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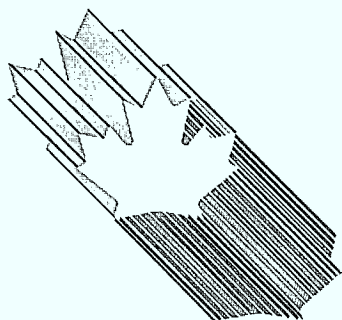


Industry, Science and
Technology Canada

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Copper Smelting and Refining

Canada



INDUSTRY PROFILE

COPPER SMELTING AND REFINING

1988

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FOREWORD

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In a rapidly changing global trade environment, the international competitiveness of Canadian industry is the key to survival and growth. This Industry Profile is one of a series of papers which assess, in a summary form, the current competitiveness of Canada's industrial sectors, taking into account technological and other key factors, and changes anticipated under the Canada-U.S. Free Trade Agreement. Industry participants were consulted in the preparation of the papers.

The series is being published as steps are being taken to create the new Department of Industry, Science and Technology from the consolidation of the Department of Regional Industrial Expansion and the Ministry of State for Science and Technology. It is my intention that the series will be updated on a regular basis and continue to be a product of the new department. I sincerely hope that these profiles will be informative to those interested in Canadian industrial development and serve as a basis for discussion of industrial trends, prospects and strategic directions.

Minister

1. Structure and Performance

Structure

The copper smelting and refining sector consists of four companies operating six smelters in Quebec, Ontario and Manitoba, and three refineries in Quebec and Ontario.

Smelting and refining are two separate operations. The raw materials for the copper smelting operation are mineral concentrate (copper concentrate) containing 25 to 35 percent copper and copper scrap; the end product is impure blister or anode copper (94 to 99 percent copper). This is upgraded to refined copper (over 99.9 percent) in a refinery which also processes scrap, and where precious metals are also recovered. The refined copper is largely sold to rod mills, brass mills and foundries, where it is processed into consumable forms.

Copper is the third most widely used metal, after steel and aluminum, with current western world consumption of about 7.2 million tonnes per year. The principal use for copper is in electrical applications, which account for more than 50 percent of total requirements. It has many other uses, such as in pipes, tubes, radiators, castings, coinage and chemicals. Copper is also widely used in alloys such as brass and bronze.

Present Canadian refined copper output amounts to some 500 000 tonnes per year, about 6.9 percent of world production. Total Canadian shipments amount to \$1 billion annually. Employment in the six smelters and three refineries is approximately 4000. Canada exports nearly 60 percent of its refined copper production, which represents about 12 percent of the world's export trade. It is the world's third-largest exporter, after Chile, 35 percent, and Zambia, 24 percent of the world's export trade. Canadian producers traditionally have supplied 90 percent, or 200 000 tonnes, of domestic consumption. Canada's main markets are the United States (63 percent of exports) and Europe (36 percent). Canadian producers find their most profitable sales in Canada, the United States and Europe, in descending order.

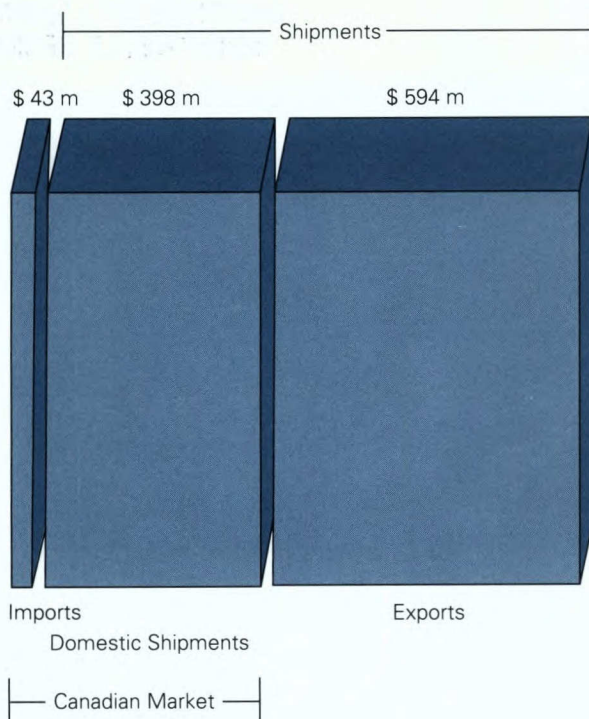
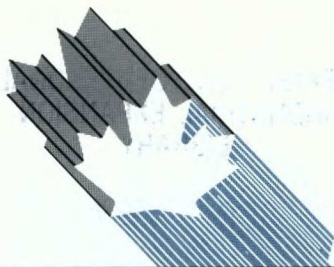
All of the smelting and refining companies operate world-scale facilities. They are vertically integrated to some degree, owning both mines and smelters. Three own refineries.

