Copper Smelting and Refining

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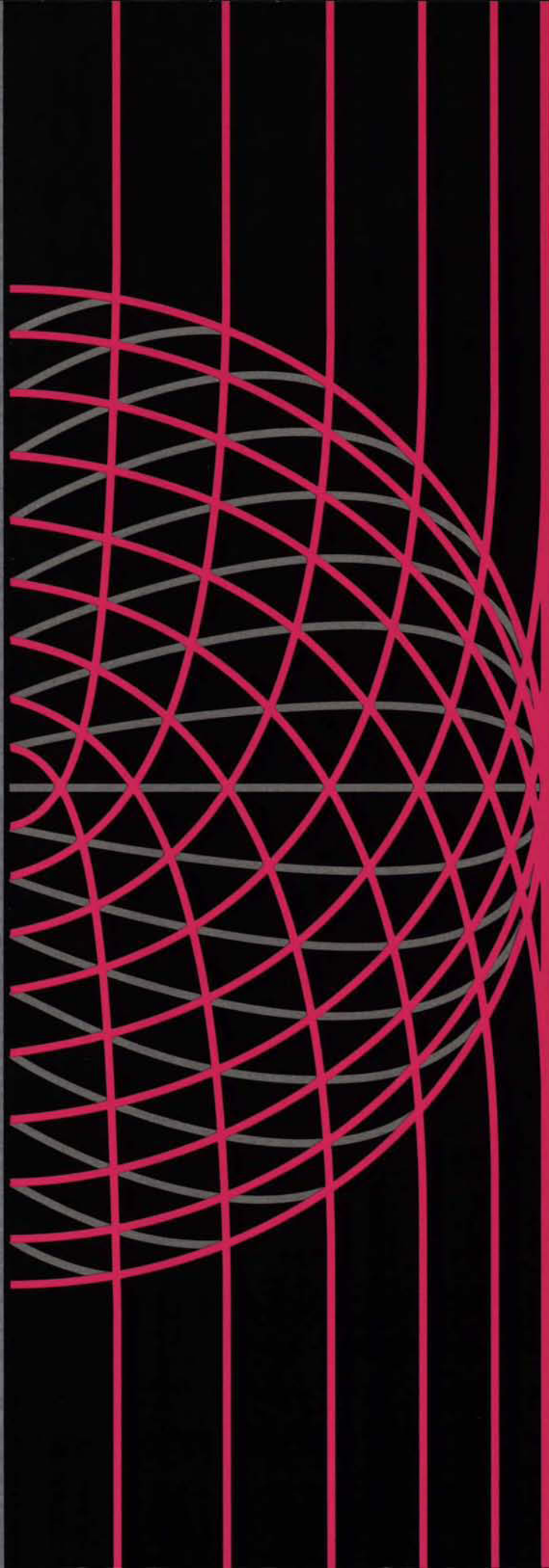
INDUSTRY PROFILE



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Canada

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1990–1991

COPPER SMELTING AND REFINING

FOREWORD

In a rapidly changing global trade environment, the international competitiveness of Canadian industry is the key to growth and prosperity. Promoting improved performance by Canadian firms in the global marketplace is a central element of the mandates of Industry, Science and Technology Canada and International Trade Canada. This Industry Profile is one of a series of papers in which Industry, Science and Technology Canada assesses, in a summary form, the current competitiveness of Canada's industrial sectors, taking into account technological, human resource and other critical factors. Industry, Science and Technology Canada and International Trade Canada assess the most recent changes in access to markets, including the implications of the Canada-U.S. Free Trade Agreement. Industry participants were consulted in the preparation of the profiles.

Ensuring that Canada remains prosperous over the next decade and into the next century is a challenge that affects us all. These profiles are intended to be informative and to serve as a basis for discussion of industrial prospects, strategic directions and the need for new approaches. This 1990–1991 series represents an updating and revision of the series published in 1988–1989. The Government will continue to update the series on a regular basis.

Michael H. Wilson
Minister of Industry, Science and Technology
and Minister for International Trade

Introduction

Copper is one of a group of non-ferrous metals that are smelted and refined in Canada.[1] In addition to *Copper Smelting and Refining*, industry profiles have been prepared covering

- *Aluminum Smelting*
- *Lead and Zinc Smelting and Refining*
- *Nickel Smelting and Refining*

Structure and Performance

Structure

Copper is the third most widely used metal, after steel and aluminum, with Western world consumption in 1989 of about 8.6 million tonnes. The principal use for copper is in electrical applications, which account for more than 50 percent of total consumption. 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.

