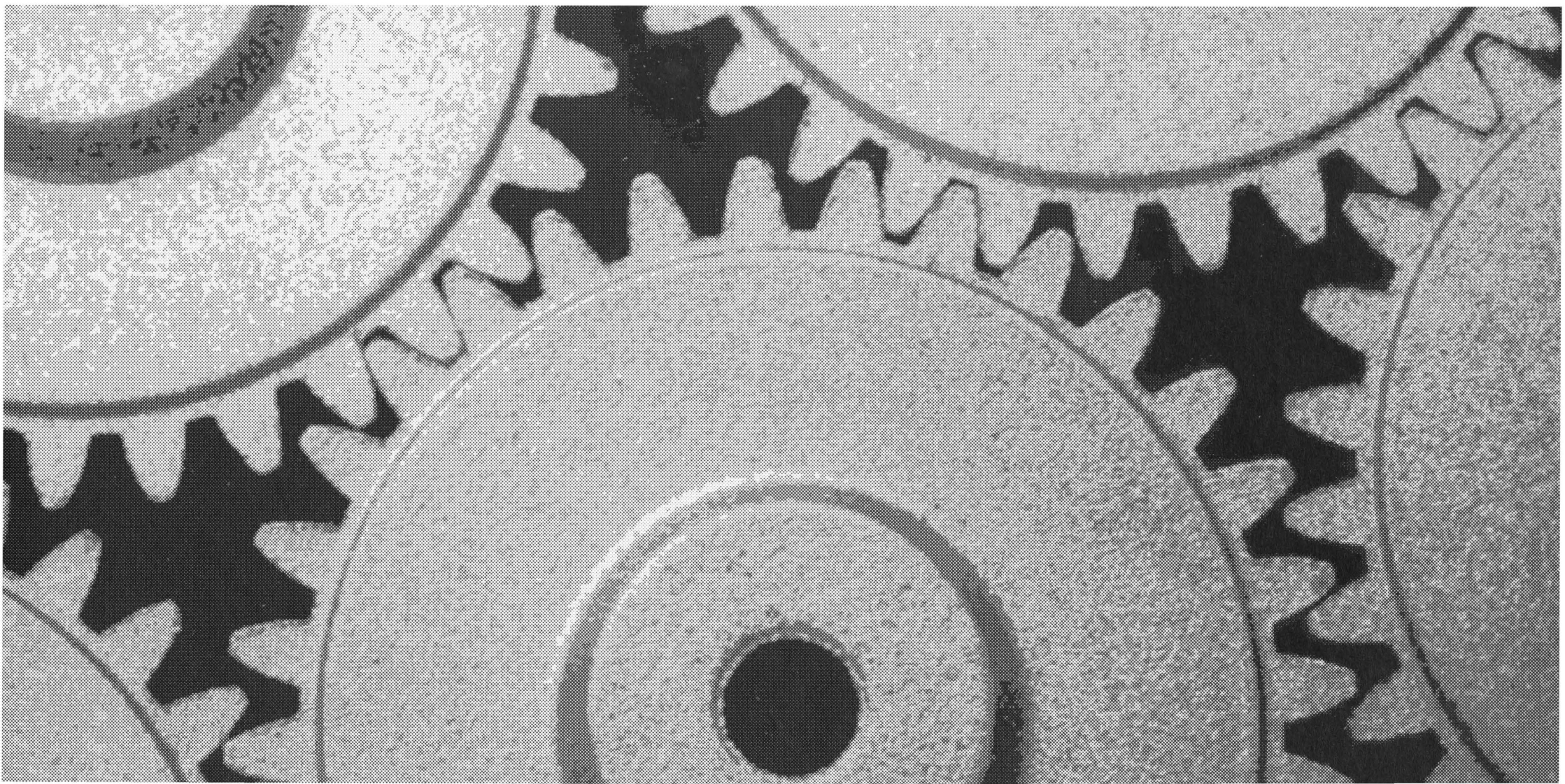
Non-ferreous metals



Non-ferrous metals - Zinc

The zinc industry in the European Community accounts for around 20% of world production.

The EC plays a dominant role in the world market for unwrought zinc (primary and secondary smelting) and semi-finished products (semis). Its main characteristic is its high degree of vertical integration.

At present, the zinc industry is recovering from 15 difficult years that were marked by constant rises in the price of oil, made worse by a zinc production capacity surplus.

Following the world upturn, the industry was unable to meet the recent strong increase in demand for zinc, despite the spare capacity created during the 1980s.

Restructuring is today underway in European and Japanese industries, and very large groups have been created at world level. Should the favourable trends witnessed today become clearer, it may be expected that supply and demand will remain in balance in the western world's zinc industry.

Description of the sector

Primary zinc is a natural substance found in the form of blende, (zinc sulphide - ZnS), smithsonite (zinc carbonate - Zn_2Co_3) and calamina (a mixture of smithsonite and zinc silicate - $ZnSi0_4$).

The blende is generally combined with galena (lead sulphide - PbS_2). Secondary zinc is derived essentially by reprocessing the residues from galvanisation (zinc matte), zinc ash-based mixed products and old zinc roofing, for which there are

4

Table 1
Zinc Ingots
Main Indicators, 1982-90

(thousand tonnes)	1982	1983	1984	1985	1986	1987	1988	1989	1990 (3)
Consumption (1) (2)	1 338	1 423	1 453	1 424	1 475	1 498	1 572	1 582	N/A
Net exports	- 29	38	137	96	71	138	114	114	N/A
Production (2)	1 423	1 501	1 567	1 594	1 619	1 674	1 708	1 687	1 725

(1) Excluding Luxembourg
(2) Remelted zinc and zinc dust are excluded
(3) Estimated
Source: Eurométaux

limited recovery possibilities. This secondary production is relatively unimportant when compared to that of primary zinc (in 1986, 4% of world production against 43% for new zinc). Zinc is marketed in different forms: ingots, rods, wires and plates, and displays varying degrees of purity. The highest quality (SHG - Special High Grade) is 99.995% pure, while the lowest quality is about 98% pure. Between these two extremes, four to five levels of quality can be counted. The main semi-finished products manufactured in zinc are the following:

- rolled products;
- pressure die casting;
- zinc dust;
- zinc oxide;
- various alloys, wires, spheres, anodes, zinc powders etc.

Current situation

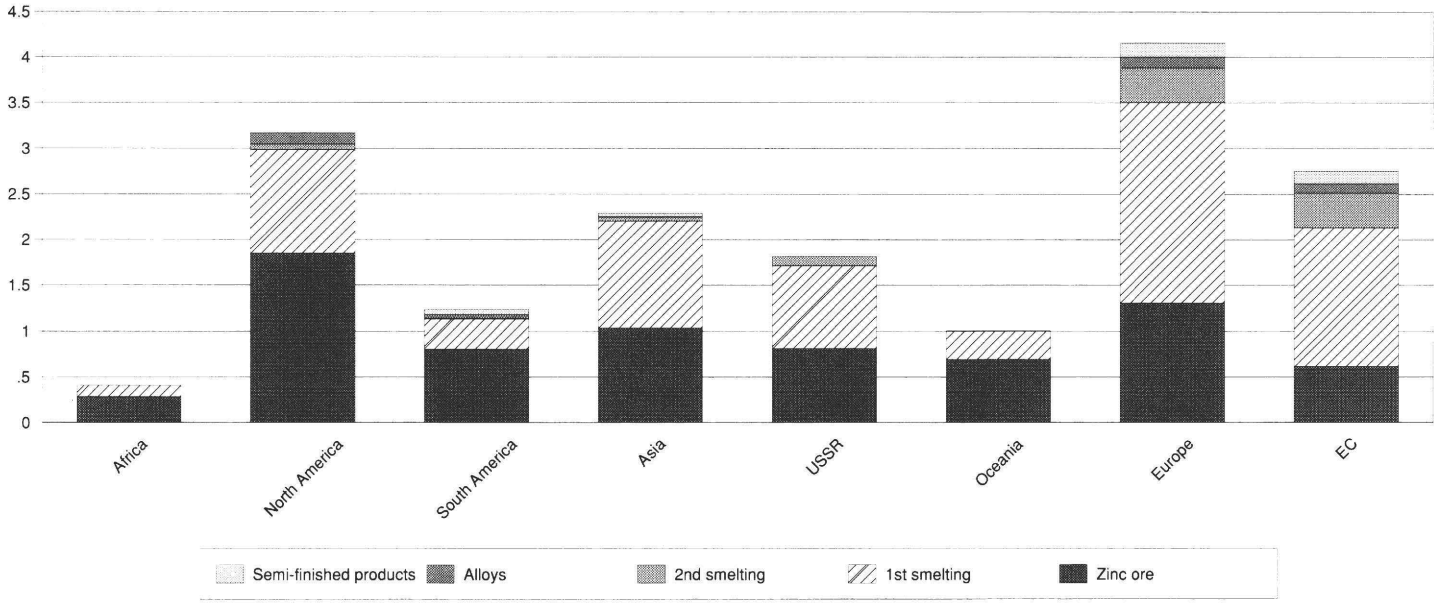
The EC is the world's leading producer of raw zinc (26% of world production in 1986). By adding its production to that of Japan and North America, the volume produced in the EC in 1989 represented 50% of this total.

The EC provides 13% of zinc mining production in the western world (9% of world production), and around 32% of the production of ingots (26% of world production). Within the EC, zinc production has increased by an average 2.5% a year since 1982, that is to say a growth rate virtually identical to that for consumption (2.4% a year on average). In 1989, zinc production fell throughout the Community (-1.2%), while consumption narrowly overtook its 1988 level (0.6%, i.e. 1.6 million tonnes). EC consumption of zinc raw metals represented around 30% of the West's consumption. It therefore comes as no surprise that the EC is a net exporter of zinc, exporting chiefly to traditional markets such as the United States.

Structure of the industry

Zinc production features high vertical integration; extraction, smelting and refining are generally taken care of by the same,

Figure 1
The world zinc market in 1986
(millions of metric tonnes)



Source: Industrial statistics (UN)

Table 2
EC production of ores and unwrought metal (1)

(thousand tonnes)	1982	1983	1984	1985	1986	1987	1988	1989
Mining production (2)	636	656	727	719	612	634	622	609
Ingot production	1 423	1 501	1 567	1 594	1 619	1 674	1 708	1 687

(1) Including Greenland up to 1985
(2) Zinc content
Source: Eurométaux

single firm, either directly or through subsidiaries.

Ireland and Greece are the only countries to carry out the first production stage (mining of the ore).

In the EC, 13 firms produce zinc ingots, 5 produce rolled products and 22 produce oxides. Table 4 shows the extent to which the largest foundries in Europe are integrated. Ten are part of the six biggest groups, which alone account for over 97% of zinc ingot production in the Community (around 1.7 tonnes in 1988).

The six groups are: Generale de Belgique (Belgium), Pasminco (Canada), Metaleurop (France), Mine Holdings (Canada, Federal Republic of Germany) Nuovo Samim (Italy), and Asturiana del Zinc (Spain). In North America, as in Japan, integration of zinc producers is less significant than in the EC. In the United States, the degree of vertical integration varies considerably from one company to another.

American factories are smaller than their European or Canadian counterparts.

In Canada, the foundries only offer alloy products intended for steel galvanisation in the iron and steel industry.

Many special alloys are also produced for the particular needs of customers.

No producer manufactures die-cast alloys or powder and dust at the foundry itself.

In Japan, the phenomenon of integration is more widespread than in North America. Six electrolytic plants in Japan produce die-cast alloys, which account for 20% to 50% of production.

These factories do not produce the full range of products. Made-to-measure zinc accounts for the larger part of production in most foundries and each factory manufactures a number of different products.

Company concentration, which is linked to vertical integration, is relatively strong.

In November 1988, French company Penarroya and the German firm Preussag merged to form a new entity: Metaleurop. Preussag AG owns 45% of shares in Metaleurop, Imetal has 24%, while the remainder were publicly distributed. The main production sites are in France, Italy, the Federal Republic of Germany and Spain.