Canada



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Imports, Exports and Domestic Shipments*
1986

* Refined copper

THE COMPANIES AND THEIR CANADIAN SMELTER AND REFINERY LOCATIONS AND CAPACITY ARE AS FOLLOWS:

Company	Smelter	Capacity (000's tonnes)	Refinery	Capacity (000's tonnes)
Noranda Minerals Inc.	Rouyn-Noranda, Que.	218	Montreal, Que.	350
	Murdochville, Que.	63		
Inco Ltd.	Sudbury, Ont.	180	Sudbury, Ont.	180
Falconbridge Ltd.	Timmins, Ont.	90	Timmins, Ont.	90
	Sudbury, Ont.**	27		
Hudson Bay Mining & Smelting Co. Ltd.	Flin Flon, Man.**	65		

** The output of Falconbridge's Sudbury smelter is refined in Norway. Hudson Bay's is processed in Noranda's Montreal refinery.

Inco and Noranda account for 68 percent of domestic smelter capacity and 86 percent of refinery capacity.

There are two general classes of smelters, those that are self-sufficient in mine production (integrated) and those that must buy or toll mineral concentrates (custom). The Rouyn-Noranda and Murdochville smelters, to a large extent, and the Flin Flon one, to a lesser extent, are in the latter class. The Rouyn-Noranda smelter is also the largest copper smelter in Canada, accounting for 36 percent of industry capacity.

In late 1986, Gibraltar Mines Ltd. at Williams Lake, British Columbia, brought into production a solvent-extraction and electrowin plant designed to produce 4500 tonnes of copper per year.

A number of other companies operate copper mines in Canada and have the concentrates smelted and refined in Canada on a custom basis; some other companies export concentrates.

Inco and Falconbridge have some foreign mining and metallurgical operations. Noranda Minerals Inc. is part of a widely diversified, resource-based company with extensive interests in oil, gas, forest products and manufacturing.

The industry consists of publicly traded companies. Noranda and Falconbridge have very high levels of Canadian ownership, while Inco, a multinational, is about 35 percent Canadian-owned. Hudson Bay is a subsidiary of Inspiration Resources, Inc. of the U.S., which in turn is controlled by South African interests.

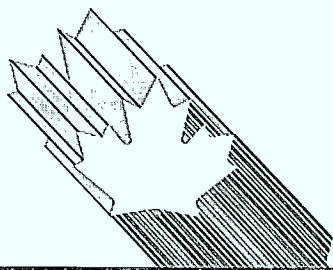
Performance

The performance of the Canadian industry must be examined in the context of the world industry. Prices are established on international metal exchanges, based on the apparent supply-demand situation.

During the late 1960s and 1970s world copper markets experienced a period of relative shortages and high prices. As a result, the mining industry worldwide stepped up exploration efforts and brought into production a number of new mines in addition to expanding existing ones located primarily in less-developed countries. Other countries expanded smelting and refinery facilities.

During the same period, other materials such as glass fibre (fibre optics), plastics and aluminum have replaced copper, to some degree. Technological trends toward downsizing and miniaturization of products have also diminished the growth rate of copper consumption. These impacts on copper demand may have largely run their course by now, but no new major uses for copper have been developed to offset them.

As a result of the 1981-1982 recession and the above factors, western world consumption of refined copper decreased in 1983 to some nine percent below the level in 1979, while production increased to about four percent above the 1979 level.



