

# Nickel

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**T**he stainless steel industry, which accounts for nearly 67% of nickel consumption, went through a period of de-stocking in 1996 and it was therefore a relatively slow year for nickel. World nickel consumption is estimated to have decreased to 936 100 t in 1996 from 983 900 t in 1995. World production, however, increased to 958 600 t, leaving the market in a slight surplus. Market fundamentals were reflected in the overall settlement price of nickel, which averaged US\$3.45/lb on the London Metal Exchange. A better year for nickel is expected in 1997 as the stainless steel industry completes its de-stocking phase and demand for stainless steel continues to increase.

## **CANADIAN OVERVIEW**

Canada's mine production of nickel increased to 193 100 t in 1996, up from 181 000 t in 1995. Canadian refined nickel production also increased to 127 000 t in 1996 from 121 500 t in 1995. These increases reflect capacity utilization increases at all three producers: Inco Limited, Falconbridge Limited and Sherritt International Corporation.

Canadian nickel production is expected to reach 197 000 t in 1997 as both Inco and Falconbridge further increase their capacity utilization and Sherritt completes its de-bottlenecking project. Over the next few years, Canadian nickel production will continue to increase with the addition of Falconbridge's Raglan project in late 1997 and Inco's McCreedy East, 1-D and Birchtree projects. Although a portion of this new production will be used to replace depleting orebodies, Canada's mine production of nickel is expected to reach 215 000 t/y by the end of the century. Then, Canadian nickel production is expected to increase substantially as the Voisey's Bay property begins production. Inco's Victor property, along with its Pipe Deep deposit, could also be in production

sometime in the new century. Canada's nickel production could reach 340 000 t/y by the year 2005.

## **Diamond Fields Resources Inc.**

On August 21, 1996, Inco completed the \$4.3 billion acquisition of Diamond Fields Resources Inc. The acquisition gives Inco control of the Voisey's Bay project located in northern Labrador. Voisey's Bay Nickel Company Limited (VBNC), a 100%-owned subsidiary of Inco, will be developing and operating the Voisey's Bay property.

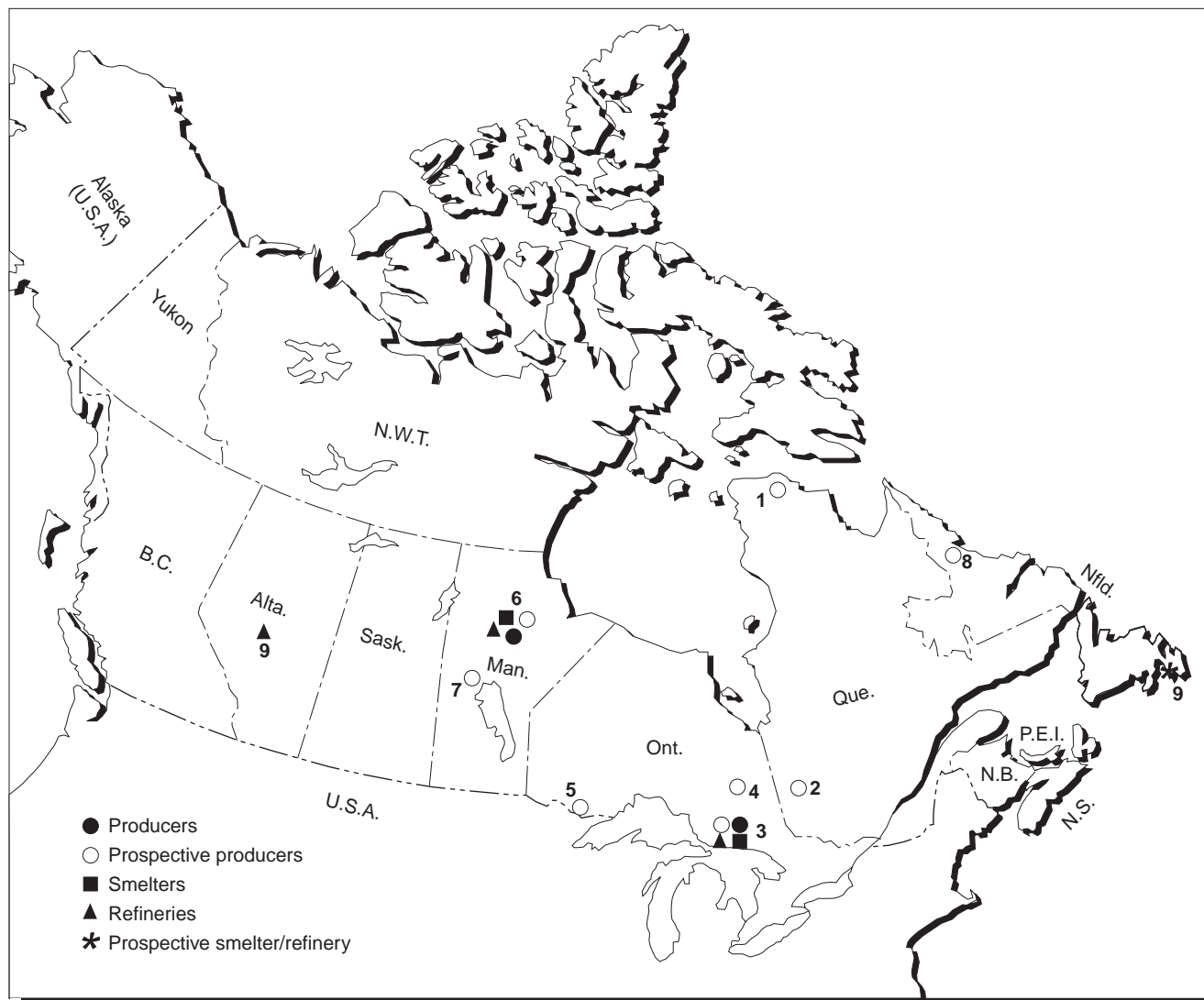
The takeover of Diamond Fields Resources by Inco was the largest acquisition in Canadian mining history. Following acceptance by Diamond Fields of Falconbridge Limited's \$4 billion bid on February 9, 1996, Inco submitted a bid for Diamond Fields on March 26, 1996. As a result, the Falconbridge-Diamond Fields arrangement was terminated on April 9, 1996, and Diamond Fields shareholders approved the Inco bid on May 22, 1996. However, Falconbridge received a non-completion fee of approximately \$73 million upon closure of the Inco-Diamond Fields arrangement. The completion of the Inco-Diamond Fields arrangement was halted for nearly three months due to a lawsuit filed against Diamond Fields by Exdiam Resources of Texas on May 14, 1996. The lawsuit was settled on August 20, 1996, when Diamond Fields agreed to pay Exdiam US\$25 million.

## **Inco Limited**

Inco produced an estimated 188 000 t of finished nickel in 1996, including an estimated 107 000 t from the Ontario Division, 37 000 t from the Manitoba Division, and 43 000 t of nickel in matte from P.T. International Nickel Indonesia (P.T. Inco). This was a 2% increase over 1995's production, but 8000 t below its scheduled 1996 production. Production was lower than planned in 1996 due primarily to a two-week work stoppage at Inco's Manitoba Division and a problem in P.T. Inco's No. 3 furnace. Inco's production is expected to be 195 000 t in 1997, which includes 109 000 t from the Ontario Division, 47 000 t from the Manitoba Division and 39 000 t from P.T. Inco.

Inco's Voisey's Bay nickel-copper-cobalt property, located 37 km from the community of Nain in northern Labrador, is believed to be the largest mineral

**Figure 1**  
**Nickel in Canada, 1996**



Numbers refer to locations on map above.

