Including a level of output equal to that in 1965 for Colombia.
- c/ Capacity in Argentina includes benzene, toluene and xylones.
- d/ Excluding Colombia.
- e/ Argentina included for benzene.
- f/ Estimate.
- g/ Excluding Brazil and including 20 000 tons for Colombia.

of the total production of petrochemicals in Latin America, and the volume of petrochemicals produced from petrochemical and non-petrochemical processes.

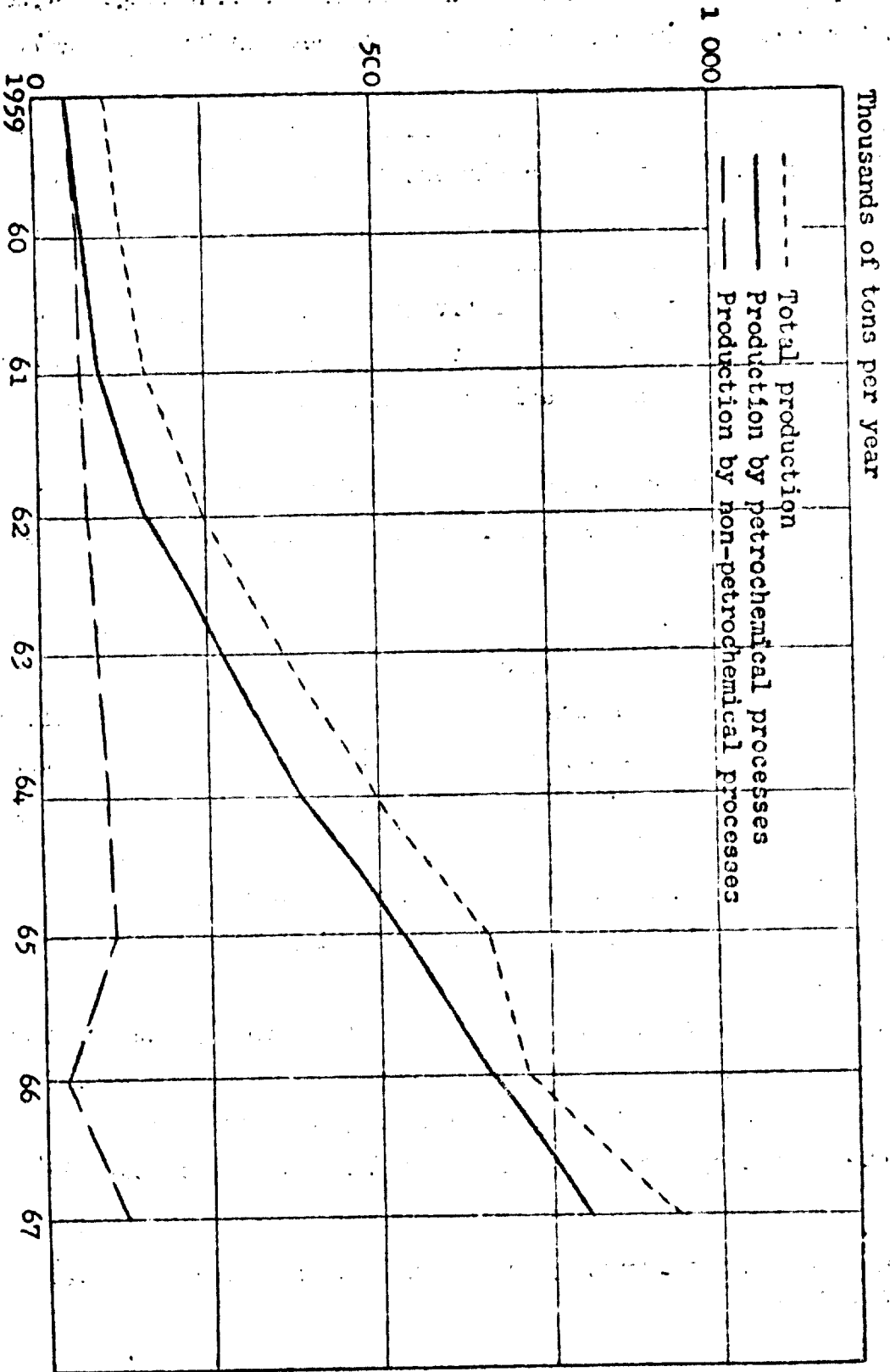


Figure I
LATIN AMERICA : VOLUME OF PETROCHEMICALS PRODUCED FROM PETROCHEMICAL AND NON-PETROCHEMICAL RAW MATERIALS

advanced countries, such as Argentina, Brazil and Mexico, which, upon the establishment of the petrochemical industry began to integrate all the production processes.

Output rose as a result from some 53 800 tons in 1959 to over 810 400 tons^{13/} in 1967, that is to 3.32 kilogrammes per capital yearly.

The relative shares of certain petrochemical products in the volume of regional output has undergone variations that are worth noting, because they reflect the composition and trends of demand between 1959 and 1967. Ammonia, for instance, continued to rank first, although it underwent a sharp fluctuation between 1963 and 1967, falling from 70.7 to 39.2 per cent (see table 4). Its importance was mainly due to the rise in demand for nitrogenous fertilizers and, although less so, for plastics, which, as early as 1959, had already made an impact in such Latin American countries as Brazil and Mexico. In that same year, the relative importance of carbon black (12.6 per cent) highlights the development of the rubber industry, just as that of methanol (19.1 per cent) testifies to the upsurge of the plastics industry.

Towards 1963 there seems to have been a sudden spurt in demand for nitrogenous fertilizers, and a continued demand for carbon black for the rubber industry.

Towards 1967, however, the production of aromatic hydrocarbons (benzene, toluene and xylenes) made a sharp comeback. Together these represented 30.5 per cent of regional production and also of the production of olefins (ethylene, butadiene and propylene), which totalled 13.4 per cent. Thus, basic hydrocarbons alone (aromatic and olefins) accounted for nearly 50 per cent of petrochemical production proper in the region, whereas in 1959 they had been barely 17.7 per cent. This is a sign of the progress that has been made in integrating production processes in Argentina, Brazil and Mexico.

In 1965, total production in the region required only 52 per cent of installed capacity, which meant that far too big a margin was lying idle.

^{13/} Excluding output in Colombia for lack of data.

Table 4

LATIN AMERICA: RELATIVE SHARES OF PRODUCTS IN THE BASIC PETROCHEMICAL INDUSTRY
(Percentages)

Product	Output			Installed capacity 1967-68
	1959	1963	1967	
Ammonia	39.2	70.7	35.6	29.2
Butadiene	-	-	3.6	2.6
Benzene	6.9	2.3	9.7	16.5
Toluene	-	-	12.4	7.4
Xylenes	-	-	8.4	4.4
Naphthalene	4.5	1.5	0.7	0.8
Methanol	19.1	4.2	4.4	3.0
Carbon sulphide	-	2.5	0.6	1.5
Ethylene	8.6	3.3	7.2	8.3
Propylene	2.2	0.9	7.6	17.6
Carbon black	18.6	13.8	9.3	8.7
Naphthenic acids	0.9	0.8	0.5	...
Total	100.0	100.0	100.0	100.0

Source: ECLA.