Since then world economic conditions have improved, and western world consumption in 1987 was five percent above the 1979 level. Production in 1987 was approximately 7.5 million tonnes, or five percent lower than consumption, due to unusual supply problems. These problems (strikes, technical problems and transportation difficulties) coupled with a surge in demand resulted in substantially higher world prices, which reached highly profitable levels for most producers. This is a short-term phenomenon, however, and prices are not anticipated to stay at such high levels (prices averaged about US\$1.11 per lb. during the fourth quarter of 1987 and the first quarter of 1988).

Among the developing countries, only Chile, Peru and the Philippines have increased their integrated mining, smelting and refining capacity over the last 15 years. In general, these countries have not cut back mining or smelting operations in times of low demand, adding to the pressure on prices. During the same 15-year period, cutbacks were undertaken by North American producers who operate with a view to achieving reasonable profits over the long term. Chile is an exception among the developing countries, because its expansion is based on rich, low-cost ore bodies that generate profits even at depressed copper prices.

Despite a decline in Canadian copper mine production in the 1970s and early 1980s, particularly east of the Saskatchewan-Manitoba border, there has been no appreciable change in the rate of production of copper metal in the Canadian industry over the past 10 years. The reduced domestic mine output has been replaced by imports of copper concentrate and copper scrap. Although employment fell by some 11 percent between 1983 and 1987, the maintenance of the level of metal production indicates that productivity has increased.

Detailed information on the financial performance of the smelting and refining sector itself is not available, as the companies report only on their overall operations. On this overall basis, the industry sector has shown annual losses from 1981 to 1985. An after-tax profit of \$89 million was reported in 1986, and 1987 was certainly better.

2. Strengths and Weaknesses

Structural Factors

The key factors influencing the competitiveness of Canadian smelting and refinery operations are economies of scale, technology, access to raw materials at reasonable cost, the presence of co-products, location and proximity to markets and environmental regulations.

Canadian operations are world-scale, with the Sudbury, Rouyn-Noranda and Montreal operations being among the largest in the world. Most facilities employ state-of-the-art technology, much of which was developed in Canada.

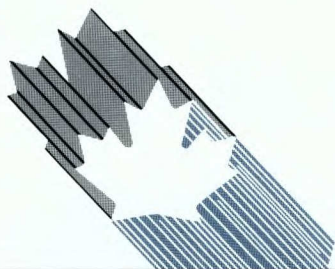
Published data indicate that average Canadian and U.S. production costs for copper are toward the low end of the world cost spectrum. This applies to total costs from mine to refinery, as cost data for smelters and refineries themselves are not available. The world's lowest-cost copper is produced in Chile, with costs at about 70 percent of the Canadian level, while copper production in Europe is at cost levels up to 50 percent higher than the Canadian average.

The vertical integration of Inco and Falconbridge is a vital strength of these companies. On the other hand, the degree to which Hudson Bay and Noranda must find other sources of concentrate is a weakness, as it may at times be difficult to obtain adequate supplies of concentrate at economic prices to maintain optimum production rates.

Over the last ten years, the Canadian copper smelting sector has processed most of the concentrates that have been produced by Canadian mines east of the Manitoba-Saskatchewan border. Copper concentrates produced in British Columbia cannot be considered as an economic source of feedstock for eastern smelters, because of the cost of inland transportation and the higher prices offered by Japanese smelters. Some shipments from British Columbia to Quebec are made, but these must be regarded as exceptional.

Because of low copper prices over the past four years, 1983 to 1986, some Canadian mines have closed and certain copper deposits have been dropped from the ore classification. As a result of this, and the depletion of other ore bodies, the Rouyn-Noranda and Murdochville smelters are slowly exhausting their domestic sources of supply, and at present are importing some foreign copper concentrates in addition to increasing the amount of copper scrap consumed to maintain an economic level of production. Similarly, the Flin Flon smelter faces diminishing ore reserves. A strong exploration program has been sustained by the companies for several years in eastern Canada to improve the resource situation, but so far there has been no major copper find.

The polymetallic ores of the Canadian Shield give Canadian producers an advantage in providing a number of co-product values. The Sudbury ores offer nickel, copper and platinum, while other ores have copper, zinc, gold, silver and other metals. The sum of the revenues available from sales of all these metals is important in establishing the strong competitive standing of the Canadian companies operating mines, smelters and refineries. Another aspect of this polymetallic nature of the ores, however, is the difficulty of separating one metal from another, requiring complex, high-cost processing and a strong research and development capability.



