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**Regional Expert Group Meeting  
on Production Complementarities  
in the Aluminium Industry  
in Latin America**

**Kingston, Jamaica, 23-26 July 1990**

**IDENTIFICATION AND VIABILITY OF PRODUCTION COMPLEMENTARITIES  
OF THE MAIN PRODUCERS OF ALUMINIUM IN THE SOUTH AMERICAN  
REGION (ARGENTINA, BRAZIL AND VENEZUELA)\***

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\*The views expressed in this paper are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO. Mention of firm names and commercial products does not imply the endorsement of the United Nations Industrial Development Organization (UNIDO).

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Explanatory notes

References to dollars (\$) are to United States dollars.  
References to tonnes (t) are to metric tonnes.

Besides the common abbreviations, symbols and terms, the following have been used in this report:

ALADI Asociación Latinoamericana de Integración

ECLAC Economic Commission for Latin America and the Caribbean

FINEP Financiadora de Estudios y Proyectos

LME London Metal Exchange

OLAMI Organización Latinoamericana de Minería

RECADI Oficina del Régimen de Cambios Diferenciales

SELA Sistema Económico Latinoamericano

SICE Secretaría de Industria y Comercio Exterior

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## INTRODUCTION

The First Consultation on the Non-Ferrous Metals Industry held at Budapest, Hungary, from 30 November to 4 December 1987 was followed by the Regional Expert Group Meeting on the Development of the Non-Ferrous Metals Industry in Latin-America and Possibilities for Complementarity at Cordoba, Argentina from 27 to 30 March 1989. Both meetings were organized by the United Nations Industrial Development Organization (UNIDO) with the support of the Governments involved.

While the Budapest Consultation had dealt with the global problems of non-ferrous metallurgy, the Cordoba Meeting focused its activity on questions particular to the countries of the Latin-American and the Caribbean region. The participants analysed the situation and the prospects of the non-ferrous metals industry of the region, especially with regard to aluminium, copper, tin and nickel. They examined the possibilities for production complementarities in the fields of raw materials, concentrates, refined and semi-finished products among Latin American countries producing these metals. They also established specific lines of action for increasing subregional and regional co-operation in the areas of production, research, technological development and information.

On the basis of above-mentioned objectives the participants agreed on several conclusions and recommendations which can be found in the report of the Meeting. 1/

The Cordoba Meeting gave a framework of possible complementarities as identified at a preliminary stage and which were to be thoroughly analysed later. The aim of this study is therefore an in-depth analysis of different production complementarities in the aluminium industry of the region with a view to achieving a more coherent productive system in Latin America as well as to encouraging and supporting efforts to establish highly integrated structures of industries.

The study is based on visits to Argentina, Brazil, Jamaica and Venezuela. The purpose of the field work was to collect more detailed information in order to substantiate the opportunities of complementarities identified in previous studies. On that basis it was possible to implement them as well as to identify new possibilities for co-operation, following discussions with governmental institutions, companies, enterprises and industrial associations. The information obtained (primary and secondary) was analysed primarily with a view to identifying the weak links of the subregional and regional aluminium industries that would need to be reinforced through co-operation.

The study gives an overall picture of the aluminium industries of three countries of the region: Brazil, Venezuela and Argentina, ranked by the importance of their aluminium industry. Special attention was devoted to imports coming from outside the region since their replacement by regional products would increase possibilities for production complementarities. Bottlenecks in production, existing co-operations, import substitution as well as short- and long-range development projects were considered as essential elements in the identification and further development of production complementarities.

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1/ Report - The promotion of a more coherent productive system in the field of non-ferrous metals in Latin America: possibilities for complementarity (ID/WG.481/6).

The pricing and tariff systems are also examined with a view to proposing their unification. With regard to potential and possible complementarities it is suggested to develop institutional frameworks and supportive policies for them.

## I. SURVEY OF INSTALLED CAPACITIES AND NATIONAL PROJECTS FOR THE DEVELOPMENT OF THE ALUMINIUM INDUSTRY

The vertical structure of the aluminium industry consists of three parts corresponding to the upstream, downstream and processing operations. The upstream operations involve bauxite mining, alumina production and metallurgical processing. The different manufacturing technologies are the basis for distinguishing downstream operations such as casting, rolling, extrusion, drawing etc. Processing shows the greatest difficulty with regard to differentiating operations, due to the highly diversified nature of technologies and types of products involved. This is the reason why that part of the aluminium industry is generally treated in a separate form, and the vertical structure of the aluminium industry is considered up to the manufacture of semi-finished products. The present report follows that pattern insofar as only an overall picture and references for the processing sector are given.

This chapter contains summarized data on the present situation, the capacities and the planned developments of the aluminium industries concerned, with a brief survey of the general economic situation. It covers only the years 1986, 1987 and 1988 because UNIDO documents prepared for the Cordoba Meeting contained a detailed statistical evaluation of the earlier period. As national plans for the development of the aluminium industries cover the period up to the year 2000, forecasts in this study cannot go beyond that year.

### A. Brazil

In 1988 Brazil's economy and industrial production did not perform well, mainly because of the high inflation, the instability of government economic policy and a decline in the purchasing power of consumers. Industrial production was about 3.4 per cent lower than in 1987. In order to compensate the poor domestic demand the companies strove to increase exports and in fact achieved an overall figure of \$34 billion, i.e. a rise of 29 per cent over 1987. Imports amounted to \$19 billion, leaving a trade balance surplus of \$15 billion for 1988.

The aluminium industry accounts for about 3.3 per cent of the gross industrial product. The export of aluminium products reached \$1.5 billion, a rise of 66.6 per cent over 1987. The improved performance during that year was mainly due to the higher prices at the London Metal Exchange (LME), the price-freeze policy of the Government and the weak domestic demand.

The Brazilian aluminium industry embraces the whole range of the vertical structure and its favourable position is attributable to the enormous bauxite deposit of an estimated 2.2 billion t. Data on production, exports, imports, scrap recycling as well as present and expected capacities are given in tables 1 and 2.

Table 1. Production, exports, imports and scrap recycling of the Brazilian aluminium industry, 1986-1988 (Thousand tonnes)

Product	1986	1987	1988
<b>Production</b>			
Bauxite	6 446.3	6 566.5	7 727.6
Alumina	1 262.8	1 396.3	1 427.3
Primary aluminium	757.3	843.5	873.5
Semis	462.9	429.7	414.1
<b>Exports</b>			
Bauxite	2 900.3	2 673.0	4 429.6
Alumina	30.9	41.9	59.7
Primary aluminium	323.5	430.9	514.9
Semis	33.5	26.0	41.6
<b>Imports</b>			
Bauxite	1.0	3.0	2.0
Alumina	285.4	393.0	373.1
Primary aluminium	1.4	2.3	0.1
Semis	2.2	6.3	9.5
Scrap recycling	60.6	65.9	66.8

Source: Anuario Estatístico ABAL, 1988.

Table 2. Present and expected capacities in the Brazilian aluminium industry, 1988-2000 (Thousand tonnes)

Product	1988	1990	1995	2000
Bauxite	7 800	8 000	8 000	8 000
Alumina	1 580	1 580	2 700	2 800
Primary aluminium	869	869	1 364	1 394
Semis	655	700	1 100	1 200

Sources: Anuario Estatístico ABAL, 1988; personal information.

### Bauxite mining

Five big companies (ALCAN, ALCOA-Pocos de Caldas, ALCOA-São Luis, CBA and MRN) and some smaller ones are engaged in bauxite mining. For the past decade the quantity of bauxite produced shows an ever increasing tendency. From



table 1 it can be seen that a relatively big jump occurred between 1987 and 1988 and the total annual production approached 8,000 thousand t. From that quantity only 3,180 thousand t remained in Brazil for metallurgical processing, while the greater part (4,500 thousand t) was exported. Almost 50 per cent of the total exports went to Venezuela. Among the countries of the region, Suriname and Argentina imported bauxite from Brazil (in 1987, 315 and 8 thousand t respectively).

There are significant export markets for Brazilian bauxite in North America, namely Canada and the United States of America. Both countries import from Brazil about 300 thousand t/y each.

During the next decade the capacity of bauxite mining will be only slightly increased. As domestic alumina plants operate close to their maximum capacity, their present bauxite demand will not increase in the near future. A drastic change in the domestic bauxite consumption will occur when the new alumina project ALUNORTE will go into operation. It is expected to operate at its full capacity of 1,100 thousand t/y in 1993, with an annual requirement of about 2,500 thousand t of bauxite. That increased domestic consumption will offset the expected decrease in bauxite exports to Venezuela as the new bauxite capacities of Venezuela will be able to supply its alumina plants with suitable quantities.

