Magnesium

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	2000	2001	2002	2003
		($ millions)		
Exports (1, r)	205	176	267	188
Imports (1, r)	139	123	114	110

(r) Revised.
(1) Exports and imports given here include those classified as HS Code 8104.

	2000	2001	2002	2003 (f)
		(tonnes)		
Primary metal production capacity (1,e)	50 500	59 500	70 000	56 000
Exports (HS 8104) (r)	47 182	43 295	71 244	58 632
Imports (HS 8104) (r)	33 851	32 870	34 895	37 937

(e) Estimated; (f) Forecast; (r) Revised.
(1) Canadian magnesium production data are confidential due to the limited number of companies reporting. This number is based on published capacity for primary metal. Note that other published estimates of Canadian magnesium production include quantities of recycled material.

CANADIAN DEVELOPMENTS

Producers

Canadian primary magnesium metal production capacity fell in 2003 by 20% to approximately 56 000 t/y after Magnola Metallurgy Inc. closed its Danville, Quebec, smelter. In 2003, Canada ranked second after China in magnesium production capacity, exporting $188 million worth of magnesium metal and metal products, down 30% from $267 million in 2002.

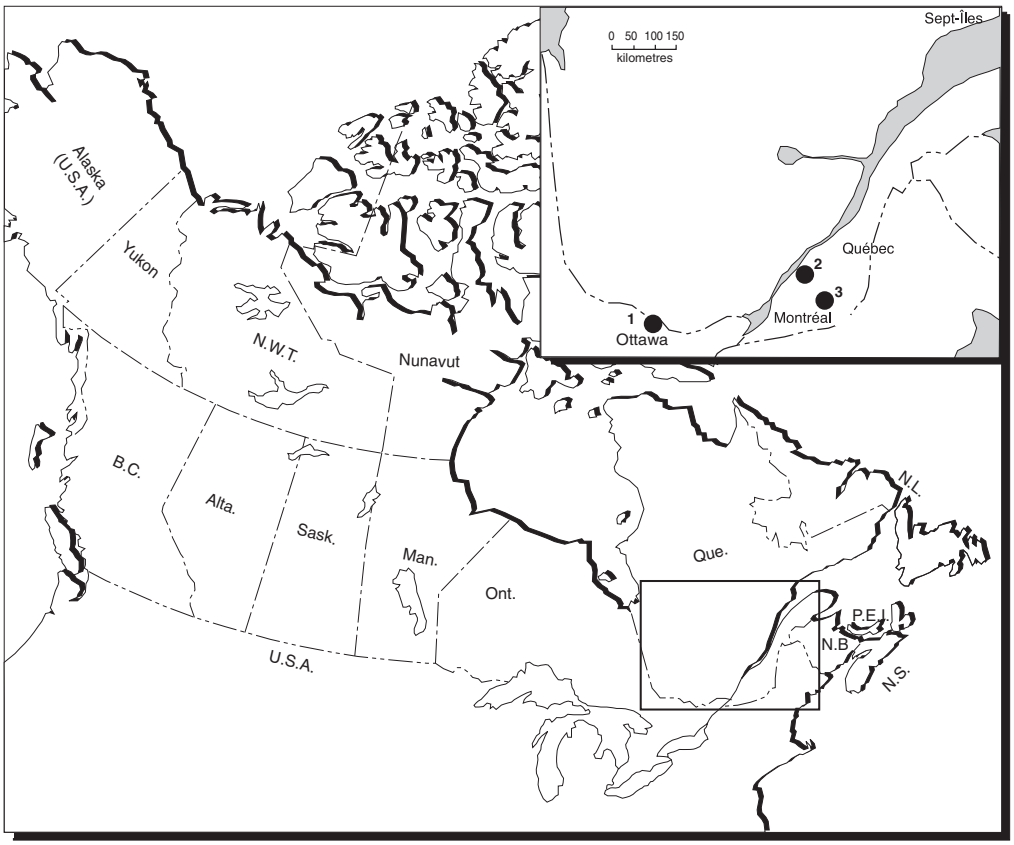
Norsk Hydro Canada Inc. (Norsk Hydro), a wholly owned subsidiary of Norsk Hydro ASA of Norway, has produced primary magnesium metal at its 50 000-t/y[1] Bécancour, Quebec, plant using an electrolytic process since 1989. The plant also recycles magnesium scrap produced by its customers and has a recycling capacity of 22 000 t/y.[1] Norsk Hydro (www.magnesium.hydro.com) has been working on a series of new alloys for high-temperature applications and has started casting trials and testing as part of the work done by the European Council for Automotive Research and Development (EUCAR). The company is the leader in the production and provision of pure and alloyed magnesium. It has a global service network offering assistance in metal management and logistics, recycling, technical support and application development.

Timminco Limited (www.timminco.com) operates a silicothermic reduction facility producing high-purity metal (up to 99.98% pure) for specialized markets at its 6000-t/y magnesium plant in Haley, Ontario. The operation includes a dolomitic limestone deposit and facilities for calcination, feed preparation, reduction, refining, and the casting of magnesium ingots and billets. Processing facilities include an extrusion and anode fabrication and assembly plant, as well as magnesium billet and slab processing facilities. The company also produces highly corrosion-resistant magnesium die-casting alloys and extruded anode rods for hot-water heaters. The casting facility at Haley provides magnesium billets for Timminco's extrusion facilities at Haley Station, Ontario, and Aurora, Colorado.

In April 2003, Timminco completed its financial restructuring to resolve financial difficulties and is now on a course expected to provide long-term stability for the company. During the year, the company also completed installation of dual casting capacity to increase productivity, reduce operating costs, and allow the casting of more varied shapes. In early April 2004, Timminco delayed a previously announced temporary four-month closure of the Haley metal production facility due to increased customer demand for metal. On a longer-term basis, the company intends to broaden its activity. In line with this goal, it announced in March 2004 that it had acquired 24% of the equity in Fundamus, an aluminum wheel manufacturer based in Hoyanger, Norway.

Magnola Metallurgy Inc., owned 80% by Noranda Inc. and 20% by Société générale de financement du Québec (www.norandamagnesium.com), closed the 58 000-t/y

Figure 1
Magnesium Smelters, 2003



SMELTER	COMPANY	CAPACITY (t/y)
1. Haley Station, Ontario	Timminco Limited	6 000
2. Bécancour, Quebec	Norsk Hydro Canada Inc.	50 000
3. Danville, Quebec	Magnola Metallurgy Inc. (*closed in 2003)	*58 000

magnesium metal smelter at Danville, Quebec, in April 2003. The plant had a number of start-up problems, but many of the initial technical problems were reported to have been resolved by late 2002. The company cited low magnesium prices as the reason for the closure and indicated that the price of magnesium needed to increase to in the range of US$1.30/lb to financially justify resumption of the operation. Noranda announced that it had granted rights for its patented magnesium-aluminum-strontium alloy system to BMW Group for exclusive use in planned production of a future high-pressure die-cast magnesium engine block for a three-year period. Noranda has also been participating in the EUCAR magnesium casting trials and the United States Council for Automotive Research (USCAR) work on magnesium (www.noranda magnesium.com, www.hydro.lt/en/press_room/news/archive/2003_03/mg_trials_en.html, www.autoweek.com/search/search_display.mv?port_code=autoweek&cat_code=carnews&content_code=01213389&Search_Type=STD&Search_ ID=2280706&record=1 and www.sae.org/servlets/productDetail?PROD_TYP=PAPER&PROD_CD=2004-01-0654).

