Magnesium

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(*Note: This is a brief review of magnesium metal projects related to Canada and is not intended to be a comprehensive global review.*)

2002 exports: $267 million
2002 imports: $114 million

	1999	2000	2001	2002 (f)
			(tonnes)	
Primary metal production capacity (1,e)	49 000	50 500	59 500	70 000
Exports (HS 8401)	49 747	47 181	43 292	71 243
Imports (HS 8401)	38 377	34 586	33 478	34 943

(e) Estimated; (f) Forecast.
(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 significant quantities of recycled material.

CANADIAN DEVELOPMENTS

Producers

Canadian production[1] capacity for primary magnesium metal will fall to approximately 54 000 t/y in 2003 as a result of the announced closure of Magnola Metallurgy Inc.'s Danville smelter. On a global basis, in 2002, Canada ranked second after China in magnesium production capacity. The value of Canadian exports of magnesium metal and metal products in 2002 was $267 million.

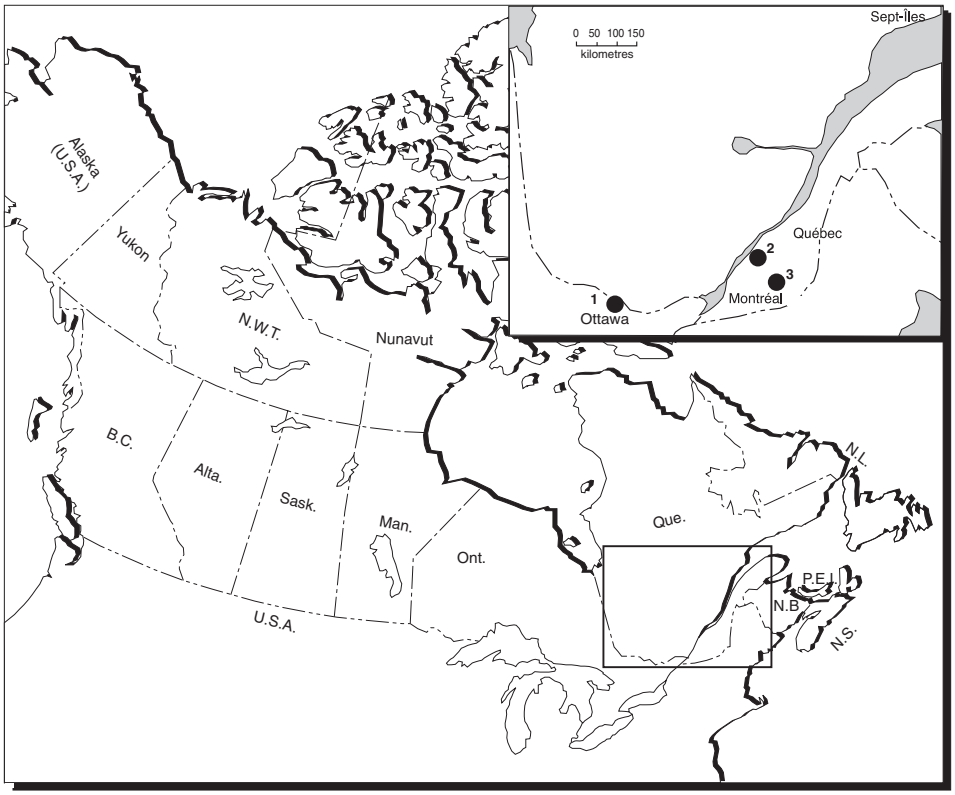
Magnola Metallurgy Inc. (owned 80% by Noranda Inc. and 20% by Société générale de financement du Québec) scheduled the closure of the 58 000-t/y magnesium metal plant at Danville, Quebec, for April 2003. The plant had a number of start-up problems but, by late 2002, many of the initial technical problems were reported to have been resolved. It was reported that the plant produced 24 648 t of magnesium in 2002 and that the company expected to reach full production in 2003. The company cited low magnesium prices as the reason for the closure and indicated that the price of magnesium needed to increase to the range of US$1.30/lb to financially justify resumption of the operation (www.norandamagnesium.com).