#### PRODUCERS

3. Falconbridge Limited (Craig, Fraser, Lindsley, Onaping, Lockerby, Strathcona)  
Inco Limited (Coleman, Copper Cliff North, Copper Cliff South, Crean Hill, Creighton, Froid, Little Stobie, McCreedy West, Garson, Stobie)
5. Inco Limited (Shebandowan)
6. North American Palladium Ltd. (Lac des Iles)
6. Inco Limited (Thompson, Birchtree)

#### SMELTERS

3. Falconbridge Limited (Falconbridge)  
Inco Limited (Copper Cliff)
6. Inco Limited (Thompson)

#### REFINERIES

3. Inco Limited (Sudbury)
6. Inco Limited (Thompson)
9. Sherritt International Corporation (Fort Saskatchewan)

#### PROSPECTIVE PRODUCERS

1. Falconbridge Limited (New Quebec Raglan)
2. Timmins Nickel Inc. (Dumont)
3. Inco Limited (Levack, Murray, Totten, McCreedy East, Victor)
4. Outokumpu Mines Ltd. (Moncalm Township)  
Timmins Nickel Inc. (Langmuir)  
Black Hawk Mining Inc. (Redstone)
6. Inco Limited (Soab North, Soab South, Pipe No. 1, Pipe No. 2)
7. Black Hawk Mining Inc. (Minago)
8. INCO Limited (Voisey's Bay mine site)

#### PROSPECTIVE SMELTER/REFINERY

9. INCO Limited (Voisey's Bay smelter/refinery), Argentina

find in Canada in 35 years. The projected mineral resource of the deposit, as of October 1996, was estimated at 150 Mt, including 32 Mt of proven reserves grading 2.83% nickel, 1.68% copper and 0.12% cobalt in the Ovoid portion of the property that is amenable to open-pit mining, and 50 Mt of indicated resources in the Eastern Deeps section grading 1.35% nickel, 0.67% copper and 0.09% cobalt.

Exploration on the property will be ongoing with an estimated \$20 million allocated by VBNC for exploration work over each of the next four years. The property will include both open-pit and underground mining operations, a mill with an initial capacity of 15 000 t/d of ore, and related facilities. The nickel concentrate will be shipped from Voisey's Bay to a smelter and refinery complex to be located in Argentia - Long Harbour, Newfoundland.

When Voisey's Bay reaches capacity, it is expected to produce about 122 500 t/y of nickel, or one third of Inco's planned world production. The capital costs of developing the mine, mill, smelter and refinery are estimated at US\$1.4 billion.

Inco's US\$72 million Victor advanced exploration project near Sudbury, including a feasibility study, is scheduled to be completed in the third quarter of 1998. Reserves to date there stand at 5.4 Mt grading 2.26% nickel and 0.54% copper in the upper zone (1500 m below surface) and 6.4 Mt grading 1.9% nickel and 5.1% copper in the lower zone (more than 2100 m below surface). Included in the project is the sinking of a 7.3-m-wide, 1770-m-deep shaft, development of 1675 m of exploration drifts, and development of 38 100 m of underground diamond drilling to the 2730-m horizon. A production rate of 17 000 t/y of contained nickel could begin by 2001.

Development work continued on the McCreedy East mine near Sudbury. Production from Phase I began in 1996 at a rate of 3500 t/y, and full production of 11 000 t/y is scheduled for 1999. The McCreedy East mine will become one of Inco's lowest cost Canadian mines. Phase I contains an estimated 15 Mt of ore grading 4.32% copper and 1.44% nickel, and has an expected mine life of 17 years. Engineering work is also being done on Phase II of the mine, which has an average combined nickel and copper grade of 2.79% and could produce an additional 11 000 t/y for 18 years.

In addition, engineering work is being conducted on Phase II of the Garson mine. The average combined nickel and copper grade of Phase II is 2.67% and production could be 10 000 t/y over a mine life of 16 years. The Garson mine re-opened in 1994 and Phase I is producing at a rate of 7000 t/y of contained nickel for an estimated 13 years.

The Manitoba Division and its 1400 United Steelworkers of America agreed to a new three-year contract at Thompson, Manitoba. The contract

increases wages, pensions and benefits, and also enables Inco to schedule shifts up to a maximum of 12 hours in its mines and utilities departments. The agreement followed a two-week work stoppage that began on September 16, 1996, and resulted in a production decrease of 3600 t.

Phase I of the Manitoba Division's 1-D orebody, which began production in 1995, is now producing at a rate of 9000 t/y of contained nickel. Its production is scheduled to increase to 14 000 t/y by 1999. A total of \$160 million has been spent on the project to date, with an additional \$9 million allocated for 1997. Phase I has an average grade of 2.51% nickel and an estimated mine life of 13 years. Engineering work is being done on Phase II of the 1-D orebody.

Work continued on the deepening of the Birchtree mine in Thompson, Manitoba. The deepening will access between 9 and 11 Mt of ore with an average combined nickel and copper grade of 2.02%. Production will start in late 1998 at a rate of 12 000 t/y of nickel for an estimated 23 years.

Inco reported earnings of US\$179 million for 1996 compared to US\$227 million in 1995. The decrease was primarily the result of lower realized metal prices. Inco's 1996 average realized nickel price was US\$3.61/lb, down from US\$3.86/lb in 1995.

## Falconbridge Limited

Falconbridge Limited's Canadian mine production of nickel was a record 42 100 t in 1996, up from 34 000 t in 1995. Its 1995 production was below schedule due to various disruptions and delays. The increased Canadian production, together with an increase in purchased matte, resulted in higher production at Falconbridge's refinery in Norway of 61 600 t, compared to 53 200 t in 1995. Production from Falconbridge's Dominican Republic operation was 30 400 t of nickel in ferronickel. Thus, Falconbridge's total nickel production was 92 000 t in 1996, compared to 84 100 t in 1995. Its production is estimated at 95 000 t for 1997.

Despite a higher production level in 1996, Falconbridge's reported earnings decreased to \$247.9 million from \$333 million in 1995. The production increase was offset by lower nickel and copper prices, a less favourable U.S. exchange rate, and lower precious-metal revenues. The company's average realized nickel price was US\$3.55/lb, down from US\$3.87/lb in 1995. The 1996 results included \$101.5 million paid by Diamond Fields under the Merger Offer Delivery Agreement, which includes \$73 million received as a non-compliance fee.

Development of Falconbridge's \$486 million Raglan nickel property in northern Quebec is proceeding ahead of schedule and on budget. Initial production will begin in late 1997 with full production of 20 000 t/y of nickel in concentrate scheduled for 1998.

Reserves at the property have been increased to 20.5 Mt grading 3.17% nickel and 0.88% copper through continued exploration. Concentrate from the Raglan operation will be shipped to Québec City and railed to Falconbridge's Sudbury smelter.

In preparation for the Raglan concentrate in 1998, Falconbridge is spending approximately \$80 million to upgrade its Sudbury smelter. The program will include the installation of four hoods in the converter aisle to reduce sulphur dioxide emissions. Falconbridge is also in the process of spending \$35.4 million to modernize and consolidate its entire smelting complex, which includes the construction of a world-class technology centre.

### Sherritt International Corporation

Sherritt International completed its first full year of operation in 1996, following a reorganization and transfer of properties from Sherritt Inc. in November 1995. Sherritt International's Fort Saskatchewan nickel output increased again in 1996 to 25 000 t of nickel from 23 300 t produced in 1995. The increase reflected improvements at both the Fort Saskatchewan refinery and at the Moa Bay mining and preliminary processing facility located in Cuba.

Work continued on the de-bottlenecking project at the Fort Saskatchewan refinery. The project will result in a total production capacity of 27 000 t/y of nickel and 2400 t/y of cobalt that is expected to be achieved in 1997.

### Other Canadian Developments

Production at Black Hawk Mining's Redstone nickel mine near Timmins, Ontario, was suspended in January 1996. The mine had been brought back into production in October 1995 at a capital cost of \$1 million, but lower-than-anticipated nickel prices forced the operation to close again.

In August, the Quebec government reported a nickel-copper-cobalt discovery near the city of Sept-Îles with surface samples grading 2% nickel, 2.3% copper and 0.1% cobalt. The Quebec government imposed a six-week staking freeze on an 800-km<sup>2</sup> area surrounding the discovery. The freeze was lifted on October 9, 1996, and the area was subsequently the site of a flurry of staking activity. By year-end, nearly 12 000 claims had been staked.

Outokumpu Mines Ltd. completed 1087 m of exploration ramp at its Montcalm property located west of Timmins, Ontario. A diamond drilling program began off the ramp in November. A total of 15 600 m of diamond drilling is scheduled with results to be available in September 1997. Drill-indicated reserves to date are estimated at 7.1 Mt grading 1.54% nickel and 0.72% copper.

Cameco Corporation built and operated a pilot plant in 1996 to evaluate the feasibility of recovering nickel and cobalt from uranium tailings at its Key Lake facility located in northern Saskatchewan. Based on the results from the pilot plant, a commercial plant is now being considered that could produce a total of 4000 t of nickel and 335 kg of cobalt over a 10-year period. Production is possible by 1999.