Potential and Prospective Metal Project Proposals

Active Canadian projects currently include: Globex Mining Enterprises Inc., a magnesite-talc project at Timmins, Ontario; Leader Mining International Inc., a silicate-based project near Hope, British Columbia; Gossan Resources Ltd., a dolomite project at Inwood, Manitoba; and an asbestos-based project at Thetford Mines, Quebec.

Globex (www.globexmining.com) continues to work on its magnesium-talc deposit 13 km south of Timmins, Ontario. Previous work has indicated the potential for production of both magnesium metal and high-quality talc from the deposit. Results of a scoping study conducted in 2001 by Hatch Associates were positive and indicated a good economic potential using available technology. The project has the advantages of access to competitive power prices; ready access to large consumer markets; access to a stable, high-calibre work force; excellent infrastructure, including highways and railways; and a high-quality talc by-product to provide additional revenue.

The company is working on financing both the recommended full bankable feasibility study with an expected cost of US$12 million and the project with a US$1.0 billion construction cost. During the year, Globex received a letter of understanding on the project from a potential partner and endeavoured to finalize an agreement. The project would include a mine-mill complex located near Timmins, Ontario, and a 95 000-t/y smelter located west of Rouyn-Noranda, Quebec.

Leader Mining International Inc. (www.leadermining.com) continued work on its Cogburn ultramafic intrusive near Hope, British Columbia, which contains magnesium-bearing silicates. Pilot-scale testing was carried out in 2002 on core samples with positive results. Other activities have include initial work on environmental permitting, infrastructure studies, and bench-scale testing on composite samples, as well as agreements for construction and power. In May 2003, the company reported that Hatch Associates had delivered a positive project feasibility study for a mine and a 120 000-t/y smelter project.

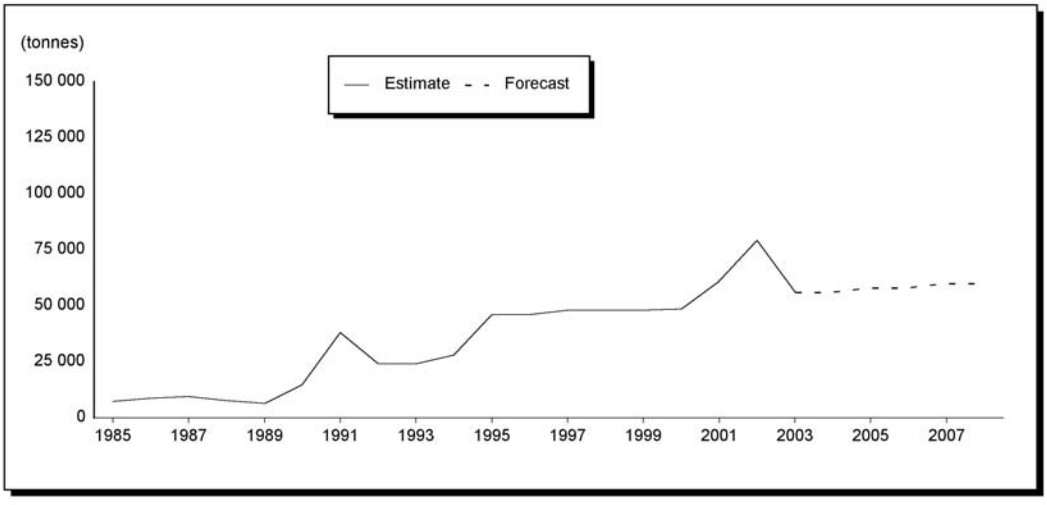
Gossan Resources Ltd. holds a dolomite deposit at Inwood, Manitoba, on which the company is conducting studies towards a metal project. The company's high-purity dolomite resource is estimated at 67 Mt grading 21.6% magnesium oxide with additional inferred resources. In 2003, a five-hole drill program was completed and Mintek Engineering of South Africa tested a 75-kg bulk sample of Inwood dolomite. Mintek determined that dolomite from the deposit was suitable for a new silicothermic process for the extraction of magnesium. The company has entered into an agreement with Hatch Associates for the first in a series of studies for a preliminary feasibility study. Currently, an initial economic assessment of using Mintek's atmospheric silicothermic magnesium extraction process is under way. (Additional information is available on the Internet at www.gossan.ca and www.mintek.ac.za.)

The town of Thetford Mines, Quebec, continued work on a proposal to process mining residues from asbestos mines into magnesium metal. The town reports that more than 300 Mt of material grading approximately 24% magnesium is available in the area for processing. Work continued to find and license a process that could be used to extract the magnesium. Discussions were also under way with possible partners in the project.

Canadian Production and Use

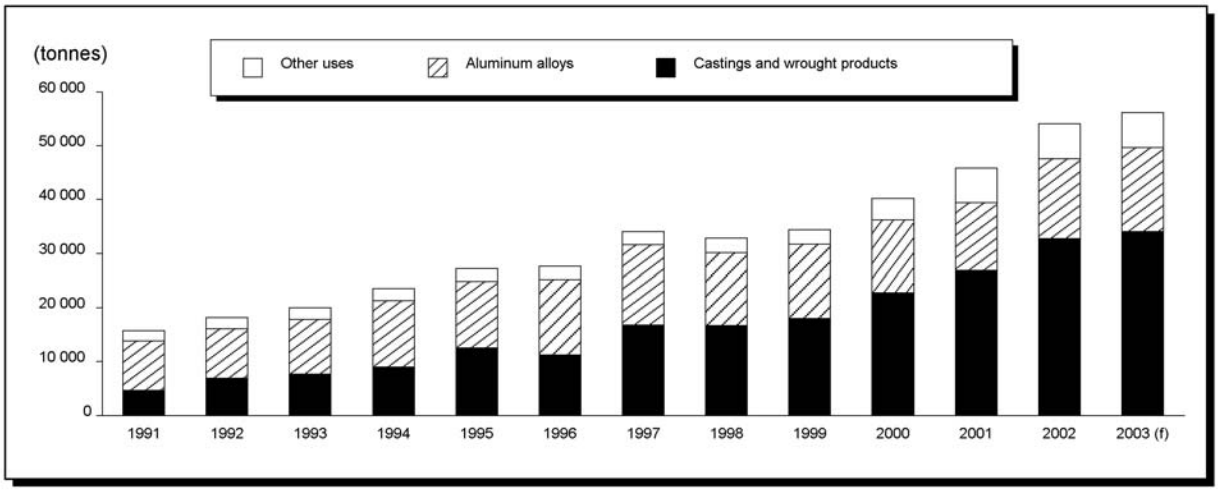
Canadian production capacity for magnesium (reported capacity in public reports) fell to approximately 56 000 t/y in 2003 with the closure of Magnola.