#### Alumina production

Five plants of four big companies are involved in alumina production, namely ALCAN, ALCOA-Pocos de Caldas, ALCOA-São Luis, BILLITON and CBA. Considerable development has been experienced in that field, and even over the last three years the rate of increase of alumina production was some 100 thousand t/y as can be seen from table 1. In 1988 the output of the plants was as follows:

<u>Company</u>	<u>Thousand tonnes</u>
ALCON	145.5
ALCOA	667.3
- Pocos de Caldas	(233.1)
- São Luis	(434.2)
BILLITON	289.4
CBA	325.1

The capacity utilization of the companies is close to its maximum. In spite of the significant quantity of alumina produced it is not sufficient to meet the demand of the domestic smelters and alumina has to be imported. In 1988, 373.1 thousand t were imported. The main suppliers were Venezuela and Caribbean countries. It is interesting to note that, on the other hand, ALCOA exported about 150 thousand t of alumina in 1988, since its production exceeded its own metallurgical demand. That excess was sold in North America and Mexico. The import of alumina is governed by interstate agreements and the imported alumina goes to the ALBRAS smelter (Belem) and to VALESUL (formed by BILLITON and CVRD at Santa Cruz).

The alumina deficit is the weak point of the Brazilian aluminium industry. Since existing plants have practically no idle capacities, their development will yield only a limited additional output in the future and the only solution of the problem seems to be to invest into a new alumina plant. Various projects have been elaborated at institutional level, and for the time being

the project of the alumina plant ALUNORTE is in the phase of implementation. Originally ALUNORTE should already have gone into production, however, because of financial problems, the plant is now expected to start operating by 1992. The initial capacity of the plant will be 200 thousand t/y. By the end of the running-in period the maximum capacity will be 1,100 thousand t/y. As the capacities of existing plants will not increase considerably until 1990, an alumina import of about 300 thousand t/y is expected for the next couple of years. By 1995 the situation will probably have changed, and the Brazilian alumina production will be able to meet the demand of the domestic aluminium metallurgy.

For the production of alumina large quantities of caustic soda are needed. The Brazilian industry is able to produce well above its domestic demand. In 1988 the total production of caustic soda was 954 thousand t, of which only 126 thousand t were supplied to local alumina plants while the larger part was exported or used by other domestic industrial sectors.

### Metallurgical processing

Six companies are producing primary aluminium from alumina. In 1988 their capacity was fully utilized. Their current and projected production up to the year 2000 are summarized in table 3.

Table 3. Current and projected production of Brazilian aluminium smelters, 1988-2000  
(Thousand tonnes)

Company	1988	1989	1990	1995	2000
ALBRAS	160	160	160	320	320
ALCAN	118	118	118	148	178
Ouro Preto	60	60	60	60	60
Aratu	58	58	58	88	118
ALCOA					
Pocos de C.	90	90	90	90	90
ALUMAR a/	245	245	245	380	380
CBA	170	170	170	340	340
VALESUL	86	86	86	86	86
Total	869	869	869	1 364	1 394

Source: Anuario Estatístico ABAL, 1988.

a/ ALUMAR = ALCOA (São Luis) + BILLITON (São Luis).

From table 3 can be seen that until 1995 the Brazilian aluminium industry intends to increase its production by about 60 per cent of the present level. As the domestic market is expected to grow only by 5 per cent annually, in 1995 the demand will presumably be not more than 600 thousand t. This means that in the middle of the next decade 800 thousand t of excess metal will be available for export.

Problems in two areas may influence the planned developments in metallurgical processing: the supply of electric power and of petroleum coke. Important quantities of both inputs are needed to produce primary aluminium: 13.5 MWh of electric energy and 0.42 t of petroleum coke are necessary for 1 t of metal. The Brazilian industry has already experienced energy shortages, especially in the southern metallurgical region in the neighbourhood of São Paulo. The price of electric power has been raised several times and according to the latest information it now is about \$0.027/kWh. That high price has an unfavourable effect on the competitiveness of Brazilian aluminium on foreign markets. The production cost of primary metal ingots is about \$1,400/t. In 1988 the domestic industry produced 350 thousand t of petroleum coke which was sufficient for anodes and pot lining of electrolyzers. Because of other industrial demands, 152 thousand t of coke were imported in 1988, half of which came from Argentina, the rest from the Netherlands and the United States of America.

In connection with ingot production attention should be paid to the relatively low price laid down by the Government for normal quality ingot, i.e. about \$1,200/t, in order to promote the growth of the domestic aluminium consumption. Since this price does not even cover the production costs, the smelters are forced either to export the ingots (at LME price) or to transform the primary metal directly into billets, slabs or semis since these products are not subjected to price control and their domestic prices follow the actual LME ones (sometimes these are even higher than LME prices). Direct ingot exports have the additional advantage for the smelters that they get permission of duty-free imports for their own production according to the draw-back system. The domestic ingot price has been under debate for a long time between the companies and the Government. As the companies want to achieve a minimum profit margin of \$200-300/t on the domestic market, they resort to producing the extra quality which is exempted from price control.

#### Downstream operations

Many firms and companies are engaged in these operations, but among them only three play a dominant role and have an impact on activities and outputs, namely ALCAN, ALCOA and CBA. Their characteristics were detailed in a UNIDO document prepared for the Cordoba Meeting. 2/ There are about 70 smaller enterprises, but their total production does not reach the output of any of the big companies. Data on production, domestic consumption and production capacities of semis are given in table 4.

On the basis of table 4 it can be stated that foil rolling, extrusion, die-casting and production of explosives are the bottlenecks in downstream operations. Comparing the production data to that of domestic consumption, including periods before 1988, it appears that a permanent demand can be expected for both foil and extruded products. In accordance with this tendency, present developments concentrate on increasing the rolling and extrusion capacities. In the case of rolling, emphasis is put on foil-production capacities while efforts are also made to establish rolling facilities for can-stock materials. The export of semis is on a rather low level, the main cause being the above-mentioned domestic pricing system. But also the quality of semis and transportation problems (export packaging, great distances) have had an adverse effect on exports. The consumption of semis by different industrial branches in 1988 is shown in table 5.

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2/ Identification of specific projects for the production of semi-finished non-ferrous metals in Latin America (ID/WG.481/2).

Table 4. Production, domestic consumption and capacities in the downstream operations of the Brazilian aluminium industry, 1988 (Thousand tonnes)

Product	Production	Consumption	Capacity
Plate, sheet, strip	101.4	83.7	200
Foil	34.5	26.2	40
Extrusions	98.8	89.9	131
Wire rod, wire	73.5	63.9	132
Die-castings	82.6	77.6	100
Powder, paste	16.1	14.4	26
Explosives	<u>25.5</u>	<u>25.5</u>	<u>26</u>
Total	432.4	381.2	655

Source: Mercado do aluminio no Brasil, ABAL, Marco 1989.

A comparison of the figures of table 5 with the data of previous years shows a slight decrease of aluminium consumption in the building industry, an increase in transportation, a decrease in the electrical industry, a sharp drop in consumer durable goods and a stagnation both in packaging and machinery industry. The total annual consumption by the other sectors of the national economy has been about 50 thousand t for years.

The main aim for increasing the capacities of the aluminium downstream operations is to produce exportable semis for foreign markets. Hence the products that are favoured are such that present export possibilities. This explains the increase of the rolling capacity of ALCAN and CBA, both in can-stock and foil rolling. In addition, the domestic demand motivated the expansion of the extruding capacity of ALCOA, especially in order to manufacture semis for its own processing sector (production of truck bodies which have a good market in Brazil).

In connection with the quality of semis, a growing emphasis is put on their surface properties such as appearance, corrosion resistance etc. All over the world different methods and technologies (for example pickling, anodization, painting, electrodeposition) are employed to improve the physico-chemical surface features of aluminium and to ensure a good appearance. In Brazil increased efforts are being made to improve the surface finishing of semis since domestic and export markets require products of better quality. ALCOA, for example, has introduced a new painting line into its manufacturing process in order to paint extruded products of given types.

#### B. Venezuela

In 1988 Venezuela's economy and industrial production performed nearly on the level of the previous year. The economic policy of the new Government aims at improving the performance of the economy and at overcoming the serious problem of foreign debt. Great emphasis is put on the aluminium industry in order to increase its share in the national income. At present the oil industry accounts for about 80 per cent of the total exports. According to the new policy the export structure has to be changed and a shift to the aluminium industry seems to have the most promising perspectives.

Table 5. Consumption of aluminium semi-finished products, by sector  
of the Brazilian industry, 1988  
(Thousand tonnes)

Type of product	Building	Transportation	Electrical industry	Consumer durable goods	Packaging	Machinery	Other
Sheet, strip	22.9	14.3	2.2	26.3	9.8	4.1	4.1
Foil	-	1.5	1.8	2.8	19.5	0.2	0.4
Extrusions	49.9	15.4	4.8	10.5	-	5.7	3.6
Wire, cable	-	-	63.9	-	-	-	-
Castings	0.4	64.0	1.1	3.9	-	7.5	0.7
Powder, paste	-	-	-	-	-	-	14.4
Explosives	-	-	-	-	-	-	25.5

Source: Anuario Estatístico ABAL, 1988.