Norsk Hydro Canada Inc. (Norsk Hydro), a wholly owned subsidiary of Norsk Hydro ASA of Norway, has produced primary magnesium metal at a 48 000-t/y 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 10 000 t/y, but a portion of that facility was reported as operating at 75% of capacity in 2002 due to a shortage of scrap. The plant has been recently debottlenecked and future capacity increases at Bécancour will be based upon profitability. Norsk Hydro 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) (www.magnesium.hydro.com).

Timminco Limited 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. On a longer-term basis, the company intended to expand operations in the wrought products area.

In 2002, Timminco completed work to develop dual-casting capability and ramped up the new Haley casthouse to commercial production levels. During the year, the company continued to restructure its operations and, in

Figure 1
Magnesium Smelters, 2002



SMELTER	COMPANY	CAPACITY (t/y)
1. Haley Station, Ontario	Timminco Limited	6 000
2. Bécancour, Quebec	Norsk Hydro Canada Inc.	48 000
3. Danville, Quebec	Magnola Metallurgy Inc.	58 000

February 2003, announced that Safeguard International Fund L.P. had agreed to purchase new and existing shares in the company after regulatory approval expected in April (www.timminco.com).

Metal Project Proposals

In Canada, as in the rest of the world, there has been a continued interest in the production of magnesium metal from dolomite and magnesite deposits or from previously mined asbestos deposits. The Canadian projects include: Globex Mining Enterprises Inc., a magnesite-talc project at Timmins, Ontario; Leader Mining International Inc., a project near Hope, British Columbia; Gossan Resources Ltd. at Inwood, Manitoba; Cassiar Resources Inc. at Cassiar, British Columbia; Canadian Magnesium Corporation at Baie Verte, Newfoundland and Labrador; and an asbestos-based project at Thetford Mines, Quebec.

Globex Mining Enterprises Inc. has continued work on its Timmins-area 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 by Hatch Associates of Canada in 2001 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 has worked on financing both the recommended full bankable feasibility study, with an expected cost of US$12 million, and a US$1.0 billion construction cost. The project would include a mine-mill complex located near Timmins, Ontario, and a 95 000-t/y smelter located in Quebec west of Rouyn-Noranda. Further details are available on the Internet at www.globexmining.com.

Leader Mining International Inc. acquired property in 2001 over the Cogburn ultramafic intrusive near Hope, British Columbia, which contains magnesium-bearing silicates. Scoping-level studies were undertaken in 2001 that indicated a capital cost estimate of US$1 billion for a mine and smelter with a production rate of 120 000 t/y. A definition diamond drilling program conducted in 2002 provided core samples for a composite sample for pilot scale testing. Other work has included initial work on environmental permitting, infrastructure studies, and bench-scale testing on composite samples. The company signed an agreement with the Ukraine State Research and Design Titanium Institute of Zaprozhye and the Russian National Aluminium and Magnesium Institute (VAMI) regarding the use of their technology on the project. A number of contractors, including Hatch Associates, were engaged to complete a study for a mine and a 120 000-t/y smelter project. Results were expected in 2003. Further details are available at www.leadermining.com.

Gossan Resources Ltd. maintained its interest in a dolomite property at Inwood, Manitoba. The company's dolomite resource is estimated at 67 Mt grading 21.6% MgO with additional inferred resources. Gossan indicates that the next phase of activity would be a drill program, which could in turn lead to a prefeasibility study. Tests on this material have shown that production of commercial-grade magnesium metal is possible using the Magnetherm process (www.gossan.ca).

The town of Thetford Mines, Quebec, worked on a prefeasibility study on a proposal to process mining residues from asbestos mines into magnesium metal. The town reports that more than 300 Mt of material with a grade of 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.