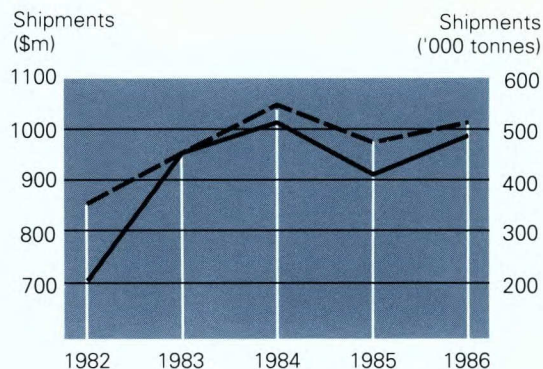
Government policies in other countries, aimed at ensuring adequate supplies of refined copper, can have a negative impact on Canadian smelters. Japan, Brazil, Korea and Taiwan have erected high tariff barriers against the imports of refined metal in order to support a higher domestic price for refined copper, and to encourage domestic facilities. The higher domestic price in these countries for refined copper allows these smelters to pay premium prices for copper concentrates. This situation has created a world surplus of custom smelting capacity, providing strong competition for those smelters that do not control a source of concentrate, and that are not assisted through tariff barriers by their governments. The companies most adversely affected by this situation seem to be Noranda and Norddeutsche Affinerie in the Federal Republic of Germany. The remote location of the Rouyn-Noranda smelter (some 900 km from water transport) places it at a further disadvantage. On the other hand, British Columbia copper mines benefit from the higher prices paid by the Japanese smelters for copper concentrates.

Most copper minerals are sulphides and they give rise during the smelting process to smelter fumes (sulphur dioxide) which constitute a main component of acid rain. Conventional control consists of converting the sulphur dioxide to sulphuric acid in an acid plant. Such plants recover a portion of the gas from the operations of Inco, Falconbridge and Noranda (Murdochville), while sulphur dioxide is not recovered at the Rouyn-Noranda smelter or at Hudson Bay's Flin Flon smelter. New emission regulations have been established which will require a large increase in the production of sulphuric acid by smelters. These measures will increase operating and capital costs.

Trade-related Factors

Neither Canada nor the European Community (E.C.) has tariffs or other trade barriers restricting trade in primary forms of copper metal.

While there are no tariffs imposed on concentrates, tariffs on the metal are being used indirectly by some consuming countries to control world trade in concentrates and secure feedstocks for domestic smelters and refineries. For example, tariffs on refined, unwrought copper in Brazil, Japan, Korea and Taiwan range from eight percent to 20 percent.



Shipments ——— (\$m)

Shipments - - - - - ('000 tonnes)

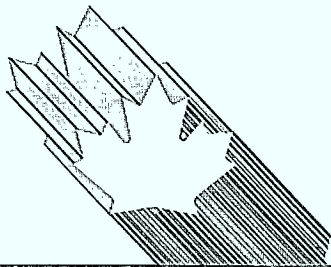
Total Shipments*

* Refined metal

The tariffs for items relating to Canada-U.S. trade in the copper smelting and refining industry sector are set out below. Under the Canada-U.S. Free Trade Agreement (FTA), these tariffs will be phased out over the periods shown.

CANADA-U.S. COPPER TARIFFS

Tariff Item	Description	Base Rate		Years to zero rate under FTA
		Canada	U.S.	
Copper				
7402	Anodes	free	1%	5
7403	Refined, unwrought	free	1%	5
7404	Waste and scrap	free	free	
7405	Master alloys	1.3%	2.4% to 6%	5
*7406	Powders and flakes	4% to 10.6%	3% to 5.4%	10
*7407	Bars, rods and profiles	4% to 10.3%	1% to 6.3%	10
*7408	Wire	4% to 10.3%	1% to 4.4%	10



While the products noted with an asterisk are further processed products, and not included in this industry sector, they could be affected by the application of the Rules of Origin for Goods under the FTA. More specifically, if third-country scrap is combined with Canadian scrap and/or concentrates in production of primary copper, the downstream products, tariff items 7403-7408, will not meet the current FTA definition of Canadian origin.