Figure 2
Canadian Primary Magnesium Production Capacity, 1985-2008



Source: Published reports.
Note: Canadian production data are confidential due to the limited number of producers. This is the primary capacity or production of plants in Canada reported from credible published sources.

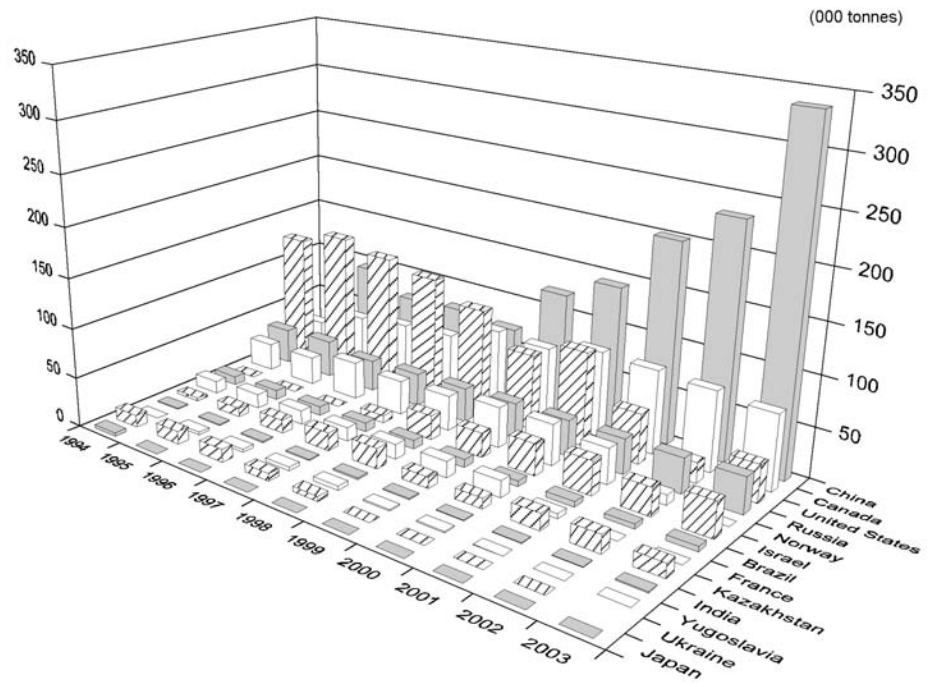
Figure 3
Canadian Use of Magnesium, 1991-2003



Source: Natural Resources Canada survey of 35 Canadian users of magnesium.
(f) Forecast.

Figure 4
World Magnesium Production, 1994-2003

Total = 615 000 t



Sources: International Consultative Group on Nonferrous Metal Statistics; reports in various journals (also see notes on the accompanying production table).

In Canada, the reported use of magnesium increased from 45 840 t in 2001 to 54 100 t in 2002. In both years, 35 companies were surveyed on their use of magnesium.

GLOBAL CONTEXT

China is by far the largest producer of primary magnesium in the world. Production from China has replaced that from Western producers that have closed over the last several years. The Chinese Statistics Bureau reported that magnesium production increased by 45% in 2003 to 336 000 t[2] from 231 500 t in 2002. This follows a 16% increase in 2002.

This large volume of primary magnesium production from large numbers of smaller producers located in China has placed pressure on magnesium prices and producers around the world. In late 2003 and early 2004, however, the availability of, and costs for, power and raw materials within China have increased, causing the prices of magnesium for export from China to rise substantially, resulting in difficulties for some producers to fulfill contracts.

Government and producer activities in 2003 included:

- The European Union (Council Regulation [Ec] No. 579/2003[3]) removed anti-dumping duties on magnesium of Chinese origin. This removal resulted from the Pechiney Électrométallurgie closure of the Marignac plant in France, the last primary magnesium smelter in Europe. The 31.7% duty was originally imposed in 1995 and was doubled to 63.4% in 2000.

- Brazil's Department of Development Industry and Commerce investigated dumping of metallic magnesium from China based on a complaint from Rima Industrial SA, Brazil's only magnesium producer. A decision is expected in 2004. (Additional information is available on the Internet at www.rima.com.br and www.desenvolvimento.gov.br/arquivo/secex/decom/investigacoes/emCurso.pdf.)

- In the United States, U.S. Magnesium LLC and U.S. workers filed an anti-dumping suit against China and Russia in February 2004. The U.S. International Trade Commission (ITC) later determined that there is a reasonable indication that the U.S. industry was materially injured by reason of imports of pure magnesium from Russia and alloy magnesium from China and Russia that are allegedly sold in the United States at less than fair value. Existing duties on Chinese magnesium range up to 305.56%; however, previous rulings on Russian material have determined a 0% margin with no duty applied.

- A bi-national Panel Review pursuant to the North American Free Trade Agreement resulted in a Panel decision on April 28, 2003, ordering the U.S. Department of Commerce to revoke an anti-dumping order concerning pure and alloy magnesium from Canada. The Panel also determined that the International Trade Commission should remove the reporting of an "all others rate," which was subsequently done.[4]

Although some exploration and development projects have had positive developments, those needing funds have faced larger difficulties in advancing their projects.

- Australian Magnesium Corporation (www.austmg.com) met with higher-than-anticipated costs for its magnesium metal plant in Stanwell, Queensland, on which it began construction in 2002. It stopped work on the project in June 2003. The company initially had difficulty raising money and subsequently ran short of funds to complete the project. The federal and state governments, which had supported the project, as well as Newmont Mining Corporation, refused to inject more capital and subsequently ended their involvement in the project. The company continues to seek new partners and funds.

- Magnesium Alloy Corporation (MagAlloy) continued work on developing its Kouilou project in the Republic of the Congo (Brazzaville). The company signed a preliminary long-term off-take agreement[5] with Stahlex Metall GmbH (formerly Stinnes Metall GmbH) whereby Stinnes will purchase and market 100% of the pure magnesium and magnesium alloys produced at Pointe-Noire. It also signed a Memorandum of Understanding with Ferrostaal AG of Germany on construction management.