The Lac-des-Iles platinum group metals mine located near Thunder Bay produced an estimated 350 t of nickel in concentrate in 1996, all of which was processed at Falconbridge's Sudbury facilities. The mine is owned by North American Palladium Ltd.

## WORLD OVERVIEW

### Australia

Outokumpu and Mining Project Investors (MPI) started development work on the Silver Swan nickel project in Western Australia at a cost of A\$46 million. The property, with 440 000 t grading 14% nickel, will produce 12 000 t/y of nickel in concentrate for five years beginning in mid-1997. Mineable ore reserves are estimated to be 640 000 t grading 9.5% nickel. Additional reserves could be added to the Silver Swan production from the nearby Cygnet deposit that is currently being explored.

As part of the A\$1.3 billion expansion and upgrading project that began in 1991, Western Mining Corporation Holdings Limited (WMC) completed the construction of an A\$145 million sulphuric acid plant at its Kalgoorlie nickel smelter to reduce sulphur dioxide emissions by 90%. Also in 1996, construction was completed on the Goldfields gas transmission pipeline from the northwest coast of Australia to the Eastern Goldfields. By converting its power generation to natural gas, WMC's production costs and carbon dioxide emissions will decrease. WMC also expanded its Mt. Keith mine from 28 000 t/y of nickel in concentrate to 42 000 t/y in 1996. WMC's overall capacity now stands at 95 000 t/y of nickel in concentrate. Production in its 1995/96 fiscal year was 94 800 t of nickel in concentrate, compared to 83 500 t. Production from the Kalgoorlie smelter was up 6% to 77 300 t, and production from the Kwinana refinery was up 10.3% to 46 700 t.

Queensland Nickel Pty Ltd.'s Yabulu nickel refinery expansion was completed in 1996. Included in the expansion were two additional roasters and an electrostatic precipitator at a cost of A\$35 million, which allow its capacity to be increased by 10-15%. Late in 1996, Queensland Nickel completed an A\$47 million dedicated port facility in Townsville that will facilitate the handling of ore imported from New Caledonia and Indonesia. Disruptions in the ore supply from New Caledonia and Indonesia during the latter half of 1996 resulted in lower production from the Yabulu refinery.

Resolute Limited completed a bankable feasibility study of the Bulong Laterite Nickel Project located 30 km east of Kalgoorlie in Western Australia and began development of the project on the basis of a 550 000-t/y plant. Commissioning of the plant is expected to start in mid-1998. The total resource identified by detailed drilling currently stands at 140 Mt grading 1.0% nickel and 0.1% cobalt.

Gencor Ltd. and Forrestania Gold NL are involved in the 50/50 joint-venture exploration of the Lake Johnstone project in Western Australia, which includes the Maggie Hayes prospect. Encouraging drilling results will be followed up with further regional exploration.

### Botswana

BCL's production increased in 1996 to 24 200 t of nickel contained in matte as the result of the Phoenix mine opening in October 1995. Production is expected to be sustained at this level until the year 2000, at which time depletion of existing ore reserves will occur, after which production is expected to decrease to 20 000 t/y of nickel contained in matte by the year 2005.

### Brazil

RTZ Mineração Ltda (RTZ-CRA 100%) is developing its Fortaleza nickel sulphide deposit at a cost of US\$233 million. The property will produce 10 000 t/y of electrolytic nickel over a mine life of 20 years. The

property's reserves stand at 10 Mt grading 1.68% nickel, 0.33% copper and 0.04% cobalt. Commissioning is expected to begin in late 1997. Outokumpu is supplying detailed engineering and technical services for the flash smelter furnace along with its proprietary equipment.

Inco and Korea Zinc Co. Ltd. are in the process of conducting a US\$6 million engineering study on the Barro Alto laterite deposit located northwest of Brasilia. The plant would produce 18 000 t/y of nickel in matte over a mine life of 30 years. The deposit contains an estimated 36 Mt of proven and probable ore grading 1.94% nickel.

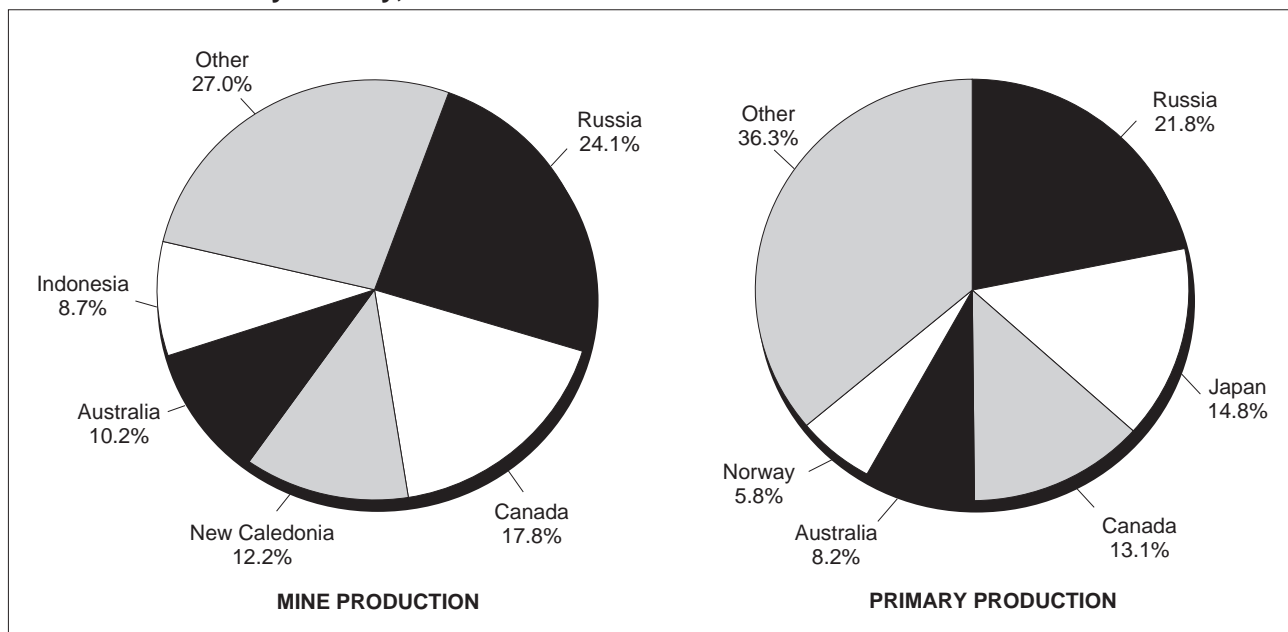
### China

China produced an estimated 43 400 t of primary nickel in 1996 compared to 38 100 t in 1995. China's consumption of nickel in 1996 was estimated at 40 000 t. The Jinchuan Nonferrous Metals Corporation is believed to have completed Phase II of its expansion project to increase its production to 40 000 t/y of nickel, 20 000 t/y of copper and 600 t/y of cobalt. The expansion, which began in 1988, includes a new flash furnace and a new sulphuric acid plant. The technology for the flash furnace was supplied by Outokumpu and WMC.

### Colombia

Cerro Matoso S.A., owned by Billiton International Ltd. (52.3%) and the Institute for Industrial

**Figure 2**  
**Nickel Production by Country, 1996**



Sources: Natural Resources Canada; International Nickel Study Group.

Development (47.7%), produced 22 900 t of nickel in ferronickel in 1996, down from the record 24 600 t produced in 1995. The decrease was due primarily to plant shut-downs, which included rebricking of the reduction kiln. Process improvements were also under way. One of these was a larger ore stockpile, to be increased from 30 000 t to 100 000 t, to allow better control over feed quality variations, which in turn is expected to improve output quality.

The Colombian government began selling its 47.7% stake in the operation. According to Colombian law, these shares must first be offered to union members, employees and pension funds. Gencor, who bought out Billiton in 1995, has expressed interest in increasing its ownership of Cerro Matoso.

## Cuba

Cuba produced 55 000 t of nickel in 1996 compared to 42 700 t in 1995. Production was up at all three operations, Moa Bay, Punta Gorda and Nicaro, due to process improvements and an incentive plan that pays cash bonuses to workers. Production is expected to increase again in 1997 to 66 000 t of contained nickel: 26 000 t from Moa Bay, 25 000 t from Punta Gorda, and 15 000 t from Nicaro.