The Venezuelan aluminium industry has a vertical structure and, with the exception of the processing sector, is under the responsibility of the Corporación Venezolana de Guayana (CVG), a holding company controlling all aluminium enterprises. At the same time CVG is an industrial complex, covering other industrial activities ranging from iron and steel production, international trade, ferro-alloys and gold to hydro-electric power stations. Enterprises created by CVG are responsible for their administration and operation, the main aim being to increase productivity and profitability.

Figures on production, exports and imports as well as scrap recycling in 1986-1988 are summarized in table 6. Present and expected capacities are shown in table 7.

### Bauxite mining

CVG BAUXIVEN is operating in bauxite mining. Enormous deposits of about 5 billion t are being mined near Los Pijiguaos, 600 km west of Puerto Ordaz, where plants for the next production phases are located. The Orinoco river which connects the deposit and the alumina plant is the most convenient and cheapest way of bauxite transportation. The only problem is caused by the dry season when the water level is too low for shipments, which is overcome by storing excess bauxite at CVG INTERALUMINA. According to recent information new bauxite deposits were discovered in the neighbourhood of Puerto Ordaz (at El Palmar which is located only 60 km away from the alumina plant); this would ensure a continuous bauxite supply to the plant. The abundant bauxite reserves of Venezuela will ensure self-sufficiency for decades.

Table 6. Production, exports, imports and scrap recycling of the Venezuelan aluminium industry, 1986-1988  
(Thousand tonnes)

Product	1986	1987	1988
		<u>Production</u>	
Bauxite	-	131.0	755.0
Alumina	1 269.0	1 347.0	1 301.0
Primary aluminium	423.0	430.8	453.8
Semis	135.0	145.0	136.8
		<u>Exports</u>	
Bauxite	-	-	-
Alumina	496.2	430.0	n.a.
Primary aluminium	277.9	302.8	218.0
Semis	96.9	100.0	n.a.
		<u>Imports</u>	
Bauxite	2 000.0	n.a.	n.a.
Alumina	-	n.a.	n.a.

continued

Table 6 (continued)

Product	1986	1987	1988
Primary aluminium	6.0	n.a.	n.a.
Semis	17.0	n.a.	n.a.
Scrap recycling	15.8	15.8	n.a.

Sources: Anuario Estadístico ABAL, 1988; Guayana Program, CVG, 1988; World Metal Statistics, May 1989; Statistics on International Trade in Aluminium, UNCTAD, 1989.

Table 7. Present and expected capacities in the Venezuelan aluminium industry, 1988-2000  
(Thousand tonnes)

Product	1988	1990	1995	2000
Bauxite	800	3 000	6 000	8 000
Alumina	1 300	2 000	3 000	4 000
Primary aluminium	650	856	1 811	2 000
Semis	230	350	375	n.a.

Source: Guayana Program, CVG, 1988.

At present, however, the mining capacity is below the domestic demand; the quantity of bauxite available to CVG INTERALUMINA enables it to produce some 1,300 thousand t/y of alumina. For that reason approximately 2,000 thousand t/y of bauxite are imported mainly from the neighbouring countries (Brazil, Guyana and Suriname). In case of Brazil, the annual shipments of bauxite were about 1,600 thousand t during the last few years. For the period 1989/90 a considerable increase of the mining capacity is expected which will result in an annual bauxite supply of 3,000 thousand t to CVG INTERALUMINA in the early 1990s.

#### Alumina production

Since 1983 CVG INTERALUMINA, of which the company ALUSUISSE owns 15 per cent of the equity, has been the only enterprise engaged in alumina production. Production started on the basis of imported bauxite and at the beginning the annual output was 560 thousand t of alumina. As a result of the continuous increase of capacity, the present output is over 1,300 thousand t/y, which is more than the actual demand of the CVG smelters, i.e. about 500 thousand t. Therefore alumina could be exported, and in 1987 140 thousand t went to North America and 290 thousand t to Europe.

According to long-term plans, CVG INTERALUMINA will increase its capacity up to 3,000 thousand t/y until 1995 in order to meet the growing alumina demand of existing and new smelters. By the end of this century the expected

smelters' capacity will reach 2,000 thousand t/y, requiring more than 4,000 thousand t/y of alumina. A comparison of the demand with the expected capacity of INTERALUMINA shows a deficit of around 1,000 thousand t/y. In order to ensure that quantity CVG wishes to develop a new alumina plant by the mid 1990s.

The local production of caustic soda is low, about 40 thousand t/y, and a major part of the required quantity has to be imported, i.e. about 90 thousand t/y. Although CVG has projects under way to increase the production capacity for caustic soda, further imports will be necessary to ensure the expected production of 4,000 thousand t/y of alumina. An interesting solution would be to co-operate with countries of the region which also have a shortage of caustic soda for their alumina production (among them Guyana and Jamaica are considered important) and to establish a joint production for that material.

### Metallurgical processing

Two companies - CVG VENALUM and CVG ALCASA - have been engaged in metallurgical processing. In both enterprises there is participation of foreign capital: the transnational company Reynolds has a share of 15 per cent in ALCASA, while a Japanese consortium participates in VENALUM with also 15 per cent. In 1987 the production of primary ingot was 430 thousand t but as a result of the continuous development the present capacity has reached 650 thousand t/y, of which ALCASA and VENALUM produce 210 and 440 thousand t, respectively. After the introduction of the new pot lines and an improvement of the old ones, the two smelters will produce 856 thousand t/y of primary metal by the end of 1990. In the 1990s further enterprises will be set up in order to export mainly to outside the region. The new capacities identified are given in table 8.

Table 8. New aluminium smelters in Venezuela

New Company	Capacity (thousand t/y)	Existing companies involved	Expected date of starting
ALUSUR	115	CVG, ALCOA, SURAL	1993
ALAMSA	180	CVG ALCASA, AUSTRIA METAL, PECHINEY	1993
ALUYANA	180	CVG/FIV, ITALIMPIANTI, TECdINT	1994
VEXXAL	180	CVG, ASEA B.B.	1994
ALISA	246	CVG, INVERSIONES RIPESA	1994
ALDANCA	190	CVG, ODC/INVERSIONES TAME	1994
ALUGUAY	180	CVG, ALUMAX, ALUSUISSE	1994

Source: Antony Bird Associates, Aluminium analysis No. 42, July 1989.

The main motivation for promoting these investments is the low production cost due to the low price (about \$0.009/kWh) of electric power available in the Guayana industrial region. The cost of the metal is about \$800/t, which is very favourable as compared with other producers.



In 1987 the total quantity of primary metal produced was 431 thousand t, of which 303 thousand t were exported: 117 to Japan, 45 to North America, 41 to Europe and 40 to Latin America. The remaining 128 thousand t and around 16 thousand t of secondary aluminium coming from scrap recycling as well as some thousand tonnes of ingots with special quality were used in the domestic downstream sector.

The necessary amounts of anode and cathode materials manufactured from petroleum coke are supplied from within CVG by the firm CARBONORCA. The initial capacity of CARBONORCA which is 115 thousand t/y (sufficient for 800,000 pieces of anodes) will be increased to 386 thousand t/y and will reach 1,200 thousand t/y in the final stage.

Downstream operations

In 1988 about 220 thousand t of metal were utilized in downstream operations to manufacture rolled, extruded, cast-rolled, drawn and die-cast products. The existing manufacturing capacities are given below:

<u>Technology</u>	<u>Capacity (thousand t/y)</u>
Rolling	50
Extrusion	50
Cast-rolling	200
Foil rolling	10
Die-casting	70

A detailed breakdown of the product mix can be found in UNIDO document ID/WG.481/2.

In 1987 about 100 thousand t of semis were exported, of which 62 thousand t went to North America, 28.5 to Europe, 8 to Latin America (including the Caribbean) and 1.5 to Japan. The export-import structure of semis is detailed in table 9.

Table 9. Exports and imports of semi-finished products, Venezuela, 1984 and 1986 (Thousand tonnes)

Type of product	1984		1986	
	Export	Import	Export	Import
Rolled	3.0	24.2	4.2	17.5
Extruded	4.2	0.7	2.3	1.2
Drawn	52.8	-	63.1	0.2
Cast	-	0.1	-	-
Other	-	0.2	-	0.1

Source: Monografia industrial del aluminio, FIV, noviembre 1987.