- MagAlloy also announced the creation of MagEnergy Inc., a wholly owned subsidiary that will work with Eskom Enterprises Ltd. to jointly develop energy solutions for the project, including the rehabilitation and development of the Inga hydro-electric plant and the transmission of power to Pointe-Noire. The company continues to raise funds for the project. The planned capacity of the proposed plant is 60 000 t/y with initial production to start around 2007. The company has a web site at www.magnesiumalloy.ca.

- Australian projects include Magnesium International Ltd. and Latrobe Magnesium, who continue to work on developmental projects and obtaining new partners and funding sources (www.mgil.com.au and http://latrobemagnesium.com).

- The Government of the Sverdlovsk Region in Russia has continued working on a project to produce metal from asbestos mining residues with Siberian-Urals Aluminium Company (SUAL) and JSC Uralasbest (www.sual-holding.com and www.uralasbest.ru).

- Plans to purchase and move the closed Northwest Alloys Inc. magnesium smelter in the United States to Malaysia fell through when financing efforts were not successful (www.newworldalloys.com/bodyfrm.html).

Recycling Updates

- Hydro Magnesium (www.magnesium.hydro.com) will double its recycling capacity in Bottrop, Germany, to 15 000 t/y by September 2004 due to increased recycling demand, particularly from the automotive industry.

- Imco Recycling Inc. announced plans to build a magnesium recycling plant in Germany. BMW Group has contracted Imco to recycle a new magnesium engine block. Initial production of 5000 t/y will rise to 15 000 t/y as Imco obtains scrap from other customers (www.imcorecycling.com).

- Advanced Magnesium Alloys Corp. purchased the magnesium recycling plant at Anderson, Indiana, from Xstrata Plc. and increased capacity to 30 000 t/y (www.amacor.us).

- Remag Recycling GmbH started production at a new 10 000-t/y plant in Groningen, Netherlands. A Canadian company, GENIVAR Inc. (www.genivar.com), carried out the feasibility study for this project and handled engineering, supply and construction work.

PRICES

Prices published by *Metals Week* for magnesium again trended downward until November when they started firming. The U.S. Spot Western Mean started the year at US$1.10/lb, declined to $1.08/lb in November, rose to US$1.10/lb in December and increased to US$1.14/lb in early 2004. The mean U.S. dealer import prices have increased from US$1.03/lb early in the year to US$1.07/lb at the end of the year. The *Metal Bulletin*'s World Free Market Price for minimum 99.8% magnesium metal started the year at US$1880-$1980/t and remained relatively flat, ending the year at US$1850-$1950/t.

Reported prices of Chinese magnesium on a spot basis f.o.b. China started the year at approximately US$1360-$1380/t and strengthened throughout 2003. Spot sales were reported at US$1650-$1750/t at year-end.

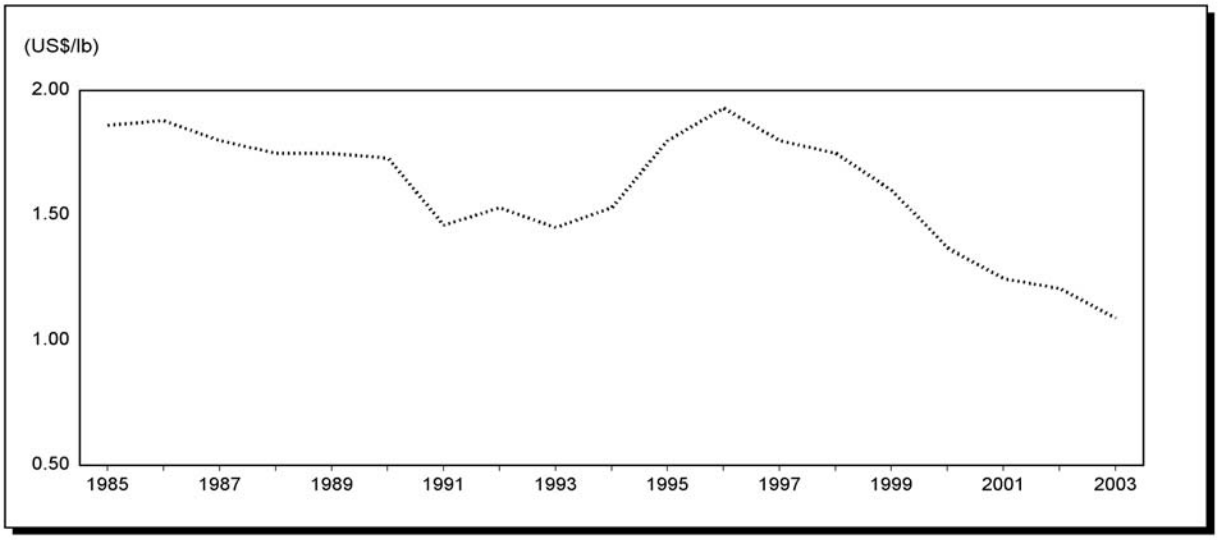
Reflecting the trend toward higher magnesium prices, Hydro Magnesium (www.magnesium.hydro.com) increased its European producer price for magnesium alloy from €2.50/kg to €2.75/kg on March 15, 2004.

ANNUAL AVERAGE PRICES, *METALS WEEK* (U.S. SPOT WESTERN MEAN)

1998	1999	2000	2001	2002	2003
		(US$/lb)			
1.59	1.55	1.37	1.25	1.21	1.09

Source: Calculated from data published in *Metals Week*.

Figure 5
Magnesium Prices, 1985-2003



Source: *Metals Week* (U.S. Spot Western Mean).

GENERAL INFORMATION ON MAGNESIUM

For recent statistics and events in the Canadian and global industry, see:

- the magnesium chapter of the *Canadian Minerals Yearbook* at www.nrcan.gc.ca/mms/cmy/com_e.html;
- the *Nonferrous Metals Outlook* at www.nrcan.gc.ca/mms/pubs/nfo_e.htm;
- the web site of the International Magnesium Association at www.intlmag.org;
- Magnesium.com on-line resource at www.magnesium.com/w3/; and
- the U.S. Geological Survey web site at http://minerals.usgs.gov/minerals/pubs/commodity/magnesium.