This new group plays a dominant role in the production of lead, zinc and silver in the western world.

It also occupies a strategic position in the production of rare metals such as germanium and indium.

Consumption

Around 30% of the metal tonnage consumed in the western world is absorbed by the EC. The other industrialised countries, chiefly Japan and the United States, share the rest.

The processing and consumption of zinc, given the nature of its uses, are actually

Table 3
International comparisons
Production of zinc (1)

(thousand tonnes)	1982	1983	1984	1985	1986	1987	1988	1989
Belgique/België	228	263	271	271	269	284	298	287
BR Deutschland	334	356	356	367	371	378	356	354
España	190	198	212	216	202	224	245	246
France	244	249	259	247	257	249	274	266
Italia	158	156	167	210	230	247	242	246
Nederland	186	187	210	203	198	205	210	203
Portugal	4	4	6	6	6	6	6	5
United Kingdom	79	88	86	74	86	81	77	80
EC	1 423	1 501	1 567	1 594	1 619	1 674	1 708	1 687
USA	303	305	331	334	316	344	330	358
Canada	512	617	683	692	571	610	703	670
Japan	662	701	754	740	708	666	678	664

(1) Remelted zinc and zinc dust are excluded
Source: Eurométaux

Table 4
Zinc production capacities

	Marketable slab(1)			Products produced			
	Total Capacity	Total	(Galv. alloys)	Rolled zinc	Die-cast alloys	Oxides/ Powder	Semis
(thousand tonnes)							
Auby(F)	205	90	*	40	15	x	x
Balen(B)	180	*	*	x	*	*	*
Noyelles Godault(F)	105	75	40	x	15	*	*
Dattein(D)	135	80	*	40	15	x	*
Berzeilius(D)	90	80	20	x	x	x	x
Nordenham(D)	125	100	33	x	17	x	x
Overpelt(B)	120	*	x	x	*	*	*
Budel(NL)	210	170	*	15	*	*	*
Porto Vesme(I)	150	140	x	x	x	x	x
Crotone(I)	105	65	x	x	12	9	*
San Juan de Nieva(E)	215	140	15	x	18	13	x
Cartagena(E)	40	21	*	x	12	x	x
Avonmouth(UK)	100	85	x	x	x	x	x

(1)Total includes all grades_SHG,HG,GOB debased continuous galvanizing grade(GGA) and other galvanizing alloys.
(2)Semis include wrought products,battery callots and plating anodes.
* indicates production at the smelter.
x indicates no production.
Source : Eurométaux

closely tied to the level of development in the producer and consumer regions.

The main outlets for zinc products are galvanisation, brasses and alloys, which account for 45%, 21% and 15% respectively of world consumption.

The trend in growing demand can be explained particularly by:

- the world economic upturn in the 1980s (1984-85);
- the development of galvanisation (motor vehicle industry and construction sector);
- the boom in demand from the brass and alloy sectors.

Between 1982 and 1988, EC consumption grew on average by 2.4% a year; in 1989, the growth rate stood at slightly under 1%. This can be explained by the economic slowdown triggered after several years of strong growth; not forgetting that the sectors much further upstream in the production cycle always accentuate upward as well as downward movements.

Prices

Until 1964, the price of zinc was fixed in London (LME).

Thereafter, all contracts for the buying of ores were based on the basic price of zinc, which was known as the "producer price". This price was fixed in US dollars. On 31 December 1988, the producer price was again replaced by the LME quotation (SHG Zn). When calculated in 1989 constant dollars (current price deflated by the consumer price index), the evolution in the price of zinc is somewhat different. It actually remained relatively stable between 1964 and 1987, save for a short period (1973-77) during which prices rose. Since 1988, the price of zinc has gone up considerably (see Graph 2). In both current and constant prices, this sharp increase would seem to reflect the shortage on the market.

When calculated on the basis of the producer price, the actual selling price of the metal in the EC was influenced by the dollar exchange rate against the different monetary units in the Community and by the quotations on the London (non-ferrous) Metals Exchange (LME).

External trade

The EC is a net exporter of zinc, particularly to traditional markets such as the United States.

The situation as regards third countries may be summarised as follows. In the past, Japan, a major zinc consumer, managed to satisfy its own demand.

Today, it has to import, its production hav-

Table 5
EC Zinc Ingot consumption, 1982-89

(thousand tonnes)	1982	1983	1984	1985	1986	1987	1988	1989
Ingot consumption	1 338	1 423	1 453	1 424	1 475	1 498	1 572	1 582
% of Western world consumption	31.5	31.1	30.7	29.9	30.0	29.5	30.0	30.4

Source: Eurométaux

Table 6
International comparisons
Consumption of zinc (1)

(thousand tonnes)	1982	1983	1984	1985	1986	1987	1988	1989
Belgique/België	126	166	156	169	172	163	175	175
Danmark	10	9	10	12	15	10	12	12
BR Deutschland	368	405	425	410	434	452	450	453
Hellas	13	11	12	15	15	14	14	10
España	97	107	101	103	100	110	104	111
France	264	271	282	247	260	253	290	279
Ireland	1	2	1	1	1	1	2	2
Italia	202	208	210	218	232	245	254	262
Nederland	59	54	60	51	54	50	67	74
Portugal	16	9	11	9	10	12	10	11
United Kingdom	182	181	185	189	182	188	193	195
EC	1 338	1 423	1 453	1 424	1 475	1 498	1 572	1 582
USA	801	933	980	962	998	1 052	1 089	1 060
Canada	120	144	146	156	154	158	168	151
Japan	703	771	774	780	753	729	774	768

(1) Remelted zinc and zinc dust are excluded
Source: Eurométaux

ing fallen sharply at the beginning of the 1980s. South-East Asia and the countries of Latin America are taking on more and more importance in the international zinc trade. The industrialisation of these regions has given rise to increased production and demand.

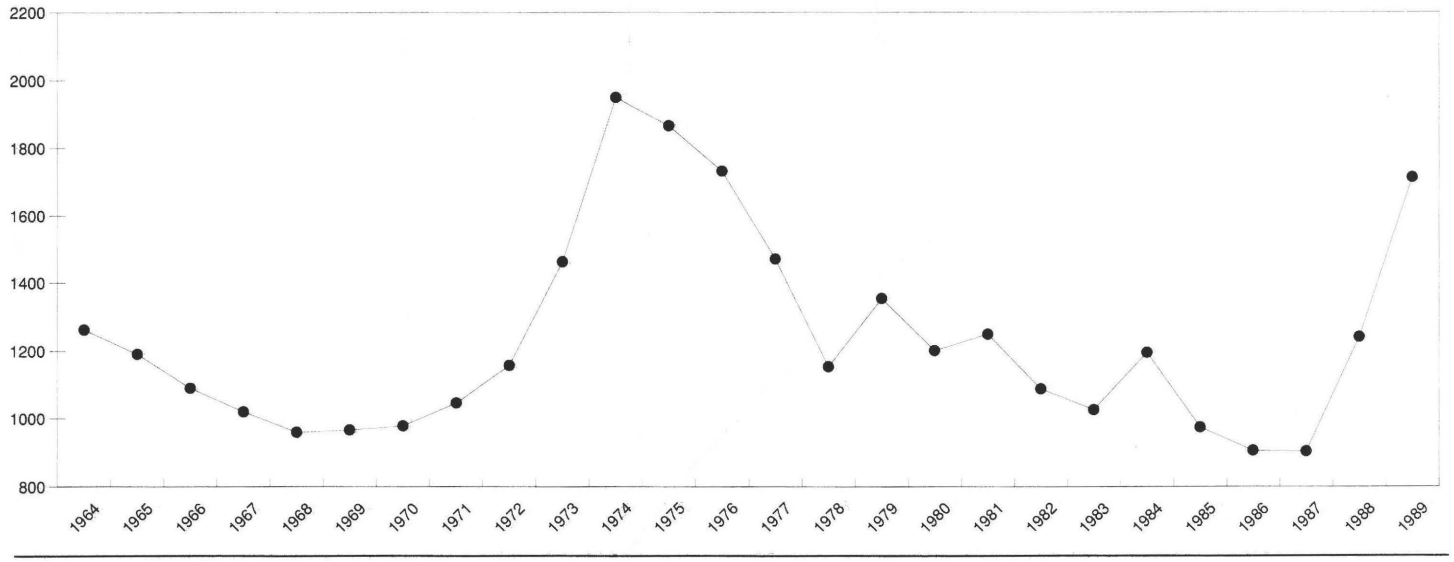
For the time being, African countries play a minor role, with demand for zinc remaining very low. Trade between the industrialised countries and countries with planned economies is founded on demand for quality products or on the foreign currency needs of the latter.

Trends in technology

Without a doubt, the industry's efforts are essentially aimed at optimising integrated lines of production. Most factories have a twin role; on the one hand, the production of zinc, and, on the other hand, the production of by-product metals linked to the recovery of different metals. These metals are significant, both in terms of quantity and quality.

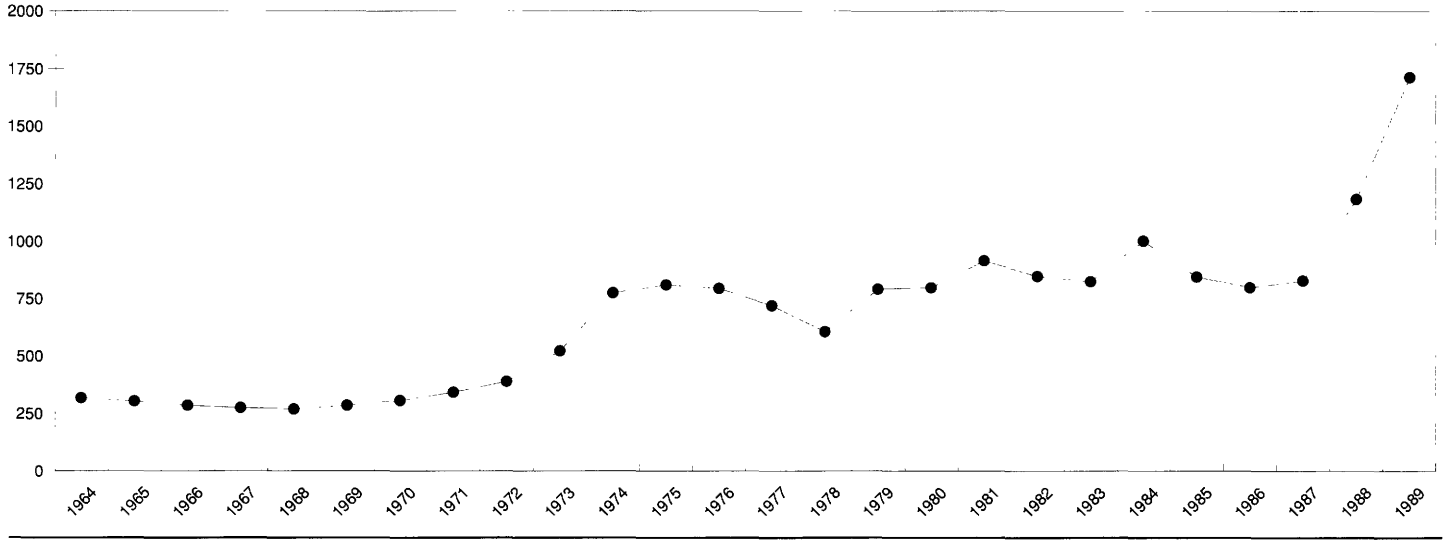
Account must also be taken of the fact that technological choices are founded in general on a number of factors, among which are demands on product quality, environmental aspects, recycling, energy consumption and the availability of the required energy sources. As far as product quality is concerned, the direct production of 99.995% pure zinc is only possible using the process of electrolysis. Consideration must also be given to the fact that zinc production consumes large amounts of