The main export products of the downstream operations are drawn wires and cables, while mainly rolled products, especially can-stock materials are imported. The total domestic consumption of semis is estimated at about

100 thousand t/y, of which the five main aluminium consuming sectors, i.e. the building, electrical, transportation, packaging and consumer durable goods industries account for about 20 per cent each. An analysis of export-import figures shows that the weak point in downstream operations was the manufacture of rolled products, particularly foil and can-stock rollings. This is the reason why developments will concentrate on that area. In relation with the project to produce 856 thousand t of ingots in 1990, 375 thousand t will be used to manufacture semis in the following breakdown:

- 60 thousand t for die-casting
- 180 thousand t for billet casting
- 20 thousand t for foil production
- 60 thousand t for can-stock rolling (alloyed material)
- 55 thousand t for rolling (unalloyed material).

For the time being the biggest manufacturing capacity is at CVG ALCASA where a continuous programme of expansion has taken place in the Guacara rolling mill as well as in the Puerto Ordaz plant. At the same time ALCASA has a share of 40 per cent in ALUNASA of Costa Rica in order to increase its output of rolled products as well as to find export outlets in Canada and the United States of America. Once all expansion programmes will be completed, the total manufacturing capacity of semis in ALCASA is expected to be above 135 thousand t/y (55 thousand t of normal sheets and strips, 60 thousand t of can-stock material and 20 thousand t of foil). VENALUM has also acquired equity abroad (50% in ALEUROPE of Belgium) with the intention to ensure export markets in Europe. In the future two other firms - PIVENSA and ALLOYVEN - will enter into rolling to produce alloyed sheets and strips. Their initial annual capacities will be 40 and 15 thousand t respectively.

A significant increase of the die-casting capacity is to be expected to produce automotive parts, especially wheels. Three aluminium wheel plants with a total output of about 2,000,000 units/y were identified, namely RUALCA, BWA Venezuela and Western Wheel of Venezuela. As besides wheels, many other automotive parts such as connecting rods, cylinder heads, pistons etc. are made from aluminium by die-casting, the company ALUMEN will start manufacturing these types of products. It is foreseen that foreign companies involved in the automotive industry (mainly from the United States) will partake in the investments with the intention to supply car producers in the United States as well as in other countries.

SURAL is the most important firm for drawn products with a wire-rod capacity of 137 thousand t/y. The annual drawing capacity is estimated at 22 thousand t. There are plans to increase the cast-rolling capacity of wire rods by another 65 thousand t/y, but at present the market opportunities are rather limited.

With respect to extrusion, the leading firm of Venezuela is ALREYVEN where about 20 thousand t/y of extruded profiles are produced, although the capacity is much higher. That company also employs the roll-forming technology in order to enlarge the product-mix and to minimize the impact of the economies of scale.

As far as smaller plants are concerned, the situation is rather complicated. There are approximately 350 firms of different sizes and outputs. Among them about 100 are only engaged in rolling, 90 in extrusion, 80 in die-casting, 43 in wire and cable manufacturing and 32 in casting by scrap recycling. Their total output is less than 50 thousand t/y. These enterprises face from time to time problems with regard to supply of raw materials.

C. Argentina

The general economic situation in 1988 was characterized by two facts: a shrinkage of the domestic market and an important improvement in foreign trade. In 1988 the rate of inflation was twice that of the preceding year, and the industrial production decreased by 5 per cent, which is closely connected with the reduction of purchasing power of the local market. At the same time the foreign trade surplus increased from \$560 million in 1987 to \$3,600 million in 1988; industrial exports went up by 45 per cent and reached \$2,450 million.

Argentina's aluminium industry is not vertically integrated since neither bauxite deposits nor an alumina production exist. There are deposits of different kinds of ores containing aluminium such as alunite and a complex alumino-silicate hematite-magnetite-ilmenite ore, however, at present it is not possible to extract alumina in an economical way. Therefore, the only upstream operation is metallurgical processing, and that is confined to one company named ALUAR. Data on production, exports, imports and metal recovery of the whole aluminium industry are summarized in table 10, and existing and expected capacities up to the year 2000 are shown in table 11.

Table 10. Production, exports, imports and scrap recycling of the Argentine aluminium industry, 1986-1988  
(Thousand tonnes)

Product	1986	1987	1988
		<u>Production</u>	
Primary aluminium	147.6	152.5	155.1
Semis	126.3	151.1	149.2
		<u>Exports</u>	
Primary aluminium	34.8	13.8	10.9
Semis	60.6	73.3	78.3
		<u>Imports</u>	
Alumina	340.0	350.0	350.0
Primary aluminium	-	-	-
Semis	1.4	3.5	2.0
Scrap recycling	6.6	7.7	7.1

Sources: ALUAR Statistics, 1989; Aluminium, vol. 65 (1989), No. 7/8.

Table 11. Present and expected capacities in the Argentine aluminium industry, 1988-2000  
(Thousand tonnes)

Product	1988	1990	1995	2000
Primary aluminium	160	170	190	190
Semis	210	220	220	220

Source: Personal interviews.

### Metallurgical processing

The only metallurgical company, Aluminios Argentinos S.A. (ALUAR) with its smelter located at Puerto Madryn, has been operating since 1975. The projected capacity was 140 thousand t/y with 380 pots and 150 kA. Through technical improvements the installed capacity has been increased and is now about 160 thousand t. The smelter has been modernized and the amperage increased to achieve higher efficiency and to improve environmental protection. At present alumina loading is being automated and the installation of a dry scrubbing system is in progress. In the next decade a further increase of capacity will be realized to reach an annual output of 190 thousand t of primary aluminium.

The alumina demand of the smelter is on a rather constant level of 350 thousand t/y. It is imported from Australia on the basis of a long-term contract which, however, will expire in 1993. Therefore, in the near future, possibilities of how to meet the alumina demand of the smelter during the following decade and how to make best use of regional complementarities in the solution of the problem, will have to be investigated.

The annual production of primary metal shows a slightly increasing tendency. In 1988 it was about 155 thousand t, of which 123 thousand t was ingot, 18 thousand t billet and 6 thousand t slab. The majority of primary metal goes to domestic downstream operations in accordance with the institutional decision to promote exports of products with higher value added. Table 10 shows clearly that exports of primary aluminium sharply decreased in 1987 and 1988 (from 34.8 thousand t in 1986 to 10.9 thousand t in 1988), as the Government of Argentina wants to ensure the supply of local aluminium to domestic manufacturers and permits exports only of excess quantities.

The domestic metal supply is somewhat supported by scrap recycling, but that quantity is less than 10 thousand t/y.

The domestic aluminium consumption decreased by 6.8 per cent in 1988, and, after a further drop during the first five months of 1989, is expected to shrink by about 20 per cent in 1989. That decline has been compensated by increasing exports, so that the level of production will remain about 150 thousand t/y. This means that the capacity utilization of the smelter will be close to the maximum and modernization projects will have to be carried out.

With regard to the main inputs required by the smelter, Argentina is self-sufficient in petroleum coke for anodes and cathodes of pots and is even able to export a surplus.

On the domestic market the price of primary metal follows the actual LME price with a certain delay. In recent times problems were experienced in the price system due to inflation and the devaluation of the national currency.

#### Downstream operations

Many firms and enterprises are engaged in downstream operations but the majority of them have a rather limited capacity and a low output of about some hundred tonnes each. The total capacity for finished and semi-finished products is about 390 thousand t/y. The distribution of the semi-finishing capacity is given below:

<u>Technology</u>	<u>Capacity (thousand t/y)</u>
Rolling	50
Extrusion	60
Cast rolling and drawing	70
Die-casting	20
Foil rolling	10
Total	<u>210</u>

Half of the output of the downstream operations is exported, Argentina being the second biggest exporter of the region behind Venezuela. Except for Brazil and Venezuela, most of the other South American countries offer possibilities for importing semi-finished products. Among the regional countries Chile is the main buyer of aluminium semis from Argentina, and also the Federal Republic of Germany, Japan and the United States of America import a lot of semis.

The biggest enterprise of this field is the KICSA Industrial y Comercial S.A. which has a hot-rolling and three cold-rolling mills, two extrusion presses as well as coil-coating and profil-treating lines. The annual capacities of the different manufacturing units are: 34 thousand t of billets and slabs, 15 thousand t of rolled products, 24 thousand t of extruded products and 10 thousand t of foil. The biggest producer of drawn products is Pirelli Cables Saic which has a cable factory with an annual capacity of 63 thousand t. This factory can produce 11 thousand t of wire, 9 thousand t of bare cable and 21 thousand t of insulated cable annually. The second biggest, Cimet S.A., has production capacities for 12 and 4 thousand t of bare and insulated cables, respectively.

In the field of continuous casting, scrap recycling and production of special (hard) alloys, Refineria Metales Uboldi S.A. is the largest company. Its annual output is 30 thousand t of billet, ingot and T-bar, 12 thousand t of casting alloys and 18 thousand t of strip and wire-rod. Die-casting activities are closely linked with the manufacture of automotive parts. Wheels are produced in two firms named PROTO and CIMETAL using raw materials (special casting alloys) of RAGOL. According to estimations, the annual domestic production is about 20 thousand t/y, of which some 2.5 thousand t are exported. KICSA plans to introduce die-casting technologies in the near future with an estimated capacity of 10 thousand t/y. The breakdown of the domestic consumption of semis is shown in table 12.