The situation was the same in 1967, thus indicating that the surplus capacity was due to the opening of several new plants in those years.^{14/}

Although intermediate petrochemical products will not be dealt with for the reasons given in the introduction, table 5 gives a list of products deriving from the basic petrochemical industry that are now or will be processed in Latin America.^{15/}

3.3. Prices

The small size and sluggish state of the domestic markets for basic petrochemical products, the structure and sources of capital for the industry, and the industry's development through import substitution are, among others, some of the reasons for the high prices of petrochemical products in Latin America (see table 6).

The comparison made in that table relates to 1964-65, and shows that prices for many of these products are unquestionably much higher in Latin America than in the United States or Europe.

The effect of these prices on the manufacture of other chemical products in Latin America is self-evident, and the state of the industry is directly attributable to them.

3.4. Installed capacity and its expansion

Figures for installed capacity in the basic petrochemical industry in 1964-65 and 1967-68 and for the additions and new plants planned for 1970-75 are given in tables 7 and 8.^{16/} In 1967-68 ammonia accounted for 33.7 per cent of total capacity, and its expansion will represent more than 50 per cent of the total additions provided for up to the present. Aromatic hydrocarbons constituted 25 per cent of total capacity, but accounted for only just over 12 per cent of the anticipated expansion, while olefins absorbed about 28.6 of installed capacity and 35.5 per cent of the additional capacity (ethylene projects alone accounted for 27.6 per cent). In other words, in 1968,

^{14/} Argentina: benzene, toluene, xylenes, butadiene; Mexico: ammonia, butadiene, etc.

^{15/} For further information on these products, see La industria química en América Latina, op. cit., and, also by ECLA, La industria química latino-americana en 1962-64 (E/CN.12/756).

^{16/} According to information provided by the countries in the region, irrespective of the feasibility of the projects.

Table 5 (continued)

	Petrochemical plants		Produced in Latin America in 1967/68	Projected 1968-72
	Basic petrochemical products	Directly derived intermediate products	b/	
Petroleum refineries				
Raw material for basic petrochemical products				
C ₃ , C ₄ petroleum cuts	Butadiene	Adiponitrile		X
Refinery gas	Butylene	Polybutadiene rubber		X
Natural gas	Carbon disulphide	Butanol sec (butadiene)	X	X
Petroleum cuts	Ethylene	Carbon tetrachloride	X	X
		Acetaldehyde	X	
		Styrene	X	
		Ethylene oxide	X	
		Polyethylene	X	
		Tetrachloroethylene	X	
		Trichloroethylene	X	
		Methyl acetate	X	
		Methyl bromide	X	
		Methyl chloride	X	
		Dimethyl terephthalate		X
		Dimethyl phthalate		X
		Methyl methacrylate		X
		Isoprene		
		Phthalic anhydride		
Natural gas	Methanol			
Aromatic petroleum cuts	Naphthalene			
Natural gas	Carbon black			
Petroleum oil residues				

Table 5 (concluded)

Petroleum refineries	Petrochemical plants	Produced in Latin America in 1967/68 ^{b/}	Projected for 1968-72
Raw material for basic petrochemical products	Basic petrochemical products ^{a/}		
	Directly derived intermediates/products		
C ₃ -C ₄ petroleum cut	Propylene	X	X
	Acrylonitrile	X	X
	Isopropanol	X	X
	Propylene oxide	X	X
	Polpropylene	X	X
	Propylene tetramer	X	X
	Carbon tetrachloride	X	X
	Benzoic acid	X	X
	Trinitrotoluene (TNT)	X	X
	Paraphthalic acid	X	X
	Isophthalic acid	X	X
	Phthalic anhydride	X	X
	Dimethyl terephthalate	X	X
	Styrene	X	X
	Toluene	X	X
Aromatic petroleum cut			
Aromatic petroleum cut			

Source: WOLA.

a/ Following the definition given in document E/CN.12/744.
b/ Exclusively by petrochemical processes.

Table 6

LATIN AMERICA: PRICES FOR BASIC PETROCHEMICAL PRODUCTS, 1964-65

Products	Latin America ^{a/} (dollars per ton)		United States ^{b/} (dollars per ton)		Western Europe ^{c/} (dollars per ton)	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
Ammonia	509	88		102	129	97
Butadiene		588		261.10	333.30	277.75
Benzene	244	97		81.54	88	78
Toluene	294	93		64	73	57
Xylenes	302	179		75	71	60
Naphthalene	114	270		72.20	106.65	75.50
Methanol	275	191		97.30	108.90	77.00
Carbon sulphide	359	160		94.40	175.50	93.30
Ethylene	165	88	110		65	...
Propylene		145		...	232	93
Carbon black	400	161		155.50	224.40	188.90

Sources:

- a/ Factory selling prices in 1964; data supplied by the CADI/LAFPA Study Group on Petrochemicals.
- b/ Oil, Paint and Drug Reporter, 1965.
- c/ European Chemical News, 1965.

Table 7

LATIN AMERICA: GROWTH OF INSTALLED CAPACITY OF THE BASIC PETROCHEMICAL INDUSTRY
(Thousands of tons per year)