Moa Bay is jointly owned by Sherritt International and the General Nickel Company S.A., a Cuban state company. An estimated US\$165 million is being spent between 1995 and 1999 on rehabilitating and sustaining the Moa Bay facilities. Improvements to the Moa Bay facility in 1996 included the refurbishment of two acid plants and related facilities.

WMC's wholly owned subsidiary, Westminer Holdings, continues working on evaluating the Pinares de Mayari West nickel deposit in the Holguin Province of Cuba. The deposit contains over 200 Mt of reserves grading more than 1% nickel and 0.1% cobalt. Gencor was negotiating with Geominera to carry out exploration on the state-owned San Felipe laterite nickel prospect.

## Dominican Republic

Production from Falconbridge Dominicana C por A was relatively unchanged over the previous years at 30 400 t of nickel in ferronickel compared to 30 900 t in 1995. Production is expected to remain at just under 31 000 t in 1997.

## Finland

Outokumpu's exploration program of the Kevitsa copper-nickel deposit in northern Finland is expected to last three years. A feasibility study is to be completed by the end of 2001. If warranted, mining could start by the end of 2004.

## Greece

General Mining and Metallurgical Co. S.A. LARCO produced 20 400 t of nickel in ferronickel in 1996, compared to 19 900 t in 1995. Work continued on trying to improve the company's financial situation.

## Indonesia

Inco began work on its US\$580 million P.T. Inco expansion to increase production capacity from 45 000 t/y of nickel in matte to 68 000 t/y by late 1998. The expansion includes the construction of a fourth smelting line at Soroako and additional hydro-electric generating capacity on the Larona River. Production decreased by 3200 t to 40 000 t in 1996 due to an eruption in the No. 3 furnace on September 10. The furnace was back in full production by the end of 1996. Production is expected to be around 39 000 t in 1997.

P.T. Aneka Tambang is considering doubling its capacity to 22 000 t/y of nickel in ferronickel. A smelter expansion was completed in 1995 that increased its capacity from 5500 t/y to 11 000 t/y of nickel in ferronickel. The company produced 11 000 t/y of nickel in 1996. Queensland Nickel, Gencor Ltd. and P.T. Aneka Tambang are investigating the feasibility of an integrated nickel and cobalt processing facility in Indonesia and Australia.

## Ivory Coast

Exploration work continued in 1996 on the Touba-Biankouma laterite property. In total, the global resource, in all categories, now stands at 226.3 Mt grading 1.50% nickel and 0.10% cobalt. The project is a joint venture between Falconbridge, the Société d'État pour le Développement Minier de la Côte d'Ivoire (SODEMI), and Trillion Resources of Canada. Falconbridge can earn a 60% interest in the project by funding and completing a feasibility study.

## Japan

Japanese nickel production was relatively unchanged in 1996 at 132 000 t, compared to 135 000 t in 1995. All three ferronickel producers, Sumitomo Metal Mining, Pacific Metals, and Nippon Yakin Kogyo, experienced little or no problems throughout the year.

## New Caledonia

Production from the Société Métallurgique Le Nickel's (SLN) operations was relatively unchanged at 42 200 t of nickel contained in ferronickel and nickel matte. An expansion project is planned that will increase its production to 60 000 t/y by the year 2000.

Falconbridge and its partner Société Minière du Sud Pacifique (SMSP) are considering a plan for a 55 000-t/y ferronickel plant in the North Province of the island. A scoping study was jointly prepared in 1996 and presented to the governments of France and New Caledonia. A minimum of 25 years of reserves is required at the planned production rate for the project to proceed. SMSP is currently involved in discussions with the French government regarding the required nickel reserves. Falconbridge is expected to begin further evaluation of the project once the additional reserves are available.

Queensland Nickel is forming a joint venture to mine lateritic ore in New Caledonia with Société des Mines de la Tontouta on a 2/3, 1/3 basis. The venture would supply approximately 1 Mt of ore to Queensland Nickel's Yakabindi refinery in Australia.

Inco continued work on its Goro nickel feasibility study. The deposit contains reserves of 165 Mt grading 1.6% nickel and 0.16% cobalt. Pressure acid leach technology is being considered.

## Norway

Output from Falconbridge Limited's Nikkelverk refinery increased to 61 600 t in 1996 from 53 200 t in 1995. Production was below normal in 1995 due to a decrease in custom feed materials. By 1998, its refining capacity will be increased from 69 000 t/y to 85 000 t/y to accommodate production from the Raglan operation located in northern Quebec.

## The Philippines

Stellar Metals Inc. controls approximately 20 000 ha of mineral claims hosting over 300 000 t of ore in three locations. Average grades are 1.4% nickel and 0.1% cobalt on the Palawan and Mindanao properties. Stellar is preparing to ship high-grade nickel saprolite to overseas smelters in 1997, and plans to form a joint venture with another company to construct a Philippines-based ferronickel smelter.

Interest still exists in purchasing the Nonoc nickel refinery that closed in 1986. Preliminary estimates indicate that the 30 000-t/y nickel operation could be refurbished for around US\$370 million. New exploration data have also suggested that the property contains a total resource of more than 81 Mt grading 1.16% nickel and 0.11% cobalt.

## Russia

Russian production of nickel remained relatively unchanged in 1996 at 199 000 t compared to 1995. Its production is expected to be relatively constant again in 1997 despite continued reports of financial difficulties resulting in strikes over unpaid wages and poor living conditions, along with a general lack of working capital for general care and maintenance of the facilities. These financial difficulties are in addition to the natural disadvantages of being

located in an Arctic setting with no permanent road links and high shipping costs. The mining complex supports a large urban complex, which adds to the operating costs. In addition to these ongoing problems, Norilsk is faced with the need to commit substantial resources to the modernization and maintenance of an adequately developed reserve base to support ongoing production. Consumption, which decreased dramatically after the break-up of the former Soviet Union in 1990, is also estimated to be relatively unchanged in both 1996 and 1997 at 36 000 t.

The renovation of the Pechenganikel smelter on the Kola Peninsula has not yet begun. The tender for the US\$250 million project had been awarded in 1993 to a consortium of Elkem Technology, Kvarner Engineering, and Boliden Contech. The project would have decreased the quantity of sulphur dioxide emitted, but it is not expected to begin because of funding difficulties.

Alexander Khloponin, a representative of Uneximbank, was appointed Chief Executive of RAO Norilsk Nickel in May 1996. This was the first major change initiated by Uneximbank since it obtained the right to manage the Russian government's 38% controlling interest in Norilsk in 1995. Uneximbank obtained the right to manage the government's share in Norilsk in exchange for a US\$170 million loan to the Russian government.

## South Africa

South Africa produced an estimated 36 000 t of nickel in 1996 as a co-product of platinum production, compared to 29 800 t in 1995. Anglovaal continued work on the Slaaihoek - Uitkomst/Nkomati joint-venture project in the Eastern Transvaal Province in which Anglovaal Limited holds a 75% interest and Anglo American Corporation holds the remaining 25%. The small high-grade property is expected to produce less than 5000 t/y of nickel in concentrate.

## Tanzania

Sutton Resources Ltd. continued exploration work on its Kabanga nickel deposit. Resource calculations completed in 1995 returned an estimation of 31 Mt grading 1.5% nickel, 0.23% copper and 0.13% cobalt at a 0.5% nickel cut-off grade. Various production alternatives will be considered.

## United States

Cominco Ltd.'s Glenbrook nickel smelter produced 15 100 t of nickel in ferronickel in 1996, an 81% increase over 1995. Glenbrook was re-opened during the second quarter of 1995. The U.S. Defense Logistics Agency sold 6183 t of nickel in 1996 compared to 8940 t in 1995. The allocation for sale in fiscal year 1996 (October 1995 to September 1996) is 9072 t. As of December 31, 1996, a total of 10 257 t of uncommitted nickel remained in the stockpile.

## Venezuela

Environmental approval has been received from state authorities on the Loma de Niquel ferronickel deposit, where reserves are estimated at 40 Mt grading 1.48% nickel. The project awaits funding. Capital costs are estimated at between US\$350 million and US\$400 million with operating costs estimated at US\$1.60/lb. If funding were to be secured, annual production of 16 000-18 000 t of nickel contained in ferronickel could start in mid-1999. The property is owned by Minorco SA (85%) and Corporacion Federal de Minas CA (COFEMINAS) (15%).

