UNITED STATES INTERNATIONAL TRADE COMMISSION

Unwrought Aluminum

Industry & Trade Summary

Office of Industries
Publication ITS-06
March2010
Control No. 2010001

UNITED STATES INTERNATIONAL TRADE COMMISSION

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PREFACE

The United States International Trade Commission (USITC) has initiated its current Industry and Trade Summary series of reports to provide information on the rapidly evolving trade and competitive situation of the thousands of products imported into and exported from the United States. From 1988 to 2008, U.S. international trade in goods and services rose by almost 350 percent, compared to an increase of 180 percent in the U.S. gross domestic product (GDP), before falling sharply in late 2008 and 2009 due to the economic downturn. During the same two decades, international supply chains became more global and competition increased.

Each Industry and Trade Summary addresses a different commodity/industry and contains information on trends in consumption, production, and trade, as well as an analysis of factors affecting industry trends and competitiveness in domestic and foreign markets. This report on unwrought aluminum primarily covers the period 2004 through 2008.

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ABSTRACT

This report addresses trade and industry conditions for unwrought aluminum for the period 2004–08.

- Aluminum is used in a variety of end markets including the transportation, construction, electrical and consumer durables industries. As such, the demand for unwrought aluminum is principally derived from demand for the downstream aluminum products used in these industries. Since the downturn that began in late 2007, the transportation and construction industries (aluminum's two largest end markets) have been negatively impacted. Consequently, apparent consumption of aluminum in the United States decreased by 5 percent from 2007–08, from 8.9 million metric tons MT to 8.4 million MT. Furthermore, after five consecutive years of price increases due to strong worldwide aluminum demand, prices began to decline. From January 2008 to January 2009, the average price of primary aluminum dropped by 42 percent.

- While most of the unwrought aluminum produced in the United States is used to satisfy domestic consumption, the United States is also highly dependent on imports to satisfy domestic demand. Many domestic primary aluminum companies are globalized and have plants abroad where they smelt and/or fabricate aluminum to ship to the United States.

- During 2004–08, U.S. imports of unwrought aluminum decreased by 15 percent, from 3.3 million MT to approximately 2.8 million MT due to a decline in demand in aluminum end markets. Canada is the largest exporter of unwrought aluminum to the United States, accounting for approximately 71 percent of total U.S. unwrought aluminum imports in 2008.

- The share of the U.S. market held by domestic producers rose during 2004–08, from 61 percent to 67 percent. However, despite the recent rise in the domestic producers' share of apparent consumption, the overall trend in the past 10 years is that the domestic producers' share has been declining; in 1999, 71 percent of U.S. aluminum consumption was supplied by domestic production.

- The domestic producers' share of apparent consumption in the United States is, in part, dictated by the demand and price for aluminum. When the economy is stagnant and demand and prices for aluminum decrease, the domestic producers' share of apparent consumption tends to increase as it becomes less profitable for foreign companies to export the metal into the U.S. market. Conversely, when aluminum demand grows, imports will gain more market share in satisfying apparent consumption.

- Continuing a longer-term trend, during 2004–08, the U.S. primary aluminum smelting industry shrank, while the secondary aluminum industry (which recovers aluminum scrap) became more competitive. Although domestic primary production rose by 6 percent during 2004–08, from 1999 to 2008, primary production decreased by 30 percent. High domestic electricity prices that drove up costs for primary smelters in combination with the economic downturn that began in late 2007 and caused demand to decline, resulted in the closure or idling of numerous primary smelting facilities. In 2008, secondary aluminum production accounted for 56 percent of domestic unwrought aluminum production while primary aluminum production accounted for 44 percent of total production.

- China, Russia, and Canada, in decreasing order, are the three largest global aluminum producers, accounting for over 50 percent of worldwide production during 2004–08. During the same time period, Canada and Russia furnished 31 percent of global unwrought aluminum exports. In addition, emerging foreign aluminum producers benefiting from access to relatively inexpensive electricity rates are entering the market; examples include Iceland, Qatar, and the United Arab Emirates.

INTRODUCTION

Aluminum is the world's second most widely used metal after steel, and its production volume exceeds that of all other nonferrous metals combined. Aluminum is strong, durable, flexible, lightweight, corrosion-resistant, completely recyclable, and a good conductor of electricity and heat.[1] Due to its numerous positive attributes, the metal has many end uses including the transportation, construction, and packaging industries. Approximately three-quarters of all aluminum ever produced in the world remains in use today, and the metal is heavily traded on global markets.[2]

Over the last decade, since production of primary aluminum requires large amounts of electricity, there has been a shift globally toward building primary aluminum smelting facilities in locations where electricity rates are inexpensive and where smelters do not need to compete for the electricity with local populations. Given the relatively high electricity rates in the United States, the domestic primary aluminum industry has been gradually shrinking as new primary smelting facilities have been constructed abroad. By contrast, U.S. production of secondary aluminum has increased. Since much less electricity is required, the cost of producing ingot from scrap aluminum is lower than the cost of primary aluminum production, making secondary aluminum producers more competitive in recent years.

Imports typically supply 35–40 percent of the domestic market demand because domestic aluminum production is insufficient to satisfy demand. Canada is the dominant source of U.S. imports and many Canadian producers are affiliates of U.S. firms. Since U.S. producers are focused on the domestic market, U.S. exports tend to only account for 6–7 percent of production.

Since late 2007, the United States has been experiencing an economic downturn, which has lowered demand for aluminum in several of the metal's key end markets, such as transportation, construction, and containers and packaging. Consequently, the price for aluminum has declined, making it unprofitable for certain aluminum smelters to continue to operate at full capacity; some have closed altogether. Nonetheless, in the long term, the U.S. market for unwrought aluminum is expected to rebound with improvements in the overall economy.

This report analyzes the unwrought segment of the U.S. aluminum industry, including both primary aluminum and the recovery of aluminum scrap (secondary aluminum) (box 1). The report examines the production of both forms of aluminum, together with the structural characteristics of their respective producers, the end markets served by the metal, and domestic market trends during 2004–08. It also discusses competitive factors, such as lower production costs associated with access to inexpensive electricity rates. The final section examines major foreign consumers of U.S. unwrought aluminum.

[1] International Aluminium Institute, Story of Aluminum, n.d.
[2] Ibid.

BOX 1 Industry definitions

For the purpose of this report, terms are defined as follows unless otherwise specified.

• *Alumina:* refined aluminum oxide produced from bauxite, which is then smelted into aluminum metal.

• *Bauxite:* the ore used to make alumina.

• *Billet:* unwrought aluminum cast into round or square shapes intended for extrusion presses.

• *Casting:* a process used to work aluminum metal into a product at or near its finished shape. The molten aluminum is introduced into a mold where it solidifies.

• *Drawing:* a process used to work aluminum metal into a semi-finished product. The aluminum metal is worked by being pulled through a die.

• *Extrusion process:* a process used to work aluminum metal into a semi-finished product. Aluminum in the shape of a billet is placed in a container and is forced under pressure through a die.

• *Forging:* the aluminum metal is heated and then pressed, pounded, or squeezed under great pressure into high-strength parts. Some forgings may be produced without heat; however, forged components are generally shaped by either a hammer or a press.

• *Foundry ingot:* ingot made suitable for the casting process.

• *Impacts:* an impact is a part formed in a confining die from a metal slug by rapid, single-stroke application of force through a punch, causing the metal to flow around the punch and/or through an opening in the punch or die. An impact implies a hammering action and can be differentiated from an aluminum extrusion in that an ingot or billet is forced under applied pressure through a die opening to form an elongated shape or tube.

• *Ingot:* unwrought aluminum intended for remelting or forming by hot or cold working.

• *New (post-manufacturing) scrap:* aluminum remaining (e.g., shavings, trimmings, etc.) from the production of wrought aluminum and cast products. The fabricator either recycles the scrap or, if not so equipped, sells the scrap into the secondary market.

• *Old (postconsumer) scrap:* aluminum that becomes available when durable and nondurable consumer products are discarded.

• *Primary aluminum:* aluminum made by smelting alumina into unwrought aluminum.

• *Rolling:* a process used to work aluminum metal into a semi-finished product. Aluminum ingot is rolled, while either cold or hot, between two rotating cylinders to attain the desired thickness. This process is commonly used to make foil, sheet, and plate aluminum products.

• *Secondary aluminum:* aluminum recovered from old and new scrap that is collected and remelted to form unwrought aluminum.

• *Semifinished product:* product that has undergone some processing but still needs to be further processed before it is ready for use.

• *Rolling ingot:* ingot made suitable for rolling.