Table 12. Consumption of aluminium semi-finished products  
in Argentina, 1986-1988  
(Thousand tonnes)

Type of product	1986	1987	1988
Sheet, strip	16.3	17.5	16.2
Foil	7.9	8.1	6.9
Extrusions	14.3	15.1	13.9
Cable and wire	7.1	10.6	7.6
Die-castings	16.1	19.0	20.7
Powder and paste	0.3	0.4	0.4
Others	<u>2.0</u>	<u>3.0</u>	<u>3.0</u>
Total	64.0	73.7	68.7

Sources: ALUAR Statistics, 1989; Aluminium, vol. 65 (1989), No. 7/8.

Up to now the main weak point has been the powder and paste production. At KICSA a project is under preparation for establishing a powder/pigment plant. Since that company's foil production generates scraps of some 2.5 thousand t/y, they can be used as an input for the powder/paste production, so that the powder plant will increase the efficiency, the product-mix and the level of production of KICSA. The output of the plant will not only substitute present imports of powders and pastes but also permit exports of some 2 thousand t. Chile and Peru are the biggest potential buyers of aluminium powders and pastes.

With regard to prices there is no remarkable difference between internal and export prices. Both follow the LME price, but domestic prices are somewhat distorted due to inflation. In order to limit the impact of inflation on prices, internal trade is done through short-term deliveries and in limited quantities. Only enterprises that have met the internal demand can get export licenses for their products. The sectorial breakdown of the internal consumption of aluminium is given in table 13.

Table 13. Consumption of aluminium by sector  
of the Argentine industry, 1986-1988  
(As percentage of total consumption)

Industrial sector	1986	1987	1988
Building and construction	25	24	24
Transportation	16	16	19
Electrical industry	14	17	14
Consumer durable goods	9	9	9
Packaging	19	18	16
Powder, paste, pigment	1	1	1

continued

Table 13 (continued)

Industrial sector	1986	1987	1988
Machinery	3	3	2
Miscellaneous	8	7	9
Other	5	5	6
Total	100	100	100

Sources: ALUAR Statistics, 1989; Aluminium, vol. 65 (1989), No. 7/8.

Table 13 shows that the structure of the aluminium consumption did not change significantly over the past three years. An analysis of the projected demand indicates that a major change in the consumption structure is unlikely in the near future. Therefore no significant modifications are expected in the structure of the downstream operations.

#### D. The processing industry in Argentina, Brazil and Venezuela

The task of the aluminium processing industry is to transform semi-finished products, employing a great variety of different processing technologies and manufacturing methods, including shape-forming/ deformation processes, innumerable machining methods, joining, welding, surface finishing etc. Compared with upstream and downstream areas, the product scale of the processing industry is the widest among all and the highest number of firms are involved in it. The size and output of firms vary considerably; there are small workshops with some ten tonnes of output as well as big factories with an output of several thousand tonnes. Due to the diversified nature and relatively small size of the processing plants, they are very flexible i.e. they can easily modify their technologies, change products as well as respond to the changing market requirements. All of these facts indicate that this sector offers the greatest possibility for regional co-operation.

The number of aluminium processing firms is in the order of hundreds in all three countries. Exact figures are not available because in many cases such companies are also partially engaged in downstream operations and in statistics they are not considered separately. In Venezuela, for example, the number of enterprises in downstream operations is about 500, of which about 150 are working in processing. Even the biggest companies of the downstream area are also engaged in processing (e.g. ALCOA of Brazil) which has the advantage of self-sufficiency in raw materials while manufacturing products with a high value-added.

## II. POSSIBILITIES FOR REGIONAL CO-OPERATION AND COMPLEMENTARITIES

On the basis of the present capacities, the expansion projects being developed and the existing programmes of co-operation in the regional aluminium industries, the following possibilities for regional complementarities were identified:

## A. Brazil

In Brazil efforts are being made to achieve a full vertical integration of its aluminium industry. Complete self-sufficiency is not expected earlier than 1995, however that forecast can be considered somewhat optimistic due to the economic constraints faced by the country, which can also create difficulties for regional programmes of co-operation and complementarities. The possibilities of production complementarities identified are given below.

### Bauxite mining

At present the exploited quantity is much higher than the domestic consumption, thus Brazil is able to export bauxite of some 4,500 thousand t/y. As soon as the new alumina plant ALUNORTE will begin to operate a greater part of the production will be sold on the domestic market. However, this will coincide with a decrease of Venezuelan bauxite imports from Brazil, so that the quantity exploited will remain almost the same, that is around 8,000 thousand t/y. Another regional country to which Brazil exports bauxite is Suriname. Under a bauxite-alumina agreement concluded between the two countries, Brazil supplies about 315 thousand t/y of bauxite and Suriname delivers alumina of some 160 thousand t/y. In the near future Canada and the United States could become the main export markets for Brazilian bauxite. In the longer run that situation could change due to a redeployment of upstream operations from developed to developing countries. After 1995 the quantity of bauxite exported may drop to an annual level of 2,000 thousand t.

### Alumina production

At present the alumina deficit is covered through imports from Jamaica, the Netherlands, Suriname, the United States and Venezuela. The quantity of alumina imported from Venezuela (70 thousand t/y) will probably decrease in the near future due to the increasing alumina demand of the Venezuelan smelters. It could be substituted by imports from Jamaica as in 1987 that country delivered only 26 thousand t of alumina to Brazil and has a substantial idle capacity in alumina production. As a result of the reopening of the alumina plant ALPART, the Jamaican capacity is now 3,000 thousand t/y while the production is projected to reach only 2,000 thousand t in 1989. It would also seem reasonable to substitute alumina imported from the Netherlands and the United States by alumina from Jamaica or Suriname, as these countries are closer to Brazil which would reduce transportation costs. However, the main reason for such a change would be that with both countries barter agreements could be concluded, compensating alumina supplies by shipment of other products of the Brazilian aluminium industry or by industrial and agricultural goods in order to save foreign currency for the countries concerned. In that respect it is worth mentioning that the Brazilian Government offered technical support and credit to Guyana in order to reopen its alumina plant which was closed in 1982. Besides Brazil, the Reynolds and Norsk Hydro companies are also interested in putting that plant in operation.

### Metallurgical processing

The main goal of increasing capacities is to augment exports of primary metal, so that Brazil could become a potential exporter to Latin American and Caribbean countries if mutual interests can be found. The modalities of such trade need to be clarified, however, if a tolling system is applied in order to save foreign currency, then Brazilian metallurgical products will be exchanged for other aluminium products (alumina, semis etc.). Until ALUNORTE



will start operating, alumina should be considered for exchange, and among the semis such products that are of special quality or produced in small quantities and which Brazilian companies are not interested in producing for the time being.

As far as the expansion of metallurgical processing is concerned, the two big transnational aluminum companies of Brazil project only a moderate growth. They prefer to invest in downstream operations in order to produce products of a high value-added. The Minas Gerais and Aratu plants of ALCAN intend to increase their annual capacity by only 60 thousand t up to the end of the century. The Pocos de Caldas plant of ALCOA does not project any capacity increase. The São Luis plant of ALCOA which takes part in the ALUMAR joint venture has not yet decided about investing in a third pot line with a capacity of 52 thousand t/y. The biggest capacity expansions will be in the northern part of the country due to the more favourable energy situation; nevertheless CBA, located in the southern region, wants to increase its production of primary metal by 170 thousand t/y in the next 10 years.

In general, companies organize their regional co-operation on the basis of mutual interests. Recently ALCOA has developed some production complementarities with Argentine and Mexican partners, by which ALCOA will deliver ingots of normal quality in exchange of special semis and alloys.

#### Downstream operations

In this area the two transnational companies complement each other to a certain extent since ALCAN is basically interested in rolling technology and supplies the market mainly with rolled products, while ALCOA is first of all concerned with extrusion and has the greatest share in the market of extruded products. CBA is operating in all branches and its future development is oriented towards the integration of upstream and downstream operations.

The development strategy for downstream operations is to cover current deficits, and particularly to meet the demand for can-stock material as well as to increase exports of semis to hard-currency markets. To achieve that goal, mainly the rolling capacity for sheets, strips and foils has to be increased.

As the press-forging capacity is insufficient to achieve an integrated structure, there is a need to establish a press-forging plant. The products of such a plant would enlarge the product-mix, offer possibilities for regional complementarities and, in many cases, could substitute die-cast products thus providing a more proper combination of properties and a considerable material saving. Automotive parts are products for which the press-forging technology is particularly advantageous and where a substitution could take place in a first instance.

With regard to possible regional complementarities in downstream operations, the existence of parallel structures, i.e. similar product-mix and applied technologies, in Argentina, Brazil and Venezuela poses a problem. It is therefore hard to find complementarities. Semis made from special alloys or by special technologies may offer a possibility for regional co-operation through tolling or barter systems.