## Zimbabwe

Refined nickel production in Zimbabwe increased to an estimated 16 000 t in 1996 from 15 500 t in 1995 due primarily to increased matte shipments from Botswana.

Anglo American plans to raise its Bindura nickel refinery output to 20 000 t of nickel, of which 11 000 t of nickel in matte would come from Bindura itself, with the remaining coming from BCL in Botswana and as by-product nickel carbonate from Western Platinum Limited in South Africa. The development of Anglo's Hunters Road deposit could supply Bindura with an additional 6000 t/y of nickel ore at a development cost of between US\$60 million and US\$100 million.

Development work continued in 1996 on the Delta Gold N.L. and Broken Hill Proprietary Company Limited's Hartley platinum project. An estimated

3000 t/y of nickel will be produced as a by-product of platinum production. The project should reach full capacity by 1997.

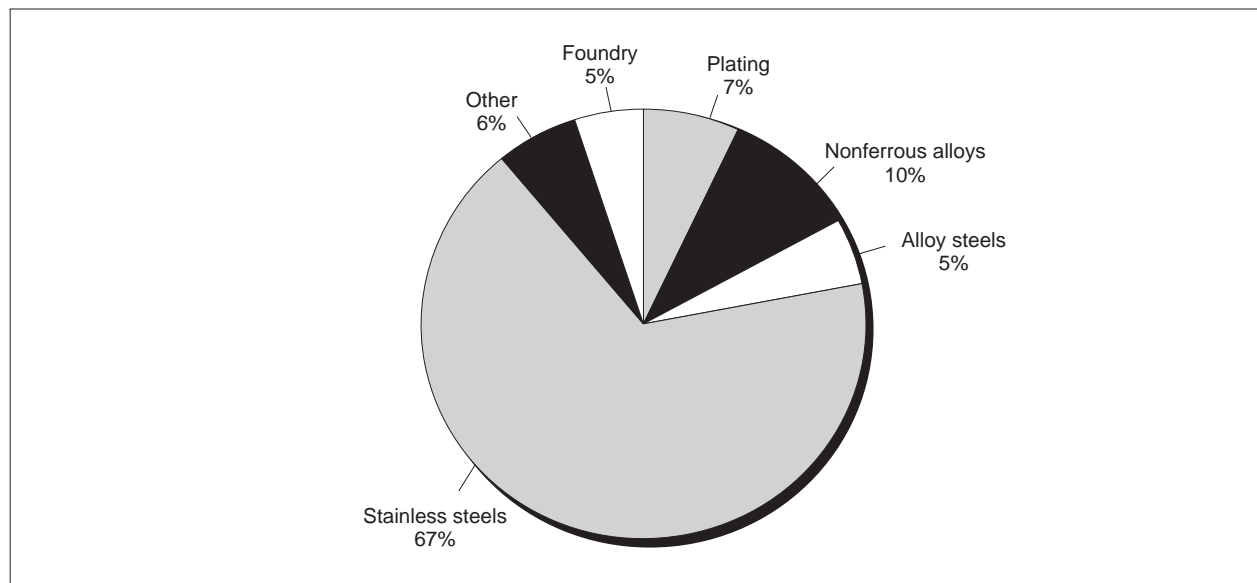
## THE INTERNATIONAL NICKEL STUDY GROUP

The International Nickel Study Group (INSG) is an autonomous intergovernmental organization based in The Hague, Netherlands. It was formed in 1991 to improve market information and to provide regular inter-governmental consultations on nickel markets and a forum for discussion of issues of concern to the industry. Membership is comprised of nickel-producing, consuming and trading countries, and Canada is an active member. At present, there are 15 member countries representing close to 80% of the world's nickel mine production, 65% of world nickel trade and 60% of world nickel consumption. The INSG publishes a monthly world nickel statistics bulletin that contains information on world nickel production, consumption and trade, along with a World Directory of Nickel Production Facilities.

## CHARACTERISTICS AND USES

Nickel is a hard, tough, greyish-white metallic element that ranks 24th in the abundance of elements found in the earth's crust. Its many desirable properties, particularly its resistance to corrosion in both acidic and basic environments, its high strength over a wide temperature range and its pleasing appear-

**Figure 3**  
Nickel, World Consumption by First Use



Source: Inco Limited.



ance, have resulted in its wide application in both the alloyed and unalloyed state.

Along with chromium, nickel is alloyed with iron to produce stainless steels that account for approximately 67% of the primary nickel consumed. Secondary sources such as scrap stainless steel compete with primary nickel and ferronickel in making stainless steel. Stainless steels are used in a wide variety of applications, primarily for their resistance to corrosion, strength, and ease of cleaning. Their applications include use in chemical and food processing equipment; petroleum refining equipment; tanks for road, rail and sea transportation of various liquids; household goods; surgical equipment; and building facings and trim.

Stainless steels can contain varying quantities of nickel, but must have at least 10% chromium. The addition of large quantities of nickel, usually between 7 and 12%, changes the crystal structure of the steel to austenitic, making the steel non-magnetic. This type of stainless steel is thus called austenitic stainless steel and is widely referred to as 18/8 due to the most common content of chromium (18%) and nickel (8%). Austenitic stainless steel is readily fabricated and welded, and accounts for three quarters of all stainless steel produced.

Nickel is used as an alloying agent and is a component in some 3000 different alloys that are used in more than 250 000 end-use applications. When nickel is alloyed with other metals such as chromium, its high-temperature performance makes it indispensable to the aerospace industry, specifically in gas turbine aircraft engines. When alloyed with metals such as molybdenum or copper, its resistance to corrosion makes it essential in aggressive chemical processes, the petroleum industry, and nuclear power plants. These highly corrosion-resistant nickel alloys have been the overwhelming choice in environmental equipment such as flue-gas desulphurization scrubbers.

In an unalloyed state, nickel is used for the plating of automotive products and household appliances. The use of zinc-nickel coatings can provide five to six times more resistance to road salt corrosion than ordinary galvanized steel.

The chemical properties of nickel enable it and some of its salts to be used as catalysts in the chemical industry. It is also used in the production of batteries and fuel cells, in carbide and hard-facing materials, and in ceramics to form a bond between the enamel and metal, as well as in the manufacturing of colours and pigments. Although nickel has been used in coinage, its use is slowly decreasing as countries are replacing nickel coins with coins made of other metals or metal alloys.

At present, Japan, the United States and Germany account for nearly 50% of all nickel consumed in the

world. However, China, Taiwan, Korea and other growing economies have experienced tremendous growth in nickel consumption over the past few years, resulting in an increase in Asia's share of the world's consumption of nickel from 27% in 1991 to 38% in 1996. It is expected that Asia will continue to be an above-average growth market for nickel over the next few years with stainless steel accounting for the increase.

## HEALTH AND THE ENVIRONMENT

Nickel is a naturally occurring element that exists in all soils and is believed to make up a large percentage of the earth's core. Nickel is also considered to be an essential element for plants and most animals. In fact, nickel has been proven to be an absolute growth requirement for certain types of bacteria and algae, and nickel deficiencies in animals have been linked to growth retardation. Besides being an essential element for plants and many animals, it is the view of many experts that nickel is likely an essential element for humans as well.

The average human body contains an estimated 7-10 mg of nickel, with nickel also being present in human fetal tissue. Food is the major route for nickel intake by humans. It has not been shown that ingested nickel is a cause of cancer in humans or that ingestion makes people sensitive to nickel. The principal health risks associated with oxidic, sulphidic and soluble nickel compounds include lung or nasal cancer and contact dermatitis.

Nickel dermatitis is caused through long-term direct or indirect contact of the skin with certain nickel-containing items that can dissolve in sweat and penetrate the skin. However, many nickel alloys, including stainless steels, do not react with sweat and therefore do not cause a nickel allergy. It is estimated that 10-20% of women and 1-2% of men are "sensitive" to nickel, with nickel dermatitis being one of the principal adverse health effects associated with nickel.

In the past, increased rates of lung and nasal cancers were experienced by personnel employed in certain dusty nickel-processing facilities where most of the workers involved were also exposed to other substances in the dust and where tobacco smoking was a compounding factor.