• S*pecification ingot:* alloyed, unwrought aluminum used to satisfy specific end markets.

• *Unwrought aluminum:* aluminum metal that is obtained by casting without further hot or cold working and is either smelted from alumina or recovered from scrap; in either case, it is available as both ingots and billets.

• *Wrought aluminum:* aluminum that is processed by hot and or cold working into customer-specific shapes, such as sheet or foil.

Sources: Plunkert, *Aluminum Recycling in the United States in 2000;* International Aluminium Institute, *Terms and Definitions,* March 2009.

U.S. INDUSTRY AND MARKET

Industry Structure

Unwrought aluminum[3] can be manufactured using either of two forms of production: primary or secondary. The production of primary unwrought aluminum requires the use of raw materials (bauxite and alumina), while production of secondary aluminum relies on the collection of old (postconsumer) and new aluminum scrap, which is remelted into unwrought aluminum. The U.S. industry includes both primary and secondary producers.

There are important differences between these two types of producers. U.S. primary aluminum manufacturers tend to be globalized and highly integrated, owning or having interests in production processes ranging from the mining of bauxite (in foreign countries) to the production of unwrought aluminum to the manufacturing of semi-finished products. Both domestically and internationally, primary aluminum facilities are generally located where electricity costs are lowest because of the energy intensity associated with smelting aluminum. By contrast, U.S. secondary aluminum producers are not as vertically integrated and operate almost exclusively in the domestic market rather than globally. This is largely because secondary aluminum's feedstock relies on the collection of old and new scrap, which is generally sourced domestically, instead of the raw materials used in primary aluminum production. In addition, producing unwrought aluminum from scrap requires significantly less electricity, so companies are less inclined to move abroad in search of lower electricity rates.

Domestic Firms

In 2008, the overall U.S. aluminum manufacturing industry generated approximately $43.8 billion in revenue,[4] an increase of 23 percent, up from $35.6 billion in 2004.[5] Of the $43.8 billion generated in 2008, primary aluminum shipments accounted for $7.06 billion, an increase of 50 percent, from $4.7 billion in 2004.[6] In 2008, U.S. companies produced approximately 2.7 million MT of primary aluminum with the four largest firms accounting for 82 percent of the total. The largest firm, Alcoa Inc. (Alcoa), accounted for about half of U.S. production (table 1) and is a major player up and down the supply chain. Alcoa's activities, like other major primary aluminum producers,

[3] The North American Industry Classification System (NAICS) codes for bauxite, alumina, and aluminum (unwrought and semi-finished) are as follows: 212299–bauxite mining and/or beneficiating; 3313–alumina and aluminum production and processing; 33131–alumina and aluminum production and processing; 331311–alumina refining; 331312–primary aluminum production; and 331314–secondary smelting and alloying of aluminum. U.S. Department of Commerce, Bureau of the Census, North American Industry Classification System (accessed on various dates).

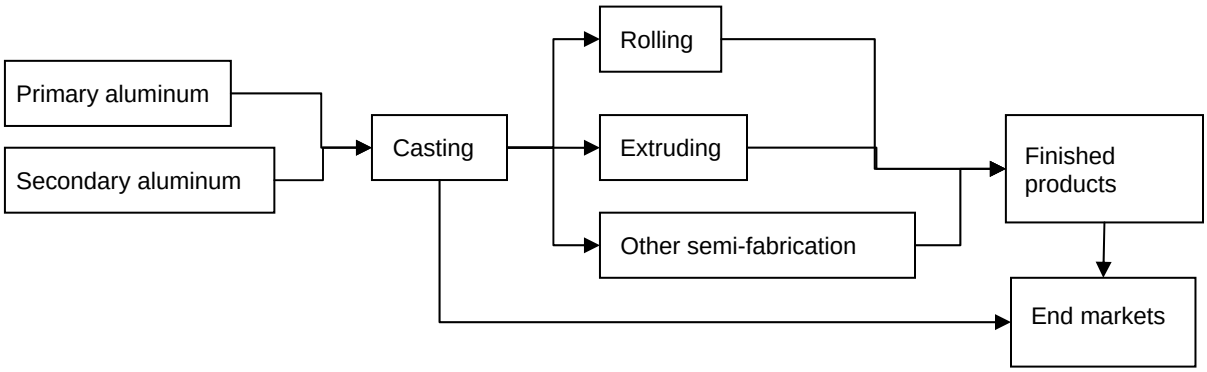
[4] The industry consists of establishments primarily engaged in one or more of the following: refining alumina; manufacturing primary and secondary aluminum; and manufacturing semi-finished products (e.g., bar, foil, pipe, plate, rod, sheet, tube, wire) from primary aluminum sources.

[5] IBISWorld, *Aluminum Manufacturing in the US: 33131,* September 15, 2008, 10.

[6] Plunkert, *Aluminum Recycling in the United States in 2000,* 2000; industry official, telephone interview with Commission staff, June 29, 2009.

include mining bauxite overseas, refining bauxite into alumina, smelting the alumina into unwrought aluminum, and further fabricating the unwrought aluminum into wrought products for use in various end markets (figure 1).[7] While some primary aluminum companies also produce secondary aluminum from scrap, the quantity of secondary aluminum produced by these companies is limited.[8]

FIGURE 1 Finished aluminum products are sourced from both primary and secondary aluminum



Source: U.S. International Trade Commission.

Approximately half of the aluminum smelters located in the United States are U.S.-owned and they tend to focus solely on the production of aluminum. However, other aluminum smelting firms in the United States are subsidiaries of foreign companies. For example, Columbia Falls Aluminum Co. and Vanalco, Inc. are owned by Glencore International AG (Glencore), a mining company headquartered in Switzerland, and Rio Tinto Alcan is owned by Rio Tinto, a global mining company with headquarter operations in Australia and in the United Kingdom. Both Glencore and Rio Tinto produce a wide range of metals and minerals besides aluminum.

TABLE 1 U.S. primary aluminum market share, by production volume of company, 2008

Company	Ownership in 2008	Market share (%)
Aloca, Inc.	Alcoa, Inc., 100%	50.8
Century Aluminum Company	Century Aluminum Co., 100%	21.2
Rio Tinto Alcan	Rio Tinto Alcan Ltd., 100%	5.3
Columbia Falls Aluminum Co.	Glencore International AG, 100%	5.0
Other		17.7
Total		100.0

Source: Datamonitor Group, *Aluminum in the United States,* September 2008, 12.

As noted, the primary aluminum industry, which already was under stress, contracted further during the study period. In 2004, 11 companies owned 21 primary aluminum smelters in 14 states (table 2), of which seven were either temporarily or permanently idled.[9] In 2008, eight companies owned 18 primary aluminum smelters in 13 states, of

[7] Datamonitor Group, *Aluminum in the United States,* September 2008, 16–17.

[8] Alcoa is a major producer of secondary ingot and sheet used for the production of beverage cans in the United States. Industry official, site visit by Commission staff, September 18, 2009.

[9] Smelters east of the Mississippi accounted for approximately 75 percent of production. Plunkert, "Aluminum," 2004.

which 5 smelters were either temporarily or permanently idled by the end of the year. At yearend 2008, approximately 34 percent of domestic primary aluminum smelting

TABLE 2 Annual U.S. primary aluminum production capacity, by company, 2004 and 2008

Company and location	Year-end capacity (thousand MT) 2004	2008	Completely/ partially operational at end of 2008
Alcoa, Inc.:			
Alcoa, TN	215	215	Yes
Badin, NC	120	120	No
Evansville, IN (Warrick)	309	309	Yes
Ferndale, WA (Intalco)[a]	278	278	Yes
Frederick, MD (Eastalco)[b]	195	195	No
Massena, NY (St. Lawrence)	125	125	Yes
Massena, NY	130	130	Yes
Rockdale, TX	267	267	No
Wenatchee, WA	184	184	Yes
Goose Creek, SC (Mount Holly)[c]	224	224	Yes
Subtotal	2,050	2,050	
Century Aluminum Co.:			
Hawesville, KY	244	244	Yes
Ravenswood, WV	170	170	Yes
Columbia Falls Aluminum Co., Columbia Falls, MT	168	168	Yes
Goldendale Aluminum Co., Goldendale, WA	160	160	No
Kaiser Aluminum & Chemical Corp., Mead (Spokane), WA	200	–	No
Longview Aluminum, LLC, Longview, WA	204	–	No
Noranda Aluminum, Inc., New Madrid, MO	250	250	Yes
Northwest Aluminum Corp., The Dalles, OR	82	–	No
Ormet Primary Aluminum Corp., Hannibal, OH	265	265	Yes
Rio Tinto Alcan Ltd., Sebree, KY	196	196	Yes
Vanalco, Inc., Vancouver, WA	116	116	No
Subtotal	2,055	1,569	
Grand total	4,105	3,619	

Sources: Bray, "Aluminum," February 2009; Plunkert, "Aluminum," 2004.