Figure 2
Price of zinc in 1989 $US



Source: Vieille Montagne

Figure 3
Price of zinc in current $US



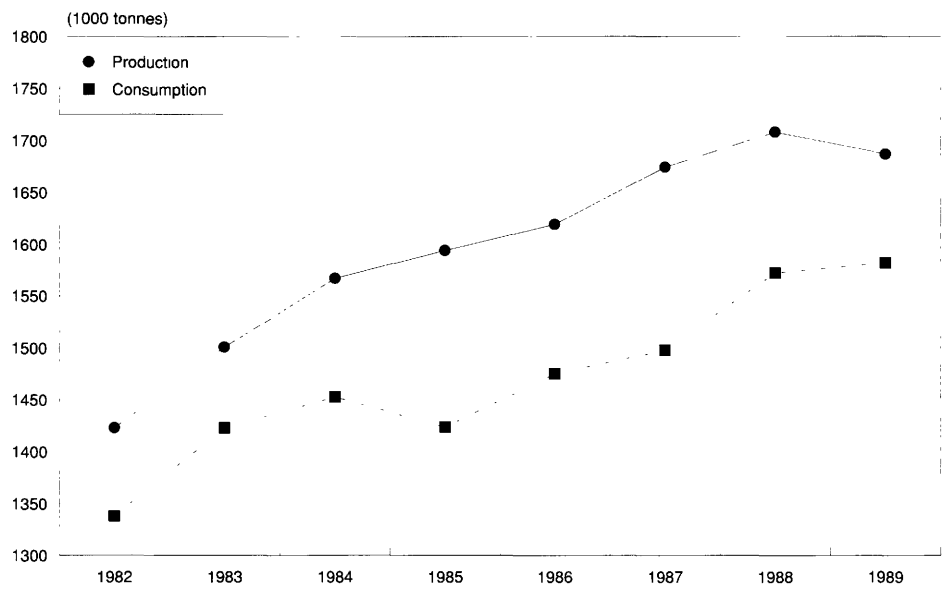
Source: Vieille Montagne

energy. This factor accounts for around 30% to 35% of the cost of production.

Environmental protection

The major problem with zinc production is that it contains cadmium, which is given off during processing and poses major risks to human health. This explains why liquid effluent from zinc production is the subject of several directives. In October 1983, the Council of the European Communities adopted a directive (83/513) setting maximum values and quality objectives for dumping cadmium in water. Another directive, which was adopted by the Council in 1986 (86/278), regulates the concentration of trace elements (zinc, cadmium, as well as other heavy metals) in the use of agricultural sewage sludge. The use of secondary zinc is still minimal and limited by technical factors. Scrap zinc which can be recycled comes from the construction and motor vehicle industries. Moreover, zinc processing requires high energy consumption, and the recovery and processing of residues makes it possible to make energy savings of over 60%. The industry is therefore endeavouring to develop waste recovery as much as it can. However, new coatings are being used increasingly in the construction sector and, as a result, there are diminishing quantities of zinc available for recovery.

Figure 4
Zinc production and consumption (1) in the EC



(1) With the exception of re-melted zinc and zinc dust
Source: Eurométaux

Outlook

At present, there is an unstable balance between production and consumption at world level. In Europe, however, there is a production surplus which is exported. Galvanisation, which is a boom area, relies exclusively on zinc.

From this, there is every reason to believe that the trend will remain favourable. In the future, it will nevertheless be crucial for industry in the Community to slowly adapt supply to demand.

In the medium term, predictions are for demand for zinc to grow by around 2% to 2.5% a year in the western world, which equals roughly 100 000 to 130 000 tonnes

of metal.

Increases in capacity, chiefly outside Europe, are under way and are expected to satisfy demand by 1994. For example, 1990 will see the bringing on line of the RED DOG site in Alaska. The very high cost of setting up new capacity is a factor that cannot be ignored.

Nevertheless, the predicted economic slowdown, which had already begun in 1990, including in the EC, will be felt first in those sectors furthest upstream in the production cycle.

A slowdown in demand for zinc cannot therefore be ruled out. The scale of any such slowdown will also depend on increases in the price of energy.

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Non-ferrous metals - Aluminium

In the course of the 1980's, the aluminium industry underwent major structural changes, mainly in the form of increased specialisation and a new international division of labour. The EC aluminium sector has a strong technological lead in terms of the production of both raw aluminium (primary and secondary smelter aluminium) and semi-finished goods. However, it has to contend with countries where production costs are highly competitive, thanks to the integration of bauxite-alumina-aluminium and the availability of domestic energy resources. The EC aluminium market has benefitted from a favourable economic climate, consumption levels having grown steadily in recent years. This recovery, on both the world and EC market, has even resulted in a bottleneck, leading to the reintroduction of certain capacities (particularly in the United States). High growth potential still exists in certain sectors such as packaging or car making and should help to further the growth of the aluminium industry within the EC.

Description of the sector

The EC aluminium industry covers mining production (bauxite), production of alumina, primary and secondary smelter aluminium (aluminium which has been recovered from waste and scrap materials) as well as the manufacture of semi-finished goods (alloys, bars, profiles, wire, sheet metal, foil, tubes and pipes).

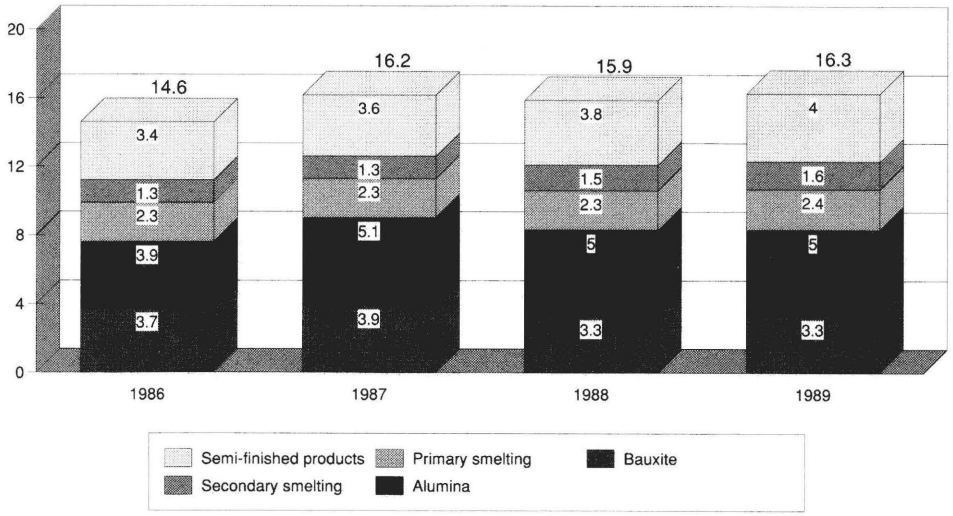
The aluminium industry is the largest and youngest of the non-ferrous metal industries, insofar as aluminium smelting only came into being a century ago.

Its numerous characteristics - lightness, longevity, resistance to corrosion, electrical and thermal conductivity, make it a popular choice in many sectors of the economy. Its aesthetic qualities, alloy possibilities and the fact that it can be easily recycled all add to its appeal.

Current situation

The aluminium market is a worldwide market so it is important to place the EC industry within this context. In 1989, EC bauxite production reached 3.3 million tonnes (3.5% of output for the Western world as a whole) while alumina production stood at 5 million tonnes (15%).

Figure 1
Aluminium
Industry structure by product in the EC



Source: European Aluminium Statistics, Eurométaux

Primary aluminium (2.4 million tonnes) accounts for 16% of the West's output while secondary aluminium (1.6 billion tonnes) accounts for 30%.

Output of semi-finished aluminium products increased to around 4 million tonnes, i.e. 25% of output for the Western world as a whole.

Although modest in terms of mining production, the EC aluminium industry becomes considerably more important the further one moves towards the manufacture of finished goods.

Production

Although primary aluminium already suffered from surplus production capacity before the first oil crisis in 1973, the ensuing increases in oil prices and world recession exacerbated the problem. Prices soared and demand for aluminium products collapsed.

In Japan, the crisis was particularly severe and 14 out of 15 electrolysis plants in operation at the beginning of the decade were closed. In 1980, Japan was the third-largest world producer of primary aluminium; by 1987, it was producing just 4% of the volume achieved in 1980.

In the United States (leading producer of primary aluminium), 22% of the production capacity installed in 1981 was dismantled.

EC producers also streamlined their electrolysis plants by closing small, unprofitable units. In the EC, the number of production sites has been reduced from 38 to 29 since the early 1980's. Measures aimed at cutting production costs have been adopted together with efforts to restructure, including diversification (new products for new applications), closer integration (recentred around semi-finished goods in Europe and the United States) and changes in production methods (computerisation and automation).

The fact that aluminium producers in the Western world increased their production capacity by a mere 1% from 1981 to 1988, even though demand for primary aluminium increased by 25% (approximately 3 million tonnes), shows the scale of the rationalisation efforts made. The dismantling of numerous production facilities at the beginning of the eighties however, resulted in a bottleneck once demand began to increase. In 1988, in spite of the reintroduction of all available capacities, world demand for primary aluminium outstripped supply throughout the entire year, greatly reducing stocks. Alongside the closure of plants in traditional producer countries, new plants were built in countries with ample supplies of bauxite and energy resources.

Waste recycling is continuing to grow, particularly in the traditional producer countries. Increased efforts are being made to develop higher-performance products and semi-finished products are now more widely used in the construction, car making and packaging sectors.

Structure of the industry

The markets for aluminium and its various products can be regarded as oligopolies

Table 1
Aluminium - Semis (1)
Main indicators, 1980-90

(thousand tonnes)	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990(2)
Apparent consumption	2 904	2 633	2 743	2 990	2 887	2 940	3 190	3 359	3 693	3 863	N/A
Net exports	171	235	263	289	328	331	213	220	160	106	N/A
Production	3 075	2 868	3 006	3 279	3 215	3 271	3 403	3 579	3 890	3 971	3 982

(1) 1981, excepted Greece
(2) Estimated
Source: Eurométaux

Table 2
Aluminium
Production, 1988-89

	Bauxite		Alumina		Primary aluminium		Secondary aluminium		Semis	
(thousand tonnes)	1988	1989	1988	1989	1988	1989	1988	1989	1988	1989
EC	3 531	3 308	5 412	5 179	2 312	2 372	1 543	1 599	3 890	3 971
Belgique/België,Luxembourg	0	0	0	0	0	0	0	0	347	355
Danmark	0	0	0	0	0	0	0	0	17	18
BR Deutschland	0	0	1 563	1 374	744	742	530	537	1 305	1 328
Hellas	2 533	2 576	533	533	149	148	6	7	105	102
España	3	0	881	919	294	353	85	78	261	269
France	978	720	737	624	328	335	225	233	656	675
Ireland	0	0	879	891	0	0	0	0	2	3
Italia	17	12	705	722	226	220	378	390	587	610
Nederland	0	0	0	0	271	277	116	130	146	142
Portugal	0	0	0	0	0	0	3	4	35	36
United Kingdom	0	0	114	116	300	297	200	220	429	433

Source: Eurométaux

where production capacity is concentrated in the hands of a few large transnational companies, according to a pattern of vertical integration which extends from bauxite extraction to the production and sale of finished and semi-finished goods. Seven companies account for around 44% of the total smelting capacity and 50% of the capacity of developed countries with a market economy. Their market share has declined in recent years and will no doubt continue to do so even though such firms, having diversified into every area of the aluminum industry, will continue to play an important role on the world market. The firms in question are: ALCOA (United States), Alcan (Canada), VIAG (Germany), Reynolds Metals (United States), Alusuisse (Switzerland), Amax (United States) and Kaiser Tech (United States).

The main components in production costs are alumina, electricity and plant costs. As a result, regional differences in terms of natural resources (bauxite and energy resources), government policies on electricity prices and investments made (particularly the new installations in Canada, Western Asia, Latin America and the Gulf) have given rise to specialisation and the redistribution of production co-operatives. Within this context, one should note the important role played by secondary aluminium. Production of secondary aluminium requires only 5% of the energy required by the primary aluminium industry. In future, energy costs and the price of alumina will be heavily influenced by market trends.