## PRICES AND STOCKS

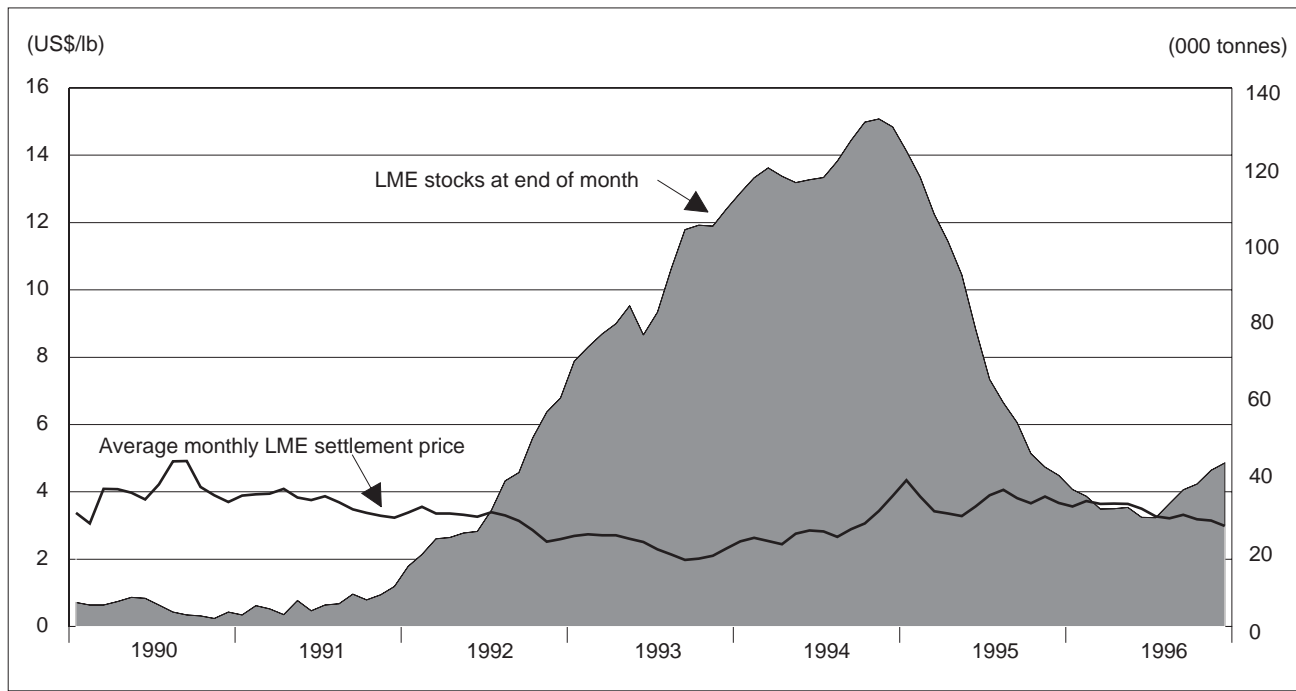
Despite the decrease in consumption and increase in production, the nickel market is expected to have only a slight surplus in 1996. The average London Metal Exchange (LME) settlement price for nickel, however, is estimated to decrease in 1996 to US\$3.45/lb, compared to US\$3.74 in 1995. The decrease in price reflects a decrease in nickel demand. The nickel price

**Figure 4**  
**London Metal Exchange Nickel Settlement Prices, 1993-96**



Source: Natural Resources Canada.

**Figure 5**  
**Nickel, LME Monthly Settlement Price and LME Stocks, 1990-96**



Source: Natural Resources Canada.

was somewhat higher in the first few months of 1996 than fundamentals dictated, due in part to investment fund activity and a decrease in LME stocks. LME stocks decreased from 40 700 t at the beginning of the year to 32 300 t in July, despite the decrease in nickel consumption. The reason for the decrease in stocks is not known. It could have been due to nickel producers covering their sales contracts, expanding stainless producers stocking up, or a build-up in off-warrant nickel stocks that are not recorded as official LME inventories.

The nickel price is forecast to be somewhat higher in 1997, around US\$3.85/lb, as de-stocking of stainless steel is completed and demand for primary nickel increases. The long-term cash price for nickel is forecast to be between US\$3.25 and US\$3.75/lb in real terms.

## CONSUMPTION AND PRODUCTION

World nickel consumption decreased in 1996 to 936 100 t, compared to 983 900 t in 1995. The decrease is due to a decrease in stainless steel production and an increase in the availability of stainless steel scrap. Real demand for stainless steel has increased, but a build-up of stainless steel stocks

forced producers to cut back, thereby cutting back on the quantity of primary nickel consumed. Nickel consumption is expected to increase in 1997 to 1 007 000 t as demand for stainless steel continues to increase and the de-stocking of stainless steel is completed.

The long-term outlook for nickel consumption is very good; it is forecast to increase at an overall rate of 2%. Stainless steel demand is expected to increase in developing regions such as China, Taiwan and South Korea. Additional growth potential exists in countries undergoing their transition from centrally planned to free market economies in Eastern Europe. The use of nickel in batteries is also seen as a growth market.

World primary nickel production increased in 1996 to 958 600 t, and is expected to increase again in 1997 to 1 004 000 t. These increases are primarily due to increased production at existing operations. New capacity, through both greenfield projects and capacity expansions at existing operations, will be coming on stream in 1998.

*Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 70. (2) Information in this review was current as of January 31, 1997.*

### TARIFFS

Item No.	Description	Canada			United States Canada	EU MFN	Japan <sup>1</sup> GATT	Brazil UR	India UR	Taiwan 1996	Korea UR, 1997
		MFN	GPT	USA							
2604.00	Nickel ores and concentrates	Free	Free	Free	Free	Free	Free			Free	1%
2825.40.00	Nickel oxides and hydroxides	Free	Free	Free	Free	Free	5.4%		40%	5%	8%
7202.60.00	Ferronickel	8.1%	4.0%	Free	Free	Free	5.2%	6%		5%	5%
7501.10	Nickel mattes	Free	Free	Free	Free	Free	Free		40%	Free	2%
7501.20	Nickel oxide sinters and other intermediate products of nickel metallurgy	Free	Free	Free	Free	Free	Free-66.2 yen/kg <sup>2</sup>			Free	2%
7502.10	Unwrought nickel, not alloyed	Free	Free	Free	Free	Free	66.2 yen/kg	6%	25%	1.25%	5%
7502.20	Unwrought nickel alloys	Free	Free	Free	Free	Free	Free-6.6% <sup>3</sup>		40%	1.25%	5%
7503.00	Nickel waste and scrap	Free	Free	Free	Free	Free	Free		40%	Free	1%
7504.00.10	Nickel powders containing by weight 60% or more of nickel	Free	Free	Free	Free	Free	Free	6%	40%	Free	5%
7504.00.20	Nickel powders containing by weight less than 60% of nickel; flakes	Free	Free	Free	Free	Free	55.4 yen/kg-4.8%			Free	5%
7505.11	Bars, rods and profiles of nickel, not alloyed	Free	Free	Free	Free	1.8%	5.5%			2.5-5%	8%
7505.12	Bars, rods and profiles of nickel alloys	Free	Free	Free	Free	3.5%	4.7%			2.5-5%	8%
7505.21	Nickel wire, not alloyed	Free	Free	Free	Free	1.8%	5.5%			2.5%	8%
7505.22	Wire of nickel alloys	Free-1.6%	Free	Free	Free	3.5%	4.7%			2.5%	8%
7506.00	Nickel plates, sheets, strip and foil	Free-3.6%	Free-1%	Free	Free	2-3.9%	Free-5.5%			5%	8%
7507.00	Nickel tubes, pipes, and tube or pipe fittings	Free-5.9%	Free-3%	Free	Free	2.1-3%	3.9-5.5%			5%	8%
7508.00	Other articles of nickel	Free-6.2%	Free-4%	Free-1.1%	0.4-0.5% <sup>4</sup>	1.8%	5.2%			2.5-7.5%	8%

Sources: Customs Tariff, effective January 1997, Revenue Canada; Harmonized Tariff Schedule of the United States, 1997; The "Bulletin International des Douanes," Journal Number 14 (18th Edition), European Union, 1995-1996, "Conventional" column; Customs Tariff Schedules of Japan, 1996, "WTO" column.