	Ammonia	Butadiene	Benzene	Ethylene	Methanol	Naphthalene	Carbon black	Propylene	Carbon sulphide	Toluene	Xylenes	Total	Percentage
Argentina													
1964/65	-	32.0	42.0 ^{a/}	39.5	26.5	-	13.0	5.0	14.0	b/	b/	172.0	16.1
1967/68	68.0	35.0	113.0 ^{a/}	39.5	28.5	2.5	30.0	125.0	19.5	b/	b/	461.0	29.3
Growth	200.0	-	52.0 ^{a/}	500.0	16.5	-	-	63.0	-	b/	b/	831.5	18.8
1972/75	268.0	35.0	165.0 ^{a/}	539.5	45.0	2.5	30.0	188.0	19.5	b/	b/	1 292.5	21.6
Brazil													
1964/65	34.5	-	-	20.8	8.0	-	36.0	11.0	-	-	-	110.3	10.4
1967/68	34.5	-	-	20.8	12.0	4.9	36.0	22.0	-	-	-	130.2	8.3
Growth	250.2	111.2	16.5	6.2	-	66.8	-	4.5	0.6	456.0	10.3
1972/75	284.7	-	-	132.0	28.5	11.1	36.0	88.8	-	4.5	0.6	586.2	9.8
Chile													
1964/65	-	-	-	-	-	-	-	-	-	-	-	-	-
1967/68	-	-	-	-	-	-	-	-	-	-	-	549.0	12.4
Growth	330.0	9.0	100.0	60.0	-	-	-	-	-	b/	b/	549.0	9.2
1972/75	330.0	9.0	100.0	60.0	-	-	-	50.0	-	b/	b/	549.0	9.2
Colombia													
1964/65	115.0	-	-	-	-	0.8	7.5	-	-	-	-	122.5	11.5
1967/68	115.0	-	-	20.0	-	0.8	7.5	-	-	-	-	143.3	9.2
Growth	300.0	-	40.0	20.0	-	1.0	11.2	10.0	-	6.5	39.6	428.3	9.7
1972/75	415.0	-	40.0	40.0	-	1.8	18.7	10.0	-	6.5	39.6	571.6	9.5
Mexico													
1964/65	194.0	45.0	65.0	36.5	15.0	-	34.6	60.0	-	100.0	46.0	556.1	56.0
1967/68	194.0	45.0	116.0	54.0	15.0	2.6	34.6	89.0	-	100.0	59.0	709.2	45.1
Growth	462.0	55.0	54.0	378.0	21.6	-	-	-	-	100.0	40.0	1 110.6	25.1
1972/75	656.0	100.0	170.0	432.0	36.6	2.6	34.6	89.0	-	200.0	99.0	1 819.8	30.3
Peru													
1964/66	25.0	-	-	-	-	-	-	50.0	-	-	-	25.0	2.3
1967/68	45.0	-	-	-	-	-	-	-	-	-	-	45.0	5.4
Growth	249.0	-	-	-	-	-	-	-	-	-	-	249.0	5.6
1972/75	294.0	-	-	-	-	-	-	-	-	-	-	294.0	5.6
Venezuela													
1964/65	33.0	-	-	-	-	-	6.4	-	-	-	-	39.4	3.7
1967/68	33.0	-	-	-	-	-	9.0	-	-	-	-	42.0	2.7
Growth	450.0	-	100.0	150.0	-	-	-	100.0	-	b/	b/	800.0	18.1
1972/75	483.0	-	100.0	150.0	-	-	9.0	100.0	-	b/	b/	842.0	14.0
Totals (thousands of tons per year):													
1964/65	401.5	77.0	107.0	96.8	49.5	-	97.5	76.0	14.0	100.0	46.0	1 065.3	100.0
1967/68	489.5	80.0	229.0	134.3	55.5	10.8	117.1	236.0	19.5	100.0 ^{a/}	59.0 ^{a/}	1 530.7	100.0
Growth	2 241.2	64.0	346.0	1 219.2	54.6	7.2	11.2	289.8	-	111.0 ^{a/}	80.2 ^{a/}	4 424.4	100.0
1972/75	2 730.7	144.0	575.0	1 353.5	110.1	18.0	128.0	525.8	19.5	211.0	139.2	5 955.1	100.0
Percentages													
1964/65	37.7	7.2	10.0	9.1	4.6	-	9.2	7.2	1.3	9.4	4.3	100.0	
1967/68	33.7	5.1	14.6	8.5	3.5	0.7	7.5	15.0	1.2	6.4	3.8	100.0	
Growth	50.7	1.4	7.8	27.6	1.2	0.2	0.3	6.5	-	2.5	1.8	100.0	
1972/75	46.2	2.4	9.6	22.6	1.8	0.3	2.1	8.8	0.4	3.5	2.3	100.0	

Source: ECLA, on the Basis of Official Statistics.

a/ As BTX (benzene, toluene and xylenes).

b/ Included under benzene.

c/ Figures for Mexico only; for all other countries included as BTX under benzene.

d/ Figure for Brazil, Colombia and Mexico only; for all other countries included as BTX under benzene.



53,6 per cent of capacity was used to produce basic hydrocarbons (aromatics and 81efins.

Projects of new plants include some on a considerable scale, which indicates a regional tendency to cut down production costs. There are projects for producing 100 000 to 120 000 tons of ethylene a year in Argentina, Mexico and Venezuela, from 600 to 1 000 tons of ammonia a day in Chile, Colombia, Mexico and Venezuela, and from 60 000 to 100 000 tons of benzene a year in Argentina, Brazil, Mexico and Venezuela.

Up to 1967-68, Argentina, Brazil, Colombia, Mexico, Peru and Venezuela were the only countries in Latin America producing basic petrochemicals, Argentina, Brazil and Mexico accounting for almost 83 per cent of total production (82.5 per cent in 1964-65) (see table 8 and figure 11). Over the period 1964-68, the capacity of the region as a whole grew by 47.5 per cent, with appreciable variations between countries. In Peru, for example, it grew by close to 240 per cent, while in Venezuela by only 7 per cent: in both these countries only very small plants (ammonia) were expanded, Peru increasing capacity from 15 000 to 35 100 tons per year and Venezuela from 39 000 to 42 000 tons per year. Argentina, by contrast, increased its capacity from 172 000 to 261 000 tons per year (almost 170 per cent) and made some progress towards greater economies of scale in its production of aromatic hydrocarbons (benzene: 45 000 tons per year); Brazil, Colombia and Mexico expanded their capacity by less than 20 per cent: Brazil increased capacity from 110 000 to 130 000 tons per year, Colombia from 122 500 to 143 500, and Mexico from 596 000 to 700 000, on the basis of large-scale plants producing ammonia (1 000 tons per day) and carbon black (30 000 tons per year). Latin America's capacity, covering a wide range of plants of very different sizes, increased from 1 065 000 to 1 570 000 tons per year. In Argentina, Brazil, Colombia and Mexico the increases were the result of a process - which was not always planned - of integration of the national production structure aimed at import substitution.

On the basis of the data available, the anticipated increases in capacity can be projected (see table 7) for the total capacity of plant planned to date. Although it is not certain how many of the plans will actually be implemented, it is interesting to consider certain points.