The creation of a unique dispute settlement mechanism and the possibility of exemption from multilateral safeguard-type actions taken by the United States will give Canada more secure access to the U.S. market.

Technological Factors

The non-ferrous metal smelting and refining industry is, to a significant extent, technology-based. Research and development on smelter processes have been of prime importance in Canada for many years, because of the close combination of two or more metal values in a typical Canadian Shield ore body, and the difficulty of separating these metals. For example, the nickel-copper ores of the Sudbury basin were not exploitable for a decade after their discovery, until the development of new smelting and refining processes.

The Inco development of the copper flash smelting process introduced a new era of effective, low-cost, environmentally acceptable smelting. The Noranda process for copper smelting has been a more recent major development, featuring high productivity and flexibility with respect to feed materials, and the possibility of controlling emissions. This process, along with the large scale of operations, has been essential to the survival of Noranda's Rouyn-Noranda smelter in the past few years, as it no longer has sources of local mine output to provide adequate feedstock.

Such developments have given Canada prominence in process development, which is important to the survival and growth of the industry. Such processes are recognized worldwide. Canadian plant design has been used in other countries, usually under licence. There are no barriers to buying or selling technology.

The recent tightening of environmental controls gives a strong incentive for the development of new smelting processes which will not emit sulphur dioxide.

Other Factors

The Canadian government's tax reform is not expected to significantly alter the financial performance or the competitive standing of Canadian smelters or refineries.

The federal Minister of Environment, and some provincial ministers, agreed in 1985 to a program of environmental control, which includes major reductions in emissions of sulphur dioxide gas from smelters by 1994. The Minister of Regional Industrial Expansion has established the Acid Rain Abatement Program which will give financial assistance to projects for reduction of sulphur dioxide emissions. Under this program, federal-provincial support has recently been announced for an acid plant to be built at the Rouyn-Noranda smelter.

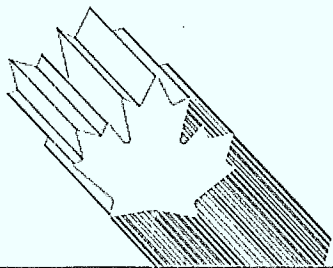
3. Evolving Environment

A tight world copper supply is anticipated for the first half of 1988 with the situation easing in the second half. Industry sources indicate that supply in 1988 could be about three percent greater than consumption. Over the longer term, it is anticipated that supply will be greater than demand and prices will be lower than they are at present.

The FTA is not likely to have a significant impact on either volume of production or level of employment in this industry sector, although, profitability will be improved as a result of tariff elimination. The elimination of the existing U.S. tariff of one percent on primary copper would increase Canadian companies' profits by the amount of the tariff which the companies currently absorb.

While hard to quantify, increased security of access to the U.S. market will also be beneficial. In the future, when safeguard actions are taken by either country, the other party to the agreement will be excluded from the action unless its imports are substantial and are contributing significantly to the serious injury or its threat, caused by the imports. Canadian producers will no longer be sideswiped by actions primarily directed at other exporters, and this may benefit Canadian copper producers in future U.S. safeguard actions. Had the proposed safeguard measures been in effect earlier, the Canadian copper industry would not have had to involve itself in a time-consuming and costly defence against the safeguard actions taken by the United States in 1978 and 1982.

The application of the Rules of Origin under the FTA could have an adverse impact on Canadian smelters and refineries. Under the Rules of Origin, copper that is smelted and/or refined in Canada from either copper scrap or copper alloy scrap from third countries would not enjoy duty-free entry into the United States. The current interpretation is that the comingling of third-country copper scrap in one facility would disqualify all the copper produced in the facility from duty-free status. This could affect over 50 percent of Canadian refined capacity. Also, in the future, products included in tariff items 7404 to 7408 would be affected.



4. Competitiveness Assessment

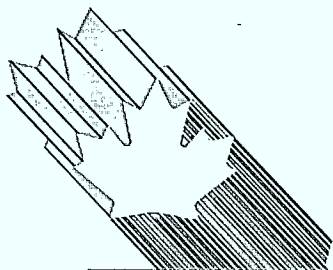
Canadian companies with fully integrated mine-smelter-refinery operations are world-competitive in cost, although, with some high-cost developing countries producing regardless of price, being cost-competitive does not guarantee profitability. Subject to the future availability of locally mined concentrates, Canadian operations are expected to remain viable over the long term.