Canadian magnesium metal producers have web sites located at:

- Hydro Magnesium: www.magnesium.hydro.com
- Timminco Limited: www.timminco.com
- Noranda Magnesium Inc.: www.norandamagnesium.com

Canadian companies with an interest in producing magnesium metal[6] have web sites located at:

- Globex Mining Enterprises Inc.: www.globexmining.com
- Gossan Resources Ltd.: www.gossan.ca
- Hatch Associates of Canada: www.hatch.ca
- Lakefield Research of Canada Limited: www.lakefield.com
- Leader Mining International Inc.: www.leadermining.com
- Magnesium Alloy Corporation: www.magnesiumalloy.ca

Occurrence

Magnesium is the eighth most abundant element, comprising over 2% of the earth's crust. It is the third most abundant element dissolved in seawater with a concentration averaging 0.14% by weight. Magnesium does not naturally occur in its native or metallic state, but is found in more than 60 different minerals. The principal magnesium minerals include carbonate forms in dolomite and magnesite, as silicate forms in olivine and brucite, as an oxide/silicate in serpentine, and as a chloride in seawater, natural brines and evaporites. In the past, magnesium metal has been produced from dolomite, magnesite, brucite, seawater, brines, and residues from asbestos mines. Companies have also studied the production of magnesium from other magnesium-rich sources such as fly ash.

Technology

Magnesium metal is currently produced by several methods that can be classed into two general processes. These are: metallothermic, in which a reducing agent such as ferrosilicon or aluminum is mixed with magnesium oxide and heated in a furnace, generally in a vacuum to produce magnesium metal vapour; and electrolytic, in which molten magnesium chloride salts are electrolyzed/reduced to produce liquid magnesium metal. Larger plants generally use electrolytic methods, which account for over one third of the world's production. Metallothermic methods require more labour and are more suitable for small batch operations; these have become more important with the increased production from China.

Research has taken place to refine, modernize and replace existing production processes. Although production improvements have been made in existing operations, other options exist. The results of work to date have not been successfully adapted to large-scale production, although some changes in material supply and feedstock production and preparation have been implemented by existing producers.

Magnesium Production in Canada

In 1939, Dr. Lloyd Pidgeon and a research team in the National Research Council of Canada's (NRC) Division of Chemistry developed a method of producing pure solid metallic magnesium in a process that combined ferrosilicon and dolomite. The first magnesium produced by this method to be used in aircraft came from the NRC's Sussex Drive laboratories in Ottawa, Ontario. A pilot plant built with funding from mining companies became Dominion Magnesium Company after the war.

Canada is now the second largest producer of magnesium in the world. In early 2003, there were three operating magnesium smelters in Canada.[7]

Timminco Limited was established in 1934 and produces high-purity metal (up to 99.98% pure) for specialized market applications at its 6000-t/y magnesium plant at Haley Station, Ontario. Timminco uses the Pidgeon magnesium process in which calcined dolomite is reduced by

ferrosilicon in a vacuum retort in controlled batches of known and consistent chemistry. As a result, the company produces the highest-purity commercial magnesium in the world. Timminco mines the dolomite at the plant site, but purchases the ferrosilicon feed on the open market. The company also produces highly corrosion-resistant magnesium die-casting alloys and extruded anode rods for hot-water heaters. Timminco's magnesium products are used for a variety of applications such as alloying agents for aluminum and calcium, in Grignard reagents for the pharmaceutical industry, and in electronic products. (For further information, see Timminco's web site at www.timminco.com.)

Norsk Hydro Canada Inc., a wholly owned subsidiary of Norsk Hydro ASA of Norway, produces magnesium metal at a 50 000-t/y[1] Bécancour, Quebec, plant using an electrolytic process and purchased magnesite. The plant opened in 1989 with a capacity of 40 000 t/y and has subsequently increased production through debottlenecking of the original plant. It also recycles magnesium scrap produced by its customers and has a remelt capacity of 22 000 t/y.[1] This plant is one of the most efficient in the world and is the lowest-cost Western producer of magnesium metal. The company offers a global service network, including metal management and logistics, recycling, technical support and application development. (For further information, see Norsk Hydro's web site at www.magnesium.hydro.com.)

In early 2001, Magnola Metallurgy Inc. (owned 80% by Noranda Inc. and 20% by Société générale de financement du Québec) completed construction of its 58 000-t/y magnesium metal plant in Danville, Quebec. Magnola was to use asbestos mine tailings as a feedstock to a proprietary process developed by the Noranda Technology Centre of Noranda Inc. to produce the magnesium chloride needed for electrolysis. The plant started producing magnesium metal in October 2000 in a plant based on electrolysis of magnesium chloride from the serpentine feedstock. Although the company faced some start-up problems, it expected to reach commercial production levels in 2002 but, in early 2003, closed the plant. The shutdown is for an indefinite period of time until the market conditions allow for a viable operation of the plant. (For further information, see the company's web sites at www.norandamagnesium.com and www.noranda.com.)

Use

Although magnesium is consumed in some applications (such as in flares or pyrotechnics, or when magnesium is used in chemical reactions in the production of other metals), most use in industrial and consumer products is generally non-destructive and the metal can be recycled and re-used. The energy inherent in the metal remains and the process of recycling the metal recovers that energy in a repeating and sustainable manner. Discussions on metals taking place in a number of fora indicate that usage of the word "consumption" in reports should be modified to more appropriately reflect the actual use of the metal.

Magnesium metal is best known for its light weight and high strength-to-weight ratio, making it suitable for a wide range of applications. It is the lightest of all structural elements and is easily malleable and easily alloyed. Magnesium alloys are stiff and resist denting. When used as a structural material, magnesium is alloyed with other elements, including aluminum, manganese, rare earth metals, silver, thorium, zinc and zirconium. When alloyed with one or more of these elements, the resulting alloys can have unusually high strength-to-weight ratios. Magnesium-aluminum alloys are the most common and are principally used in die-casting applications.

The use of magnesium in larger-scale structural applications is relatively new, and metal and alloy development for specific applications is not as advanced as for better-known metals such as iron or aluminum. In addition, ways to avoid potential problems with corrosion are not as well developed for magnesium. As a result, some magnesium alloys have limitations on their use due to this potential for corrosion in some environments. In addition, the use of some magnesium metal and magnesium alloys at higher temperatures is limited due to the creep that can occur in those environments. Work by metal producers such as Noranda/Magnola and Hydro Magnesium has resulted in new creep-resistant alloys for use in higher-temperature environments. Engineering data on their physical properties are being generated to allow increased use in larger-component automotive applications such as transmission housings, oil pans and engine blocks.

The use of die-cast magnesium parts can help automobile manufacturers reduce total vehicle weight while meeting the consumer demand for larger vehicles. The interest in magnesium metal in the automotive market is largely due to weight savings of more than 30% compared to aluminum and to a desire to increase fuel efficiency through weight reduction.

Magnesium has good vibration-dampening characteristics. Its lower heat of solidification, which increases die-casting production capacity by 25%, results in major process energy savings. Its characteristics also allow the casting of thinner and more complex shapes, which can replace a number of parts made with other materials, which in turn can also reduce the cost of assembly. Dies for magnesium castings are reported to have more than twice the life of aluminum dies and, at a magnesium-to-aluminum price ratio of about 1.7:1.0 or less, many magnesium metal parts can be fabricated at a lower cost than those made from aluminum. In this regard, over the last few years, the increased price of aluminum and the decreased price of magnesium have made the use of magnesium relatively more economical.