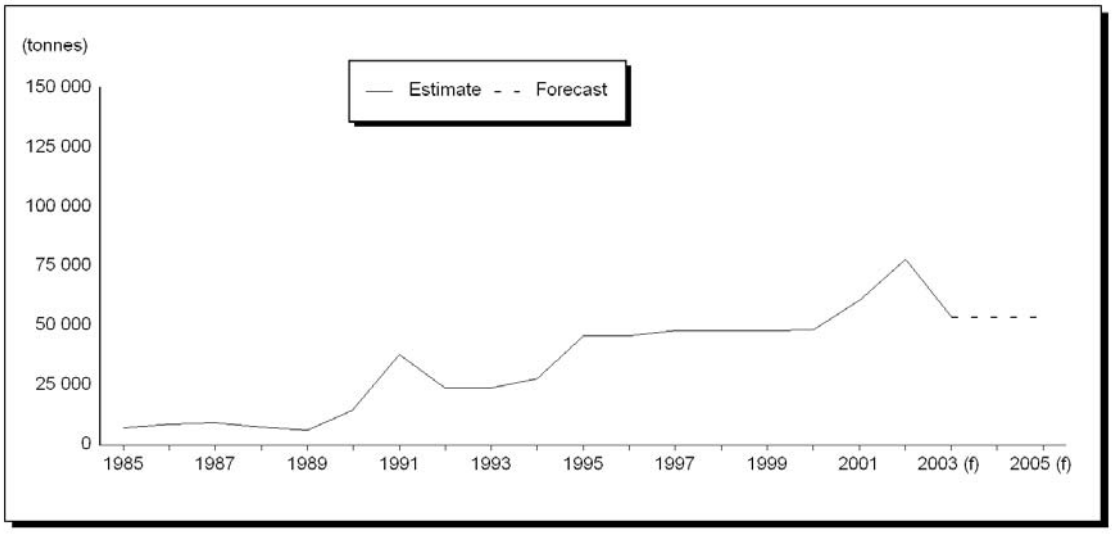
The Canadian Magnesium Corporation has proposed a project to extract magnesium oxide from serpentine in the tailings at the former Baie Verte asbestos mine in Newfoundland and Labrador. In 1999, CMC completed prefeasibility studies and bench-scale testing on mineral residues. Results of the work were positive and indicated that a clean product could be produced. The company continues to review its financing options prior to committing to piloting and marketing studies.

Cassiar Resources Inc. had a stockpile of 23 Mt of serpentine tailings that grade approximately 24% magnesium at the former Cassiar Asbestos Corporation Limited's mine at Cassiar in northern British Columbia. In 2002, the company continued to seek potential investors and decided not to actively pursue magnesium metal potential.[2]

Canadian Production and Use of Magnesium

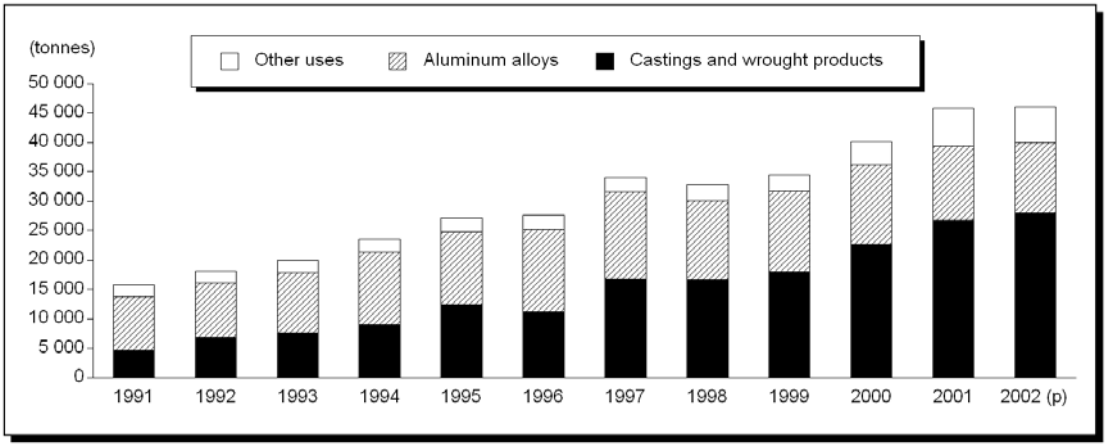
Canadian production capacity for magnesium (reported production for Magnola plus reported capacity for other smelters) was approximately 75 000 t/y in 2002, but with the closure of Magnola in 2003, capacity will fall to approximately 54 000 t/y in 2003.