At present, it takes approximately 16 Kwh of electricity to produce one kilogram of aluminium using electrolysis. The deregulation of the energy markets will serve to reinforce the links between electricity and gas networks, far beyond national borders. The result will probably be an increase in trade and more intensive and hence more efficient use of production facilities. More transparent pricing should further encourage the harmonisation of energy prices within the EC, with possible repercussions on primary aluminium production costs. Following the two oil crises, the large transnational companies revised their strategies. Foundries producing primary aluminium were closed in countries where energy prices were too high and switched instead to semi-finished goods. Restructuring is still going on and new companies have been set up via mergers and take-overs. HYDRO Aluminium for example, was the outcome of a merger between ASV (Ardal og Sunnal Verka.s.) and the aluminium division of Norsk Hydro, a leading Norwegian firm. Founded in 1986, HYDRO Aluminium is now the leading producer of primary aluminium in Western Europe and the eighth-largest producer worldwide. The French company Péchiney has also focused its attention on its downstream activities. The purchase of ANC

Table 3
Primary aluminium production
Ranking of main world producers, 1989

(thousand tonnes)	Production
U.S.A.	4 030
EC	2 015
Canada	1 555
Australia	1 241
EFTA	1 209
Brasil	888
Norway	859
Germany	743
China	700
Venezuela	546
India	422
Spain	352
France	335
United Kingdom	297
Japan	35

Source: World Bureau of Metal Statistics

Table 4
Aluminium
Per capita consumption

(kilogrammes)	1975	1989
Belgique/België	7.5	7.4
Danmark	8.2	13.1
BR Deutschland	14.6	25.3
Hellas	4.4	7.7
España	6.6	9.0
France	9.2	17.5
Ireland	3.4	7.7
Italia	7.5	20.4
Nederland	8.6	17.5
Portugal	1.1	5.7
United Kingdom	9.8	10.7
EC	9.2	16.1
Europe	9.3	16.0
USA	19.2	25.7
Japan	13.1	27.4

Source: Eurométaux

Cans (American National Can, United States) has enabled Péchiney to become the leading packaging manufacturer and to corner over 25% of the US can market.

Consumption

Total consumption of aluminium

Total consumption of raw aluminium amounted to 20.2 million tonnes in the Western world in 1989. Europe, of which the EC accounts for 86%, ranked second with 5.2 million tonnes, behind the USA (6.9 million tonnes).

From 1972 to 1989, Western consumption grew at an average rate of 3.3% per year. This growth was much lower than that recorded for the period 1960 to 1972 (roughly 10% per year). From 1972 to 1989, the average annual growth rate of aluminium consumption within the EC was virtually equal to that of the Western world as a whole (2.9%).

While at a world level, consumption per capita varies considerably from one country to the next, from 25 kg in the most industrialised countries to 1.5 kg in other regions, disparities can also be found among the industrialised nations. In the EC, average consumption per capita was 16.1 kg in 1989, i.e. a much lower level than that of the United States (25.7 kg) or Japan (27.4 kg). A similar pattern exists in terms of sectors.

Consumption by sector In the OECD countries, three industrial outlets are responsible for over 60% of aluminium consumption: transport, construction and packaging. The pattern and degree of consumption vary markedly from one sector to another depending on the region. EC consumption per capita in the construction and transport sectors (4 to 5 kg) is less than that of the United States and Japan (5 to 8 kg). In the packaging sector it is 8 kg in the United States and less than 2 kg in Europe and Japan. This has to do with the differences which exist in terms of industrial structure, production methods, as well as other factors such as climatic variations.

In the industrialised countries, the packaging sector witnessed the highest rate of growth over the past ten years (up 5%), particularly in the United States where it is the main consumer of aluminium. In Japan, on the other hand, consumption of aluminium is concentrated in the car making industry and the construction sector.

In the European Community, the transport industry, particularly car making, is the number one consumer of aluminium (30% in 1988). Whereas the construction sector tends to be the main user in Spain and the United Kingdom. However, certain other countries have been slow to adopt new construction materials. Finally, the drinks can industry has not yet acquired major importance in the EC. The recent success of aluminium drinks cans has been facilitated by the development and use of recycling methods based on an impressive cost-effectiveness ratio as well as technological progress and developments in terms of design, which have enabled manufacturers to greatly reduce the weight of aluminium cans. In West Germany, for example, only 15% of cans are made from aluminium while tin is still the most popular material in Belgium, France, Spain and the Netherlands. Quite apart from any diversification in terms of marketing, these differences also stem from the degree of sophistication of the collection system. Recycling plays a crucial role because aluminium has a higher unit value than that of steel or tin.

Table 5
Aluminium
Consumption by sector in the EC, 1989

(thousands tonnes)	Consumption	%
Transportation	1 605	30.6
General engineering	420	8
Eletrical engineering	430	8.2
Building and construction	1 170	22.3
Chemical, food and agricult. appliances	63	1.2
Packaging	598	11.4
Domestic and office equipment	325	6.2
Powder and paste	21	0.4
Metallurgy and iron and steel industry	225	4.3
Various	388	7.4
Total	5 245	100

Source: Eurométaux

Consumption of secondary aluminium

Over the past ten years, secondary aluminium has grown at a faster rate in Western countries than primary alumi-

Table 6
Aluminium
Semis in the EC, 1987

(thousand tonnes)	Production	Consumption	Exports	Imports
EC	3 970	3 832	488	380
Intra-EC trade			1 120	1 092
Belgique/België, Luxembourg	355	140	313	98
Danmark	18	58	16	56
BR Deutschland	1 328	1 264	490	436
Hellas	102	78	32	8
España	269	255	50	36
France	675	585	310	219
Ireland	2	28	2	28
Italia	610	638	130	159
Nederland	142	150	128	137
Portugal	36	47	8	19
United Kingdom	433	589	129	286

Source: Eurométaux

nium. Whereas the proportion in relation to total aluminium consumption fluctuated between 16% and 19% since 1960, it increased to over 20% in 1979 and has grown constantly ever since, reaching 28% in 1989. Within the EC, secondary aluminium has expanded at a slower rate than in the United States and Japan. Over the past fifteen years, output of aluminium increased by a mere 2.6% per year in Europe compared with 5.6% per year in Japan. Over the same period, aluminium recovery in the United States grew by 4% per year.

Consumption of primary aluminium

Consumption of primary aluminium in Western countries grew at a rate of 2.1% per year between 1972 and 1989. Within the EC, primary aluminium grew at a slightly higher rate (2.4%). Between 1984 and 1989, consumption gathered pace (3.4% per year) to reach 3.9 million tonnes in 1989, putting the EC in second place behind the United States (4.3% per year). Consumption levels in the developing countries have increased at a much faster rate than in the industrialised countries in spite of the fact that the latter are still the main users of aluminium.

External trade

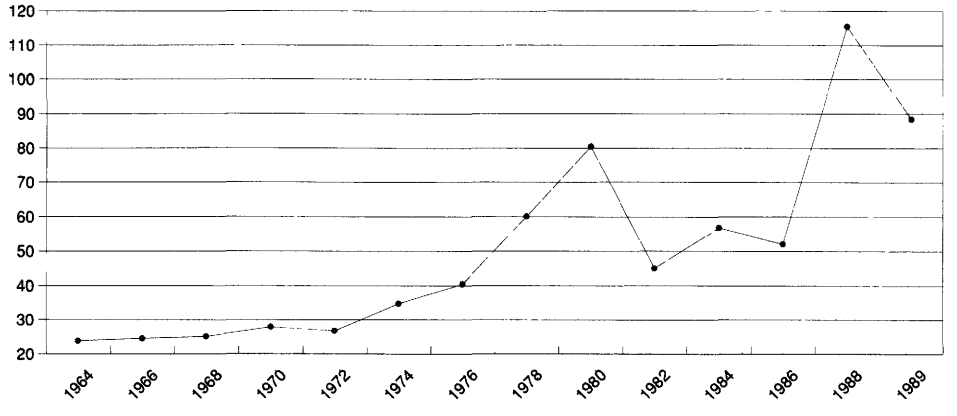
The upheavals which have occurred in the production of primary aluminium, as a result of restructuring in the Western world, have helped to stimulate trade between producer and consumer countries. On the one hand, regions with a low level of local consumption have become major net exporters; within the space of ten years (1978-1988) Latin America and Oceania realised around one million tonnes' worth of export potential. On the other hand, regions with high levels of local consumption are now running large trade deficits. In the EC, the growth in consumption of primary aluminium, coupled with the fall-off in production, has led to a decline in the rate of cover by local production (61% in 1988, as against 73% in 1984). Intra-EC trade in primary aluminium grew during the eighties, exceeding the one million tonne mark in 1986 and in 1989 accounted for around 45% of EC output. In 1989, 63% of the extra EC imports came from EFTA countries (mainly Norway) and Africa (15%). This industry is also affected by fluctuations in the US dollar. Since primary aluminium is priced in dollars, EC producers are particularly vulnerable as regards any drop in the American currency. The European Community is a net exporter of semi-finished goods: the trade surplus in semi-finished goods reached 110 million tonnes in 1989. Following a marked rise which lasted until 1985, the EC's net exports to the United States were halved in 1988 compared with 1985. This reversal shows to what extent the aluminium processing industry is susceptible to any drop in the US$-ECU parity. In terms of volume, intra-EC trade in semi-finished goods is equivalent to that of primary metal. In 1987, the latter also exceeded the one million tonne mark, i.e. 28% of EC output.

Research and development

The aluminium industry has made significant efforts to reinforce its competitiveness and constantly improve the quality of the products and techniques offered to its clients. Aluminium products tend to incorporate increasingly sophisticated knowledge, developed in close collaboration with users.

Among the most notable forms of technological progress, have been the development of new alloys (aluminium-lithium) and the mastery of new techniques (continuous strip casting, electromagnetic casting of plates and billets). Every sector which uses aluminium has been affected by the technological developments undertaken by the aluminium industry. In the transport sector, the latest innovations have tended to focus on hi-tech applications (particularly in aeronautics, aerospace) and combinations with other products in the form of composites. In the packaging sector, efforts aimed at improving productivity have met with success (thin strips and cans) and original solutions using other materials (plastics and

Figure 2
Aluminium prices
(US cents per pound)



Source: DRI Europe

paper) are increasingly widely used. In the electronics sector, value-added materials are opening up the prospect of new markets (high-grade aluminium).

Finally, the recycling of aluminium represents a vital asset for the future insofar as it meets the ever more pressing need to protect the environment.

Outlook

Over the past few years, consumption of aluminium within the EC has grown at a faster rate than that of economic activity as a whole. This applies to consumption of both semi-finished aluminium goods and primary aluminium. In comparison with the United States in particular, but also Japan, the overall sectoral disparity in terms of aluminium consumption per capita within the EC indicates that there is potential for increased consumption within the European Community, particularly in the packaging sector.

Supply was unable to keep up with demand in 1988 and, less noticeably, in 1989, leading to a drastic reduction in raw aluminium stocks. According to some experts, this bottleneck will persist within the EC in spite of the completion of a series of new projects. Consumption should grow even more over the next few years and there is very little slack in terms of utilisation of capacities.

Although the aluminium industry has numerous applications and hence numerous outlets and although the outlook is encouraging, the saturation of capacities suggests that output of primary aluminium will grow at a slower rate in 1990 (1.5%). Surplus consumption will therefore have to be met by imports. Demand for and hence production of semi-finished goods will tend to follow the general economic trend. In any event, and in keeping with the structural developments already under way, production of secondary aluminium will grow at a faster rate.

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Revised by: DRI Europe

The European Community is a world leader in the refining and processing of precious metals, even though its mineral resources of such metals are extremely limited. The consumption of gold and silver is dependent on jewellery fashion and investment demand for both bars and coins. Industrial demand for gold and silver is relatively stable.The consumption of platinum group metals in Europe will rise significantly as the new EC standards for automobile emission control come into effect.