The primary use of magnesium metal is as an alloying agent for aluminum where it imparts strength and rigidity to alloys used in various applications, including aluminum sheet, such as that used in the manufacture of aluminum beverage containers. These alloys allow the use of less material, producing thinner walls and lighter containers than would normally otherwise be possible.

The next most important use for magnesium metal is for die-cast products. These castings can be used in structural applications such as instrument panel beams of automobiles or as equipment cases for electronic equipment such as cameras, cell phones, computers, portable tools and sporting goods. Magnesium's advantages for these applications are its good strength-to-weight ratio, heat dissipation, electromagnetic field containment, and radio frequency interference dissipation.

The third largest use of magnesium is as a deoxidizing and desulphurizing agent in the ferrous industry where it is consumed in the production of steel and cast iron. Magnesium is introduced into the melt during the production of nodular iron, which is used primarily for the production of ductile iron pipes and die-cast parts for use in automobiles and farm equipment.

Other uses are much smaller in comparison to those above. These include:

- Chemical uses: in pharmaceutical and chemical products, perfumes and pyrotechnics;
- Electrochemical applications: in batteries and in anodes for the cathodic protection of gas pipelines and water heaters;
- Wrought products: in extruded products, sheets and plates; and
- Magnesium metal is also used to produce other metals such as titanium, beryllium, zirconium, hafnium and uranium.

The biggest potential for growth in the use of magnesium lies in the aluminum alloy and automotive markets sectors. However, growth will be dependent upon prices and price stability as magnesium continues to face stiff competition from other materials, including aluminum, steel and plastics.

Recycling

The production of recycled magnesium from metallic scrap requires about 5% of the energy required to produce primary magnesium. The recycling of old or post-consumer magnesium scrap is expected to increase with the anticipated growth in the use of magnesium die-cast automobile parts and electronics. In addition, casting operations produce a high proportion of new or process scrap in their operations that is recycled either on the site or at another location. Producers collect new magnesium scrap from their clients and recondition and recast the metal into a usable form and shape. This source of scrap is expected to increase with time as magnesium metal further penetrates the automotive and electronics markets and the vehicles and electrical equipment are scrapped. However, as technology and methods for recycling magnesium improve, it is likely that more recycling of this and other clean new scrap will take place in facilities using the original metal. As figures are not collected on this run-around or new scrap, statistics on recycling magnesium may eventually show a decrease, although recycling itself would not decrease.

Major North American auto manufacturers, including Daimler-Chrysler Canada Inc., Ford Motor Company and General Motors Corporation, use magnesium alloy parts containing recycled magnesium. The recovery and use of this recycled magnesium reduce the cost of die-cast components and contribute to sustainable practices in metal use.

Prices

Magnesium metal does not trade on the London Metal Exchange or the New York Mercantile Exchange Inc. Producers and metal traders deal directly with users as the volumes of metal are not large enough for inclusion in an organized market. Producer and dealer pure and alloy magnesium metal price quotes can be found in various metal publications such as *Metal Bulletin*, *American Metal Markets*, or other similar papers and journals with metals news. It should be noted that duties and other taxes can significantly change prices within regional areas and published data may not apply to all markets.

REFERENCES

1 www.magnesium.hydro.com/hits/osl02201.nsf/Files/presentations/$file/2004_HM_Company_presentation.pdf.

2 The Chinese Magnesium Association (www.chinamagnesium.org) reported that production for 2003 was 356 000 t. It also reported that exports of magnesium rose to 299 000 t.

3 http://europa.eu.int/eur-lex/pri/en/oj/dat/2003/l_083/l_08320030401en00320033.pdf.

4 www.nafta-sec-alena.org/app/DocRepository/1/Dispute/english/NAFTA_Chapter_19/USA/Ua00062e.pdf, http://minerals.er.usgs.gov/minerals/pubs/commodity/magnesium/mgmis2q03.pdf, www.setonresourcecenter.com/Register/2003/Jun/06/33920B.pdf and http://frwebgate5.access.gpo.gov/cgi-bin/waisgate.cgi?WAISdocID=035720423268+0+0+0&WAISaction=retrieve.

5 As there is no organized market for magnesium metal, companies producing magnesium will often make arrangements with

another company or broker on sales of metal to assist with planing and to establish an outlet and purchaser for their production to create more certainty for their investors.

6 If you are a Canadian company with an interest in producing magnesium metal and are not listed here and wish to be included, please contact the author by e-mail at wwagner @ nrcan.gc.ca.

7 Noranda Magnesium closed the Magnola smelter and placed it on care and maintenance in April 2003.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of March 30, 2004. (3) Some differences are noted in some data from independent sources. Readers are cautioned to confirm these data. (4) Lorraine Ralph and others in the Minerals and Metals Statistics Division created Tables 1 and 2 and provided input into other tables and figures. (5) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

NOTE TO READERS

TARIFFS (1)

Item No.	Description	Canada			United States	EU	Japan
		MFN	GPT	USA	Canada	Conventional Rate (2)	WTO (3)
3824.90.90.42	Granular metallic magnesium coated with inorganic salts, mixed with lime	6.5%	3%	Free	Free	6.5%	Free-3.9%
3824.90.90.43	Other granular metallic magnesium coated with inorganic salts	6.5%	3%	Free	Free	6.5%	Free-3.9%
8104.11	Magnesium and articles thereof, unwrought; containing by weight at least 99.8% of magnesium	2.5%	Free	Free	Free	5.3%	Free-3%
8104.19	Magnesium unwrought, other						
8104.19.10	Magnesium-rare earth, magnesium-didymium, magnesium-thorium, magnesium-zirconium and magnesium-thorium-neodymium-rare earth for use in the manufacture of magnesium castings	Free	Free	Free	Free	4%	Free-3%
8104.19.90	Other	2.5%	Free	Free	Free	4%	Free-3%
8104.20	Magnesium waste and scrap	Free	Free	Free	Free	Free	Free
8104.30	Magnesium raspings, turnings and granules, graded according to size; powders	2.5%	Free	Free	Free	4%	3%
8104.90	Other magnesium	2.5%	Free	Free	Free	4%	3%

Sources: Canadian *Customs Tariff*, effective January 2004, Canada Border Services Agency; *Harmonized Tariff Schedule of the United States, 2*004; *Official Journal of the European Union* (October 30, 2003 Edition; *Customs Tariff Schedules of Japan, 2003.*