Figure 2
Canadian Primary Magnesium Production Capacity, 1985-2005



Sources: Natural Resources Canada; published reports.
Note: Canadian production data are confidential due to the limited numbers of producers. This is the primary capacity or production reported of plants in Canada from credible published sources.

Figure 3
Canadian Use of Magnesium, 1991-2002



Source: Natural Resources Canada survey of Canadian users of magnesium.
(p) Preliminary.

In Canada, reported use of magnesium increased from a revised 40 154 t in 2000 to 45 840 t in 2001, due in part to an increased number of companies reporting.

GLOBAL CONTEXT

Production from many small companies in China continued to place pressure on magnesium producers around the world.

Following the closures in 2001 and early 2002 (refer to the chapter on Magnesium in the 2001 *Canadian Minerals Yearbook* at www.nrcan.gc.ca/mms/cmy/content/2001/36.pdf), Pechiney Électrométallurgie closed its 18 000-t/y Marignac magnesium smelter in France, but planned to continue operations at the site to recycle magnesium at a rate of about 5000 t/y. Further information is available on the Internet at www.pechiney.com.

Magnesium Corp. of America (Magcorp), after filing in 2001 for protection from its creditors under Chapter 11 of the bankruptcy code, was sold in 2002 to U.S. Magnesium LLC, another subsidiary of the Renco Group Inc. The company is modernizing equipment at its 43 000-t/y smelter in Rowley, Utah. Modernization of the plant is expected to eventually increase its capacity to 56 000 t/y, at which point it would be the company with the largest production capacity in the world.

The pressure from Chinese production also extended around the world, creating difficulties for exploration and for development projects, particularly those needing a large investment.

Magnesium Alloy Corporation continued work on developing its Kouilou project in the Republic of the Congo (Brazzaville). The company signed memoranda on evaluations of energy production and transmission and an off-take agreement for the purchase and marketing of up to all of the plant's production. The company has a web site at www.magnesiumalloy.ca.

PRICES

Prices published by *Metals Week* for magnesium trended slightly downward through the year. The U.S. Spot Western Mean started the year at US$1.25/lb and ended it at US$1.10/lb in December, while the mean U.S. dealer import prices decreased from US$1.07/lb early in the year to US$1.04/lb. The *Metal Bulletin*'s World Free Market Price for minimum 99.8% magnesium metal started the year at US$1775-$1875/t and increased to end the year at US$1880-$1980/t.

Reported prices of Chinese magnesium on a spot basis f.o.b. China started the year at approximately US$1200-$1300/t and strengthened but remained historically low throughout 2002. Spot sales were reported at US$1360-$1380/t at year-end.

Hydro Magnesium reduced its European producer price for magnesium alloy to 2.50/kg from 2.62/kg early in 2002. The company also announced that it would not continue to issue a European producer price for pure magnesium (www.magnesium.hydro.com).

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

1997	1998	1999	2000	2001	2002
		(US$/lb)			
1.65	1.59	1.55	1.37	1.25	1.21

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

STOCKS

International Magnesium Association (IMA) data indicate that reported inventories of primary magnesium decreased in 2002 to end the year at 18 834 t, down from 45 180 t at the end of 2001. This inventory does not include inventories in the Commonwealth of Independent States and China.