<sup>1</sup> GATT rate is shown; lower tariff rates may apply circumstantially. <sup>2</sup> Free except for nickel oxide sinters containing by weight not less than 88% nickel, for which the tariff rate is 66.2 yen/kg, and nickel oxide containing by weight not more than 1.5% copper, for which the tariff rate is 5.5%. <sup>3</sup> Tariff rate of 6.6% applies to nickel alloys other than those containing by weight less than 50% of nickel and not less than 10% of cobalt. <sup>4</sup> Lower tariff rates may apply circumstantially.

Note: UR = Uruguay Round Most Favoured Nation rates; the final rate in place by January 1, 1999.

TABLE 1. CANADA, NICKEL PRODUCTION AND TRADE, 1995 AND 1996

Item No.	1995		1996P		
	(tonnes)	(\$000)	(tonnes)	(\$000)	
<b>PRODUCTION<sup>1</sup></b>					
	All forms				
	Ontario	133 864	1 580 268	148 818	1 579 105
	Manitoba	38 243	451 459	35 731	379 139
	Total	172 107	2 031 727	184 548	1 958 243
	Refined	121 523	—	126 593	—
<b>EXPORTS</b>					
2604.00	Nickel ores and concentrates, nickel content				
	United States	—	—	...	7
	Total	—	—	...	7
2825.40	Nickel oxides and hydroxides				
	United States	624 <sup>f</sup>	9 144 <sup>f</sup>	635	9 655
	Singapore	323	4 368	365	5 159
	Belgium	292	4 131	273	3 959
	Taiwan	261	4 310	219	3 809
	China	201	3 249	246	3 754
	Mexico	22	404	77	1 317
	Other countries	200	3 176	137	2 234
	Total	1 923 <sup>f</sup>	28 782 <sup>f</sup>	1 952	29 887
7202.60	Ferronickel				
	Taiwan	65	679	—	—
	Total	65	679	—	—
7501.10	Nickel mattes				
	United Kingdom	39 799	467 716	43 195	497 425
	Norway	29 705	380 625	40 462	453 339
	United States	21	240	—	—
	Total	69 525	848 581	83 657	950 764
7501.20	Nickel oxide sinters and other intermediate products of nickel metallurgy				
	South Korea	4 289	30 499	7 664	76 425
	Taiwan	3 175	28 979	3 710	37 465
	United States	511	5 318	479	4 867
	Belgium	390	4 686	351	3 870
	Singapore	672	7 937	336	3 687
	Other countries	145	1 287	45	466
	Total	9 182	78 706	12 585	126 780
7502.10	Nickel unwrought, not alloyed				
	United States	42 944	469 225	47 970	511 184
	Belgium	14 412	163 585	14 404	159 063
	Taiwan	5 921	63 781	9 607	101 781
	Netherlands	2 638	30 028	3 807	35 719
	Japan	4 836	55 459	3 402	34 782
	China	2 033	22 314	3 007	34 367
	Germany	1 904	39 648	2 887	29 222
	Singapore	1 667	18 805	1 498	15 351
	South Korea	1 941	20 552	1 453	15 225
	Switzerland	—	—	1 500	14 879
	Spain	948	10 327	1 168	13 337
	Hong Kong	1 020	11 050	1 217	12 070
	Other countries	4 169	48 374	5 133	55 174
	Total	84 433	953 148	97 053	1 032 154
7502.20	Nickel unwrought, alloyed				
	United States	1 075	13 186	75	817
	Singapore	19	241	...	3
	Belgium	225	3 246	—	—
	Other countries	106	1 332	—	—
	Total	1 425	18 005	75	820
7503.00	Nickel waste and scrap				
	United States	2 903	19 474	2 223	8 830
	Japan	43	244	181	547
	United Kingdom	61	188	57	148
	Kyrgyzstan	—	—	19	64
	Other countries	132	322	—	—
	Total	3 139	20 228	2 480	9 589
7504.00	Nickel powders and flakes				
	United States	6 459 <sup>f</sup>	94 780 <sup>f</sup>	6 660	96 370
	Japan	3 316	42 901	3 344	42 322
	Belgium	613	7 593	685	8 649
	China	778	12 401	458	7 291
	Netherlands	405	4 708	440	5 084
	Singapore	193	3 562	173	2 733
	Other countries	493	8 598	512	8 672
	Total	12 257 <sup>f</sup>	174 543 <sup>f</sup>	12 272	171 121

TABLE 1 (cont'd)

Item No.	1995		1996p	
	(tonnes)	(\$000)	(tonnes)	(\$000)
<b>EXPORTS (cont'd)</b>				
7505.11	Bars, rods and profiles of nickel, not alloyed			
	United States	–	–	10
	Total	–	–	10
7505.12	Bars, rods and profiles of nickel alloy			
	United States	1	17	390
	Other countries	1	13	19
	Total	2	30	409
7505.21	Nickel wire, not alloyed			
	United States	4	38	30
	Total	4	38	30
7505.22	Wire, nickel alloy			
	United States	61	1 052	1 731
	Other countries	13	82	–
	Total	75	1 134	1 731
7506.00a	Nickel plates, sheets, strip and foil			
	United States	93	1 585	306
	Poland	15	180	226
	Other countries	3	41	88
	Total	111	1 806	620
7507.00b	Nickel tubes, pipes, and tube or pipe fittings			
	United States	..	4 740 <sup>r</sup>	4 672
	Saudi Arabia	–	–	69
	Other countries	..	258	98
	Total	..	4 998 <sup>r</sup>	4 839
7508.00	Other articles of nickel			
	United States	..	4 151 <sup>r</sup>	4 807
	Singapore	..	12	191
	Netherlands	..	172	143
	Other countries	..	601	505
	Total	..	4 936 <sup>r</sup>	5 646
<b>IMPORTS<sup>2</sup></b>				
2604.00.00.20	Nickel ores and concentrates, nickel content			
	Australia	1 490	11 424	915
	United States	968	5 344	929
	Canada	–	–	190
	Other countries	16	92	82
	Total	2 474	16 860	2 116
2825.40	Nickel oxides and hydroxides			
	United States	139	1 491	106
	Finland	41	496	82
	Total	180	1 987	188
7202.60	Ferronickel			
	United States	–	–	64
	Russia	632	2 616	–
	Total	632	2 616	64
7501.00c	Nickel mattes, nickel oxide sinters and other intermediate products of nickel metallurgy			
	Cuba	33 987	237 874	46 134
	Australia	6 392 <sup>r</sup>	62 632 <sup>r</sup>	1 016
	South Africa	–	–	2 451
	United States	4 284	8 665	5 232
	Sweden	701	1 558	732
	Poland	450 <sup>r</sup>	675 <sup>r</sup>	518
	China	758	5 237	79
	United Kingdom	101 <sup>r</sup>	149 <sup>r</sup>	235
	Other countries	1 159	1 305	346
	Total	47 834 <sup>r</sup>	318 095 <sup>r</sup>	56 743
7502.10	Nickel unwrought, not alloyed			
	Norway	2 276	22 430	2 626
	Russia	443	5 233	619
	United States	1 041	10 993	309
	United Kingdom	1 622	19 435	97
	Other countries	550	6 386	96
	Total	5 932	64 477	3 747
				37 362

TABLE 1 (cont'd)