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

The Canadian copper smelting and refining sector consists of four companies operating six smelters in Quebec, Ontario and Manitoba, and three refineries in Quebec and Ontario (Table 1). In 1989, Canadian production of refined

[1]See *Standard Industrial Classification, 1980*, Statistics Canada Catalogue No. 12-501, industry group 295. Data on each industry are not collected separately and should be considered only as indicators of trends.

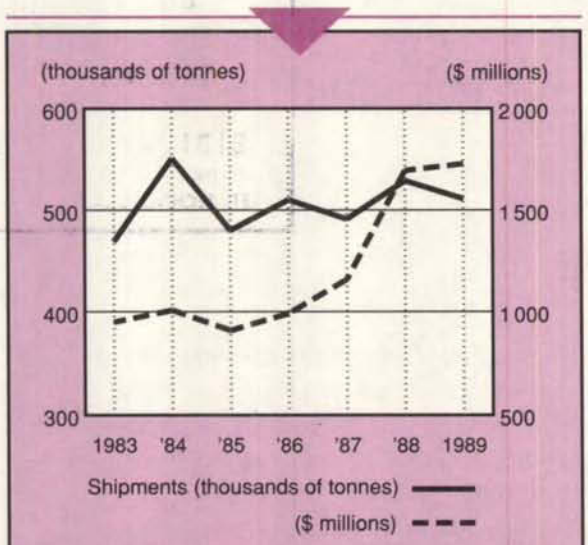

Figure 1 — Shipments of Refined Copper

copper amounted to approximately 500 000 tonnes, about 6 percent of world production. Total Canadian shipments amounted to about $1.7 billion in 1989 (Figures 1 and 3). Canadian producers traditionally have supplied over 90 percent, equivalent to 230 000 tonnes in 1988, of domestic consumption. Canada exports over half of its refined copper production, which represents about 11 percent of the world's export trade. It is the world's third-largest exporter, after Chile (35 percent) and Zambia (15 percent). Canada's main foreign markets are the United States (55 percent of exports) and Europe (41 percent). The tonnage shipped to these markets can vary, depending on prices received from each market. Shipments to other parts of the world are not traditional and result from sales made on a spot basis.

The industry consists of publicly traded companies. Noranda Minerals is a wholly owned subsidiary of Noranda Inc., which in turn is controlled by Brascan, a Canadian company. Falconbridge and Inco have about 50 percent and 46 percent Canadian ownership, respectively. Hudson Bay Mining and Smelting is a subsidiary of Inspiration Resources Corp. of the United States, whose largest shareholder is South African.

All of the Canadian smelting and refining companies operate world-scale facilities. Together, they employ about 4 000 people. They are vertically integrated to some degree, owning both mines and smelters. Three own refineries. 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 Noranda account for 70 percent of domestic smelter capacity and 84 percent of refinery capacity.

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

There are two general classes of smelters — those that are self-sufficient in mine production (integrated), and those that must buy or charge a toll for mineral concentrates treated (custom). The Rouyn-Noranda and Murdochville smelters, to a large extent, as well as the one at Flin Flon, to a lesser extent, are in the latter class. The concentrate is normally sourced in Canada. In late 1986, Gibraltar Mines at Williams Lake, British Columbia, brought into production a solvent-extraction and electrowinning plant designed to recover 4 500 tonnes of copper metal per year.

Table 1 — Canadian Smelters and Refineries, 1989

Company	Smelter location	Capacity (thousands of tonnes)	Refinery location	Capacity (thousands of tonnes)
Falconbridge[a]	Timmins, Ontario	92	Timmins, Ontario	92
	Sudbury, Ontario	27		
Hudson Bay Mining and Smelting Co. Limited[b]	Flin Flon, Manitoba	65		
Inco	Sudbury, Ontario	180	Sudbury, Ontario	180
Noranda Minerals	Rouyn-Noranda, Quebec	180	Montreal, Quebec	320
	Murdochville, Quebec	63		

[a] The output of Falconbridge's Sudbury smelter is refined in Norway.
[b] Hudson Bay's output is processed in Noranda's Montreal refinery.