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; and
- for other information, see the USGS web site at http://minerals.usgs.gov/minerals/pubs/commodity/magnesium.

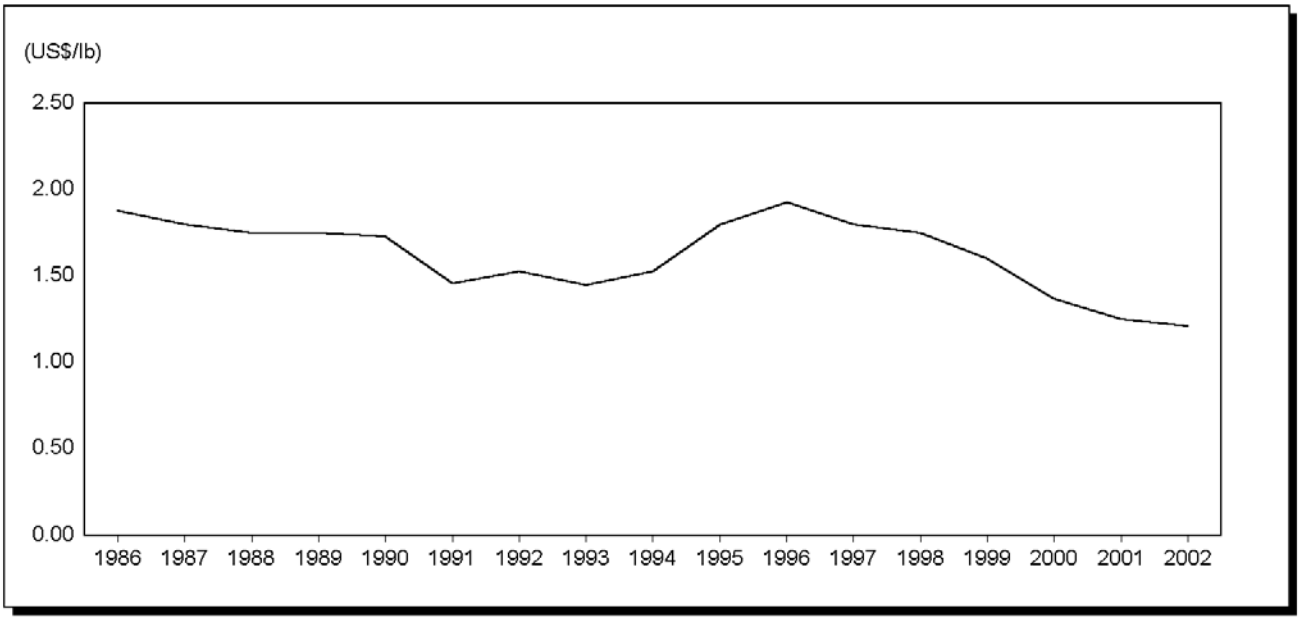
Canadian magnesium metal producers have web sites located at:

- 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[3] have web sites located at:

- Globex Mining Enterprises Inc.: www.globexmining.com
- Gossan Resources Ltd.: www.gossan.ca

Figure 4
Magnesium Prices, 1985-2002



Sources: Natural Resources Canada; *Metals Week* (U.S. Spot Western Mean).

- 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 about one half 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. Results of work to date have not been successfully adapted to large-scale production, although some changes in material supply, 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. As of early 2003, there were three operating magnesium smelters in Canada.[4]

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 48 000-t/y 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 20 000 t/y. 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 Center 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 serpintine 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 shut-down 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 temperature 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 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 its use 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: the manufacture of pharmaceutical and chemical products, perfumes and pyrotechnics;
- Electrochemical applications: use in the manufacture of batteries and in anodes for the cathodic protection of gas pipelines and water heaters;
- Wrought products: 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 on 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 runaround 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. 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 Market*, or other similar papers and journals with metals news.