Notes: By mid-2009, Alcoa shutdown two primary aluminum smelting facilities (Alcoa and Massena), Century Aluminum closed one smelter (Ravenswood), and Columbia Falls Aluminum stopped primary aluminum production.

Data are rounded and may not add to totals shown.

[a] The aluminum smelter in Ferndale, WA, is a joint venture between Alcoa Inc. (61%), Mitsui & Co. Ltd. (32%), and YKK Corp. (7%).
[b] The aluminum smelter in Frederick, MD, is a joint venture between Alcoa Inc. (61%), Mitsui & Co. Ltd. (32%), and YKK Corp. (7%).
[c] The aluminum smelter in Goose Creek, SC, is a joint venture between Alcoa Inc. (50.3%) and Century Aluminum Co. (49.7%).

capacity was not being utilized.[10] In the short-term, the economic downturn that began in late 2007, caused the demand and price for aluminum to fall, reportedly making it

[10] Bray, "Bauxite and Alumina," November 2008; industry official, telephone interview with Commission staff, July 7, 2009.

unprofitable for many smelters to run at full or partial capacity.[11] Electricity accounts for 25 percent of the total production cost incurred by primary aluminum smelting companies, and long-term trends of rising electricity rates made it difficult to continue competitive U.S. production. In most cases, primary aluminum companies closed or partially idled facilities in the United States because they could not obtain long-term contracts for electricity at competitive rates.[12]

The composition of the key companies in the domestic primary industry has not changed much in recent years because of high entry barriers resulting from the substantial investments required in production facilities and expertise development.[13] The companies within this industry employ similar production processes and maintain product portfolios that substantially overlap. Due to this overlap, major primary aluminum producers compete intensely for market share.[14] Furthermore, the concentration of primary aluminum production and processing is high, with the two largest firms accounting for over 70 percent of industry production.[15]

The secondary aluminum industry is considerably more fragmented. In 2008, there were approximately 16 companies that produced specification ingot (unwrought aluminum intended for specific products) and 10 companies that served as scrap processors.[16] Additionally, there are hundreds of companies that serve as scrap collectors.[17] Barriers to market entry for secondary aluminum producers are also relatively low in comparison to primary smelting firms, in part because of the comparatively low capital costs associated with establishing a remelting plant.[18] During 2004–08, however, there was substantial consolidation within the secondary industry as profitability declined due to falling demand for unwrought aluminum in various U.S. end markets.[19] Like the primary aluminum segment, the larger secondary aluminum producers are vertically integrated with regard to their production processes, which include collecting and melting down scrap and further fabricating the unwrought aluminum into wrought products to meet specific end market demands.

The two leading secondary aluminum producers in the United States are Aleris International, Inc. (Aleris) and Novelis, Inc. (Novelis). Most U.S. producers of secondary aluminum are domestically-owned with the exception of Novelis, which is a wholly-owned subsidiary of Hindalco Industries Limited (Hindalco). Hindalco is headquartered in India and is also a leading global producer of copper.

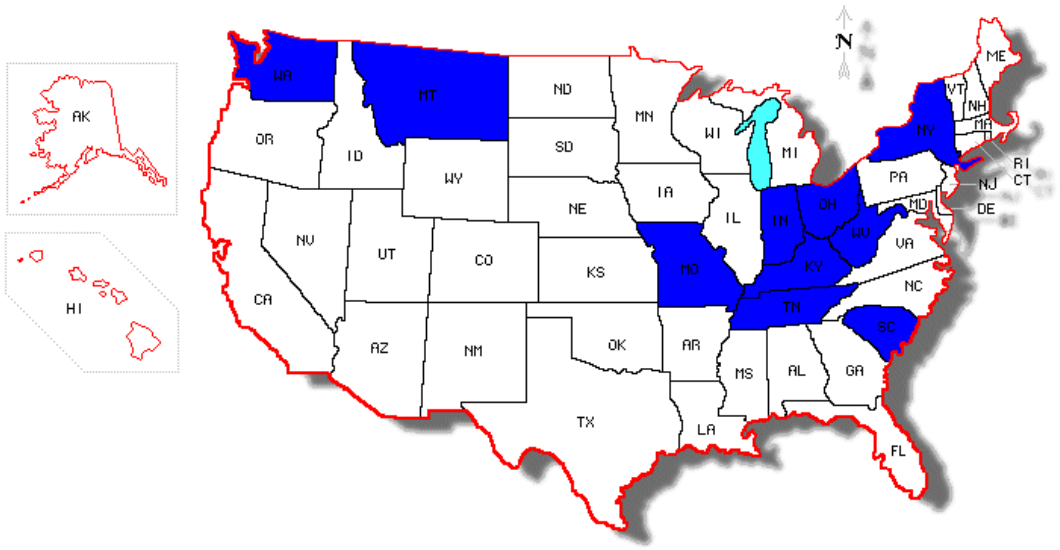
Geographic Distribution of U.S. Aluminum Production Facilities

The geographic location of primary aluminum smelting plants in the United States is directly tied to the availability and cost of electricity, whereas access to scrap influences where secondary recovery facilities are located. Primary smelters are mostly built in

[11] *CNN Money*, "It's Official: Recession since December '07," December 1, 2008; industry official, telephone interview with Commission staff, July 8, 2009.
[12] Ibid.
[13] IBISWorld, *Aluminum Manufacturing in the US: 33131,* September 15, 2008, 14.
[14] Datamonitor Group, *United States: Aluminum*, July 15, 2007.
[15] IBISWorld, *Aluminum Manufacturing in the US: 33131,* September 15, 2008, 10.
[16] Scrap processors rent their capacity to other firms to remelt scrap into unwrought aluminum.
[17] Industry official, telephone interview with Commission staff, July 8, 2009.
[18] Industry official, telephone interview with Commission staff, December 8, 2009.
[19] See the "Factors Affecting Demand" section for more information.

regions with an abundance of hydroelectric power and where electricity rates are lowest (figure 2). The southeastern region of the United States (South Carolina, Kentucky, and West Virginia) is a major producer of primary aluminum because its electricity rates are among the most competitive. During 2008, there were five operational smelters in the Southeast and three in the Midwest (Indiana, Missouri, and Ohio). During the same period, New York also had two aluminum smelters in full or partial operation, while the Pacific Northwest had two smelters operating in Washington and one in Montana. High electricity costs, compounded by decreasing demand for aluminum and falling aluminum prices, were cited as reasons for the plant closures.[20]

FIGURE 2 Thirteen U.S. primary aluminum smelters were operational by year-end 2008



Sources: Map template from DIY Maps Web site. http://monarch.tamu.edu/~maps2 (accessed July 22, 2009); Bray, "Aluminum," February 2009; and Plunkert, "Aluminum," 2004.

Secondary aluminum smelters are generally found near major industrial centers and other populated areas with ready access to large quantities of aluminum scrap.[21] They have historically been located in the Midwest (e.g., Michigan, Illinois, and Indiana) and the Northeast (e.g., New Jersey and New York), which are also locations for the secondary producers' largest traditional customer, the automotive die-casting industry. The migration of automotive plants to the South (e.g., Georgia, Kentucky, Texas, Tennessee) has resulted in an increase in secondary aluminum production in that region as well.[22]

[20] *Reuters*, "U.S. Aluminum Smelter to Idle Last Potline," January 21, 2009.

[21] U.S. Department of Energy, Energy Information Administration, "Aluminum." http://www.eia.doe.gov (accessed on various dates).

[22] Industry official, interview by Commission staff, May 4, 2009.

Major Mergers and Acquisitions

During 2004–08, mergers and acquisitions changed the composition and ownership of the U.S. primary and secondary aluminum industry, making it increasingly more consolidated (table 3). The recent mergers and acquisitions in both the primary and secondary aluminum industries have made both markets more vertically integrated and resulted in more foreign ownership of domestic producers.