Description of the sector

The precious metals are:

- gold;
- silver;
- the platinum group metals: platinum, palladium, rhodium, iridium, ruthenium and osmium.

Precious metal activities can be grouped under five headings:

- mining;
- refining - the treatment of both primary and secondary precious metal materials;
- trading - dealing in the unwrought metal on a commodity basis;
- fabricating - processing, alloying and converting precious metals into wrought semi-manufactured goods, industrial components, chemical compounds and other such products;
- manufacturing - producing items for sale at retail level, e.g. jewellery, silverware.

Production and consumption

Production EC mineral resources of precious metals are extremely limited. Indeed, in the whole of Western Europe there are only 9 primary precious metals mines, compared with over 80 each in the USA and Australia and over 50 each in Canada and South Africa.

GOLD Gold mining still accounts for the largest share of total gold supply in the Western world, the other sources of supply being old scrap used for recycling. Central banks have also largely contributed to the increased supply of gold on the Western market, by selling large quantities of gold since 1984.

EC mine production of gold is currently under 10 tonnes, out of an annual Western world production of some 1650 tonnes. In addition, more than 20 tonnes of fine gold is recovered each year from in the EC, from jewellery and electronics scrap and the melting down of dishoarded coins. The two EC countries which account for the largest share of gold mining are Spain (with 5.7 tonnes of gold in 1988), and France (2.5 tonnes, representing the gold content of mattes or calciner produced from domestic ores). Gold mining production in the Western

world slowed considerably in 1989, following the rapid rates of growth experienced in previous years. No expansion of gold mining is expected over the coming years.

SILVER Some 60 countries produce primary silver, mostly as a by-product of base metal mining. Indeed, at the world level, around two thirds of primary silver is produced as a by-product of ore extraction in the production of non-ferrous metals and gold. This has two major consequences on silver supply: firstly, the supply of primary silver thus tends to be linked to the rate of growth of gold and other non-ferrous metals' mining, which boomed in the eighties. Secondly, silver production as a by-product of non-ferrous metals mining is relatively insensitive to price fluctuations, contrary to the situation for the other precious metals. EC mines yield under 400 tonnes per annum, or about 3.5% of annual world production of around 11 000 tonnes. A further 3 000 tonnes per annum comes from worldwide secondary sources, mainly scrap recovery.

OTHER PRECIOUS METALS There are currently no mineral sources of any significance in the EC for the six platinum group metals. These can be found principally in South Africa and the USSR. Platinum availability is now some 100 tonnes per annum, including USSR sales to the West. Palladium availability is also around 100 tonnes per annum but the portion sourced from the USSR is significantly higher. The other four platinum group metals - rhodium, irridium, ruthenium, and osmium - are produced in much smaller quantities.

Refining

The total precious metals refining capacity of the EC countries approaches that of major primary producing countries such as South Africa and the USSR. Refiners include both specialist precious metal firms and base metal refineries capable of both recovering precious metals as a by-product of their main activities in copper, lead, zinc, etc., and of smelting and treating precious metal scrap and ores.

All the major EC refiners are able to treat gold and silver as well as platinum and palladium, and most of them can process other platinum group metals as well.

Trading

While the number of companies actually refining or fabricating precious metals is comparatively limited, many more are involved in dealing in such metals, either as commodities in unwrought forms such as ingots, or as investment products, e.g special bars and coins. Banks, commodity traders and brokers may all deal in precious metals, particularly gold and silver, but they do not usually have any production facilities themselves and rely on the refiner-fabricators to convert the precious metals into whatever other form they may require, e.g. gold of higher purity, bars of a different weight, etc.

Such dealers trade largely in paper, with non-physical transactions on the commodity markets in London, New York or Zurich.

Refiners and fabricators are also active in such markets, both buying and selling metals to meet their customers' needs and carrying out hedging transactions in order to fix prices and protect themselves from losses due to fluctuating precious metal prices.

Fabrication Precious metal fabrication activities employ over 20 000 people in Europe, compared with a figure of around 10 000 in the USA, and several thousand in Japan. Such figures exclude base metal regineries also treating precious metals.

The EC precious metal fabricators are among the leaders in the production of precious metal materials for advanced technology fields. Another part of their business is the manufacture to close tolerances of wire, sheet and tube in carat golds and silver alloys for goldsmiths, silversmiths and manufacturing jewellers. In practice, the larger jewellery firms in the EC are tending to integrate upstream, making their own alloys and semis.

More complicated products, such as complex chemical salts and catalysts, woven catalyst gauzes and electrical contact parts, are also produced by the EC fabricators. Elsewhere, they often have to be imported from fabricators who have the production skills to produce what is required, and to a large extent it is EC firms which provide these services for Third World countries, where there is no local or regional manufacture.

Closely linked with the fabrication business is scrap recovery or recycling of precious metals. Such reworking business, using the customer's scrap metal, is an important activity of the precious metals fabrication industry, particularly in the case of the platinum-group metals.

Old scrap can indeed account for a significant share of the total supply of precious metals, especially when prices fall below most mines' profitability threshold.

Total world supply of gold scrap for instance amounted to 303.6 tonnes in 1989 (including internal recycling), or 18.4% of total mining production in the Western world. Supply of gold scrap in the EC amounted to 23.9 tonnes in 1989, less

Table 1
Precious metals
Community gold fabrication by country, 1980-89

(tonnes)	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
EC	284	341.1	373	312.3	355.2	416.9	399.8	411.6	474	570
Belgique/België, Luxembourg	3.5	2.6	2.6	2.3	2.2	2.3	2.0	16.2	12.2	8.0
Danmark	0.4	0.4	0.8	0.7	0.8	0.8	0.8	0.8	0.8	0.8
BR Deutschland	74.8	67.1	65.6	61.4	61.2	62.3	59.5	62.5	77.1	77.6
Hellas	4.7	6.2	7.0	8.0	9.2	10.6	9.1	8.3	8.4	8.7
España	19.3	18.3	17.1	14.6	13.8	16.7	16.7	18.1	25.2	33.6
France	23.7	22.6	25.7	24.0	22.6	23.4	26.0	26.7	28.8	32.1
United Kingdom and Ireland	37.4	35.4	33.1	24.0	25.1	30.7	30.4	37.9	38.9	40.6
Italia	114.9	181.9	214.2	170.3	213.6	261.6	246.9	232.8	273.7	358.8
Nederland	3.1	4.0	3.8	3.7	4.2	4.9	4.8	4.2	4.4	4.5
Portugal	2.2	2.6	3.1	3.3	2.5	3.6	3.6	4.1	4.5	5.3

Source: Gold 1990, Gold Fields Mineral Services Ltd

than 10% of the world total. Gold scrap may be either processed through a refining operation to bullion indistinguishable from primary gold, or remelted and brought back to title (i.e. to the correct caratage through the addition of a small amount of new gold.)

The supply of precious metals' scrap to secondary refiners may currently appear more stable than the primary sources from the mines but it is in fact sensitive to the movements in precious metal prices.

GOLD FABRICATION In 1989, fabrication of gold (including the use of scrap) reached a new world record, rising by 18% from the previous record level in 1988. The EC, and more specifically Italy, largely contributed to this overall performance, with output rising by more than 20% for the EC as a whole, and by more than 31% in Italy.

Within the EC, Italy is indeed by far the largest gold fabricating country, accounting for 63% of the total EC production. Ninety six percent of this represents gold fabrication in carat jewellery, compared to an EC average of 87%, and a world average of 82%. Italy is also the world leader in gold fabrication, with production of 358.8 tonnes in 1989, way ahead of the world's second largest fabricating country, India (222.3 tonnes). The second largest EC growth fabricator is the Federal Republic of Germany, with output of 77.6 tonnes (see table 1). After a buoyant year, the deceleration of consumer spending at the end of 1989 and in the beginning of 1990 caused a slow-down in gold fabrication.

Trade Given its large share of total world gold fabrication in carat jewellery, Italy is also the EC's largest exporter of jewellery made from gold. In 1989, Italian gold jewellery exports for instance amounted to 200 tonnes, a 23% increase over 1988. Forty percent of the total Italian exports go to the US market. However, despite heavy investments to boost capacity and productivity in 1989, the Italian gold fabricating industry is faced with capacity constraints, and may thus not be able to accompany a further strong market growth. Germany's traditional export markets are Switzerland (which uses gold among others in watch fabrication) and Austria. Although the EC is a net importer of raw materials, it is a large exporter of "finished" products using these raw materials as their main inputs, such as jewellery, watches, or electronic products.

The overall net contribution of the precious metals' sector to the EC's trade balance must therefore be assessed by considering not only the net trade balance of the sector itself, but also the surplus on the trade balance for jewellery made from gold, luxury watches, and all other products using gold and other precious metals as an input.

Similarly, the contribution of the sector to the total EC employment is in itself of little relevance, given that it generates much more employment downstream, in jewellery fabrication in particular. The jewellery sector is however covered in more detail in another chapter of the Panorama.

Consumption Precious metals consumption within the EC countries varies from year to year, depending on industrial demand, jewellery fashions and the markets for coins and other minted products in gold, silver and platinum.

Roughly just over a quarter of world precious metals consumption takes place in the EC countries, and this is now showing a rising trend.

Examples of the main sector where precious metals are used are:

Gold:

- jewellery and watchcases (73%);
- electrical and electronics industries (9%);

Table 2
Estimated consumption of precious metals, 1989

(tonnes)	Gold	Silver	Platinum	Palladium
EC	570	4 100	18	18
Western World	2 200	13 600	107	103
EC as % of Western World	26	30	17	17

Source: Eurométaux

- ❖ dental alloys (3%);
- ❖ surface coatings - electroplating, porcelain and glass decoration, rolled gold spectacle frames (5%).

Silver:

- ❖ photographic films and plates (50%);
- ❖ electrical and electronics industries (26%);
- ❖ jewellery and silverware (11%);
- ❖ miscellaneous (13%).

Platinum:

- ❖ car exhaust catalysts (45%);
- ❖ catalysts for the chemical and oil industries, and other usage by the glass and electrical industry (16%);
- ❖ jewellery and watchcases (39%).

Palladium:

- ❖ dental alloys (29%);
- ❖ electrical and electronics industries (49%);
- ❖ jewellery alloys (15%);
- ❖ automotive catalysts (7%).

DEMAND FOR GOLD Only in the case of gold is jewellery the major use. In 1989, within the EC, almost 500 tonnes of fine gold was fabricated as fine jewellery - mainly in Italy. Much of this Italian jewellery was then exported to markets outside the EC.

Gold's electrical conductivity, its ductility and total freedom from oxidation and tarnishing also make it a much appreciated input in various applications by the electronics industry.

The two major uses of gold in electronics are in plating the contacts of a vast array of switches, relays and connectors, and in making reliable connections between different parts of the device in semi-conductors and printed-circuit boards. Furthermore, given that the more sophisticated the product, the higher the need for reliability, the greatest use of gold is in telecommunications, business equipment and computers and defense systems.

The use of gold by the electronics industry is likely to grow in line with the output of the sector itself, as there are little prospects for a further reduction of gold usage by this sector. The amount of gold used in dentistry is falling rapidly, and is currently only half of that used in the early eighties. Cheaper palladium-based alloys have been the major substitute to gold in dental work.

Competition from cheap, light-weight carat jewellery from the Far East is increasing on the costume jewellery market, which, combined with a general tendency towards thinner plating layers and substitution of gold leaf by anodised aluminium, should keep the rate of growth for gold demand for "other applications" in check.