ENDNOTES

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.

2 The company has subsequently sold the Cassiar property but retains an interest. It has also changed its name to Troutline Investments Inc. See the company's filings at www.sedar.com.

3 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.

4 Noranada Magnesium has announced an interim closure of the Magnola smelter scheduled for April 2003. After that time, there will be two operating magnesium smelters in Canada.

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, 2003. (3) Some differences are noted in some data from independent sources. Readers are cautioned to confirm this data. (4) Lorraine Ralph and others in the Minerals and Metals Statistics Division created Table 1 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 (2)	EU (2)	Japan
		MFN	GPT	USA	Canada	MFN	MFN
3824.90.90.42	Granular metallic magnesium coated with inorganic salts, mixed with lime	7.5%	3%	Free	Free	6.5%	2.6%
3824.90.90.43	Other granular metallic magnesium coated with inorganic salts	7.5%	3%	Free	Free	6.5%	2.6%
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 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2003; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties for European Union* (42nd Annual Edition: 2002); *Worldtariff Guidebook on Custom Tariff Schedules of Import Duties for Japan* (36th Annual Edition: 2002).
(1) Does not include countervail or anti-dumping duties, which may be applied to material of certain origin. (2) Duty suspension may apply for certain goods.

TABLE 1. CANADA, MAGNESIUM EXPORTS AND IMPORTS BY COMMODITY AND COUNTRY, 2001 AND 2002

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS					
8104.11	Magnesium unwrought, containing by weight at least 99.8% magnesium				
	United States	1 625	8 053	6 791	28 888
	Netherlands	2 547	6 143	8 166	20 449
	Germany	4 638	12 928	1 482	4 267
	United Kingdom	315	2 449	603	2 532
	France	309	819	876	2 462
	United Arab Emirates	–	–	885	2 445
	Other countries	4 412	12 590	1 811	4 873
	Total	13 846	42 982	20 614	65 916
8104.19	Magnesium unwrought, other				
	United States	13 858	64 149	25 789	110 491
	Netherlands	783	3 084	5 797	19 807
	Italy	305	1 643	3 427	12 057
	Japan	153	581	317	1 262
	Taiwan	61	221	248	840
	Other countries	389	1 556	415	1 675
	Total	15 549	71 234	35 993	146 132
8104.20	Magnesium waste and scrap				
	United States	8 585	27 083	10 245	24 670
	Australia	34	202	21	118
	Other countries	2	5	–	–
	Total	8 621	27 290	10 266	24 788
8104.30	Magnesium raspings, turnings or granules, graded according to size, and powders				
	United States	1 571	6 496	1 454	5 369
	Ireland	290	2 210	270	2 010
	Netherlands	41	286	45	305
	Germany	65	496	42	296
	Other countries	175	1 163	36	254
	Total	2 142	10 651	1 847	8 234

TABLE 1 (cont'd)