TABLE 3 Major mergers and acquisitions, 2004 to mid-2009

Aleris International, Inc. (Aleris)	• In December 2004, IMCO Recycling Inc. (United States), a secondary aluminum producer, and Commonwealth Industries, Inc. (United States), a manufacturer of aluminum sheet, announced their merger to form a new company, Aleris, which is headquartered in Beachwood, Ohio. Aleris is one of the world's largest recyclers of aluminum and zinc and a leading U.S. manufacturer of aluminum sheet. • In July 2007, Aleris announced that it would acquire Wabash Alloys (United States) from Connell Ltd. Partnership (United States). Wabash Alloys produces aluminum casting alloys in the United States, Canada, and Mexico.
Novelis, Inc. (Novelis)	• In May 2007, Novelis, a U.S. firm, announced its completed acquisition by Hindalco Industries Ltd (Hindalco) (India). Novelis continues to operate as a subsidiary of Hindalco, a leading global aluminum rolling company and a producer of secondary aluminum.
Noranda Aluminum Holding Corp. (Noranda)	• In May 2007, Noranda Aluminum Holding Corp. (Canada), the parent company of Noranda Aluminum, Inc., was acquired by Apollo Management LP (Apollo Management) (Unites States), a private equity investment firm.
Rio Tinto Alcan	• On November 15, 2007, Rio Tinto Canada Holding, Inc. (RTCH), an indirect wholly-owned subsidiary of Rio Tinto (United Kingdom and Australia), announced that it had acquired 100 percent of all common shares of Alcan, Inc. (Alcan) (Canada). At the time of its takeover, Alcan had been the world's third-largest primary aluminum producer, with facilities in the United States and worldwide.
Commercial Alloys	• In November 2008, Commercial Alloys, an aluminum scrap collector and producer of secondary aluminum ingot, declared bankruptcy. In June 2009, the company announced that it sold two of its scrap yards in Twinsburg, Ohio and Jacksonville, Florida, to Reserve Management Group (United States). The remaining part of Commercial Alloys, which includes secondary smelters in Minerva, Ohio, and Scottsboro, Alabama, were sold to Imperial Zinc Corp. (United States).

Sources: Aleris International, "Aleris International, Inc. Signs Definitive Agreement to Acquire Wabash Alloys," July 5, 2007; Aleris International, "IMCO Recycling, Commonwealth Industries," December 9, 2004; *American Metal Market,* "Noranda Aluminum's Sales Rise on Higher Metal Prices," September 19, 2007; Novelis, "Hindalco Industries Completes Acquisition of Novelis, Inc," May 15, 2007; Rio Tinto Alcan, "Rio Tinto Completes Acquisition of 100 percent of Alcan," November 15, 2007; and Schaffer, "Commercial Alloys Sells Off Assets of Two Yards to RMG," June 4, 2009.

Raw Materials and the Supply Chain

Bauxite

Primary aluminum originates as a constituent of bauxite, a natural resource found in the earth's crust. There are an estimated 55 to 75 billion tons of bauxite in the earth's surface, with reserves principally located in Africa (33 percent), Oceania/Australia (30 percent), South America and the Caribbean (22 percent), and Asia (15 percent). Australia has the largest reserves of bauxite of any single country, and produces one-third of the world's supply.[23]

In 2008, approximately 216 million MT of bauxite were produced in 26 countries, an increase of 25 percent, from 168 million MT in 2004. During 2004–08, the leading producers were Australia, Brazil, China, India, and Guinea, which collectively accounted for approximately 68 percent of world bauxite production (table 4).[24] U.S. producers supply less than 1 percent of the nation's bauxite needs. Consequently, nearly all bauxite consumed in the United States is imported.[25] In 2008, more than 90 percent of all U.S. bauxite imports (11 million MT) were processed at domestic alumina refineries. The remainder was for nonmetallurgical uses, such as abrasives, chemicals, and refractories.[26]

TABLE 4 World production of bauxite, by country, 2004–08 (thousand MT)

Country	2004	2005	2006	2007	2008
Australia	56,593.0	59,959.0	61,781.0	62,428.0	63,789.0
Brazil	20,948.8	22,364.6	23,236.3	25,460.7	21,664.0
China	17,518.0	17,408.2	18,981.6	20,446.0	21,600.0
India	11,284.9	12,385.4	13,940.2	20,343.0	19,880.8
Guinea	18,799.8	19,236.9	18,783.8	18,519.0	19,296.0
Indonesia	1,330.8	1,441.9	8,380.6	15,447.4	17,220.3
Jamaica	13,296.5	14,118.3	14,865.4	14,567.7	14,636.1
Venezuela	5,814.7	5,815.2	5,927.8	5,323.3	5,799.6
Suriname	4,051.7	4,757.0	4,945.4	5,273.2	5,333.0
Russia	6,017.6	6,409.3	6,399.2	6,053.9	5,301.6
Subtotal	155,655.8	151,510.4	135,221.2	175,343.2	194,520.4
Other	12,376.2	25,517.6	56,433.9	33,674.3	21,372.6
Total	168,032.0	177,028.0	191,655.1	209,017.5	215,893.0

Sources: World Bureau of Metal Statistics, *World Metal Statistics*, December 2005 and June 2009.

[23] Bray, "Bauxite and Alumina," January 2010.

[24] World Bureau of Metal Statistics, *World Metal Statistics*, December 2005 and June 2009.

[25] Bauxite is the only raw material used in the production of alumina in the United States. However, while companies would have to use different and more costly technology, U.S. resources of clay as well as alunite, anorthosite, coal wastes, and oil shales are also feasible sources of alumina. World Bureau of Metal Statistics, *World Metal Statistics*, December 2005 and June 2009.

[26] Bray, "Bauxite and Alumina," January 2010.

Alumina

Alumina (aluminum oxide) is produced by refining bauxite, which is then smelted into aluminum metal (appendix A). The United States imports more alumina than bauxite. Most bauxite mines abroad have alumina refining plants located nearby to reduce transportation costs, since roughly two MT of dried bauxite is required to produce one ton of alumina. World production of alumina increased by 32 percent, from 61.7 million MT in 2004 to 81.6 million MT in 2008. In 2008, China, Australia, Brazil, the United States, and Jamaica accounted for 70 percent of world production (table 5); China and Australia together accounted for approximately 50 percent of the total.[27]

TABLE 5 World production of alumina, by country, 2004–08 (thousand MT)

Country	2004	2005	2006	2007	2008
China	6,990	8,610	13,700	19,500	22,800
Australia	16,700	17,704	18,312	18,844	19,321
Brazil	5,300	5,300	6,793	6,890	7,000
United States	5,350	5,220	4,700	4,240	4,300
Jamaica	4,023	4,086	4,099	3,941	4,000
Russia	3,269	3,259	3,265	3,300[a]	3,200[a]
India	2,600	2,700	2,800	2,900	3,000
Suriname	2,039	1,944	2,153	2,200	1,953
Venezuela	1,900	1,920	1,892	1,900[a]	1,900[a]
Ukraine	1,563	1,632	1,672	1,700[a]	1,700[a]
Subtotal	49,734	52,375	59,386	58,515	62,374
Other	11,966	12,025	12,114	18,485	19,226
Total	61,700	64,400	71,500	77,000	81,600

Source: Bray, "Bauxite and Alumina," January 2010.

[a] Estimated figure(s).

In 2004, there were four U.S. alumina refineries. However, due to declining alumina prices, Ormet Corp. closed its alumina facility in 2006, and the remaining three facilities (Alcoa, Gramercy Alumina LLC, and Sherwin Alumina Co.) reduced their capacity during the same year. Consequently, during 2004–08, U.S. alumina production decreased by 20 percent, dropping from approximately 5,350 MT to 4,300 MT.[28]

Supply Chain

Since the U.S. primary aluminum producers largely obtain their raw materials (bauxite and/or alumina) overseas, they have always had a global presence. Most U.S. primary aluminum producers own or have interests in bauxite mines and alumina refining facilities abroad. For example, in 2008, Alcoa's overseas operations, which include the mining of bauxite and the production of alumina, primary aluminum, and fabricated aluminum, accounted for approximately 47 percent ($12.6 billion) of its corporate revenue ($26.9 billion).[29] Alumina tends to be shipped intra-firm to the United States and smelted into primary aluminum that in turn is rolled, extruded, or drawn. Semi-fabricated

[27] Ibid.
[28] Bray, "Bauxite and Alumina," January 2010.
[29] Alcoa, *Annual Report 2008*, [2009].

products, such as sheet, plate, and wire, are then fabricated into finished products for end markets, including the automotive, construction, and packaging industries.