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

As a result of the 1981–1982 recession, the consumption of refined copper in the Western world decreased in 1983

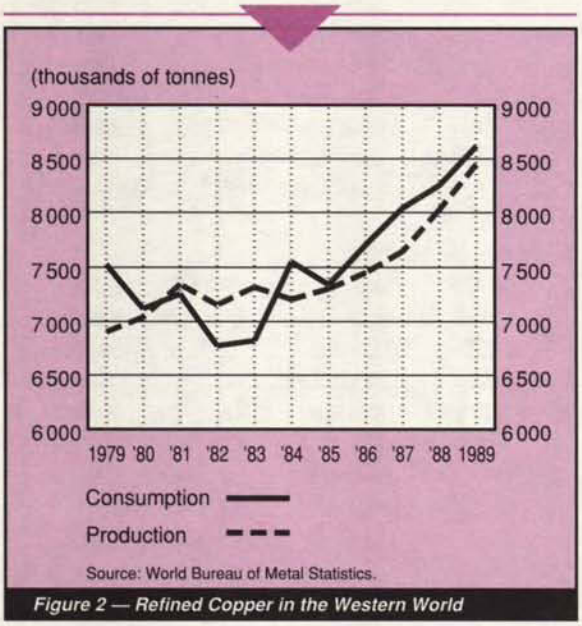

Figure 2 — Refined Copper in the Western World

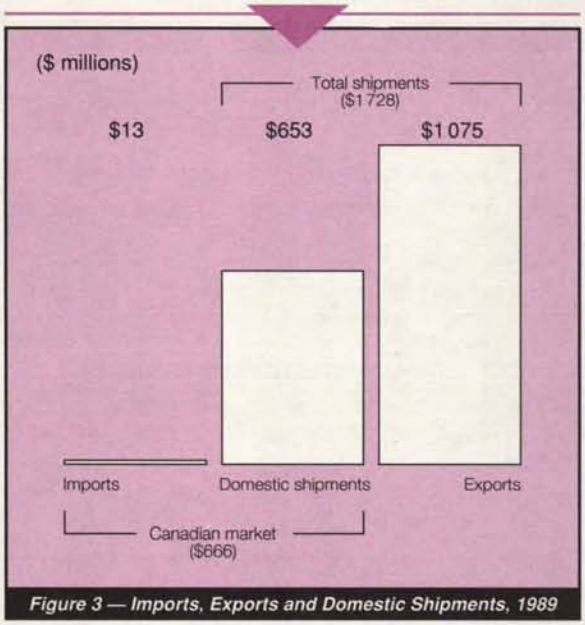

Figure 3 — Imports, Exports and Domestic Shipments, 1989

to about 9 percent below the 1979 level, while production increased to about 4 percent above the 1979 level. Production and consumption in 1979 were 6.9 million and 7.5 million tonnes, respectively (Figure 2).

Since then, world economic conditions have improved. By 1989, Western world consumption was 8.6 million tonnes, 14 percent above the 1979 level, while production was approximately 8.4 million tonnes, 20 percent above the 1979 level, leaving production only about 2.4 percent lower than consumption.

Among the developing countries, only Chile, Peru and the Philippines increased their integrated mining, smelting and refining capacity during the 1970s, when prices were high. In general, these countries did not cut back mining or smelting operations in subsequent times of low demand, thus adding to the downward pressure on prices. Chile is an exception among the developing countries, because its increased production is based on rich, low-cost ore bodies that generate profits even at depressed copper prices. During the same period, cutbacks were undertaken by North American producers.

Despite a decline in Canadian copper mine production in the late 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 during this period because of the increased use of scrap and imports of raw materials. While Canada's mine production increased by about 90 000 tonnes between 1980 and 1990, its share of world production decreased by one percentage point during the same period, to 10.9 percent. Although smelting and refining employment fell by approximately 11 percent from 1983 to 1984, the level of metal production was maintained, thus indicating increased productivity. Canada has no serious problem with availability of qualified workers for the copper smelting and refining industry.

Detailed information on the financial performance of the copper smelting and refining sector itself is not available, as companies' annual reports relate only to 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, reaching a level of $2.1 billion in 1988 and falling back to $1.7 billion in 1989.