#### B. Venezuela

Similar to Brazil, that country also wants to establish a vertically integrated and self-sufficient aluminium industry. Before such integrated

structure will be achieved, i.e. by the end of the next decade, the following possibilities of co-operation and complementarity exist.

#### Bauxite mining

The domestic bauxite exploitation will probably reach 3,000 thousand t/y in 1990 which is not enough for the projected alumina production of 2,000 thousand t/y for that year. Full self-sufficiency in bauxite will be realized around 1995 and until then Venezuela must import bauxite. The main imports come from Brazil and Guyana. On the basis of a short-term contract Guyana will deliver 500 thousand t/y of bauxite over the next three years, and the same quantity will come from Brazil. In spite of its favourable location, Jamaica has not yet been considered as a potential bauxite supplier.

#### Alumina production

During the period 1977-1986 the alumina production capacity was not sufficient to meet the domestic demand and about 900 thousand t/y were imported from Jamaica on the basis of a long-term contract. In the meantime CVG has established its own alumina plant and the present production capacity is higher than the demand of its smelters so that the excess quantity is being exported. The increases taking place in alumina and smelter capacities will result in an excess of alumina in the range of 300-400 thousand t/y which could be exported. The situation is likely to change again in 1992-1996 when the smelters will require about 4,000 thousand t/y of alumina and Venezuela will face a temporary alumina deficit which will have to be covered by imports. New capacities of about 1,000 thousand t/y of alumina will solve the problem. With respect to alumina imports, possible suppliers can be found in the Caribbean countries where surplus capacities exist.

Venezuela wants to increase the existing production capacity for caustic soda and wishes to arrange a joint venture with other Latin American and Caribbean countries for the installation of a new plant. PEREVESA is involved in this matter. The plant will have a nominal production capacity of 2,000 thousand t/y. At present CVG is looking for partners in the joint venture.

#### Metallurgical processing

Compared to other producers world-wide, the aluminium metallurgy of Venezuela is in a good position due to its low production costs. The main efforts are oriented towards increasing the quantity of metal in order to supply domestic downstream operations and to export.

It is estimated that the development programme of CVG requires foreign credits of about \$1.1 billion. In spite of very low production costs, Venezuela is confronted with financial constraints affecting the development of the new smelters. Prospects for an expansion in Venezuelan metallurgical processing may improve in the period 1995-2000. The new production capacities will get electric energy on fixed and low prices for the first five years, afterwards they will have to pay current tariffs. However, energy prices will tend to increase because the energy sector will need additional financial resources for its own development.

Besides strictly economic reasons, there is a sincere wish to increase co-operation within the region, mainly with Mexico. The Mexican and Venezuelan presidents agreed in July 1989 to develop a project for the establishment of a smelter for 120 thousand t in Venezuela in order to produce ingots for Mexico.

In Mexico about half of the downstream capacities are idle and have problems with metal supply. Venezuela delivers primary aluminium of approximately 60 thousand t/y to Mexico on the basis of a bilateral agreement based on LME price.

#### Downstream operations

Development plans for that area have two main purposes: to substitute current imports (basically can-stock material) and to increase the product-mix and quantity of semis with higher value-added. As great emphasis is put on exports, modernization programmes being implemented at CVG ALCASA aim at improving the quality of semis, especially of the rolled products. The enterprises of CVG involved in the promotion of exports of downstream products are acquiring equity of foreign companies: ALCASA has promoted ALUNASA in Costa Rica, and VENALUM has developed ALEUROPE in Belgium. The purpose of these joint ventures is to increase possibilities of selling semis of a high quality on North American and European markets. The supply of metal to these plants will be ensured by Venezuela.

As one of the basic aims is the progressive reduction of semis' imports, a programme of regional co-operation and complementarity should be oriented towards substituting imports from hard-currency markets or complementing the product-mix with special semis (e.g. roll-bond plates or forged parts). In exchange, primary metal and other semis could be delivered. Trades should be based on tolling agreements, and also barter could be considered. Since the main orientations developed by Brazil and Venezuela are very similar, especially in can-stock and foil rolling, possibilities of complementarities between the two countries are limited in that specific field.

In die-casting, planned investments are mainly for export and, above all, for automotive parts. Within the region only Brazil has an integrated automotive industry with an annual output of about 1.1 million vehicles and a demand for die-cast aluminium parts. Argentina and Venezuela have only some assembly lines with an output of approximately 100,000-200,000 vehicles per year. In the automotive production only a moderate increase of output is expected in the near future. Because every country has its own die-casting capacity to meet the domestic demand, only a small quantity of the output of the projected Venezuelan die-casting plants will be absorbed by other regional countries.

#### C. Argentina

The aluminium industry of Argentina is characterized by a lack of bauxite and alumina production in the upstream operations and by highly diversified and well developed downstream operations. Evidently, these circumstances offer opportunities for co-operation and complementarities.

#### Alumina production

All alumina is imported and that situation will not change in the future. Imports are about 350 thousand t/y and only a slight increase is predicted due to the projected capacity increase of ALUAR by 30 thousand t/y. The alumina is imported from Australia on the basis of a long-term bilateral agreement which expires in 1993. The substitution of the imported Australian alumina offers an opportunity for increasing the production complementarities in the region.

#### Metallurgical processing

Due to recent investments and modernizations the operating efficiency of the ALUAR plant has improved remarkably and the capacity has increased by

20 thousand t/y. Different development programmes are being implemented which will increase the capacity by another 30 thousand t/y in the next decade. At present there are no plans for further investments which means that Argentina will be confronted with a shortage of primary aluminium that could be provided by the region. Existing forecasts do not predict a drastic increase in the domestic consumption which would require significant amounts of metal.

#### Downstream operations

At present upstream and downstream operations are almost in balance, i.e. the capacity in downstream operations is by 40 thousand t/y higher than that in upstream. Manufacturing is thus capable of absorbing all of the primary metal produced and could absorb additional quantities resulting from upgrading the smelter's output. The only weak point in downstream operations could be eliminated by establishing a powder/pigment plant.

Since very similar semi-finishing structures exist at the regional level, possibilities for co-operation can be found only in connection with semis of special quality. For Argentina the field of special alloys appears very promising because the country has a long experience in producing a wide range of master alloys as well as alloyed billets and slabs of good quality. These products could be exchanged at the regional level for forged parts as well as rolled and extruded products of special type.

### III. ANALYSIS OF POSSIBLE COMPLEMENTARITIES

#### A. Bottlenecks identified in production structures

Two of the three countries investigated, Brazil and Venezuela, wish to achieve a complete vertical integration of their aluminium industry, based on abundant deposits of raw material. Whether this approach will strengthen the process of regional integration and maximize economic and financial resources of the region is questionable. What certainly hampers the process of regional integration is the existence of a similar product-mix in the countries studied, and also in Mexico. In all those countries the Government promoted the establishment production facilities that could cater for the domestic market. That policy and the pricing system limited the promotion of a coherent programme of production complementarities. At present there is a change in favour of supporting regional integration. To avoid duplication of investments in a region that is suffering under a heavy debt burden, it is important to harmonize development plans for downstream activities and to increase regional co-operation.

In Brazil's upstream sector there is a considerable surplus of bauxite and a deficit of alumina which has to be compensated by imports of some 370 thousand t/y until the new alumina plant will be put into operation. The import structure is rather heterogenous and could become a constraint from a commercial point of view. It would be advisable to substitute the 130 thousand t/y of alumina being imported from the Netherlands and the United States by imports from regional countries, such as Suriname (the greatest alumina supplier of Brazil), Jamaica or Guyana. In the case of Guyana the possibility of exporting alumina is linked to the reopening of an idle capacity mentioned earlier. Among the three countries, Jamaica is the only one that intends to increase its alumina production. At the same time it has no metallurgical processing and the manufacturing technologies of its downstream sector are limited. Therefore, possibilities for establishing complementarities are given. Tolling arrangements could be implemented, and for the Jamaican alumina

Brazil could deliver ingots or semis, resulting in savings of foreign currency for both countries. For Brazil it is important to strengthen its co-operation with countries of the Caribbean because the delivery of Venezuelan alumina is likely to cease in the near future.

In metallurgical processing the only serious problem which can influence the development process is the energy supply, as previously explained.

In the downstream operation of Brazil, the main aim is to meet the requirements of the domestic market and to substitute imports of semi-finished products. In 1988 imports were low (9.5 thousand t) while the total export of semis was 42 thousand t. Nearly half of the imports (4.3 thousand t) were special cable products from Spain while the majority of the remaining part consisted of rolled sheets and strips, mainly can-stock materials. Only 8 per cent of the semis exported were products with a relative high value-added.