The Canada-U.S. Free Trade Agreement will have a positive effect in giving Canada more secure access to the U.S. market. However, if the issue of the current definition of the Rules of Origin affecting the use of third-country scrap is not satisfactorily resolved, there could be a significant negative impact on a portion of the Canadian copper smelting and refining industry, and certain downstream industries.

For further information concerning the subject matter contained in this profile, contact:

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COPPER SMELTING AND REFINING

7 INDUSTRY PROFILE

PRINCIPAL STATISTICS

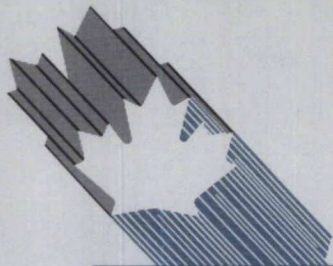
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	1973	1982	1983	1984	1985	1986
Establishments	7	10	9	9	9	10
*Employment	N/A	N/A	4 500	4 000	4 000	4 000
**Gross domestic product (constant 1981 \$ millions)	1 390	1 510	1 600	1 995	2 018	2 039
**Investment (\$ millions)	258	807	745	1 049	1 321	964
Shipments of refined metal (\$ millions)	723	706	949	1 007	908	992
(volume, '000 tonnes)	498	363	469	551	480	510
***Profit (loss) after tax (\$ millions)	N/A	(403)	(279)	(36)	(209)	89

TRADE STATISTICS (refined copper)

	1973	1982	1983	1984	1985	1986
Exports (\$ millions)	411	449	599	632	519	594
Domestic shipments (\$ millions)	293	257	350	375	389	398
Imports (\$ millions)	26	46	56	49	39	43
Canadian market (\$ millions)	319	313	406	424	428	441
Exports as % of shipments	56.8	63.5	63.1	62.7	57.1	59.8
Imports as % of domestic market	8.1	14.6	13.7	11.5	9.1	9.7
Canadian share of international market % (volume)	12	9	10	12	10	12
Source of imports (% of total value)			U.S.	E.C.	Asia	Others
		1982	32.6	1.9	—	65.5
		1983	24.4	3.4	—	72.2
		1984	20.4	2.0	—	77.6
		1985	46.1	0.1	—	53.8
		1986	42.5	0.3	—	57.2
Destination of exports (% of total value)			U.S.	E.C.	Asia	Others
		1982	37.9	56.9	0.2	5.0
		1983	31.7	42.6	23.1	2.6
		1984	53.7	28.3	13.8	4.2
		1985	48.5	38.1	9.6	3.8
		1986	63.5	32.2	1.0	3.3

(continued)



REGIONAL DISTRIBUTION — Average over the last 3 years

	Atlantic	Quebec	Ontario	Prairies	B.C.
Establishments — % of total	0	32.1	53.6	10.7	3.8
Employment — % of total (1983-84)	0	55.9	38.1	5.9	0.1
Shipments — % of total (refined copper)	0	61.9	38.1	0.0	0.0

MAJOR FIRMS

Name	Ownership	Location of Major Plants
Noranda Minerals Inc.	Canadian 97% Brascade Resource Inc. 43%	Murdochville, Quebec (S) Rouyn-Noranda Quebec(S) Montréal, Quebec(R)
Inco Ltd.	Multinational (Canadian, 35%)	Sudbury, Ontario(S)(R)
Falconbridge Ltd.	Canadian 96% Placer Dome Inc. 21.4%	Timmins, Ontario(S)(R), Sudbury, Ontario (S)
Hudson Bay Mining & Smelting	U.S.A 100% with South African control	Flin Flon, Manitoba(S)
Gibraltar Mines Ltd.	Canadian, Placer Dome Inc. 72%	Williams Lake, British Columbia(E)

* Estimated

** Relates to total SIC 295 Smelting and Refining of Non-ferrous Metals, not specifically to copper.

*** Relates to the overall operation of the companies, not just to their copper smelting and refining operations, and is taken from companies' annual reports.

(S) Smelter

(R) Refinery

(E) Electrowin plant

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