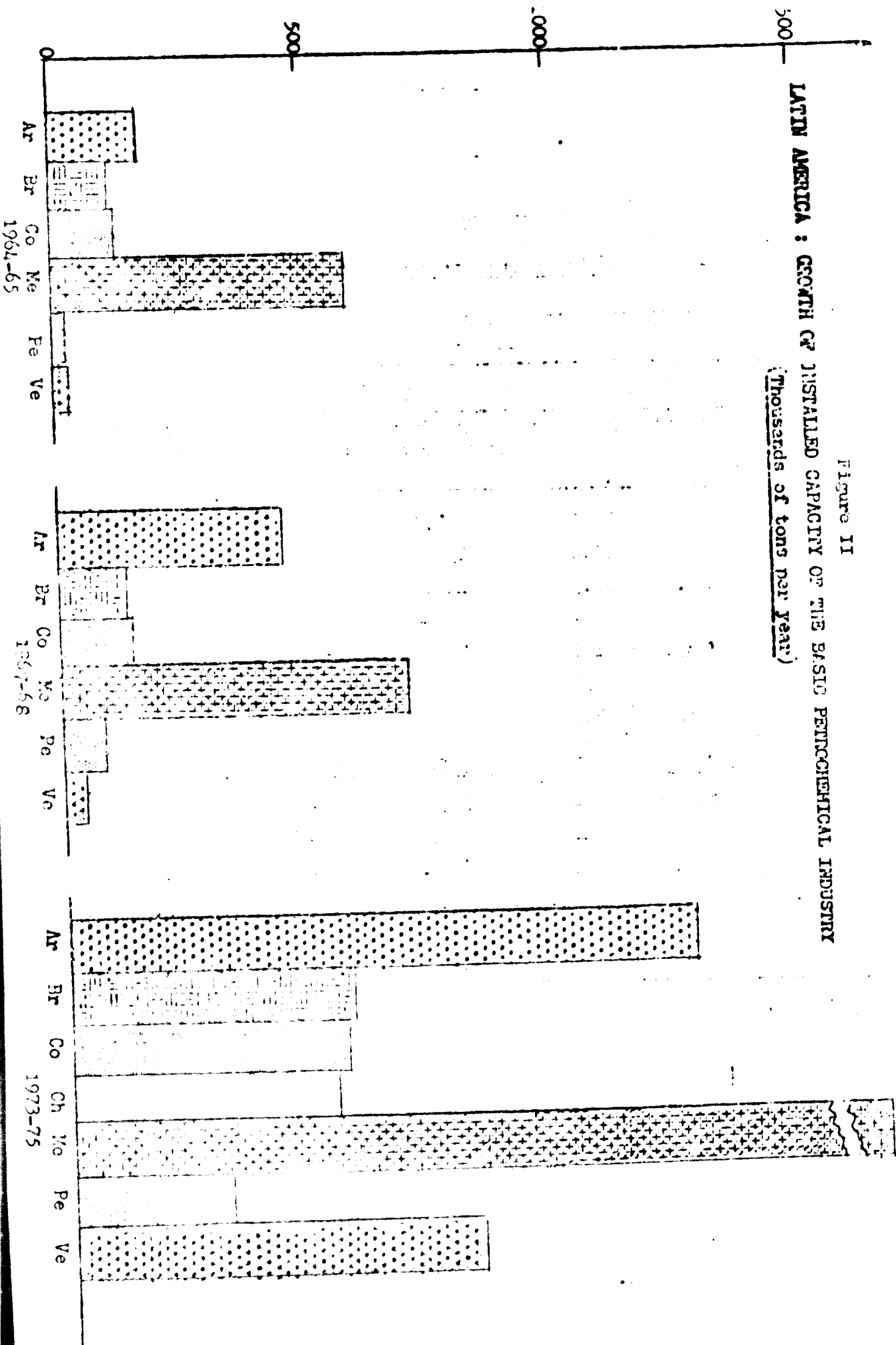
Table 8

LATIN AMERICA: GROWTH OF INSTALLED CAPACITY IN THE BASIC
PETROCHEMICAL INDUSTRY
(Thousands of tons per year)

Countries	Installed capacity					
	1964-65		1967-68		1973-75	
	Thousands of tons per year	Percentage	Thousands of tons per year	Percentage	Thousands of tons per year	Percentage
Argentina	172.0	16.1	461.0	29.3	1 292.5	21.6
Brazil	110.3	10.4	130.2	8.3	586.2	9.8
Colombia	122.5	11.5	143.3	9.2	571.6	9.5
Chile	-	-	-	-	549.0	9.2
Mexico	596.1	56.0	709.2	45.1	1 819.3	30.3
Peru	25.0	2.3	45.0	5.4	294.0	5.6
Venezuela	39.4	3.7	42.0	2.7	842.0	14.0
<u>Totals:</u>	<u>1 065.3</u>	<u>100.0</u>	<u>1 530.0</u>	<u>100.0</u>	<u>5 955.1</u>	<u>100.0</u>
Indexes	100.0	-	147.4	-	415.3	..
Growth	-	-	47.4	-	281.7	..
Rate 1965-75	-	-	-	-	15.3%	-
Rate 1965-68	-	-	13.8%	-	-	-
Rate 1968-75	-	-	-	-	16.0%	-

Source: ECLA.

Figure II
LATIN AMERICA : GROWTH OF INSTALLED CAPACITY OF THE BASIC PETROCHEMICAL INDUSTRY
(Thousands of tons per year)



Judging from the size of most of the plants planned, there seems to be a trend towards rationalizing their size, which in the past has generally been on the small side. Chile is joining the producers of basic petrochemicals with a plant for the production of ethylene (60 000 tons per year) and ammonia (330 000 tons per year). The greatest increase will come in Venezuela,^{17/} which has a whole series of plans for large-scale plant to produce aromatic and olefin hydrocarbons, ammonia and carbon black, not only for the domestic market which is still small, but also for the regional and world markets, the equipment for the first of two ammonia plants being already under construction, with a capacity of 900 tons per day.

Mexico will continue to expand its basic petrochemical industry under its state monopoly system,^{18/} with ammonia taking pride of place in line with the fast-growing demand for fertilizers in Mexico.

Virtually none of the projects relating to basic petrochemicals in the Latin American countries have been designed with regional integration in mind as regards production, even though it is estimated that several of them will need subregional markets in order to be an economic proposition.

Assuming that all the projects now on the drawing board are implemented between 1968 and 1975, the industry should grow at a cumulative annual rate of 16 per cent (in 1965-66 the rate was approximately 13.8 per cent).

3.5. Imports

It should be made clear from the outset that the figures in this report relate to imports of pure basic petrochemical products^{19/} and, therefore, they do not include the volume of these products imported in the form of chemical compounds in whose manufacture they are used to a greater or lesser degree. The figures in tables 9 and 10 cover all the Latin American countries

^{17/} Owing to the small scale of existing installed capacity and the large scale plants planned.

^{18/} All the basic petrochemical projects come under PETEX.

^{19/} Taken from the official foreign trade statistics of the countries of the region.

except those indicated in the footnotes to the tables.

Imports of basic petrochemical products have grown in volume from about 111,200 tons in 1959 to some 368,600 tons in 1967 (averaging an 8.3 per cent annually), but they have declined in importance in relation to the growth of regional production, which rose from some 102,300 to 927,000 tons annually (32 per cent) over the same period.

It is clear, therefore, that a process of import substitution is taking place in the region, since imports have gradually lost their impetus in relation to demand, which grew by approximately 25 per cent annually in the same period (see table 11). The over-all figures fail to show, however, that import substitution has followed a very different course in the various countries of the region; while some have reached a relatively high level of self-supply, others still rely exclusively on imports from inside or outside the region. Import substitution is estimated to have made considerable progress in Argentina, Brazil and Mexico, and somewhat less in Colombia, Peru and Venezuela.

Ammonia is accounting for an increasing share of total imports of basic petrochemical products, its share rising from 37 to 63 per cent between 1959 and 1967, while production in Latin America also increased substantially (see section 3.2, on production). Substitution is more advanced in the case of aromatic hydrocarbons, imports of which declined from 19 per cent in 1959 to 13 per cent in 1967, despite a peak of 30 per cent in 1963. Methanol has followed virtually the same trend. The share of carbon black declined even more sharply, from 31 per cent in 1959 to 6 per cent in 1967; this means that Latin America is importing only some special qualities of carbon black and that the rest of the demand is satisfied by regional production.^{20/} It must also be pointed out that from 1959 to 1967 imports of basic petrochemical products increased from 17.6 to 33.2 million dollars c.i.f. (see table 10), Latin America's total imports of chemical products rose from 385.8 million to 1,342.2 million dollars c.i.f. in other words, between 1959 and 1967 total imports of chemical products included from 2 to 2.5 per cent of petrochemical products.