On the basis of the facts gathered and statistical information it can be concluded that press-forging is practically missing in the aluminium industry of the region. In the developed countries the biggest consumer of forged products is the automotive industry. In Latin America only Brazil has a self-sufficient automotive industry (the other countries have only car-assembly plants), therefore press-forging operations should be introduced in that country. The erection of a medium-size press-forging plant would have two advantages: higher integration of the aluminium industry and increased possibilities of regional co-operation. Among the companies of the Brazilian downstream sector CRA has the most integrated structure and the widest scale of products and could establish such a press-forging plant. The proposed plant could have an annual capacity of approximately 3 million pieces with an average weight of 0.3-0.4 kg/piece. The quantity of metal required would be around 1 thousand t/y and the investment cost below \$6 million. The main parameters and equipment of the forging plant are given below.

Annual output	1,000 tonnes (3 million pieces)
Operating time	2 shifts, 200 days/year
Number of workers	70

Major equipment and machines:

- 2 high-speed automatic rotary saws, maximum diameter to be sawn 100 and 200 mm respectively
- 1 sharpening machine for saw band
- 1 abrasive deburring equipment, 500 kg capacity
- 2 preheating furnaces with manipulator unloading, maximum temperature 550 °C, 135 kW
- 2 rolling tables between furnace and press
- 2 direct-drive, screw-type presses, 4 and 8 MN
- 2 trimming eccentric presses, 0.6 and 1 MN
- 3 heat-treating furnaces, maximum temperature 550 °C, 370 kW
- 1 tool preheating furnace, maximum temperature 420 °C, 70 kW
- 1 pickling line
- 1 bucket tilting equipment
- 3 travelling cranes, 20 kN capacity

Total cost of machinery (including assembly mounting)	\$3 million
Cost of installation	\$2.5 million

Press-forged products could offer possibilities of complementarity; forged parts could, for example, be supplied to Argentina in exchange of special alloys.

The Venezuelan aluminium industry has a bauxite deficit for its upstream operations which is covered through imports from Brazil and Guyana. That shortage will end by 1990/91. In the alumina sector there is some excess of alumina which, at present, is being exported. This situation will not last very long because the increase of the smelters' capacity will consume the excess alumina. This means that Venezuela cannot be considered as a potential alumina exporter from 1993 onwards. On the contrary, as a consequence of the development of its metallurgical industry, Venezuela could become one of the biggest ingot exporters of the world and will be able to meet the aluminium demand of those regional countries which face a metal shortage like Mexico.

The development of the Venezuelan downstream operations follows to a great extent the growth of the ingot production. Emphasis is on rolling, because rolled products (can-stock and foils) represent the greatest quantity in the import of semis. The main aim of the development of this sector is to substitute the imports by domestic products and to increase the exports of semis. In the projected rolling capacity of 150 thousand t/y the foil production will represent 20 thousand t. As in the case of Argentina and Brazil, it seems advisable to establish a powder/pigment plant using foil scraps as input.

In Argentina the missing links in upstream operations are bauxite and alumina production. The alumina demand of the ALUAR smelter is met by imports from Australia. In the downstream sector there is no production of powder/pigment and of forged parts. A project is being formulated for a 2.5 thousand t/y powder/pigment plant that will use the foil scrap of KICSA. The domestic demand for forged products being not very high, the feasibility of setting up a separate plant should be carefully analysed. The deficit of forged products could be solved by co-operation with Brazil, whereby Argentina would provide semis (e.g. special alloys) to Brazil (to CBA) in exchange of forged parts.

#### B. Some economic considerations to promote regional complementarities

Regional complementarities could have an important impact on the savings of foreign currency by substituting imports coming from outside the region. Through barter or tolling systems the use of hard currency in trading could be avoided.

The pricing system prevailing in the Latin American region will have a major impact on the viability of the different opportunities of complementarities identified. That pricing system is strongly linked to the idea of a Regional Metal Exchange, which would not only control sales and deliveries but also protect regional producers against speculations and manipulations that happen on many occasions world-wide. It is a common practice all over the world to form regional subsidiaries and warehouses of the LME e.g. in Japan, Singapore and the United States of America. The main purpose is to offer guarantees to both, producers and consumers.

Considering the present status and the development perspectives of the regional aluminium industry, it would seem important to preserve the cost-advantageous position of the region and to ensure favourable profit margins for both, metallurgical processing and downstream operations. Therefore, priority should be given to the creation of a Regional Metal Exchange.

The first step in developing such an institution could be the harmonization of the pricing system within the region. At present domestic prices for aluminium ingots of normal quality are below the level established by LME, the main reason for which is the intention of Governments to further internal consumption. The difference between domestic and LME ingot prices is relatively small in Argentina and high in Brazil (about \$600/t). Due to this fact the smelters are forced to increase their output and to export their ingots at world-market prices. However, the world-market price is reasonable only in cases where production costs are fairly low, as for example in Venezuela. According to the President of VENALUM, a minimum profit margin of \$200-300 could be obtained if the aluminium ingots were priced at \$1,300-1,400/t. At the same time that price would put the Brazilian ingot export in a difficult position. With regard to the price of semi-finished and finished products, internal prices are at close range to LME prices and occasionally higher.

A Regional Metal Exchange with a harmonized price and a preferential tariff system would strongly support the process of integration and further close co-operation between Caribbean and Latin American countries.

### C. Factors affecting complementarities

Before identifying possible complementarities it is worth while to point out those factors which would enhance regional integration as well as those that could become a constraint.

The promotional factors are:

- (a) The relative abundancy of natural resources, especially of bauxite and oil, as well as the important idle alumina capacities in the Caribbean countries;
- (b) The strong links between some countries of the region that could strengthen production complementarities in the aluminium industry;
- (c) The possibility of producing capital goods for the aluminium industry by some countries of the region, particularly by Brazil;
- (d) The existing preferential trade systems.

The possible constraints are:

- (a) The aim of some countries of the region to achieve a complete vertical integration;
- (b) The relatively low level of aluminium consumption in the region as well as a certain lack of institutions concerned with technology and product development;
- (c) The emphasis placed on exports to outside the region;
- (d) The orientation given by some transnational companies to their operations in the region;
- (e) The lack of sufficient capital in the region and the increasing participation of foreign capital in new investments;
- (f) The unorganized nature of the processing operations and the lack of integration between the manufacturing and processing phases of production.

D. Recommendations of possible production complementarities

Upstream operations

1. Argentine-Jamaican co-operation to substitute alumina imports from Australia.

That co-operation could begin in 1993 and in its first phase be limited to about 50 thousand t/y which would be increased later. Trade arrangements could be based on a barter system since Jamaica needs a limited quantity of metal but a lot of agricultural products. The interest of Argentina in that barter can be explained by a saving of foreign currency while for Jamaica it would result in a better utilization of its idle alumina capacities. Of course many issues need to be agreed upon before implementation, such as the determination of the proper alumina quality, trading conditions etc., however until 1993 a relatively long period is available to solve all these matters. The partners of that complementarity programme would be ALUAR of Argentina and Clarendon Alumina Production Ltd. of Jamaica.

2. Brazilian-Jamaican co-operation to substitute alumina imports from the Netherlands and United States of America.

For some years, i.e. until a complete vertical integration will be achieved, Brazil will have to import alumina for its smelters. A considerable share of these imports comes from developed countries which is disadvantageous for Brazil from an economical point of view. If these imports are replaced by Jamaican alumina, this would be of advantage to both countries concerned because they can save foreign currency by applying a tolling system of trade. The Jamaican alumina could be exchanged for Brazilian metal or caustic soda. That last input is being imported by Jamaican alumina plants since it is not produced in the country. This complementarity could be further increased once the Venezuelan alumina exports to Brazil will decline due to the increasing internal consumption. The proposed co-operation could start as soon as possible (supposingly in 1990) with an estimated quantity of 100 thousand t/y. It is evident that it would last until ALUNORTE will go into operation. The partners of that complementarity programme would be the Clarendon Alumina Production Ltd. of Jamaica and ALBRAS or VALESUL from Brazil.

3. Venezuelan-Mexican co-operation in ingot production.

Mexico is suffering of a shortage of metal for its downstream operations. As Venezuela has a very low production cost and a moderate capital cost the two countries agreed to invest jointly in a smelter to be located in Venezuela and supplying Mexico with ingots of 120 thousand t/y. In that investment CVG represents the Venezuelan interests while from Mexico the supposingly interested partner is the Grupo Aluminio.

Downstream operations

4. Argentine-Brazilian co-operation in press-forging.

The erection of a press-forging plant in Brazil, suitably at CBA, would be advisable in order to supply the domestic automotive and machinery industries with forged parts and to meet the demand of the regional market, especially that of Argentina. The plant could be supplied with special alloys, mainly precipitation-hardened ones, produced in Argentina. The form of trade could be a tolling system. KICSA or the Refineria Metales Uboldi of Argentina would be the partner of the Brazilian company CBA.