DEMAND FOR SILVER Demand for silver in the EC has been rising in recent years at an average of over 5% per annum. Nearly half of this increased demand has come from the jewellery and silverware sectors. Photographic uses however remain by far the largest source of demand. Silver nitrate is in fact a major input for the manufacture of light-sensitive emulsions for coating film and paper. And, as new devel-

Table 3
Precious metals
Platinum demand by region and application, 1980-89

(kilogrammes)	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Western World Total	72 815	75 940	72 505	68 125	82 190	88 025	88 330	102 330	112 595	106 530
North America	30 625	21 875	22 190	22 500	28 440	31 415	37 015	27 995	26 905	27 840
Japan	29 375	35 940	32 815	29 690	35 625	38 880	31 415	51 320	59 095	51 785
EC and rest of western world	12 815	18 125	17 500	15 935	18 125	17 730	19 900	23 015	26 595	26 905
of which:										
Autocatalyst	940	625	625	780	1 095	2 175	4 355	7 930	9 485	11 665
Chemical	4 220	5 940	5 315	4 220	4 530	4 200	3 575	3 890	2 800	2 800
Electrical	1 565	3 125	2 500	2 030	2 030	2 490	2 175	2 175	2 335	2 175
Glass	1 565	940	940	940	1 095	1 245	1 090	1 555	1 865	2 175
Investment	0	0	155	1 405	3 905	2 955	3 575	2 175	4 045	1 245
Jewellery	3 280	3 595	4 065	4 375	4 220	3 730	2 955	2 335	3 265	4 200
Petroleum	- 780	2 190	940	- 315	- 625	- 310	310	1 245	1 090	1 090
Other	2 030	1 720	2 970	2 500	1 875	1 245	1 865	1 710	1 710	1 555

(1) Figures are net sales. This explains why there can be some negative values.
Source: Platinum 1990,Johnson Matthey

opments in photographic technology have led to price reduction for quality cameras which are now produced in series, photography has gained in popularity in the industrialised countries. Continued strong market growth is expected in the coming years, as a result of rising demand for photographic films and equipment from both the industrialised nations and the developing countries, even though the industry will continue to seek economies in the case of silver, particularly for radiography products.

DEMAND FOR PLATINUM Although platinum jewellery is now growing in popularity in some EC countries -in 1989, more than one tonne of platinum was sold in Germany as jewellery, demand remains small in comparison with Japan, whose jewellery manufacturers took 35 tonnes of platinum. The largest use for platinum worldwide is now in the catalytic convertors fitted to motor vehicles to cut exhaust pollution in North America, Japan and, to a rapidly growing extent, Europe.

DEMAND FOR PALLADIUM Electronic applications account for approximately half of the total industrial consumption of palladium, so that the sector's growth is strongly linked to the performance of the European electronics industry. Also, as mentioned above, palladium has become an important substitute to gold in the dental sector, thanks to its lower price. This sector nowadays accounts for approximately 30% of the total demand for palladium.

Palladium is less used in automotive catalysts than platinum, due to its sensitivity to the residual lead content which remains even in "lead-free" gasoline. Car catalysts nevertheless still account for 7% of the total demand for palladium.

Table 4
Precious metals
Palladium demand by region and application, 1985-89

(kilogrammes)	1985	1986	1987	1988	1989
Western World Total	85 225	90 510	99 065	103 420	102 950
North America	29 240	30 015	32 190	31 725	32 660
Japan	33 590	38 255	44 480	47 745	47 120
EC and rest of western world	22 395	22 240	22 395	23 950	23 170
of which:					
Autocatalyst	0	465	620	310	465
Dental	8 090	8 400	8 555	9 490	9 020
Electrical	6 220	7 465	7 930	8 710	8 245
Jewellery	4 355	2 800	2 335	2 020	2 020
Other	3 730	3 110	2 955	3 420	3 420

Source: Platinum 1990, Johnson Matthey

Prices Figure 1 summarises the trends in price of the various precious metals considered here.

During 1989, and in the first half of 1990, precious metals prices have been edging downwards, against a background of stronger economic growth in the OECD area, a clear commitment of central banks to prevent a rise in inflation and keep exchange rates stable, much improved East-West relationships, and increase sales by the USSR due to the need to earn more foreign currency.

Silver prices largely followed the trend in gold prices during 1989, except during some brief periods of speculative interest in silver. The fall in silver prices was accentuated by high mining production and visibly high inventory levels.

Platinum prices, shown on figure 1, developed more independently from gold, however reflecting changing perceptions of demand/supply conditions, rather than the metals' attractiveness from an investment point of view. The announcement of the EC decision to introduce the US exhaust has emission standards for passenger vehicles below a cubic capacity of 1.41 however hardly affected platinum prices.

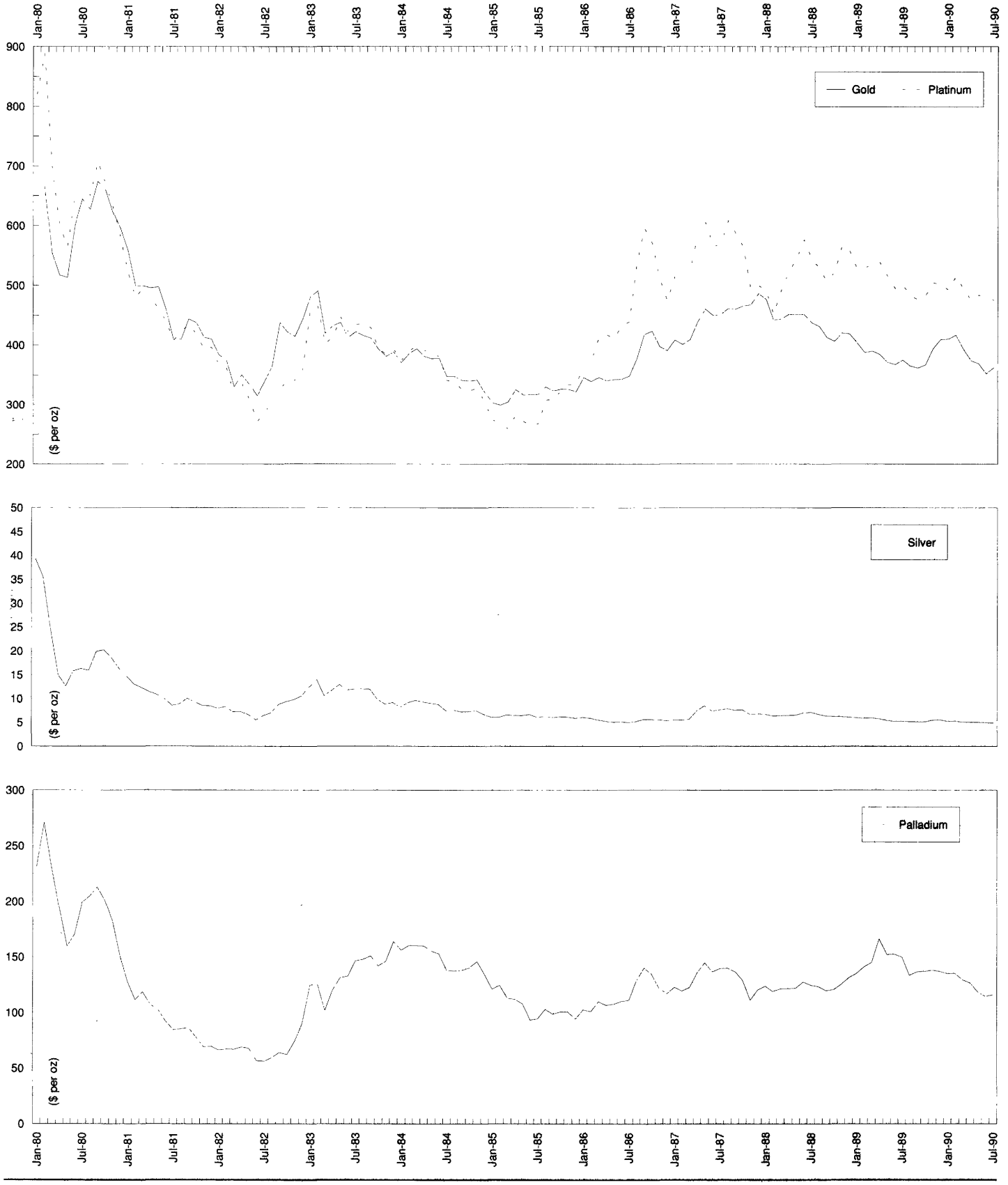
Palladium prices were however more sensitive to the announcement, and rose more or less continuously with the exception of a speculative up then downturn following the announcement in the US of a newly discovered nuclear fusion process ("cold" fusion), using palladium. Doubts about the validity of the test however led to a sharp fall in palladium prices during the second part of 1989, but the price still ended the year about 13% higher than a year earlier.

Situation in the rest of the world

In the Western World, the principal precious metal mines are situated in the Republic of South Africa, Canada, the USA, Mexico, South America and Australia. In addition, the USSR and People's Republic of China are major suppliers or potential sources, whose mineral reserves are less well documented.

However, in the past both the primary refining processes for precious metal ores and the secondary ones for all different sorts of scrap materials have largely been developed by companies based in Europe. For instance, many of the processes used in the South African platinum group metal refining industry originate from the UK, where the entire production used to be

Figure 1
Precious metals
Monthly average USD prices of gold, platinum, silver and palladium
January 1980 - July 1990



Gold: London spot price
Platinum: New York estimated spot price
Silver: London spot price
Palladium: New York estimated spot price
Source: DRI Europe

Table 5
Precious metals
Geographical location of the main EC refiner/fabricator companies

Company Head Office	Johnson Matthey England	CLAL France	Degussa Germany	Doduco Germany	Heraeus Germany	Metalor Switzerland	Engelhard USA
	UK	F	D	D	D	CH	USA
Belgique/België	F	-	S	-	-	-	-
Danmark	S	S	S	-	-	S	S
BR Deutschland	S	S	F	F	F	S	S
Hellas	-	-	-	-	-	-	-
España	S	F	S	F	S	F	-
France	S	F	S	S	S	F	F
Ireland	S	-	S	-	-	-	-
Italia	F	S	S	-	S	-	F
Luxembourg	-	-	-	-	-	-	-
Nederland	-	F	F	-	S	-	-
Portugal	-	-	S	-	-	-	-
UK	F	F	F	S	S	S	F
EC countries directly represented(1)	8	7	10	4	6	5	5
North America	Yes	No	Yes	No	Yes	Yes	Yes
Far East	Yes	No	Yes	No	Yes	Yes	Yes

(1) This chart excludes base metal refiners who also refine precious metals but do not fabricate them, e.g. MHO (Belgium), NDA (Germany), Inco (UK).
F = Fabrication company
S = Sales company
Source: Eurométaux

refined before the increased cost of transporting mineral concentrates made this uneconomic. However, final separation of Canadian primary platinum group metal production is still carried out in the UK.

Gold from Papua New Guinea is refined in Germany in substantial quantities.

In the rest of the world, there are major secondary refineries and fabricators in the USA and Japan, and smaller ones in Australia, Brazil, Canada, India, South Africa, Norway, Sweden and Switzerland. Many of these are subsidiaries or associates of the major EC refiners.

Industry structure

The larger EC precious metal firms are generally concerned with the refining, trading and fabricating activities. However, there are a few exceptions where jewellery manufacture is also a major fully integrated part of such companies' business.

The precious metals industry in the EC on the other hand, unlike the industries of certain base metals, has relatively little integration with the actual precious metal mining companies, although there are some exceptions. The most common way of assuring supplies is by long-term contracts or daily purchases on the commodity markets and from traders and banks.

The major firms operating in the EC are listed in table 5. Most of these companies, such as Johnson Matthey, Degussa, Haraeus or Englehard are also active in other regions of the world. Some of these companies are involved in activities other than precious metals processing, such as electronics, chemicals, construction materials etc.

Environmental protection

Platinum is already well known for its role as a catalyst in eliminating many of the harmful emissions from car exhausts.

Legislation that will specify a single set of car exhaust emissions standards equivalent to US 1983 levels for all cars sold in the EC is due to be debated by the Council of European Environment Ministers. These standards effectively rule out the use of the present generation of lean burn engines with simple platinum-palladium oxidation catalysts as a means for small cars to meet legislative requirements. While these systems could contain emissions at the levels specified in June 1988, they are unlikely to meet the reduced standards for combined HC and NOx laid down in July 1990. Consequently, platinum-rhodium catalysts at a ratio of 5:1, are likely to be the universal choice of car-manufacturers in Europe for emission control. Larger cars may need to use heavier loadings of platinum group metals than hitherto to keep CO emissions within the strict limits.