^{20/} From Argentina, Brazil, Colombia, Mexico and Venezuela.

Table 9.
LATIN AMERICA^{a/}: VOLUME OF IMPORTS OF BASIC PETROCHEMICAL PRODUCTS, 1959-67
(Thousands of tons)

Product	1959	1960	1961	1962	1963	1964	1965	1966	1967
Ammonia	41.2	64.2	55.7	51.7	69.9	124.0	147.7	159.7	232.9
Naphthionic acids	0.3	0.3	1.0	0.4	1.0	9.7	1.2	1.3	1.3
Butadiene	-	-	-	3.7	11.3	20.8	35.0	12.3 ^{b/}	36.8 ^{c/}
Benzene	2.9	19.5	32.4	34.7	31.2	23.0	22.3	26.2 ^{b/}	24.3 ^{d/}
Toluene	12.3	21.7	24.5	29.2	19.4	20.2	8.1	16.3	12.3 ^{b/}
Xylenes	6.1	7.1	8.6	8.1	14.8	15.5	8.0	11.6	9.3 ^{d/}
Naphthalene	4.1	6.1	7.3	7.7	3.8	12.2	12.7	9.9	11.5 ^{d/}
Methanol	8.9	9.0	10.6	20.4	16.2	23.2	24.4	22.1	18.2 ^{b/}
Carbon sulphide	0.6	0.6	0.3	1.6	1.4	2.1	1.3	-	-
Ethylene	-	-	-	-	0.3	0.5	-	-	-
Propylene	-	-	-	-	-	-	-	-	-
Carbon black	34.8	39.0	45.0	44.1	30.1	23.0	25.3	23.4	21.5
Total	111.2	166.8	192.5	192.6	204.2	271.0	288.5	283.3	368.6
Percentage annual growth	-	50.0	17.2	-1.5	6.3	32.4	6.5	-0.8	30.1
Annual growth 1959-64	-	-	-	-	-	19.5	-	-	-
Annual growth 1959-67	-	-	-	-	-	-	-	-	16.1

Source: ECLA, on the basis of foreign trade yearbooks.

a/ Excluding Cuba, Jamaica, and Trinidad and Tobago.

b/ Excluding Nicaragua.

c/ Excluding Honduras.

d/ Excluding Colombia.

Table 10

LATIN AMERICA:^{a/} VALUE OF IMPORTS OF BASIC PETROCHEMICAL PRODUCTS
(Millions of dollars)

Product	1959	1963	1965	1967 ^{b/}
Ammonia	3.8	6.9	15.7	14.4
Naphthenic acids	0.1	0.3	0.3	0.5
Butadiene	-	3.2	8.5	6.6
Benzene	1.2	3.2	3.0	2.5
Toluene	1.4	1.4	0.7	1.0
Xylenes	0.8	1.2	0.6	0.7
Naphthalene	0.8	1.0	1.6	1.7
Methanol	1.3	1.6	2.1	1.6
Carbon sulphide	0.2	0.3	0.3	...
Ethylene	-	-	-	-
Propylene	-	-	-	-
Carbon black	8.0	6.0	...	4.2
Total	17.6	25.1	32.8	33.2

Source: ECLA, on the basis of foreign trade yearbooks.

a/ Excluding Cuba, Jamaica, and Trinidad and Tobago.

b/ Excluding also Bolivia, Colombia, the Dominican Republic, Ecuador, Guatemala, Haiti, Honduras and Panama.

3.6. Apparent consumption.

Tables 11 to 14 (and figures III and IV) give an over-all idea of apparent consumption of basic petrochemical products in Latin America. They also include the volume of products still being manufactured by non-petrochemical processes in the region.

In the first place, it must be emphasized that consumption of basic petrochemical products in Latin America grew much more rapidly than the whole chemical sector in the years 1959-67 (see table 12). The respective growth rates were approximately 25 and 9.5 per cent annually, which means that consumption of petrochemicals rose from about 214,000 to 1,285,600 tons from 1959 to 1967. Per capita consumption went up from 4.1 to 9.3 kilograms per year and it has increased almost five-fold over a period of eight years, while consumption of chemical products in general barely doubled.

On the basis of the aggregate figures for apparent consumption of petrochemical products, some considerations may be presented here regarding the broad lines along which the chemical sector is developing in Latin America. It may be said that demand for basic petrochemical products has resulted from the integration of the structure of production, and that it is extending mainly to the phase of intermediate and even basic products. This seems to explain the increase in production of such items as plastics, synthetic textiles, chemical products for use in agriculture, paints, pharmaceutical products, synthetic rubber, etc. (see table 13).^{21/} A high level of self-supply has been reached in some groups of products (70 to 90 per cent in 1965): the organic synthesis products (group II), paints and solvents (group VII), synthetic fibres (group V), plastics (group IV) and pharmaceutical products (group XVI). Moreover, there are other groups of products whose local manufacture shows considerable impetus, resulting in high annual growth rates from 1959 to 1965: 63 per cent for synthetic rubber (group VI), 15.3 per cent for chemical products for agriculture

^{21/} For a detailed analysis of these points, see Las industrias químicas en América Latina y su evolución en los años 1959 a 1967, op. cit.

Table 11

LATIN AMERICA:^{a/} APPARENT CONSUMPTION OF BASIC PETROCHEMICAL PRODUCTS, 1959-67
(Thousands of tons)

Product	1959	1960	1961	1962	1963	1964	1965	1966	1967
Ammonia	79.3	117.3	141.0	197.9	304.4	426.1	483.5	505.1	572.9
Naphthenic acids	0.8	0.3	2.5	2.0	3.1	3.4	4.1	5.3	5.3
Butadiene	-	-	-	3.7	11.3	20.8	39.0	24.6	65.7
Benzene	15.2	36.9	49.6	55.1	53.6	56.7	92.0	96.2	125.4
Toluene	14.4	25.0	26.0	23.7	23.3	39.6	81.0	117.3	117.8
Xylenes	6.7	9.6	11.6	11.2	17.3	25.1	18.0	21.0	69.8
Naphthalene	6.5	9.3	10.2	11.1	13.1	17.9	16.9 ^{c/}	14.4 ^{b/}	17.3 ^{c/}
Methanol	19.2	18.0	20.7	30.4	27.9	38.8	44.2	53.7	54.2
Carbon sulphide	21.3	23.5	25.9	29.4	31.3	38.6	41.5	38.4 ^{c/}	40.2
Ethylene	4.6	4.5	6.2	5.0	9.4	18.0	27.3	37.0	58.4
Propylene	1.2	1.2	1.3	1.6	2.6	3.3	34.9	34.3	61.7
Carbon black	44.8	58.5	62.0	65.9	68.7	78.6	36.1	100.3	96.9
Total	214.0	304.1	359.0	437.0	566.0	766.9	968.5	1060.2	1235.6
Per capita consumption (kg/inhabitant per year)	1100	1519	1743	2063	2598	3420	4198	4499	5260

Annual growth rate of per capita consumption in 1959-67: 21.5 per cent

Source: ECLA

- a/ Excluding Cuba, Jamaica, and Trinidad and Tobago.
- b/ Including production by non-petrochemical processes.
- c/ Excluding Colombia also.
- d/ Excluding Cuba.