(1) Does not include countervail or anti-dumping duties, which may be applied to material of certain origin. (2) The customs duties applicable to imported goods originating in countries that are Contracting Parties to the General Agreement on Tariffs and Trade or with which the European Community has concluded agreements containing the most-favoured-nation tariff clause shall be the conventional duties shown in column 3 of the Schedule of Duties. (3) WTO rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADA, MAGNESIUM EXPORTS AND IMPORTS BY COMMODITY AND COUNTRY, 2001-03

Item No.		2001		2002		2003	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS							
8104.11	Magnesium unwrought, containing by weight at least 99.8% magnesium						
	Netherlands	2 547	6 143	8 166	20 449	5 182	11 196
	United States	1 625	8 053	6 791	28 888	2 321	9 369
	Japan	1 236	3 722	191	549	2 406	5 712
	United Arab Emirates	–	–	885	2 445	1 419	3 399
	Germany	4 638	12 928	1 482	4 267	1 178	2 923
	Austria	1 700	4 838	196	555	880	2 101
	United Kingdom	315	2 449	603	2 532	473	1 866
	Belgium	21	65	204	587	640	1 423
	France	309	819	876	2 462	577	1 372
	Brazil	39	105	237	593	298	683
	South Korea	16	38	34	88	74	188
	Greece	–	–	132	378	65	167
	India	–	2	–	–	60	149
	Italy	265	753	–	–	49	121
	Morocco	–	–	–	–	39	94
	Malaysia	–	–	–	–	34	82
	Bahrain	–	–	–	–	24	57
	Australia	427	1 221	–	–	–	–
	Mexico	59	139	–	–	–	–
	Norway	361	927	544	1 392	–	–
	Venezuela	50	122	–	–	–	–
	Denmark	–	–	42	128	–	–
	Taiwan	71	244	–	–	–	–
	Sweden	–	–	99	281	–	–
	Switzerland	–	–	127	304	–	–
	Finland	71	171	–	–	–	–
	Ecuador	1	8	–	–	–	–
	Colombia	21	54	5	18	–	–
	Argentina	74	181	–	–	–	–
	Subtotal	13 846	42 982	20 614	65 916	15 719	40 902
8104.19	Magnesium unwrought, other						
	United States	13 858	64 149	25 789	110 491	21 900	84 290
	Netherlands	783	3 084	5 797	19 807	3 956	11 642
	Japan	153	581	317	1 262	1 881	5 673
	Taiwan	61	221	248	840	956	2 825
	Norway	22	76	130	459	1 083	2 453
	France	–	–	–	–	402	1 129
	China	–	–	–	–	311	961
	United Arab Emirates	–	–	–	–	55	128
	South Korea	–	–	34	117	35	97
	Austria	–	–	–	–	24	78
	Spain	–	–	–	–	24	78
	Belgium	–	–	–	–	25	59
	Germany	23	79	44	161	1	2
	Australia	24	56	41	136	–	–
	Italy	305	1 643	3 427	12 057	–	–
	United Kingdom	112	771	73	510	–	–
	Venezuela	208	574	15	45	–	–
	Israel	–	–	3	32	–	–
	Portugal	–	–	24	81	–	–
	Switzerland	–	–	51	134	–	–
	Subtotal	15 549	71 234	35 993	146 132	30 653	109 415
	Total exports of unwrought	29 395	114 216	56 607	212 048	46 372	150 317
8104.20	Magnesium waste and scrap						
	United States	8 585	27 083	10 245	24 670	10 131	20 523
	Taiwan	–	–	–	–	3	6
	Australia	34	202	21	118	–	–
	Thailand	2	5	–	–	–	–
	Total	8 621	27 290	10 266	24 788	10 134	20 529

TABLE 1 (cont'd)

Item No.		2001		2002		2003	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)							
8104.30	Magnesium raspings, turnings or granules, graded according to size, and powders						
	United States	1 571	6 496	1 454	5 369	710	3 053
	United Kingdom	37	340	–	–	1	9
	South Africa	–	–	–	–	–	–
	Australia	17	106	–	–	–	–
	Germany	65	496	42	296	–	–
	Ireland	290	2 210	270	2 010	–	–
	North Korea	121	716	0	–	–	–
	Netherlands	41	286	45	305	–	–
	Switzerland	–	1	–	–	–	–
	Brazil	–	–	–	2	–	–
	Israel	–	–	19	145	–	–
	South Korea	–	–	17	107	–	–
	Total	2 142	10 651	1 847	8 234	711	3 062
8104.90	Magnesium and articles thereof, other						
	United States	2 564	20 169	2 016	18 104	1 081	13 292
	Italy	2	34	–	–	1	7
	United Kingdom	–	–	–	–	–	4
	South Korea	–	–	–	–	–	3
	Poland	–	–	–	–	–	3
	Japan	6	85	7	69	–	2
	Australia	520	3 357	453	3 118	–	–
	Brazil	6	52	3	41	–	–
	Chile	2	25	1	14	–	–
	Colombia	–	5	–	–	–	–
	Germany	2	48	–	–	–	–
	Israel	12	108	8	95	–	–
	Mexico	6	56	–	–	–	–
	Netherlands	14	129	34	185	–	–
	Ecuador	–	–	–	7	–	–
	Thailand	–	–	1	12	–	–
	Total	3 134	24 068	2 523	21 645	1 082	13 311
	Total exports	43 292	176 225	71 243	266 715	58 299	187 219
IMPORTS							
3824.90.90.42	Granular metallic magnesium coated with inorganic salts, mixed with lime						
	United States	607	2 376	33	34	73	71
8104.11	Magnesium unwrought, containing by weight at least 99.8% magnesium						
	China	7 478	18 170	9 440	21 483	12 724	29 685
	United States	2 679	10 439	6 979	16 745	4 582	10 268
	Russia	2 769	9 985	81	240	1 221	3 120
	Israel	687	2 315	280	910	136	621
	Kazakhstan	–	–	–	–	73	259
	Brazil	340	1 140	–	–	–	–
	Finland	263	772	–	–	–	–
	France	1	8	–	–	–	–
	Norway	162	652	–	–	–	–
	Switzerland	4	19	2	19	–	–
	Subtotal	14 383	43 500	16 782	39 397	18 736	43 953
8104.19	Magnesium unwrought, other						
	China	143	965	381	1 619	4 810	15 525
	Russia	1 288	5 383	5 210	21 987	3 500	12 537
	United States	2 444	12 316	2 868	13 626	1 455	5 205
	Norway	1 934	7 368	144	422	547	1 761
	United Kingdom	239	2 393	152	1 634	141	1 606
	Germany	–	1	–	–	–	3
	France	44	181	–	–	–	1
	Austria	–	–	–	–	–	1
	Canada	–	–	–	–	–	1
	Israel	–	–	185	993	–	–
	Subtotal	6 092	28 607	8 940	40 281	10 453	36 640
	Total imports of unwrought	20 475	72 107	25 722	79 678	29 189	80 593