Strengths and Weaknesses

Structural Factors

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

Table 2 — Canada-U.S. Copper Tariffs, 1 January 1991

Tariff item	Description	Base rate	
		Canada	U.S.
7402	Copper anodes	free	0.4%
7403	Refined, unwrought	free	0.4%
7404	Waste and scrap	free	free

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.

Inco and Falconbridge have integrated mining, smelting and refining operations. Hudson Bay and Noranda are custom smelters, principally processing domestic concentrates. Over the past 10 years, the Canadian copper smelting sector has processed most of the concentrates that have been produced by Canadian mines east of the Saskatchewan-Manitoba 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 profits obtained by selling to Japanese smelters. Some shipments from British Columbia to Quebec are made, but these must be regarded as exceptional.

A combination of strong prices, successful mine development and the value of contained precious metals has maintained eastern Canadian mine production. Mines Gaspé has recently announced an expansion of reserves, adding an additional three years of production to the mine and enhancing the supply position of the Murdochville smelter. This smelter is well situated on the Atlantic seaboard to compete with European smelters for international supplies of copper concentrates. Domestic sources are augmented by copper scrap for recycling and by relatively small quantities of imported American and other copper concentrates. The Rouyn-Noranda and Flin Flon smelters are largely dependent on successful Canadian exploration to ensure long-term future supplies.

The polymetallic ores of the Canadian Shield give Canadian producers an advantage, because they provide 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.

Trade-Related Factors

The tariffs for the items concerned in Canada-U.S. trade in the copper smelting and refining industry sector are set out in Table 2. Under the Canada-U.S. Free Trade Agreement (FTA), these tariffs will be phased out by 1993.

Under the FTA, 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.

While there are no tariffs imposed on concentrates, tariffs on metal are being used indirectly by some consuming countries to secure economic feedstocks for domestic smelters and refineries. Tariffs on refined, unwrought copper in Japan, Brazil, Korea and Taiwan range from 8 percent to 20 percent.

Neither Canada nor the European Community (EC) has tariffs or other trade barriers restricting trade in primary forms of copper metal. It is not anticipated that the economic integration of Europe after 1992 will have a significant effect on this sector, since the EC imports some 50 percent of its refined copper requirements.

Technological Factors

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

The Inco development of the copper flash smelting process in the early 1950s introduced a new era of effective, low-cost, more environmentally acceptable smelting. The Noranda process for copper smelting developed in the late 1960s features high productivity and flexibility with respect to feed materials and the possibility of controlling emissions. This process, along with the large scale of operation, has been essential to the survival of Noranda's Rouyn-Noranda smelter in the past few years.

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

Other Factors

Most copper minerals are sulphides. As a result, during the smelting process, sulphur dioxide (SO_2) fumes are released. These fumes contribute to acid rain. Conventional control consists of converting the SO_2 to sulphuric acid in an acid plant. Such plants recover a portion of the gas from the operations of Inco, Falconbridge and Noranda, but not at Hudson Bay's Flin Flon smelter. New regulations have been established that will lead to increased production of sulphuric acid recaptured from SO_2 gas emissions by Canadian smelters. These measures will also increase operating and capital costs. The tightening of environmental controls is a strong incentive for the development of new smelting processes that do not emit SO_2.

Evolving Environment

During the 1970s and into the mid-1980s, 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.

There are now signs that this trend is changing. While no new major uses for copper have been developed, new applications such as for fire sprinkler systems and natural gas systems as well as the increased intensity of copper use, most notably in the construction and automotive areas, are contributing to increased consumption.

Since its implementation, the FTA has not had a significant impact on either volume of production or level of employment in this industry sector, although the elimination of the existing U.S. tariff on primary copper will increase Canadian companies' profits by the amount of the tariff, which the companies currently absorb.

Under the FTA, when safeguard actions are taken in the future by either country, the other party to the agreement will be excluded from the action unless its imports are substantial and contribute significantly to serious injury or its threat. Canadian producers will no longer be sideswiped by actions primarily directed at other exporters; thus, the FTA may protect Canadian copper producers from future U.S. safeguard actions. Had the FTA 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 in 1978 and 1982.

The industry supports the implementation of the goods and services tax.