Table 12

LATIN AMERICA: EVOLUTION OF THE BASIC PETROCHEMICAL INDUSTRY COMPARED WITH THAT OF THE CHEMICAL INDUSTRY AS A WHOLE, 1959-67

Year	Indexes: 1959 = 100			
	Petrochemical industry		Chemical industry	
	Production	Apparent consumption	Production	Apparent consumption
1959	100	100	100	100
1960	140	142	109	109
1961	184	168	121	120
1962	315	204	133	129
1963	517	265	146	139
1964	730	358	165	155
1965	1 033	448	174	167
1966	1 264	466	195	190
1967	1 506	605	217	208

Source: ECLA.

Table 13

LATIN AMERICA: SELF-SUPPLY IN SOME GROUPS OF CHEMICAL PRODUCTS^{a/} USED AS INPUTS FOR BASIC PETROCHEMICAL PRODUCTS, 1959-65
(Percentage of total apparent consumption)

	1959	1960	1961	1962	1963	1964	1965
II. Principal organic chemical products	91	89	87	87	87	89	90
III. Chemical products for use in agriculture	44	44	45	47	50	51	51
IV. Plastic materials and synthetic resins	50	54	56	59	61	65	66
V. Artificial and synthetic fibres	84	84	82	81	85	85	84
VI. Synthetic rubber and carbon black	6	8	6	25	38	41	38
VII. Paints, dyes and other materials	72	73	73	75	74	73	74
XVI. Pharmaceutical products	63	64	66	66	68	69	67
XV. Products not specified in group III	46	43	50	48	42	43	39

Source: ECLA.

a/ According to the ECLA classification in La industria química en América Latina y su evolución en los años 1959 a 1967, op. cit.

(group III), 25.3 per cent for plastic materials and synthetic resins (group IV), 14.3 per cent for synthetic fibers (group V), and 17.6 per cent for organic compounds for unspecified uses (group XV).

As can be seen from table 5, local production of intermediate petrochemical products covers a wide range of organic compounds. In addition, the highest level of regional self-supply (90 per cent in 1965), has been reached in the principal organic chemicals (group II), and it is precisely this group that includes the basic petrochemical products, except ammonia (group III) and carbon black (group VI).

Nevertheless, the apparent consumption of basic petrochemical products shown in the above-mentioned tables represents the sum of the widely varying situations in the Latin American countries. Thus, while in countries like Argentina, Brazil and Mexico apparent consumption of these products stands at a high level as a direct result of the gradual integration of the structure of production (despite the inadequate scale of many plants), in other countries, such as Chile, Colombia, Peru and Venezuela, apparent consumption is still very small; and in the rest of Latin America it is practically nil, there existing only a chemical industry producing finished products (pharmaceutical products, fertilizers, rubber, synthetic textiles, plastics, etc.).

Moreover, the national markets were too small for projects which would take full advantage of economies of scale, as the large number of small plants and projects in the region indicates. Towards the second half of the nineteen-sixties, however, large-scale projects began to be prepared,^{22/} and some sizeable industrial complexes are now being put into operation. In addition, the first subregional agreements have been concluded for the formation of national market groupings, which would provide a suitable foundation for large-scale petrochemical projects. These are the agreements founding the Latin American Free Trade Association (LAFTA) and the Central American Common Market (CACM), and, more recently, those for the Andean subregion, the River Plate Basin and the Caribbean Free Trade Association (CARIFTA).

^{22/} Ammonia (330,000 tons per year), ethylene (130,000 tons per year) and BTX (100,000 tons a year) in Argentina, Brazil, Chile, Colombia and Venezuela.

Table 14
LATIN AMERICA: BASIC PETROCHEMICAL INDUSTRY, 1959-67

Year	Production ^{a/}		Imports ^{b/}		Total production ^{c/}		Total apparent consumption ^{d/}	
	Thousands of tons	Percent ages	Thousands of tons	Percent ages	Thousands of tons	Percent ages	Thousands of tons	Kg/h per year
	(1)		(2)		(3)		(4)	(2)+(3)-(4)
1959	53.8	25.1	111.2	52.0	165.0	48.0	214.0	1 100
1960	75.1	24.7	166.3	54.8	241.4	45.2	304.1	1 519
1961	93.9	27.5	195.5	54.5	289.4	45.5	359.0	1 743
1962	169.7	38.8	192.6	44.1	362.3	55.9	437.0	2 063
1963	278.2	49.1	204.2	36.2	482.4	63.0	566.0	2 598
1964	392.9	51.2	271.0	35.4	663.9	64.6	766.9	3 420
1965	555.8	58.0	288.5	30.1	844.3	69.9	963.5	4 198
1966	680.3	68.2	203.3	28.4	883.6	71.0	1 068.2	4 499
1967	810.4	62.6	368.6	28.4	1 179.0	71.5	1 295.6	5 260
1959-67								
percent- age rates	41.0%		16.2%		32.0%		25.0%	21.5%

Source: ECLA

^{a/} Exclusively by petrochemical processes.

^{b/} Total imports of basic petrochemical products, irrespective of the processes used to obtain them.

^{c/} Total output of basic petrochemical products, irrespective of the processes used to obtain them (petrochemical, ortho-chemical, fermentation, and other processes).

^{d/} Including production figures for Colombia.