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
8104.90	Magnesium and articles thereof, other				
	United States	2 564	20 169	2 016	18 104
	Australia	520	3 357	453	3 118
	Netherlands	14	129	34	185
	Other countries	36	413	20	238
	Total	3 134	24 068	2 523	21 645
	Total exports	43 292	176 225	71 243	266 715
IMPORTS					
3824.90.90.42	Granular metallic magnesium coated with inorganic salts, mixed with lime				
	United States	607	2 376	33	34
8104.11	Magnesium unwrought, containing by weight at least 99.8% magnesium				
	China	7 478	18 170	9 440	21 483
	United States	2 679	10 439	6 995	16 770
	Israel	687	2 315	280	910
	Russia	2 769	9 985	81	240
	Switzerland	4	19	2	19
	Brazil	340	1 140	–	–
	Other countries	426	1 432	–	–
	Total	14 383	43 500	16 798	39 422
8104.19	Magnesium unwrought, other				
	Russia	1 288	5 383	5 210	21 987
	United States	2 444	12 316	2 868	13 626
	United Kingdom	239	2 393	152	1 634
	China	143	965	381	1 619
	Israel	–	–	185	993
	Norway	1 934	7 368	144	422
	Other countries	44	182	–	–
	Total	6 092	28 607	8 940	40 281
8104.20	Magnesium waste and scrap				
	United States	7 530	26 945	6 607	22 000
	Mexico	38	149	91	318
	China	67	148	162	268
	Russia	2 563	9 839	47	167
	Other countries	322	1 000	4	13
	Total	10 520	38 081	6 911	22 766
8104.30	Magnesium raspings, turnings or granules, graded according to size and powders				
	United States	716	3 384	871	3 699
	China	5	22	81	199
	Other countries	34	126	20	87
	Total	755	3 532	972	3 985
8104.90	Magnesium and articles thereof, other				
	United States	929	7 793	1 182	7 344
	China	173	1 057	103	565
	Other countries	19	106	4	46
	Total	1 121	8 956	1 289	7 955
	Total imports	33 478	125 052	34 943	114 443

Source: Statistics Canada.
– Nil; **. . .** Amount too small to be expressed; (p) Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, MAGNESIUM USE,[1] 1991-2001

	1991 (a)	1992 (a)	1993 (a)	1994	1995 (a)	1996	1997	1998 (a)	1999 (a)	2000 (a)	2001 (p)
						(tonnes)					
Castings and wrought products (2)	4 604	6 915	7 678	8 940	12 488	11 197	16 795	16 687	17 951	(r) 22 728	26 818
Aluminum alloys	9 215	9 203	10 174	12 389	12 323	14 022	14 793	13 417	13 741	13 466	12 551
Other uses (3)	1 926	2 005	2 162	2 234	2 329	2 357	2 438	2 685	2 727	3 960	5 556
Total	15 745	18 123	20 014	23 563	27 140	27 576	34 026	32 790	34 419	(r) 40 154	44 925

Source: Natural Resources Canada.
(p) Preliminary; (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, 1994-2002

Country	Rank in 2001	1994	1995	1996	1997	1998	1999	2000	2001	2002 (e)
						(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
Canada (1,e)	2	28.9	48.1	54.0	57.7	77.1	73.7	85.7	83.4	80.0
Russia	3	35.4	37.5	31.5	33.0	34.1	35.2	35.5	35.0	35.0
United States	4	128.5	142.1	133.1	124.8	106.1	75.0	94.0	50.0	20.0
Israel	5	–	–	(r) 0.1	7.4	24.5	(r) 24.3	31.7	34.0	28.0
Kazakhstan	6	3.0	9.0	13.4	17.9	20.9	(r) 11.0	10.4	16.5	18.0
Norway	7	27.6	28.0	37.8	34.2	35.4	40.8	41.4	36.0	10.0
Brazil	8	8.8	9.7	9.0	9.0	9.0	(r) 8.0	5.7	5.5	4.5
India	9	1.0	1.0	1.0	1.0	1.5	(r) 1.0	(r) 0.5	0.5	0.5
France		12.3	14.5	14.0	13.8	14.7	(r) 16.2	(r) 16.5	4.8	
Former Yugoslavia		–	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
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
United Kingdom	2	0.5	0.5	0.5	0.5	0.5	(r) 0.5	0.5	0.5	0.7
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
Total primary and recycled		355.2	478.2	(r) 477.6	488.9	502.0	(r) 530.5	564.7	531.9	502.1

Sources: International Consultative Group on Nonferrous Metals Statistics; China Magnesium Association as reported in various journals.
– Nil; (e) Estimated by author; (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 in various journals 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, which have not reported separate production figures for recycled magnesium due to confidentiality and other reasons.