The sourcing patterns for scrap used in the production of secondary aluminum are more fragmented. Scrap is usually collected by scrap dealers and sold to companies that either remelt the aluminum into specification ingot themselves or contract scrap processors to remelt the scrap. The recovered aluminum metal is then shipped to processing facilities and further fabricated into sheet, plate, wire, etc. Scrap dealers play key roles in collecting and processing (e.g., shredding and compacting) aluminum scrap by serving as collection points and buying old aluminum products, such as discarded aluminum beverage cans from the public. Scrap dealers vary both in size and in degree of processing sophistication. For example, a large scrap dealer may have shredding and compacting machinery for the initial processing of scrap while smaller dealers often have little or no processing capabilities and tend to sell their scrap to larger dealers either directly or through a scrap broker.[30]

The scrap recovery segment of the secondary production supply chain has two distinct subcomponents. The first is companies that purchase scrap aluminum and remelt it into specification ingot. The specification ingot is then sold to other firms that further fabricate the aluminum into a final product.[31] The other subcomponent is scrap processors who "toll process" (rent out their melting capacity to convert) other firms' scrap into remelt secondary ingot (RSI), a lower grade of unwrought aluminum. The firms that rent the processor's facilities can either keep the ingot or resell it to another firm, such as a rolling mill or extrusion plant, where the unwrought aluminum is further remelted and re-alloyed into specification ingot for fabrication into end products. [32]

Firms that produce specification ingot from scrap aluminum generally serve three specific end markets and can be categorized into distinct groups. The first remelts scrap aluminum into foundry ingot, which is then made into castings destined mostly for the automotive industry. A second group remelts used beverage cans into rolling ingot, which is then used to make aluminum sheet for new beverage cans.[33] A third group produces common alloy sheet, which has traditionally been used in the construction market.[34]

Production Costs

Secondary aluminum is less expensive to produce than primary aluminum because of the costs of mining and refining raw materials for primary production, and the relatively high amount of electricity required to smelt alumina into aluminum, as compared to the much less energy-intensive secondary process. For primary producers, raw materials constitute the single largest cost (35 percent of the total, of which 31 percent is for refining alumina from bauxite) together with electricity and carbon anodes (25 percent and 16 percent retrospectively) (figure 3). In many instances, ingot can be made by combining secondary and primary aluminum. When more scrap is available, less primary aluminum is used in the mix because using scrap is more cost-efficient.[35]

[30] A scrap broker, like a dealer, trades in several different kinds of metal. Plunkert, *Aluminum Recycling in the United States in 2000*, 2000.

[31] Industry official, telephone interview with Commission staff, July 8, 2009.

[32] Ibid.

[33] All but 5 percent of recycled beverage cans are used to make new cans in the United States.

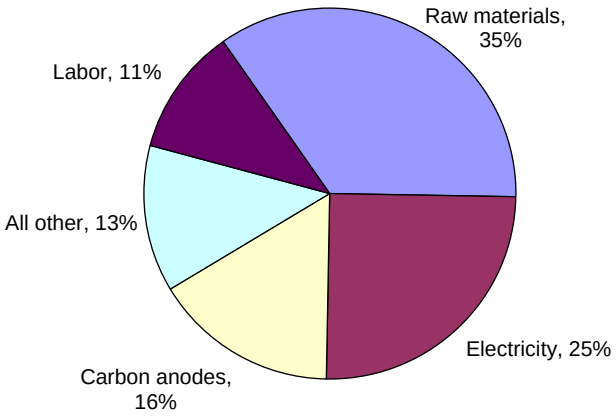
[34] Industry official, telephone interview with Commission staff, April 30, 2009.

[35] Industry official, site visit by Commission staff, September 18, 2009.

High or rising electrical energy prices can force smelters to cut back production or shut down altogether. For example, the 2001 energy crises in the Pacific Northwest reportedly resulted in a 30 percent reduction in U.S. aluminum production capacity.[36] Before that time, the states of Washington and Montana had a high concentration of aluminum smelters in operation due to the abundance of relatively inexpensive hydroelectric power provided by the Bonneville Power Administration (BPA). In mid-2001, BPA announced a 46 percent increase in its electricity rates.[37] The electricity rate hike, in combination with low aluminum prices, reportedly resulted in the closing of many of the regions' smelters. Currently, Alcoa is the only aluminum producer to operate smelters in the state of Washington. The two operating smelters, however, were both partially idled reportedly because BPA had increased the price of electricity, making the unwrought aluminum produced at these facilities less competitive.[38]

Since raw materials are sourced globally, electricity is usually the single most important factor in determining the location of a new smelter; companies build smelters where contract electricity prices are lowest.[39] The United States lost production capacity between 2004–08 due, in part, to comparatively lower raw material and energy costs and more accessible raw material supplies in the newly-emerging producing nations, such as the United Arab Emirates, Oman, and Iceland.

FIGURE 3 Raw materials and electricity are the two largest production costs for primary aluminum production, 2008



Source: Industry official, interview by Commission staff, May 4, 2009.

The lower costs of producing unwrought aluminum and aluminum products from scrap enables the smaller secondary companies to maintain a sizable–and growing–presence in

[36] Industry official, telephone interview with Commission staff, April 30, 2009.
[37] *American Metal Market*, "Northwest Aluminum Plants Face 46 Percent Power Hike," July 2, 2001.
[38] Alcoa, "Alcoa to Continue Operations at Intalco; Uncertainty About Rates Leads to Cutback," October 15, 2003.
[39] Industry official, interview by Commission staff, May 4, 2009.

the industry. As noted, companies that remelt scrap into secondary aluminum do not incur the cost of bauxite mining and alumina refining, and processing secondary aluminum requires only 5 percent of the energy[40] required to produce a similar quantity of primary aluminum.[41] Additionally, capital construction costs for a remelting plant are less than for a primary aluminum smelter.[42] Total production costs for secondary aluminum vary based on the type of furnace and scrap being melted. Most melting furnaces are fueled by natural gas rather than electricity, making the price of natural gas a significant cost driver in the scrap melting process.[43]

While it is cheaper to produce secondary aluminum than primary aluminum, the latter is still competitive in the U.S. market for two reasons. First, the domestic recycling rate is not high enough to meet domestic aluminum consumption through secondary production alone. In fact, during 1999–2008, the recycling rate for aluminum beverage cans, a large component of the aluminum recycling rate, dropped by 10 percent from 64 percent to 54 percent.[44] Furthermore, even if the recycling rate were high enough to meet demand, recycled aluminum's metallurgical properties make it unsuitable for certain end uses; as a result, primary aluminum production dominates such markets as aerospace and automotive wheels.[45]

Domestic Production

During 2004–08, primary aluminum production in the United States increased by 6 percent, from 2.5 million MT to 2.7 million MT (table 6). However, there was a 30 percent decrease in primary aluminum production from 3.8 million MT in 1999.[46] U.S. production of aluminum ingot is almost exclusively for domestic consumption; exports accounted for only about 6 percent of total U.S. unwrought production during the 2004–08 period.[47]

[40] The average energy consumption for producing 1 ton of primary aluminum was 15.456 kilowatt-hours (kWh) in 2004. The U.S. Energy Information Administration estimates that processing scrap aluminum would save approximately 14.683 kWh per ton, enough to run a typical American household for 16 months. Processing scrap aluminum not only saves on production costs but also reduces carbon emissions. U.S. Department of Energy, Energy Information Administration, "Aluminum." http://www.eia.doe.gov (accessed on various dates).

[41] Industry official, interview by Commission staff, June 2, 2009.

[42] Industry official, interview by Commission staff, May 4, 2009 and December 8, 2009.

[43] Industry official, site visit by Commission staff, September 18, 2009.

[44] In 2004, the aluminum beverage can recycling rate hit a low point of 51 percent. Aluminum Association, "U.S. Aluminum Beverage Can Recycling," July 13, 2009.

[45] Industry official, interview by Commission staff, September 18, 2009.

[46] Bray, "Aluminum," February 2009.

[47] Bray, "Aluminum," 2007–2008; Plunkert, "Aluminum," 2003–2006; and compiled from official statistics of the U.S. Department of Commerce.

TABLE 6 U.S. unwrought aluminum production, trade, and apparent consumption, 2004–08 (thousand MT)

	2004	2005	2006	2007	2008
Primary production	2,516	2,481	2,284	2,554	2,658
Secondary recovery:					
New scrap	1,870	1,950	2,280	2,220	1,980
Old scrap	1,160	1,080	1,250	1,530	1,340
Total secondary production	3,030	3,030	3,530	3,750	3,320
Subtotal, unwrought:	5,546	5,511	5,814	6,304	5,978
Imports, unwrought aluminum	3,319	3,692	3,470	2,956	2,811
Exports, unwrought aluminum	323	357	385	373	355
Apparent consumption	8,542	8,846	8,899	8,887	8,434

Sources: Bray, "Aluminum," 2006–2008; Plunkert, "Aluminum," 2003–2005; and compiled from official statistics of the U.S. Department of Commerce (accessed on various dates).