Although it does not specify the means of compliance, the Commission has expressed the belief that given the current status of car technology, these standards will have to be met by using three way catalytic converters containing platinum group metal coatings.

Demand for catalyst equipped cars is growing rapidly. In West Germany, during January 1990, eight out of ten petrol-engine cars were sold with three way autocatalysts. Annual EC demand for platinum

for this application is forecast to rise to over 20 tonnes by 1993, two and half times the 1989 level.

Outlook

Although there have been fluctuations in precious metal supply and demand, there are no long-term risks of shortages. Reserves for the foreseeable future are both ample and well documented, and at present new mines are being developed in a number of countries - the USA, Canada, South America, Australia and South Africa. Even if there are risks of disruption of supplies, whether from South Africa, the USSR or other countries due to political events, mine catastrophes or strikes, there are substantial stocks of precious metals available in the short term. In any case, as already explained, precious metals have many uses in industry and are continually being recycled. Much of this recycling activity takes place in the refineries of the EC precious metals industry, so that free movement of precious metal materials both within and across the frontiers of the EC is of great importance to the industry.

Protection of the environment amid the growth of modern industry and spread of transport systems is now regarded as of key importance to the world and the EC in particular. Over the last two decades the platinum group metals have been increasingly employed in environmental protection and energy conservation technologies. As the EC now adopts such measures - in particular the use of catalytic converters on all new cars - its needs for platinum and rhodium are expected to rise sharply over the next few weeks. Not in vain is platinum already often called the "green metal".

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Revised by: DRI Europe

Non-ferrous metals - Lead

The EC possesses few lead-mining resources, but its lead metallurgical activities are powerful and competitive. Over the last few years the EC only experienced slow growth in lead consumption and production. However, secondary smelting activities, based on recovery have followed a positive trend during the 80's, lead being amongst the non-ferrous metals, those for which secondary smelting activities are the most developed, in particular in the Community. For the lead industry, environmental problems will be the major preoccupation over the coming years. Confronted with stricter and stricter legislation and increasing pressure from Western public opinion, the European industry must prepare itself for a steep rise in costs linked to environmental protection. There is a great risk that we will witness progressive relocation of production facilities towards the developing countries where restrictions are easier.

Sector description

The lead sector covers the following activities:

- mining production;
- metallurgical production (primary and secondary smelting);
- rolled and worked product production;
- lead oxide production;
- lead shot production;

Current situation

The EC mining production only accounts for 5% by volume of total world production. However, metallurgical production and semi-finished lead product manufacturing (alloys, pipes and tubes) account for 25% and 49% respectively of world production.

Globally EC lead production represented 20% of total world production in 1986. These differing percentages reflect on the one hand the poor community industry natural resources and, on the other hand, the strong demand linked to the level of industrialisation and notably, the development of the automobile industry. Lead metallurgical production is geographically concentrated at the heart of the EC; the German Federal Republic and the United Kingdom together represented half of all community production in 1989. Compared to the United States and Japan, the EC gross lead production volume is relatively significant as it is at a level almost equal to that

Table 1
Lead industry
Main indicators, 1983-90

(thousand tonnes)	1983	1984	1985	1986	1987	1988	1989	1990(*)
Consumption	1 319	1 392	1 357	1 373	1 399	1 451	1 479	1480
Net exports	-183.5	-161.4	-173.7	-629.5	-216.4	-239.7	N/A	N/A
Production	1 322	1 392	1 383	1 340	1 376	1 460	1 422	1446

(*) Estimated
Source: Eurometaux, Eurostat (Comext)

of these two countries together, being more than 1.4 million tonnes in 1989. Finally, though the EC metallurgical production level globally satisfies demand, the Community industry is largely dependent on the rest of the world for its lead in ores. The following text deals essentially with mining production and metal production (primary and secondary smelting).

Price evolution

The lead industry is very sensitive to price variations of its main products.

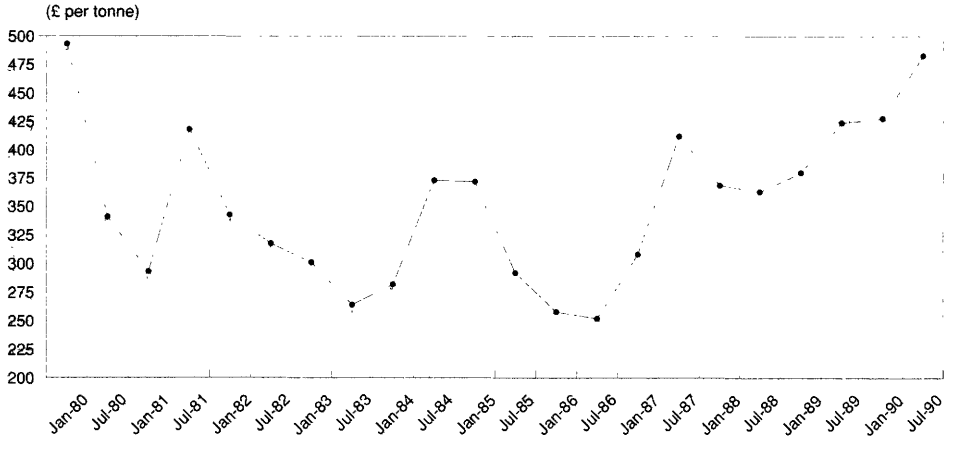
These prices are fixed on the London Metal Exchange where 70% of world sales are carried out. The London Metal Exchange (LME) prices are used as reference points both for the purchase of lead in ores and the sale of metal.

Used to establish industrial contracts, they are an important factor in determining the lead industry results. LME prices are fixed according to the laws of supply and demand, often amplifying fluctuations in an exaggerated manner. Producers and metal refiners therefore have imposed upon them prices which are sometimes far removed from the reality of trade. Whilst annual lead consumption increases by less than 2%, its price has, for example increased by more than 40% between February 1990 and March 1990, without any real justification, to then fall by 22% during April. Whilst the average price was £459 per tonne on the LME in February 1990, the rate rose to £805 per tonne on certain days in March.

This sudden price escalation was brought on by a fear of a reduction in lead supplies, a fear that was amplified by the exceptionally low stock levels on the LME. Such extreme fluctuations are prejudicial to the lead industry.

The curve of world lead prices between 1980 and 1990 reveals a trend reversal in 1986: whilst world prices were falling since 1980, after 1986 they have been following an upward trend. In 1989, lead was the exception amongst non-ferrous metals: whilst world prices for aluminium, copper, nickel, pewter and zinc experienced sharp falls, the price of lead increased by 13.5%.

Figure 1
Evolution of average monthly lead prices in £



Source: DRI Europe

Production comparison

ore production

As the Community's lead in ores resources are rather poor, this production only reached 145,000 tonnes in 1989, being 6.4% of the Western world's production (2,274,000 t) and under 5% of total world production (3,100,000 t).

Following the economic crisis at the beginning of the decade, decreasing exploration activities for natural resources, progressive depletion of currently exploited resources and development of the recovery industry, community lead ores production has been declining regularly since the beginning of the 80's (-6.5% per annum since 1983).

In 1989, EC lead in ores production fell by 15% in relation to the previous year.

In Western countries overall, a production fall of 3% has followed the 1.6% decline of 1988. This reduction is mainly due to a fall of 25% in Canadian mining production; a fall created by the closure of several very large mines.

In 1990, mining production growth should reappear with the start-up of new production facilities In North America and Eu-

rope, thus reversing the decline of 1988-89.

Metallurgical production

Metallurgical production of lead is founded, on the one hand, on ore processing (primary smelting) and, on the other hand, on scrap recycling (secondary smelting), most of which consists of used accumulators. It should be noted that Community metallurgical production represents 25% of world production; for several years it has fluctuated around 1,400,000 t. Table 5 gives a list of the largest primary smelting producers in the Community.

Since 1983 total production has increased at a rate of 1.2% per annum within the EC. On the other hand, if there is a breakdown between primary and secondary smelting, the average annual rate of increase in the volume of lead produced from ores is nil, whereas in the second category the annual rate of increase is 3%. In 1989, Western world production remained at its 1988 rate: 4,400,000 t., representing over 75% of world production (5,700,000 t. approximately). On the other hand, following a sharp drop in lead production mainly in the United Kingdom (- 6.7%), metallurgical production in the Community decreased by 2.6% in 1989.

The two largest producers within the EC are the German Federal Republic and the United Kingdom, followed by France, Italy and Spain. Although German and English production remained fairly stable during the 80's, metallurgical production of lead in Italy and France increased by about 4% per year, while decreasing at a rate of around 6% in Spain between 1983 and 1989.

Production equipment in this sector in the Community is competitive compared to that of rival producers outside the Community. It meets market requirements, both as regards quantity and quality. Thanks to its knowhow and the research and development undertaken, this sector is capable of producing specific alloys with specific technical characteristics.

As Table 6 shows, the importance of secondary smelting has become progressively greater since the beginning of the 80's. It is showing very regular growth in the West, going from 40% of total production in 1983 to 49% in 1989, i.e. 2,150,000 t.

In the EC, there was a considerable increase in the production volume of secondary smelting lead in 1983 and a relatively regular increase since 1985. Nevertheless, the proportion of secondary smelting has remained stable at around 50% of total production since 1984 and scarcely seems to move any more; in 1989 it was 51%.

Consumption

Both at EC level and at Western world level, lead production and consumption has a balanced structure. In 1989, however, the gap between production and consumption deepened, with consumption exceeding production by 57,000 t.

From 1983 to 1989, there has been relatively little increase in consumption within the EC: 1.9% per annum compared with 2.6% for all Western countries.

Swept along by demand from the accumu-

Table 2
Lead production
International comparison

(thousand tonnes)	1984	1985	1986	1987	1988	1989
Belgique/België,Luxembourg	120	105	90	90	105	93
Danmark	10	1	0	0	0	0
BR Deutschland	357	356	367	340	345	350
Hellas	12	14	19	3	23	7
España	160	168	130	126	122	114
France	206	224	230	246	256	267
Ireland	9	10	10	10	12	12
Italia	140	135	126	168	178	181
Nederland	34	37	33	40	39	42
Portugal	6	7	6	6	6	7
United Kingdom	338	327	329	347	374	349
EC	1 392	1 384	1 340	1 376	1 460	1 422
USA	965	1 054	932	1 028	1 091	1 169
Japan	363	367	362	339	340	332

Source: Lead and Zinc Study Group - April 1989

Table 4
List of lead mines in EC

BR Deutschland	Meggen
Hellas	Cassandra
España	Silicatos - Rubiales - La Troya - La Cruz - Sotiel - Aznalcollar - Reocines
France	Les Malines
Ireland	Tara
Italia	Silius

Source: Eurométaux

Table 3
Lead - Mining production in EC

(thousand tonnes)	1983	1984	1985	1986	1987	1988	1989
Western world	2 469	2 374	2 499	2 348	2 376	2 338	2 274
of which: EC	218	227	209	195	199	170	145

Source: Eurométaux

Table 5
Lead - EC lead major producers - primary smelter

Country	Name	Location	Process	Theoretical annual capacity mt
Belgique/België	Métallurgie Hoboken-Overpelt	Hoboken	F-WJ	125 000
			RTI et 2	125 000
BR Deutschland	Berzelius Metallhutten GmbH	Duisberg-Wanheim	F-ISF	32 000
		Binsfeldhammer	F-WJ	90 000
			RTI et 2	115 000
	Norddeutsche Affinerie Aktiengesellschaft	Hamburg	F-WJ	30 000
			RTL et 2	45 000
	Preussag-Boliden-Blei GmbH	Nordenham	F-WJ	90 000
			RTL et 2	100 000
Hellas	EMMEL	Lavrion	F-WJ	20 000
			RTI et 2	20 000
España	Sdad Minera y Metalurgica de Penarroya Espana	Carthage	F-WJ	90 000
			RTI et 2	90 000
France	Société Minière et métallurgique de Penarroya	Noyelles-Godault	F-WJ	110 000
			F-ISR	40 000
			RTI	150 000
Italia	Nuova Samim SpA	San Gavino	REI	30 000
			RTI	50,000
		Porto Vesne	F-ISF	30 000
			F-KV	84 000
United Kingdom	Britannia Refined Metals Ltd	Northfleet	RTI	160 000
	Commonwealth Smelting Ltd (subsidiary of AM & S Europe)	Avonmouth	F-ISF	40 000

Source: 1986 Minemet Yearbook

lator industry, annual lead consumption in Western countries has, however, increased by nearly 700,000 tonnes compared with the very low level of 3,780,000 t. in 1982, i.e. 300,000 tonnes over the previous record in 1979.