5. Argentine-Venezuelan co-operation in the investment for powder/pigment plants.

Because the capacities for powder and pigment production are higher in the two countries concerned than internal consumption, the excess production can be exported to other countries of the region and outside the region. The projected production capacity of Argentina is approximately 2.5 thousand t/y and that of Venezuela of 4.0 thousand t/y. In Argentina, after substituting the present imports, more than 1.5 thousand t/y will be available for exports and in Venezuela approximately 3 thousand t. It will be of great benefit for Argentina and Venezuela to co-ordinate their investment programmes as well as related technical aspects. The parties which could be involved in that programme of co-operation are KICSA from Argentina and ALCASA from Venezuela.

Inputs for the aluminium industry

6. Co-operation in caustic soda production.

The alumina production in the northern part of the continent and the Caribbean region are facing problems in the supply of caustic soda. The countries concerned have to import considerable quantities of that material from hard-currency markets. Venezuela has already made plans for an expansion of its own production capacity and for investing in a new plant in form of a joint venture with regional countries. The plant to be established at Perevesa will have a capacity of 2,000 thousand t/y which will cover the increasing domestic demand and permit the supply of caustic soda to other countries of the region. At present the financial aspects of that project are under study and it seems that the installation could begin in the early 1990s.

7. Co-operation in research and development activities.

At present most of the efforts of the region have been concentrated on upstream operations. In the future the emphasis will be shifting to downstream operations and processing because those products have higher value-added. That shift requires intensive research and development activities in the areas concerned to ensure the necessary technological know-how for producing more competitive products. Another aspect that research and development should be concerned with is to find ways for increasing and reinforcing the comparative advantages of the regional aluminium industry by improving the quality of products and decreasing production costs. It is important to monitor the main technological changes and the appearance of new products on a world-wide basis. A project for establishing a R and D centre in Venezuela is already underway. The centre, which will operate within CVG, will offer to different aluminium producers of the region possibilities of developing common research activities. The areas of, and modalities of co-operation in, research and development will be determined by a panel, which will be composed of experts of the countries concerned and of regional organizations involved in the aluminium industry.

Processing

8. Identification of possible complementarities in the processing sector.

As mentioned earlier, processing is of particular importance because of its direct contact with the consumers of aluminium finished products. Producers of these products are the first to acknowledge changes in demands that will affect upstream and downstream operations. The diversified nature of processing operations as well as the small size of firms involved make it

difficult to get an exact picture. It will, therefore, be necessary to elaborate a comprehensive study of the processing industry with regard to its production capacities, product-mix, structure of exports and imports as well as demands, specifications and quality requirements for finished products.

#### Summary of possible complementarities and co-operations

Argentine-Jamaican co-operation in the alumina phase  
Brazilian-Jamaican co-operation in the alumina phase  
Venezuelan-Mexican co-operation in ingot production  
Brazilian-Argentine co-operation in press-forging  
Argentine-Venezuelan co-operation in the investment for  
powder/pigment plants  
Regional co-operation in caustic soda production  
Co-operation in R and D activities  
Identification of possible complementarities in the processing sector

#### IV. SUPPORTIVE POLICIES AND INSTITUTIONAL FRAMEWORK TO PROMOTE THE PROCESS OF COMPLEMENTATION

This chapter contains a brief account of the main policies and measures promulgated by the Governments of the countries surveyed and which have an influence on the process of regional integration of the aluminium industry as well as actions to be taken in order to enhance regional co-operation.

In Argentina export licences are given only for goods which are produced in excess of the domestic demand and the general policy is to increase exports of products with the highest possible value-added. On the products being exported there is an exporting draw-back of 15 per cent which corresponds to the taxes on fuels and electric energy used. The importation of metals requires a licence authorized by SICE, however raw materials and metals imported from ALADI countries are exempted. The import duty is low for products which are not produced in Argentina. On the basis of the "Commercial Integration Agreement" between Argentina and Brazil, free entry is granted to Brazilian bauxite and metallic aluminium of high purity. It would be advisable to extend that kind of agreement to the possible Argentine-Jamaican co-operation in alumina. In the pricing policy emphasis is given to encouraging internal trade. In 1988 ALUAR and SICE agreed to arrive at more appropriate prices for the export of semi-finished and finished aluminium products.

The two main features of the Brazilian commercial policy are the promotion of exports and the limitation of imports. Due to the abundance of deposits, the export of bauxite enjoys special treatment under the regulations pertaining to "abundant ores". At the same time other arrangements, such as tariff discounts, free temporary imports and draw-back arrangements encourage the export of products with high value-added. Exporting companies can be exempted from sales and income tax, and the FINEP system may also help in financing exports. Imports are restricted by licenses and deposits of foreign currency, but at the same time "free zones" (e.g. at Manaus) for duty-free imports have been set up. The only problem with these zones is that they are quite far from the industrial zones and therefore the cost of internal transportation is nearly equivalent to or higher than the import duty. The normal customs duty for metallic aluminium is 3 per cent.

The Brazilian pricing system was elaborated with the intention to support internal manufacture. For that reason the ingot price is being kept on an artificial low level while the price of semis corresponds to international

prices or is sometimes a bit higher. Consequently, normal-grade ingots practically disappeared from the domestic market and ingots of so-called "extra" quality appeared which are sold for a higher price, i.e. a price which corresponds to the LME price for normal-quality ingots. This system, therefore, promotes first of all the export of ingots, and secondly the transformation of primary metal into semis. However, it does not promote the export of semis, although they have higher value-added. A new and more flexible pricing system is under preparation which would become effective in the early 1990's.

In Venezuela trading is practically free from regulations. There are no restrictions on exports and in case of imports the only condition is an approval of RECADI. Imported products are partially or completely exempted from customs duty if there is no production in the country or if it is proved that domestic production is not able to meet the demand (as in the case of Brazilian bauxite). Incentives exist for the export of primary metal and several funds have been created to finance exports. The Venezuelan pricing system supports the domestic aluminium consumption, however, because producers are not obliged to meet first the internal demand there are often shortages of metal for the processing sector.

With a view to supporting the regional co-operation of aluminium industries it is important to create such government policies that will ensure duty-free imports and tax-free exports of materials and products among the countries concerned. For those aluminium products which are not subject of production complementarities, a unified tariff rate of 3 per cent should be introduced.

To promote the development of production complementarities, barter should be considered the basic system of trading because of the savings in foreign currency involved. Trades should be financed through clearing which has a long tradition in ALADI countries and has been effective in bilateral trading based on clearing arrangements between central banks. In preferential trade relations, tolling agreements are frequently used and could be applied to some of the proposed complementarities e.g. in the case of the Brazilian-Jamaican co-operation concerning alumina/ caustic soda or the Argentine-Brazilian one concerning special alloys/forged parts.

Basically all such trade policies and systems will support complementarities if they are aiming at a unified price system. The existence of such a system is the precondition for the introduction of a Regional Metal Exchange as proposed in chapter II. In that connection the recommendations of the International Bauxite Association (IBA) should be given due consideration, of which some Caribbean and Latin American countries (e.g. Jamaica, Suriname and Guyana) are members. The shares of IBA countries in the world's bauxite, alumina and primary aluminium productions are 70-75 per cent, 50-55 per cent and 10-12 per cent, respectively. According to IBA data, about 50 per cent of the global production of bauxite, 40 per cent of the alumina production and only 30 per cent of the primary metal production are being traded. In the case of bauxite and alumina, the majority of the trade is among subsidiaries of transnational companies or is based on long-term contracts among producers and consumers. This means that the market price for bauxite and alumina is only a reference. IBA has proposed to relate the price of bauxite and alumina to that of primary metal which expresses the real market price. The composite reference price (CRP) for aluminium ingots of normal quality is the weighted average of eight published prices. The CIF price of bauxite is 2.5-3.5 per cent of CRP and that of alumina 14-18 per cent of CRP. These price relations ensure the interests of both, producers and consumers in all production sectors and maintain the competitive position of aluminium vis-à-vis other materials.

For a regional price system the application of the ranges' average seems to be reasonable, with some fluctuations depending on quality. The CIF prices would be 3 per cent and 16 per cent of the regional composite reference prices (RCRP) for bauxite and alumina respectively, with margins of  $\pm 0.2$  per cent and  $\pm 1.0$  per cent. However, the determination of the primary ingot RCRP is complicated because it has to reflect the differences in production costs of the countries concerned and at the same time to show the comparative advantages of the region as a whole. Furthermore, the actual LME prices have to be taken into consideration when determining the regional prices. Under these circumstances the best solution would be to calculate RCRP for primary ingots as an average of production costs of countries with an appropriate profit margin of about \$250 and of the actual LME price.

The above is only a general proposal for a regional pricing system and the question must be analysed later in much more depth. It seems advisable to form a panel which would study this problem and elaborate detailed proposals for the introduction of such a system together with a Regional Metal Exchange.