Millions of tons

LATIN AMERICA : EVOLUTION OF THE PETROCHEMICAL INDUSTRY, 1959-67

Figure III

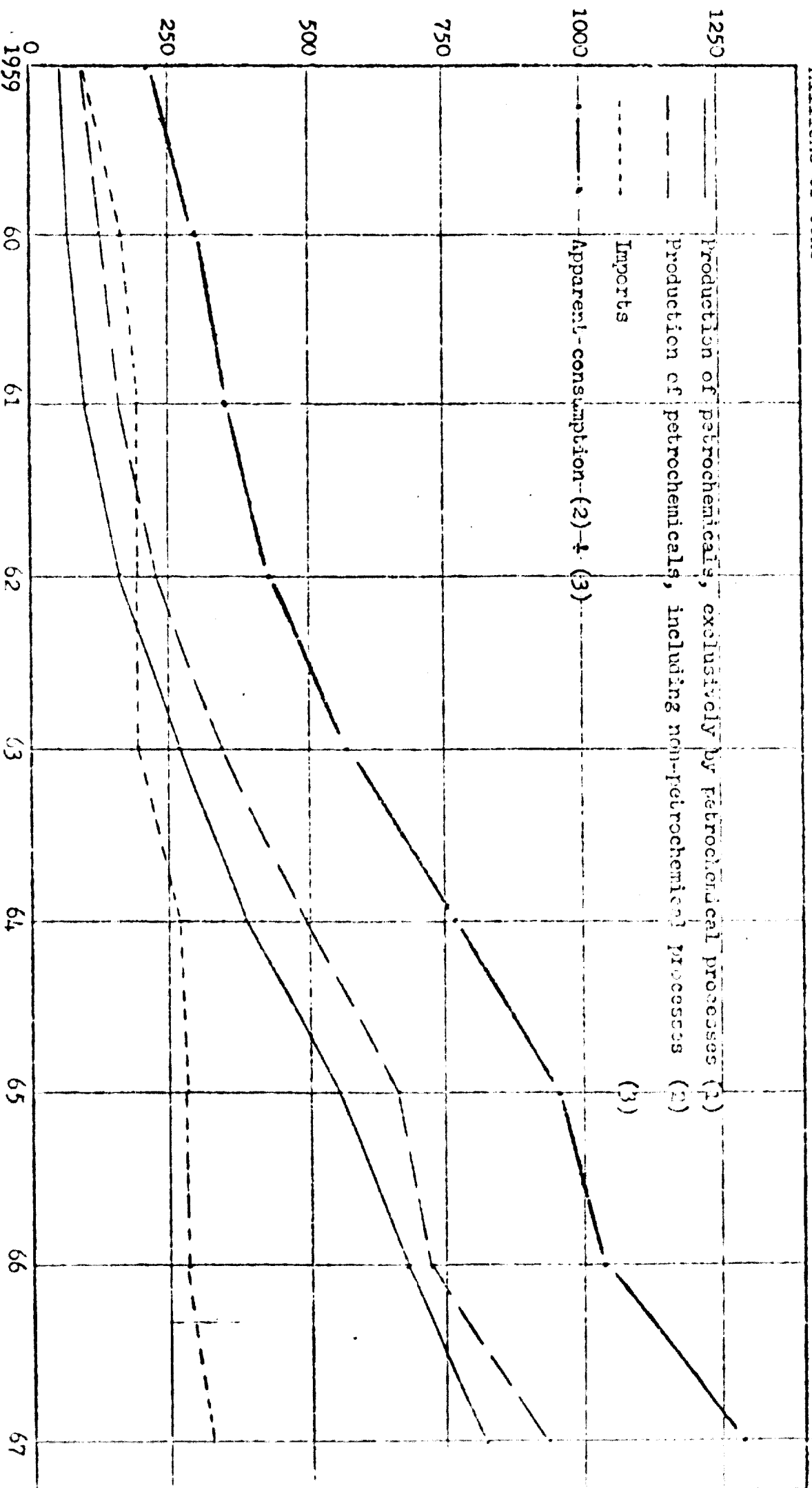
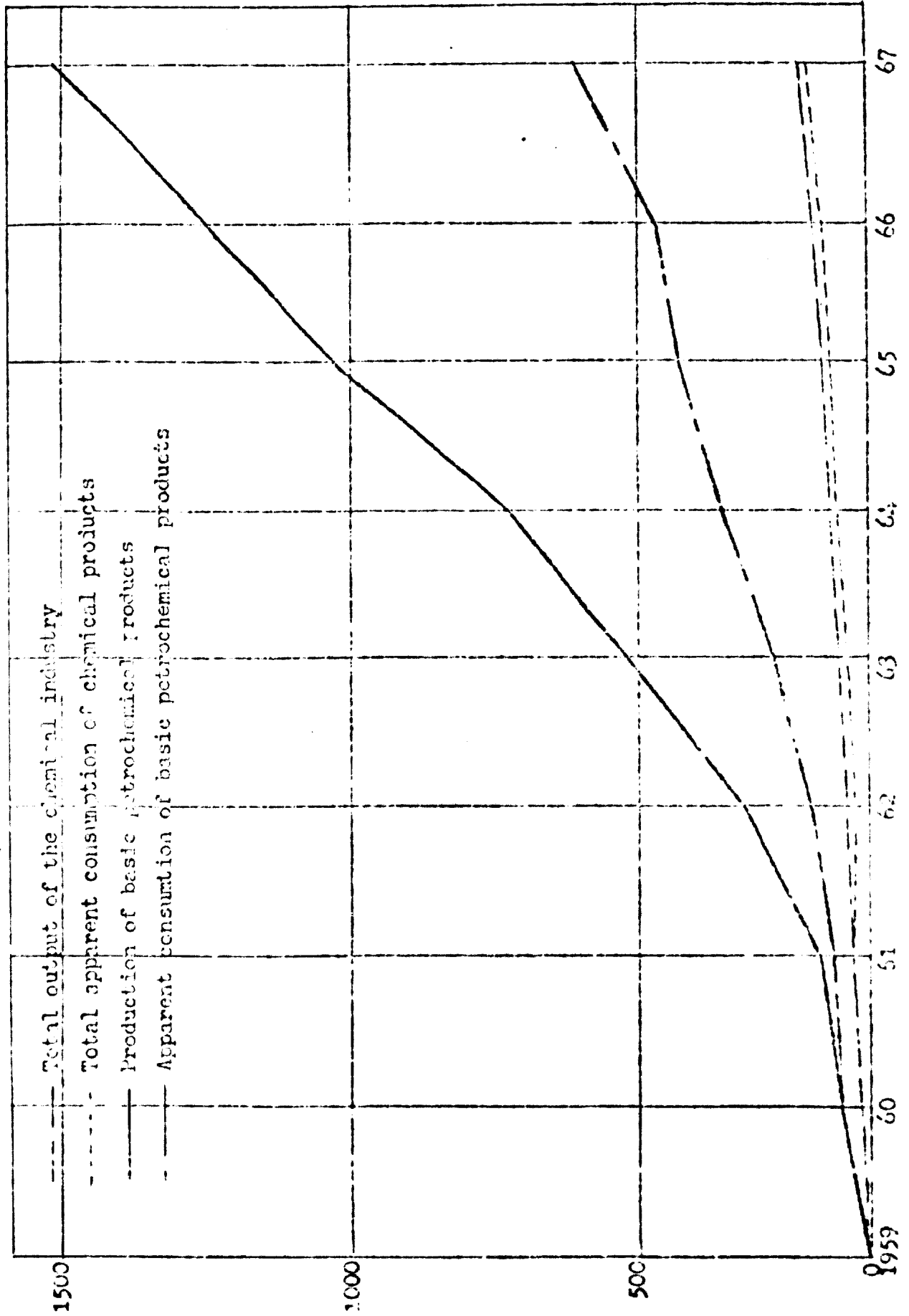


FIGURE IV
TRENDS AND RELATIONSHIPS IN THE CHEMICAL INDUSTRY, COMPARED WITH THAT OF
THE CHEMICAL INDUSTRY PROPER
(Production index: 1959 = 100)



As regards the supply of basic petrochemicals, the region has become a good deal more self-sufficient. In 1967 imports still accounted for nearly 30 per cent of total apparent consumption (see table 12). Between 1959 and 1967 apparent consumption had increased about 25 per cent, while imports had only done so by 16.2 per cent, and production, by all types of process,^{23/} by 32 per cent annually. In short, by 1967, total apparent consumption in the region stood at about 1.3 million tons, or 5.3 kg. per year in per capita terms.