The main client sectors of the lead industry are:

- ❖ the automobile industry: batteries
- ❖ the building industry: laminated products
- ❖ television manufacturers: cathode tubes
- ❖ the paint industry: anti-corrosion paints
- ❖ the glass industry: crystal

The biggest market for lead, both in volume and growth, is in accumulators for motor vehicles. In 1989, 60% of the lead produced in Western countries (compared with 51% in 1981) and 46% of that produced in the EC was used in car batteries. This demand depends not only on the production of new vehicles but also on the total number of vehicles used, a number which, for the first time, reached 500 million units in 1988 and should exceed 600 million in the year 2000. In 1989, the healthy state of the automobile industry in Europe and Japan was one of the main causes in the lead price increase. Moreover, the quantity of lead contained in each accumulator increases in line with the desire of battery manufacturers to offer better performance and longer life. While the accumulator market seems to have a good future, other lead uses are falling, some very markedly, such as the use of lead in petrol. Ecological pressure against the use of lead as a petrol additive have hit the lead industry hard. According to Shearson Lehman, an Ameri-

Table 6
Production 1983-89

(thousand tonnes)	1983	1984	1985	1986	1987	1988	1989
Western world	3 926	4 059	4 239	4 062	4 254	4 408	4 400
EC	1 322	1 392	1 383	1 340	1 376	1 460	1 422
% of which: secondary smelting							
Western world	40	45	43	46	46	47	N/A
EC	46	50	49	51	52	50	51

Source: Eurométaux

can merchant bank, this market has shrunk by over half since the start of the 80's: 105,000 tonnes were consumed for this purpose in Western countries in 1989, against 238,700 tonnes in 1980. Today this only represents 2.3% of total lead consumption. The use of lead in paints, chemical products and cable sheaths has also given rise to numerous protests. In Western countries, in 1981, 20.3% of lead consumption related to chemical products, but in 1988 the rate was only 15.8%, with the proportion of lead consumption by the cable industry dropping from 7.6% in 1981 to 4.7% in 1988; the proportion used in alloys went from 5% to 3.8%.

The trend towards lower demand can also be explained by the phenomenon of substitution, like the increasing use of plastics and aluminium instead of lead in cable production.

External trade

Lead trading between the member States seems relatively high. Indeed, 71% of exports from the United Kingdom, for example, were destined for the EC in 1988, and 71% of the German Federal Republic's imports also came from the region. On the one hand, since the EC has very few ore resources, ore imports are relatively high. Measured in tonnes, around 80% of imports from outside the EC into the United Kingdom, for example, were made up of non-refined lead in 1988, chiefly from Australia. On the other hand, given the extent of secondary smelting production, the EC is also a net importer of residue containing lead (mainly used batteries).

As regards overall metallurgical production, EC external trade is more or less balanced. Since 1986, excluding 1988, the external trade balance has been slightly negative, with the 1989 figures tending to show a larger deficit, with prices and exchange rates playing a major role.

On a worldwide scale, the main production zones of unrefined lead, based on tonnage, are the EC (1.5 million tonnes in 1988), the United States (1.2 million tonnes) and countries with planned economies (1.4 million tonnes), of which the USSR (795 thousand) represents a large proportion. The United States and the USSR are in fact the largest producers and consumers of refined lead, with the German Federal Republic and the United Kingdom in fourth and fifth positions behind Japan.

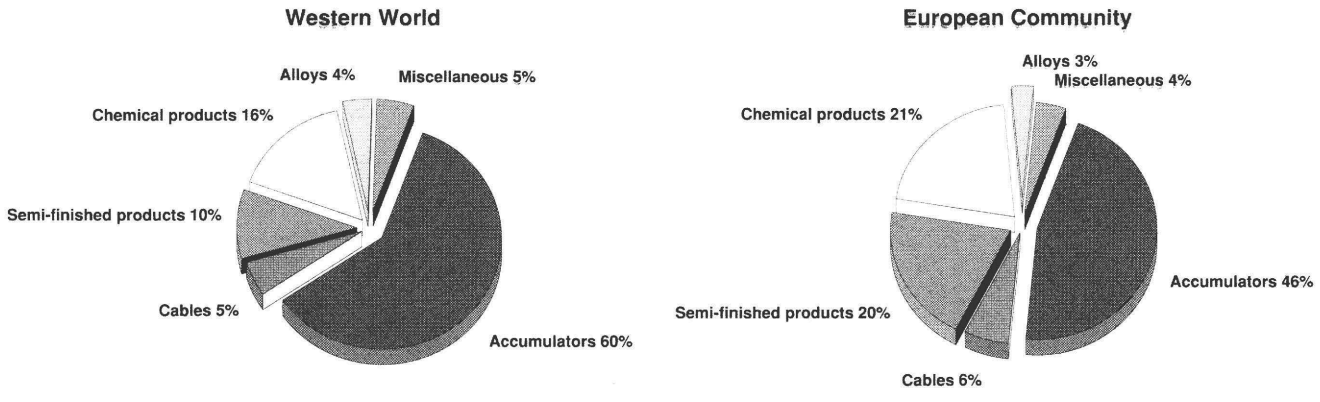
The Community's foreign trade is carried out with only a few countries. Imports mainly come from Canada, Mexico and Peru, while exports outside the EC are mainly to the USSR and Austria. Italy is a major importer of refined lead and in 1988, imported 89.5 thousand tonnes, more than 30% of which was from the regions mentioned above; 6.4% from Canada, 12.2% from Mexico and 10.7% from Peru. On the other hand, 15% of exports from the German Federal Republic, a major EC exporter, with export figures of about 61.3 thousand tonnes in 1988, went to Australia, while it is estimated that 61%

Table 7
Lead industry
Consumption, 1983-89

(thousand tonnes)	1983	1984	1985	1986	1987	1988	1989
Western world	3 830	3 972	4 026	4 117	4 249	4 359	4 474
of which: EC	1 319	1 392	1 357	1 373	1 399	1 451	1 479

Source: Eurométaux

Figure 2
Lead consumption by product, 1988



Source: Eurométaux

of the USSR's refined and non-refined lead imports came from the EC.

Protection of the environment

Lead pollution - mainly pollution of the air - can, even in small doses, cause intellectual deficiencies in children and increase cardio-vascular risks in adults. 90% of this pollution comes from lead contained in petrol, 75% of which is released into the air during combustion.

There are several Community directives aimed at limiting lead pollution in air in EC countries. Directive 82/884 (December 1982) has set a limit for lead concentration in air: 2 micrograms per cubic metre; this directive is now in force throughout the EC. The member States had until December 1989 to reach the lower levels of the fixed limit and, during that time, had to keep the Commission informed of measures taken to reduce lead content in the air. In parallel, the Commission has for a long time been anxious about the problem of vehicle exhaust gases, the main source of lead pollution in air. Numerous directives are aimed at reducing the lead content in petrol and encouraging the distribution of lead-free petrol. The latest one, directive 87/33 of 21st July 1987, authorises member States to forbid the sale of certain categories of petrol containing lead, if the ecological situation makes this necessary, on condition that lead-free petrol is freely available. These measures favouring lead-free petrol combine with those already taken in the United States and Japan. Air pollution in the urban areas of industrialised countries should decrease as these measures against leaded petrol are applied. However, none of these measures has yet been taken in developing countries.

Apart from lead-free petrol, it is the lead industry itself which appears threatened more and more by ecological pressures. Enormous pressure has been applied in the United States recently to try to get the lead industry to abandon its activities. In the United States, too, lead batteries have just been officially classified as high-risk scrap. There is, however, no viable substitute product which could be sold at a comparable price for accumulators. In the same way, the stricter and stricter control of emissions has led to a sharp rise in the cost of lead scrap smelting. The research department of the American Congress estimated, in 1986, that simply respecting the Clean Air Act of 1970 in the United States had resulted in an extra cost of lead production of 4 cents a pound, out of a price of 24 cents a pound. Under the pressure of Western public opinion, the trend is probably gradually towards a reduction in mining activity and more towards increased development of secondary recycling. Some producers have already started working with secondary smelting lead and this trend should accelerate. In Europe, recycling rates reach 80% or even 90%. Recycling plays a decisive role in improving environmental protection, economising non-renewable natural resources and lowering their residues. It also reduces the need for landfilling facilities. The recycling of lead batteries has, moreover, become a lucrative industrial activity. The German Federal Republic and the United Kingdom are the leaders in this secondary production market.

The Community lead producers are generally keen to guarantee the safety of their employees and of the public, and to protect the environment. To this end, they are trying to re-use scrap, as well as to improve collection conditions.

Employment

Mines, metallurgy and primary processing employ around 20,000 people, to which should be added the workers in downstream sectors such as accumulator production.

Outlook

Investment will be necessary to adapt the industry to regulations concerning the environment and to put in place new treatment processes, the technology for which is already being developed in the EC. It is interesting to note, as an example, that already half the electric power required for a lead smelter is consumed by the use of anti-pollution equipment, in particular by filters for the treatment of gases. Moreover, the proportion of anti-pollution investment to total investment in present smelters can be estimated at around 30%. Extra operating costs could easily reach 1.5 million ECU per annum for each smelter. In parallel, investment required for the construction of a primary smelter with a capacity of around 150,000 tonnes, using new processes, on an existing site, is almost 100 million ECU. The cost of metallurgical production of lead should increase in developed countries during the 90's, as the laws protecting the environment and covering the operation of mines and smelters become more restrictive. This trend could in time result in a diversion of productive investment towards developing countries where the cost of environmental measures would be much lower. Ecological factors will also affect demand: recycling will reduce the demand for lead ore, restrictions in vehicle use will increase, putting a brake on accumulator market growth. These eco-

logical measures will probably give rise to great uncertainty in the metal markets in the forthcoming years.

The opening up of the Eastern Europe and the changes apparent in the USSR should not greatly influence Community lead exports. Indeed, taken together, the mining production of the Eastern countries and the USSR represented, in 1988, around 20% of world production, while in terms of refined lead, their production represented 19% of world production. In the short term, with its automobile market, the EC could mitigate the lack of availability of automobiles in these countries. Directly, however, with their resources, their industries and the trade already carried out with these countries, EC lead exports should not increase significantly. However, there could be a modernisation of the production capacities of planned economy countries. The European Community could thus be induced to export its technology and its knowhow, installing new production units or modernising existing units in zones where the raw material is abundant, i.e. Bulgaria, Poland or Romania.

During the next few years, world lead consumption should increase at an average annual rhythm of 1 to 1.4%: the accumulator market will grow by 2% while other markets will stagnate or decline.

There should be a continuation of increased consumption in Latin America and Asia, whilst consumption levels will remain stable in Europe and North America. The growth in lead production in the EC will be even more closely linked to its export potential, notably owing to the anticipated diminished growth of the automobile park in Europe, and even more so if the price of a barrel of oil goes up over a long period. New regulations concerning environmental protection will, however, hinder production volumes, following an increase in production costs. Owing to these various factors, it seems that, at best, there could be a stabilisation in the production volume of lead in the EC during the next three years.

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