Scrap aluminum has become increasingly competitive in the U.S. aluminum market, a trend that industry observers suggest is likely to continue.[48] Variations in secondary production are largely due to the decrease in aluminum recycling rates; rates were low from the late 1990s until the mid-2000s and then began to increase. In 1999, U.S. secondary production was 3.7 million MT and represented 50 percent of total unwrought production,[49] while in 2008, secondary production was 3.3 million MT and constituted 56 percent.[50] Factors contributing to secondary aluminum's increased competitiveness include aluminum's highly recyclable nature and the low cost of remelting scrap.

Economic Downturn of 2007–09

As noted, the economic downturn since late 2007 has had a significant adverse impact on U.S. aluminum industry demand, particularly from the construction and automotive industries. Decreased demand was reflected in lower unwrought aluminum prices and, as a result, many smelters and scrap remelting facilities reduced production and employment during 2008–09 (tables 7 and 8).

[48] Industry official, interview by Commission staff, May 4, 2009.
[49] Ibid.
[50] Bray, "Aluminum," February 2009.

TABLE 7 Curtailment of operations at U.S. primary aluminum smelters, 2004–mid-2009

Company	Description
Alcoa	• In June 2008, Alcoa announced that it would temporarily idle one-half of its production at its Rockdale, Texas, facility and lay off 160 employees. In September 2008, Alcoa announced that it would curtail its remaining production at the Rockdale facility, laying off approximately 660 additional employees. • In March 2009, Alcoa suspended all smelting operations at its Tennessee plant. Curtailments were fully implemented by the end of first quarter 2009 and affected approximately 2,600 employee and contractors. • In March 2009, Alcoa announced that it would temporarily curtail operations at one of its primary aluminum smelters in Messena, New York. Approximately 170 employees were affected.
Century Aluminum, a wholly owned subsidiary of Century Aluminum Co.	• Century Aluminum announced in December 2008 the immediate closure of a potline at its Ravenswood, West Virginia, facility. The company subsequently announced in February 2009, that it would curtail all of its smelter operations. An estimated 580 unionized employees worked at the Ravenswood facility. • In December 2008, Century Aluminum announced plans to lay off 13 percent of its salaried work force at its Monterey, California, headquarters and its Hawesville, Kentucky, smelter. The company had 775 employees at its Kentucky facility. • In March 2009, Century announced that it closed one potline at its Hawesville smelter. The curtailment affected approximately 120 employees.
Columbia Falls Aluminum Company (Columbia Falls), a wholly owned subsidiary of Glencore International	• Columbia Falls announced that its Columbia Falls, Montana, smelter would shut down all production by February 2009, laying off approximately 320 people at the facility.
Noranda	• Noranda announced in December 2008 that it will restructure to reduce operating costs, conserve liquidity, and improve operating efficiencies. Approximately 338 employees and contractors were laid-off.

Sources: Alcoa, "Alcoa Taking Decisive Action to Address Economic Downturn," January 6, 2009; Alcoa, "Alcoa to Curtail Remainder of Rockdale, TX Smelter Due to Local Power Supply and Market Conditions," September 30, 2008; Alcoa, "Alcoa to Temporarily Idle Half of Rockdale, TX Smelter Due to Local Power Supply Issues," June 19, 2008; Alcoa, "NYPA, Alcoa Partner to Save Hundreds of Jobs at Massena, NY Operations Despite Major Production Curtailment," March 31, 2009; *American Metal Market,* "Century Slates Layoff of 13% of Salaried and KY Site Staff," December 19, 2008; Century Aluminum, "Century Announces the Curtailment of One Potline at Hawesville, KY Smelter," March 3, 2009; Century Aluminum, "Century Announces the Curtailment of Ravenswood, WV Smelter," February 4, 2009; Century Aluminum, "Century Issues Conditional WARN Notice and Announces the Curtailment of One Potline at Ravenswood, WV Smelter," December 17, 2008; Jennemann, "Columbia Falls to Halt Aluminum Production," December 23, 2008; Jennemann, "Senators Urge Columbia Falls Power Deal," January 7, 2009; and Noranda Aluminum, "Noranda Aluminum Holding Corporation Announces Corporate Restructuring to Reduce Costs, Improve, Efficiency, and Conserve Liquidity," December 4, 2008.

TABLE 8 U.S. secondary aluminum production curtailments, 2004–mid-2009

Company	Description
Aleris	• In September 2007, Aleris announced that it would permanently close its Dickson, Tennessee, facility, which produced specification aluminum alloys. (Aleris produces secondary unwrought aluminum and combines it with alloys to produce specification alloys, which mainly serve the auto industry.) The plant employed 67 employees and was part of Aleris' acquisition of Wabash Alloys. • In April 2008, Aleris announced that it would permanently close its Shelbyville, Tennessee, specification alloys facility. The plant had approximately 70 employees. • In December 2008, Aleris announced that it would permanently close its Tipton, Indiana, specification alloys facility. The facility employed 55 people and had been partially idled in March 2008. • In February 2009, Aleris announced that it and its wholly owned U.S. subsidiaries had filed petitions for voluntary reorganization under Chapter 11 of the U.S. Bankruptcy Code because of current market conditions. • In December 2008, Aleris confirmed that approximately 49 people had been laid off at its Friendly, West Virginia, plant, which processes recycled aluminum. • In January 2009, Aleris announced a one-month shutdown of its facility in Coldwater, Michigan, which produced specialty alloys. 100 employees were temporarily laid off.
Arkansas Aluminum Alloys	• In November 2008, Arkansas Aluminum Alloys suspended production at its Hot Springs, Arkansas, facility indefinitely.
Hydro Aluminum	• In July 2007, Hydro Aluminum North America, a subsidiary of Norsk Hydro ASA, announced that it would close or sell its aluminum remelting operations at Ellenville, New York. The closure, attributed to challenging market conditions, would affect approximately 55 employees.

Sources: Aleris International, "Aleris Announces the Closing of its Shelbyville, Tennessee Facility," April 9, 2008; Aleris International, "Aleris Announces the Closing of its Tipton, Indiana Specification Alloys Facility," December 1, 2008; Aleris International, "Aleris International, Inc. Announces Closure of Dickson, TN Manufacturing Facility," September 21, 2007; Aleris International, "Aleris International U.S. Operations File for Chapter 11 to Address Business and Financial Challenges," February 12, 2009; Aleris International, "Aleris Slates Month-Long Idling of Michigan Alloy Plant," January 7, 2009; Hydro Aluminum, "Hydro Takes Steps to Improve U.S. Operations," July 9, 2007; Schaffer, "Aleris Laid off Workers Amid Poor Business Conditions," December 23, 2008; and Schaffer, "Tenenbaum Opening Yard at Arkansas Aluminum Site," March 13, 2009.

Employment

During 2004–08, domestic employment in alumina and unwrought aluminum production decreased by approximately 10 percent, from approximately 57,500 employees to 51,700 employees due to capacity reductions associated with the 2007 economic downturn (table 9). At the same time, however, the mean average hourly wage for employees in the industry during this period increased by approximately 9 percent, from $16.33 to $17.82.[51] Employment has decreased as some aluminum smelting facilities either closed or were partially idled. In addition, some companies reduced production and employment in favor of production abroad as part of cost-saving strategies.[52] The mean hourly wage increase is due to several factors, including cost of living increases and an increase in the ratio of higher-skilled to less-skilled employees.

[51] U.S. Department of Labor, Bureau of Labor Statistics, NAICS 331300 (accessed on various dates).

[52] Industry official, interview by Commission staff, May 4, 2009.

TABLE 9 U.S. alumina and aluminum production workers, 2004–08

	2004	2005	2006	2007	2008
Employment (thousand)	57.5	57.8	57.3	54.4	51.7
Mean hourly wage	$16.33	$16.34	$17.02	$17.16	$17.82

Source: U.S. Department of Labor, Bureau of Labor Statistics, NAICS 331300 (accessed on various dates).