Competitiveness Assessment

As a result of up-to-date technology, economies of scale and access to economic transportation, Canadian companies with fully integrated mine-smelter-refinery operations are cost-competitive with companies elsewhere. However, because some high-cost developing countries produce 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.

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PRINCIPAL STATISTICS[a]

	1983	1984	1985	1986	1987	1988	1989
Establishments	9	9	9	10	10	10	10
Employment	4 500	4 000	4 000	4 000	4 000	4 000	4 000
Shipments of refined copper ($ millions)	949	1 007	908	992	1 159	1 695	1 728
(thousands of tonnes)	469	551	480	510	491	529	511
GDP[b] (constant 1981 $ millions)	1 600	1 930	2 069	2 039	2 192	2 345	2 306
Investment[c] ($ millions)	745	1 049	1 321	987	972	1 344	2 089
Profits after tax[d] ($ millions)	-279	-36	-209	89	779	2 138	1 723

[a]ISTC estimates, unless otherwise indicated.

[b]See *Gross Domestic Product by Industry,* Statistics Canada Catalogue No. 15-001, monthly. Data relate to total for industry group 295 (non-ferrous metal smelting and refining industries), not specifically to copper.

[c]See *Capital and Repair Expenditures, Manufacturing Subindustries, Intentions,* Statistics Canada Catalogue No. 61-214, annual. Data relate to total for industry group 295 and combine both capital and repair expenditures.

[d]Estimates relate to overall operation of the companies, not to copper smelting and refining operations only, and are taken from companies' annual reports.

TRADE STATISTICS[a]

	1983	1984	1985	1986	1987	1988	1989
Exports ($ millions)	599	632	519	594	652	802	1 075
Domestic shipments ($ millions)	350	375	389	398	507	893	653
Imports ($ millions)	56	49	39	43	35	12	13
Canadian market ($ millions)	406	424	428	441	542	905	666
Exports (% of shipments)	63.1	62.7	57.1	59.8	56.3	47.3	62.2
Imports (% of Canadian market)	13.7	11.5	9.1	9.7	6.5	1.3	1.9
Canadian share of international market (% of volume)	10	12	10	12	10	11	11

[a]ISTC estimates.

SOURCES OF IMPORTS[a] (% of total value)

	1983	1984	1985	1986	1987	1988	1989
United States	24.4	20.4	46.1	42.5	30.5	72.7	67.0
European Community	3.4	2.0	0.1	0.3	–	–	–
Asia	–	–	–	–	–	–	3.2
Other	72.2	77.6	53.8	57.2	69.5	27.3	29.8

[a]ISTC estimates.

DESTINATIONS OF EXPORTS[a] (% of total value)

	1983	1984	1985	1986	1987	1988	1989
United States	31.7	53.7	48.5	63.5	68.8	71.3	54.8
European Community	42.6	28.3	38.1	32.2	26.3	23.4	40.9
Asia	23.1	13.8	9.6	1.0	1.7	0.5	0.6
Other	2.6	4.2	3.8	3.3	3.2	4.8	3.7

[a]ISTC estimates.

REGIONAL DISTRIBUTION[a] (average over the period 1987 to 1989)

	Atlantic	Quebec	Ontario	Prairies	British Columbia
Refined copper production (% of total)	–	53.7	45.7	–	0.6
Employment (% of total)	–	55.9	38.1	5.9	0.1

[a]ISTC estimates.

MAJOR FIRMS

Name	Country of ownership	Principal shareholders	Location of major plants
Falconbridge Limited	Canada 50%	Noranda Inc. 50% Trelleborg A.B. Sweden 50%	Timmins, Ontario (S)(R) Sudbury, Ontario (S)
Gibraltar Mines Limited	Canada	Placer Dome Inc. 72%	Williams Lake, British Columbia (E)
Hudson Bay Mining and Smelting Co. Limited	United States 100% with South African control	Inspiration Resources Corp.	Flin Flon, Manitoba (S)
Inco Limited	Canada 46%		Sudbury, Ontario (S)(R)
Noranda Minerals Inc.	Canada 100%	Noranda Inc. 100%	Murdochville, Quebec (S) Rouyn-Noranda, Quebec (S) Montreal, Quebec (R)

(S) Smelter
(R) Refinery
(E) Electrowinning plant

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