TABLE 1 (cont'd)

Item No.		2001		2002		2003	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)							
8104.20	Magnesium waste and scrap						
	United States	7 530	26 945	6 607	22 000	5 712	15 591
	Russia	2 563	9 839	47	167	405	1 260
	Mexico	38	149	91	318	109	303
	China	67	148	162	268	106	223
	Canada	5	15	1	1	2	7
	Israel	238	722	3	12	–	–
	Italy	79	263	–	–	–	–
	Total	10 520	38 081	6 911	22 766	6 334	17 384
8104.30	Magnesium raspings, turnings or granules, graded according to size and powders						
	United States	716	3 384	871	3 699	361	1 384
	China	5	22	81	199	195	481
	South Korea	12	48	6	35	9	49
	Switzerland	16	62	7	31	7	35
	Germany	1	2	1	2	–	1
	Serbia and Montenegro	1	2	1	2	–	–
	Austria	–	1	–	–	–	–
	Mexico	1	5	–	–	–	–
	South Africa	–	–	5	17	–	–
	Total	752	3 526	972	3 985	572	1 950
8104.90	Magnesium and articles thereof, other						
	United States	929	7 793	1 182	7 344	1 680	9 354
	China	173	1 057	103	565	162	831
	United Kingdom	–	9	3	33	18	162
	Taiwan	–	–	–	–	1	35
	Canada	–	–	–	–	1	7
	Mexico	7	50	–	3	1	6
	India	–	3	–	–	2	5
	France	–	–	–	2	–	4
	Russia	–	–	–	–	–	4
	Sweden	–	2	–	1	–	2
	Norway	–	–	–	–	–	2
	Germany	–	–	–	–	–	1
	Luxembourg	–	–	–	–	–	1
	Italy	–	1	–	–	–	–
	Malaysia	12	38	–	–	–	–
	Poland	–	3	–	–	–	–
	Netherlands	–	–	1	7	–	–
	Total	1 121	8 956	1 289	7 955	1 865	10 414
	Total imports	33 475	125 046	34 927	114 418	38 033	110 412

Sources: Natural Resources Canada; Statistics Canada.
– Nil.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, MAGNESIUM USE, (1) **1992-2002**

	1992 (a)	1993 (a)	1994	1995 (a)	1996	1997	1998 (a)	1999 (a)	2000 (a)	2001 (a)	2002
						(tonnes)					
Castings and wrought products (2)	6 915	7 678	8 940	12 488	11 197	16 795	16 687	17 951	22728	26818	32 770
Aluminum alloys	9 203	10 174	12 389	12 323	14 022	14 793	13 417	13 741	13 466	(r) 12 562	14 857
Other uses (3)	2 005	2 162	2 234	2 329	2 357	2 438	2 685	2 727	3 960	(r) 6 460	6 472
Total	18 123	20 014	23 563	27 140	27 576	34 026	32 790	34 419	40 154	(r) 45 840	54 100

Source: Natural Resources Canada.
(r) Revised.
(a) Increase in number of companies being surveyed.
(1) Available data as reported by users. (2) Die, permanent mould and sand castings, structural shapes, tubings, forgings, sheet and plate. (3) Cathodic protection, reducing agents, deoxidizers and other alloys.
Note: Numbers may not add to totals due to rounding.

TABLE 3. WORLD PRODUCTION OF MAGNESIUM, 1994-2003

Country	Rank in 2003	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003 (f)
						(000 tonnes)					
PRIMARY PRODUCTION											
China (2)	1	11.0	93.6	73.2	76.0	70.5	120.7	142.1	(r) 199.7	231.7	336.0
Canada (1)	2	28.9	48.1	54.0	57.7	77.1	73.7	85.7	83.4	80.0	75.0
United States	3	128.5	142.1	133.1	124.8	106.1	75.0	94.0	50.0	20.0	37.0
Russia	4	35.4	37.5	31.5	33.0	34.1	35.2	35.5	35.0	35.0	36.0
Israel	5	–	–	(r) 0.1	7.4	24.5	(r) 24.3	31.7	34.0	28.0	35.0
Kazakhstan	6	3.0	9.0	13.4	17.9	20.9	(r) 11.0	10.4	16.5	18.0	14.0
Brazil	7	8.8	9.7	9.0	9.0	9.0	(r) 8.0	5.7	5.5	4.5	5.0
India	8	1.0	1.0	1.0	1.0	1.5	(r) 1.0	(r) 0.5	0.5	0.5	1.0
Norway	9	27.6	28.0	37.8	34.2	35.4	40.8	41.4	36.0	10.0	–
France		12.3	14.5	14.0	13.8	14.7	(r) 16.2	(r) 16.5	4.8	–	–
Serbia-Montenegro		–	2.6	3.1	3.9	4.0	1.2	1.3	0.2	–	–
Ukraine		12.0	13.0	12.9	7.7	5.0	–	–	–	–	–
Japan		3.4	–	–	–	–	–	–	–	–	–
Total primary		271.9	399.1	(r) 383.1	386.4	402.8	(r) 407.1	(r) 464.8	(r) 465.6	427.7	539.0
RECYCLED PRODUCTION (3)											
United States	1	62.1	65.1	71.2	77.6	77.1	(r) 86.1	82.3	65.8	73.7	75.0
United Kingdom	2	0.5	0.5	0.5	0.5	0.5	(r) 0.5	0.5	0.5	0.7	1.0
Japan		19.0	11.8	21.2	22.8	(r) –	(r) –	(r) –	(r) –	–	–
Brazil		1.6	1.6	1.6	1.6	(r) –	(r) –	(r) –	(r) –	–	–
Austria		0.1	0.1	–	–	–	–	–	–	–	–
Total recycled		83.3	79.1	94.5	102.5	(r) 77.6	(r) 86.6	(r) 82.8	66.3	74.4	76.0
Total primary and recycled		355.2	478.2	(r) 477.6	488.9	502.0	(r) 530.5	564.7	531.9	502.1	614.7

Sources: International Consultative Group on Nonferrous Metals Statistics; China Magnesium Association as reported in various journals.
– Nil; (f) Forecast; (r) Revised.
(1) Estimate per U.S. Geological Survey, includes secondary. (2) Numbers used in table are from the International Consultative Group on Nonferrous Metal Statistics. As reported in various journals, Chinese Magnesium Association reported higher numbers for Chinese production: 1994 - 25 000 t; 1997 - 92 000 t; 1998 - 120 000 t; 1999 - 157 000 t; 2000 - 194 000 t; 2001 - 268 000 t. (3) Recycled magnesium facilities exist in other locations, including Canada, that have not reported separate production figures for recycled magnesium due to confidentiality and other reasons.