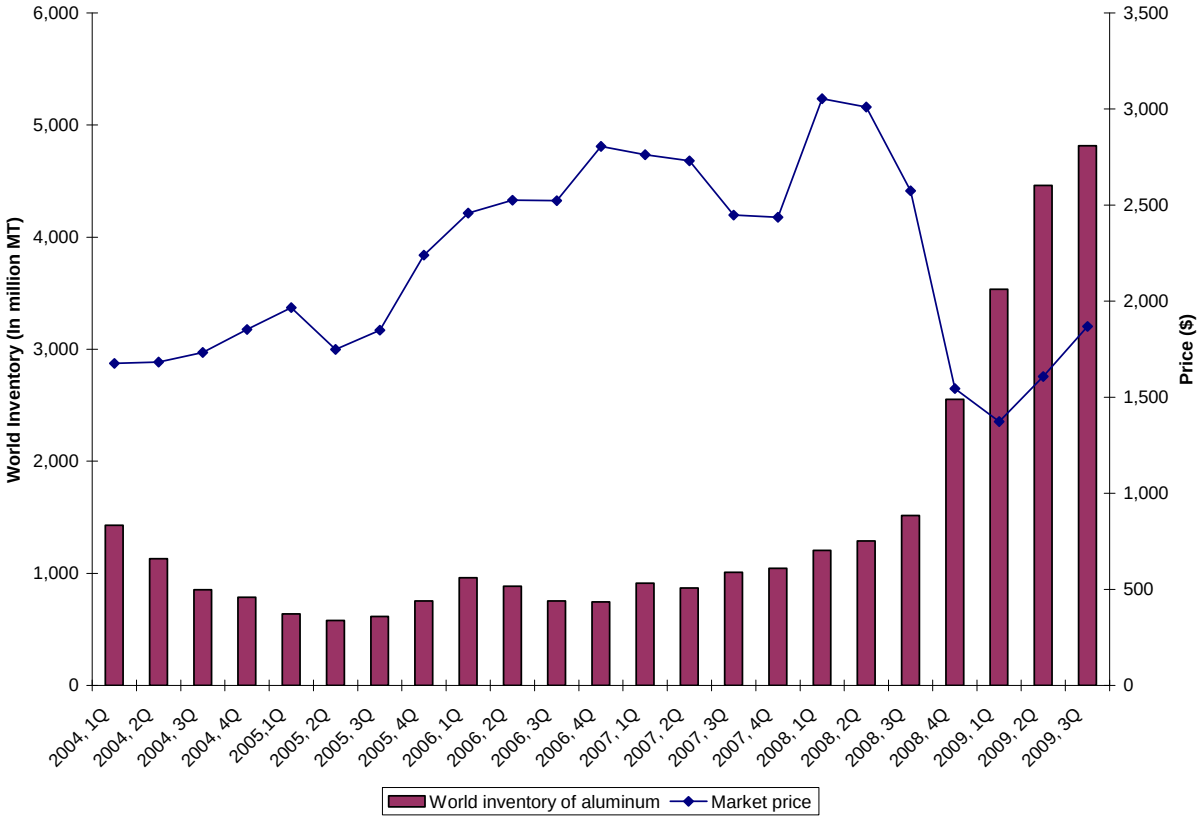
Pricing Trends

Market prices for aluminum are highly sensitive to global supply and demand conditions, including the level of global stockpiles of the metal. Aluminum inventories affect the price of unwrought aluminum. When demand for aluminum is low, stockpiles increase and the price for aluminum decreases (box 2). From 2004 to 2007, the price of primary aluminum moved steadily upward with price gains particularly in the latter part of 2005 and in 2006, when primary aluminum reached an average annual price of $1,901 per MT and $2,598 per MT respectively.[53] Price increases for both primary and secondary aluminum reflected robust global demand, especially in emerging markets such as China, which kept world inventories low. In 2007, the upward price trend eased as aluminum demand softened in response to weakening demand in downstream end markets (figure 4).[54]

By mid-2008, aluminum demand exceeded readily available supply, causing prices for the metal to reach a high of $3,354 per MT in July.[55] However, by August prices declined due to rapidly falling demand, primarily in the transport and construction markets. The financial crisis and economic downturn caused demand in end markets vital to the aluminum industry to continue dropping precipitously, and by mid-December prices had fallen to $1,483 per MT, a decrease of 56 percent from the July 2008 high and worldwide stockpiles had increased significantly. Consequently, the average price for 2008 dropped to $2,620 per MT.[56] World and domestic production slowed through mid-2009 in an attempt to balance supply with demand. However, although production was cut in many countries,[57] not all suppliers engaged in cutbacks, thereby compounding the downward pressure on prices. During 2008, domestic monthly unwrought aluminum output fell by 35 percent.[58]

[53] *American Metal Market*, "Pricing History," (accessed on various dates).
[54] Ibid.
[55] Industry official, telephone interview with Commission staff, April 30, 2009; *American Metal Market*, "Pricing History," (accessed on various dates).
[56] *American Metal Market*, "Pricing History," (accessed on various dates).
[57] Although world production has slowed, there are still large build-ups of aluminum on the London Metal Exchange, a transparent forum for the trade of all major non-ferrous metals. Industry official, interview by Commission staff, May 4, 2009.
[58] Industry official, telephone interview with Commission staff, April 30, 2009.

FIGURE 4 World aluminum inventory and price have an inverse relationship, 2004–09 (by quarter)



Sources: *American Metal Market,* "Pricing History," (accessed on various dates); and *World Metal Statistics*, December 2005 and March 2009.

Note: World inventory includes metal stock exchanges, including the London Metal Exchange as well as country stockpiles. Inventories reflect stocks at the end of the period. Prices are averages of the period.

Changes in the price of scrap, the most important raw material for the production of secondary aluminum, are often indicative of overall aluminum market conditions.[59] Between 2004 and early 2008, prices for scrap sheet and castings, automotive scrap, and used beverage cans grew (table 10). These three forms of aluminum scrap each reached a five-year peak in the first quarter of 2008. However, by mid-2008, the price for scrap aluminum declined because of the economic downturn and the precipitous decline in demand for unwrought aluminum. The price decline for scrap from January to December 2008 averaged between 54–62 percent, in part, because of falling demand for unwrought aluminum from end-uses (table 10). By November 2009, prices had stabilized and started to rise from their early-2009 lows.[60]

[59] Industry official, interview by Commission staff, December 8, 2009.
[60] *American Metal Market*, "Pricing History," (accessed on various dates).

TABLE 10 Scrap aluminum quarterly prices, 2004–09 (cents per pound)

Months	Old sheet and castings	Auto scrap	Used beverage cans
2004			
1Q	61.48	67.46	61.65
2Q	50.14	53.82	60.00
3Q	53.50	58.64	59.48
4Q	57.21	62.07	63.81
2005			
1Q	59.28	64.28	71.91
2Q	51.91	57.73	62.23
3Q	56.10	63.50	60.40
4Q	61.50	66.50	72.90
2006			
1Q	75.07	83.67	85.13
2Q	75.73	84.36	83.50
3Q	70.05	78.85	80.70
4Q	74.75	81.80	85.00
2007			
1Q	78.41	85.95	90.18
2Q	73.48	79.74	87.86
3Q	74.71	80.50	76.37
4Q	78.53	82.84	79.68
2008			
1Q	91.14	96.69	100.19
2Q	84.24	91.36	98.88
3Q	70.14	74.52	79.38
4Q	34.64	39.50	46.33
2009			
1Q	33.59	39.50	41.91
2Q	41.93	48.59	50.64
3Q	56.50	62.50	58.00

Source: American Metal Market, “Pricing History,” (accessed on various dates).

Note: Figures quote pricing for aluminum domestic producers of used beverage cans, nonferrous auto scrap, and old sheet and castings.

BOX 2 London metal exchange

Aluminum inventories can affect the price of unwrought aluminum, particularly the large inventories that are sometimes held by entities such as the London Metal Exchange (LME). The LME is a futures exchange[a] with the world's largest market for options[b] and futures contracts on base metal (including aluminum) and other metals. Consequently, the LME has become a reliable reference for the market price of aluminum on the market. There are several other exchanges for metal, such as the Comex (United States), Shanghai Metal Exchange (China), and Tokyo Commodity Exchange (Japan); however, the LME is the largest by volume.

Producers move aluminum into LME-certified warehouses and are issued a holding certificate or "warrant". These certificates can be sold to a licensed dealer which, in turn, can sell it to a consumer. While these exchanges can happen at any time, the LME tends to issue more warrants for aluminum when the demand for unwrought aluminum is low and excess stock of the metal has led to oversupply. If aluminum producers cannot find a customer for their metal because of low demand, they bring it to be sold on the LME. Conversely, when demand in aluminum's end markets is rising, the amount of aluminum stored in the LME warehouses tends to diminish. Consequently, changes in the LME inventories are helpful in signaling changes in the demand and price for unwrought aluminum. From first quarter 2004 to fourth quarter 2008, LME stocks increased from approximately 1.4 million MT to approximately 2.6 million MT. The largest increase in LME inventories occurred during 2007–08, when they increased by 180 percent, from 912,400 MT to 2.6 million MT.