4. Evaluation of development in 1959-67

Petrochemical production did not really get going until 1955-60, although it could have started at least fifteen years earlier. The region's industrial development, and hence that of the petrochemical industry, was basically geared to import substitution, which was also a dynamic factor in the expansion of non-traditional exports from several of the Latin American countries.

Geographically speaking, petrochemical production is concentrated in a very few parts of Latin America, that is, Argentina, Brazil, Colombia, Mexico and Venezuela, and latterly in Central America, Chile and Peru as well. In every case, its location was determined by national markets for such end products as plastics, man-made textile fibres, detergents, paint and pharmaceutical products. The integration of area or subregional markets was not the original objective, however. It presented itself later as a solution to the smallness of scale that was pushing up the cost of the first plants very considerably. From the outset small plants were set up which operated in the shelter of high tariff barriers. Consequently, they had little competition to face (until a few years ago it was national only), and could charge exaggeratedly high prices for their basic products (see section 3.3., on prices). Inter-Latin-American trade had been encouraged by the formation of the Latin American Free Trade Association, but it did not grow fast enough or reach a high enough level to stimulate expansion to an adequate scale of production.

^{23/} As already indicated, petrochemical production proper rose 41 per cent annually.

By 1965-66 only Argentina, Brazil and Mexico had made headway in developing a production structure that was integrated right from the basic products up to the end products and had begun to supply regional markets with a marginal volume of output. In 1967-68, the other countries (see section 3.4 on installed capacity) had a few plants that were just starting production or some quite interesting projects, but in no case can they be regarded as representing a true step forward towards regional integration, even in the Andean subregion^{24/} or the Central American Common Market.^{25/}

Marked headway has been made in import substitution at the regional level, but progress has been anything but uniform in the individual countries.

Although the introduction of petrochemical production into Latin America brought with it a development technology consisting in the installation of modern automated chemical processes and special training for labour, serious problems have arisen because of the sectoral relationships between this and the other branches of the chemical industry which are obviously technically obsolescent. In other words, concentration on the petrochemical industry without promotion of the other branches in the chemical sector has evidenced a technological gap which is affecting production costs. Moreover, industrial promotion has not been adequately backed by policy measures for the transfer of technology, so that the sector has had to rely too heavily on foreign technology, and local technology has failed to develop.

Essentially, petrochemical production in Latin America began and developed virtually without any real national or regional planning.

5. Prospects for the petrochemical industry in Latin America

Broadly speaking, the main features of Latin American petrochemical production in the next ten years will be the inauguration of some big industrial plants comparable in size to those elsewhere in the world, marked diversification of production, together with a drop in the currently very high level of domestic prices and an increase in intraregional trade. There is also a likelihood that its products will gain a foothold on world markets.

^{24/} Bolivia, Chile, Colombia, Ecuador, Peru and Venezuela.

^{25/} Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua.

The scale of the known projects to be undertaken, some of which are already under construction, indicates that the Latin American countries are resolved not to repeat the mistakes of the past ten years, and to make every effort to prevent the proliferation of small plants. Some of the projects for basic chemicals, such as ammonia, the aromatic hydrocarbons and olefins,^{26/} confirm this opinion, in the sense that they envisage individual large-scale plants or big complexes whose functions will range from the processing of cracked products to the manufacture of plastic resins, synthetic rubber, carbon black and so on.

In view of the abundance of petroleum and natural gas in several Latin American countries and the current price policy of promoting their exploitation, the resulting economies of scale will probably make possible a considerable reduction of production costs, and hence of domestic prices, even if the system of protection is maintained, albeit more rationally, and enable the industry to compete on world markets.

In this way backed by the activities of some of the regional bodies (LAFTA, CACM and CARIFTA), it may be possible to increase the still meagre flow of intraregional trade in chemical products. Private entrepreneurs are also interested in this, since if intraregional trade attained a sufficient volume and grew fast enough, they could lay the bases for expanding current capacity and be fairly certain of producing on an economic scale, particularly in countries where the potential market is small and/or the level of per capita income is low.

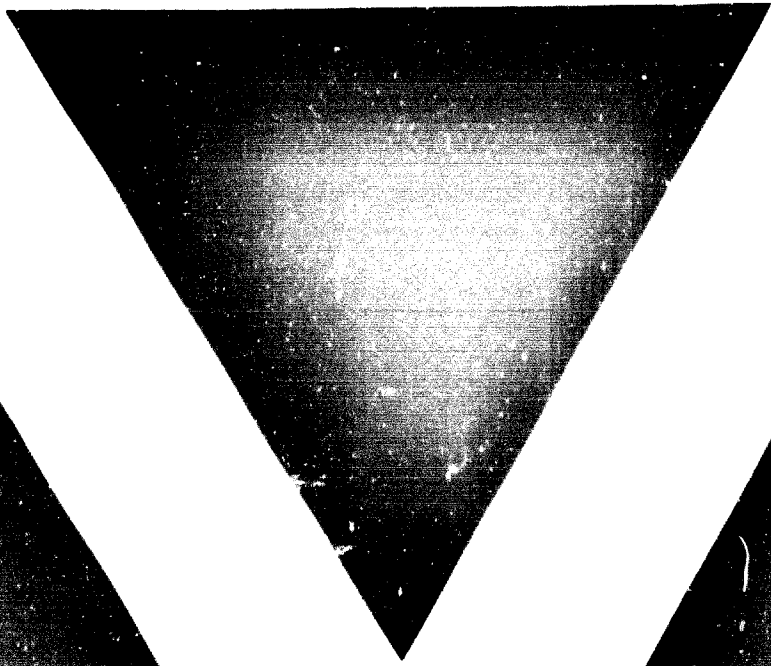
It is clear from this and from the economic development goals of nearly all the countries of the region^{27/} that Latin America intends to break into the world chemicals market. There is a general trend in national development plans towards diversification of the external sector through the export of non-traditional items, including petrochemical products, and in the last few years some shipments have been made to the United States.^{28/} This process will be strengthened by the agreements now being negotiated between some Latin American public enterprises and major international chemical companies.

^{26/} Ammonia: 1,000-1,500 tons per day in Chile, Colombia, Mexico and Venezuela.
Ethylene: 100,000 - 180,000 tons per year in Argentina, Brazil, Colombia, Mexico and Venezuela. BTEX: 50,000-100,000 tons per year in Argentina, Brazil, Colombia, Mexico and Venezuela.

^{27/} According to talks with government officials.

^{28/} Aromatic hydrocarbons, carbon black and ammonia.





24 . I . 72