Item No.		1995		1996P	
		(tonnes)	(\$000)	(tonnes)	(\$000)
<b>IMPORTS (cont'd)</b>					
7502.20	Nickel unwrought, alloyed				
	United States	1 221	4 810	2 615	12 810
	United Kingdom	38	520	68	1 038
	Russia	56	775	18	198
	Other countries	61	532	1	15
	Total	1 376	6 637	2 702	14 061
7503.00	Nickel waste and scrap				
	United States	19 538	38 378	13 895	43 900
	United Kingdom	757	5 175	975	6 014
	Germany	397	1 528	528	1 326
	Netherlands	534	2 363	340	1 185
	Other countries	691	4 310	314	1 233
	Total	21 917	51 754	16 052	53 658
7504.00	Nickel powder and flakes				
	United Kingdom	175	1 881	1 819	20 178
	Australia	922	10 930	1 003	10 664
	United States	696	6 943	709	5 475
	Russia	1	13	213	2 706
	Finland	121	1 438	122	1 433
	Other countries	31	477	75	822
	Total	1 946	21 682	3 941	41 278
7505.11	Bars, rods and profiles of nickel, not alloyed				
	United States	10	180	6	117
	Other countries	...	4	...	3
	Total	10	184	6	120
7505.12	Bars, rods and profiles of nickel alloys				
	United States	276	6 307	290	6 597
	United Kingdom	13	351	17	422
	Germany	2	46	10	138
	Other countries	8	116	1	30
	Total	299	6 820	318	7 187
7505.21	Nickel wire, not alloyed				
	Japan	12	99	20	147
	United States	9	103	5	86
	Other countries	23	399	...	14
	Total	44	601	25	247
7505.22	Wire, nickel alloy				
	United States	298	6 085	369	6 748
	Germany	55	872	58	1 150
	Sweden	2	51	3	59
	Other countries	9	157	4	106
	Total	364	7 165	434	8 063
7506.00	Nickel plates, sheets, strip and foil				
	United States	759	16 480	905	16 810
	Germany	208	3 708	145	2 717
	United Kingdom	2	45	97	1 293
	Japan	33	168	55	399
	Other countries	13	450	48	568
	Total	1 015	20 851	1 250	21 787
7507.00	Nickel tubes, pipes, and tube or pipe fittings				
	Japan	751	47 264	404	36 260
	United States	473	10 189	538	12 778
	United Kingdom	18	431	53	1 407
	Germany	18	492	35	883
	Sweden	34	732	28	561
	Italy	9	205	23	429
	Other countries	168	7 681	2	75
	Total	1 471	66 994	1 083	52 393

TABLE 1 (cont'd)

Item No.	1995		1996 <sup>P</sup>		
	(tonnes)	(\$000)	(tonnes)	(\$000)	
<b>IMPORTS (cont'd)</b>					
7508.00	Other articles of nickel				
	Germany	198	3 863	1 383	27 405
	United States	373	7 281	504	10 650
	France	927	7 437	534	4 579
	China	13	123	122	910
	United Kingdom	18	382	24	551
	Other countries	96	755	41	386
	Total	1 625	19 841	2 608	44 481

Sources: Natural Resources Canada; Statistics Canada.

- Nil; . . Not available or not applicable; . . . Amount too small to be expressed; <sup>P</sup> Preliminary; <sup>r</sup> Revised.<sup>a</sup> Included in the data are HS codes 7506.10 and 7506.20. <sup>b</sup> Included in the data are HS codes 7507.11, 7507.12 and 7507.20.<sup>c</sup> Included in the data are HS codes 7501.10 and 7501.20.<sup>1</sup> Recoverable nickel in concentrates shipped. <sup>2</sup> Imports from "Other countries" may include re-imports from Canada.

Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, NICKEL PRODUCTION AND CONSUMPTION, 1970, 1975, 1980 AND 1985-96

	Production <sup>1</sup>	Consumption <sup>2</sup>
	(mine output)	
	(tonnes)	
1970	277 490	10 699
1975	242 180	11 308
1980	184 802	9 676
1985	169 971	7 206
1986	163 640	8 865
1987	193 391	9 732
1988	216 589	9 250
1989	200 899	10 421
1990	196 225	8 410
1991	192 259	10 322 <sup>a</sup>
1992	186 384	12 528
1993	188 080	13 884 <sup>a</sup>
1994	149 886	16 746 <sup>r</sup>
1995 <sup>r</sup>	181 820	16 815 <sup>P</sup>
1996 <sup>b</sup>	193 059	. .

Source: Natural Resources Canada.

. . Not available; <sup>P</sup> Preliminary; <sup>r</sup> Revised.<sup>a</sup> Increase in number of companies being surveyed. <sup>b</sup> Total of monthly reported production for 1996.<sup>1</sup> Refined nickel and nickel in oxides and salts produced, plus recoverable nickel in matte and concentrates exported. Data for 1987-96 are nickel contained in concentrates produced.<sup>2</sup> Consumption of metallic nickel, all forms (refined metal, and in ferronickel oxides and salts) as reported by consumers on the Natural Resources Canada survey "Consumption of Nickel."

TABLE 3. CANADIAN PROCESSING CAPACITY, 1996

	Inco Limited		Falconbridge Limited	Sherritt International Corporation
	Sudbury	Thompson	Sudbury	Fort Saskatchewan
	(t/y of contained nickel)			
Smelter	100 000	63 000	45 000	n.a.
Refinery	59 000	55 000	n.a.	25 000

Source: Natural Resources Canada.

n.a. Not applicable.

**TABLE 4. WORLD MINE PRODUCTION OF NICKEL, 1994-96**

	1994	1995	1996
	(000 tonnes)		
Russia	212.0	251.0	257.0
Canada	149.9	181.0	193.1
New Caledonia	97.3	120.7	124.4
Australia	75.9	104.0	113.0
Indonesia	81.2	86.6	87.9
Cuba	26.0	42.7	55.0
People's Republic of China	36.9	42.2	47.4
South Africa	30.1	29.8	33.3
Dominican Republic	30.8	30.9	30.4
Brazil	20.1	19.2	20.5
Other	115.4	115.0	110.5
Total	876.5	1 023.1	1 068.1

Sources: Natural Resources Canada; International Nickel Study Group.

**TABLE 5. WORLD PRIMARY PRODUCTION OF NICKEL, 1994-96**

	1994	1995	1996
	(000 tonnes)		
Russia	180.9	200.0	199.0
Japan	112.6	135.0	131.7
Canada	105.1	121.5	126.6
Australia	66.6	76.9	74.0
Norway	68.0	53.2	61.6
New Caledonia	39.5	42.2	42.2
People's Republic of China	31.3	38.1	43.4
United Kingdom	28.4	39.0	39.0
Dominican Republic	30.8	30.9	30.7
South Africa	30.1	29.8	33.3
Other	131.3	152.2	176.7
Total	824.6	918.8	958.6

Sources: Natural Resources Canada; International Nickel Study Group.

**TABLE 6. WORLD CONSUMPTION OF NICKEL, 1994-96**

	1994	1995	1996
	(000 tonnes)		
Japan	181.1	205.1	187.3
United States	133.8	159.0	154.4
Germany	87.8	93.9	77.5
Taiwan, China	26.0	48.0	50.0
Republic of Korea	39.0	44.0	46.0
Italy	44.0	49.0	44.0
United Kingdom	38.0	43.0	42.2
People's Republic of China	40.0	40.2	42.0
France	45.6	48.5	41.8
Russia	37.5	36.2	35.0
Other	192.9	216.9	215.9
Total	865.7	983.3	936.1

Sources: Natural Resources Canada; International Nickel Study Group.



**TABLE 7. AVERAGE ANNUAL NICKEL PRICES, 1986-96**

	London Metal Exchange Settlement Price	
	(US\$/lb)	
1986	1.76	
1987	2.21	
1988	6.28	
1989	6.05	
1990	4.03	
1991	3.70	
1992	3.18	
1993	2.40	
1994	2.88	
1995	3.74	
1996	3.40	

Source: Natural Resources Canada.

**TABLE 8. AVERAGE MONTHLY NICKEL PRICES, 1994-96**

	London Metal Exchange Settlement Price		
	1994	1995	1996
	(US\$/lb)		
January	2.53	4.35	3.57
February	2.64	3.86	3.73
March	2.54	3.42	3.64
April	2.45	3.36	3.65
May	2.76	3.28	3.64
June	2.85	3.57	3.50
July	2.83	3.90	3.27
August	2.66	4.06	3.22
September	2.89	3.81	3.32
October	3.06	3.66	3.19
November	3.43	3.66	3.15
December	3.88	3.87	2.99

Source: Natural Resources Canada.

**TABLE 9. LME MONTHLY STOCKS, 1994-96**

	1994	1995	1996
		(000 tonnes)	
January	128.8	141.3	40.7
February	133.3	133.5	38.6
March	136.3	122.4	34.9
April	133.8	114.4	35.0
May	132.0	104.5	35.4
June	132.7	88.5	32.4
July	133.3	73.4	32.8
August	138.2	66.5	36.6
September	144.5	60.5	40.6
October	149.8	51.4	42.4
November	150.7	47.3	46.4
December	148.4	44.9	48.9

Source: Natural Resources Canada.