Sources: London Metal Exchange, (accessed various dates); industry official, telephone interview with Commission staff, October 6, 2009 and December 8, 2009.

[a] A futures exchange is a financial exchange where people can trade contracts to buy specific quantities of a commodity at a specified price with a delivery date set for a specific time in the future.

[b] An option is a contract between a buyer and seller that gives the buyer the right, but not the obligation, to buy or sell a particular asset at a later day at an agreed price. In return, the seller collects a payment from the buyer.

Research and Development

The production process for primary and secondary aluminum is fairly mature, and the technology used to produce aluminum is not rapidly evolving. Nevertheless, the aluminum industry is actively engaged in several types of research and development (R&D), including work to reduce greenhouse gas (GHG) emissions, reduce the energy required for aluminum production, and improve scrap recovery.

The aluminum industry invests in a significant amount of R&D. For instance, Alcoa is pursuing three major R&D initiatives to reduce GHG emissions in the production process for primary aluminum. The first would replace carbon anodes with longer-lasting noncarbon anodes that would eliminate carbon dioxide (CO_2) from smelting cells while also reducing capital costs. The second initiative involves the development of carbothermic smelting, which uses 30 percent less electricity. The third initiative focuses on capturing and reusing substantial amounts of energy normally lost during refining, smelting, and casting in a way that either enhances output or improves energy efficiency, leading to net reductions in CO_2 emissions.[61]

Other companies involved in aluminum production are also investing in R&D to reduce GHG emissions. Rio Tinto Alcan has announced technology that will reduce CO_2 emissions as well as reduce energy consumption in the production of primary aluminum by 2012.[62] The aluminum industry also is seeking to develop technologies to reuse a range of scrap aluminum that traditionally has not been easily or cost-effectively convertible–scrap that is especially light, dirty, painted, or unsegregated. A number of

[61] Ibid.

[62] Rio Tinto Alcan, "Next Generation Technologies," (accessed April 6, 2009).

these technologies are already being implemented and can improve the energy efficiency and emissions levels of production facilities.[63]

Firms also conduct R&D to create new ways to gain market share and increase customer satisfaction. For example, in 2006, Novelis announced a new process that simultaneously casts multiple layers of unwrought aluminum with various chemical properties into a single aluminum rolling ingot. With this development, companies no longer are limited to one alloy base and have to make trade-offs in physical product characteristics.[64]

U.S. Markets

Overview

Unwrought aluminum is an intermediate product and, to meet end market demand, must be transformed into semifabricated products, which are then typically further worked into fabricated products. Companies that produce unwrought aluminum either further work the aluminum into a semi-finished product (table 11) or sell the ingot to a downstream company that will fabricate it. The semi-finished product is then sold to a firm that manufactures the finished aluminum goods (i.e., auto parts, aluminum foil, kitchen utensils, beverage cans, etc.).

Although the immediate consumers of unwrought aluminum are the producers of wrought aluminum products, the demand for primary and secondary aluminum principally derives from demand for downstream products used in the transportation equipment, packaging, and construction industries (figure 5). Other important demand factors include the metal's substitutability for other materials and its manufacturing cost.

[63] Industry official, interview by Commission staff, May 4, 2009.

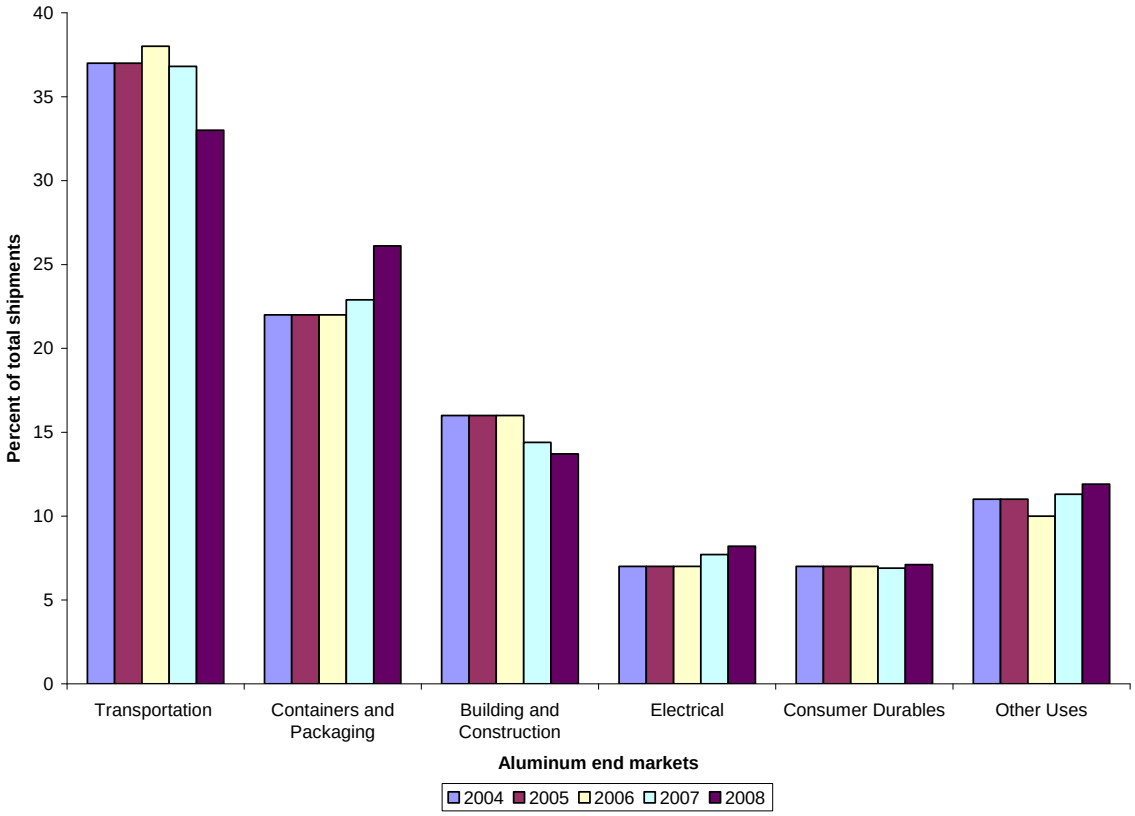
[64] Novelis, "Novelis Technology Achieves Breakthrough in Multi-Alloy Casting," June 13, 2006.

TABLE 11 Semi-fabricated and fabricated forms of aluminum

Castings	The aluminum casting process is widely used to make automotive parts and accounts for more than one-half of the aluminum used in cars. Other casting applications include parts for other forms of transportation, parts of small appliances, hand tools, lawnmowers, and cookware.
Foil	Foil, like sheet and plate, is produced by passing aluminum between rolls under pressure. Foil is the thinnest of these three products and is 0.0079 inch or less in thickness. Flexible packaging (aluminum foil) and foil containers account for about three-fourths of all foil usage. Foil is also used to back building materials, in electrical capacitors (found in virtually all electrical equipment), and as a heat exchanger in some air-conditioning units and baseboard space heaters.
Powder and paste	Aluminum powder and paste are used in various applications, such as paints and coatings, as well as chemical and metallurgical applications.
Sheet	Sheet (.0006–.249 inches thick), the most widely used form of aluminum, is used in all of the aluminum industry's major markets, such as cans and closures; automobile bodies and tractor-trailers; home appliances and cookware; building and construction (siding and gutters, downspouts and roofing, and awnings and carports); license plates and light bulb bases; boats and printing plates; and highway signs and high-flying planes.
Plate	Plate (.25 inches or more in thickness), like sheet, is made by rolling hot or cold ingot in a continuous motion until the desired thickness is achieved. Plate is used in heavy-duty applications, such as in the aerospace, machinery, and transportation markets. Aluminum plate forms the exterior of jumbo jets and spacecraft fuel tanks. It is also used for storage tanks and containers and provides structural sections for rail cars and large ships, as well as armor protection for security vehicles.
Wire, rod, and bar	Wire, rod, and bar products can be rolled or extruded. Drawn from rod or bar, wire is less than three-eighths of an inch in diameter, whereas rod and bar are larger. Furthermore, rod is round, while bar can have any number of flat sides. Aluminum faces virtually no competition from other metals and is used almost everywhere there is an electrical impulse to conduct, such as in commercial buildings, machinery and equipment, and transportation and consumer durables. Rod and bar are also made into rivets, nails, screws, bolts, and parts of machinery and equipment.
Forgings	A forging is a wrought-aluminum product formed by hammering or pressing heated aluminum between open or closed dies. Forged products include hand tools and hardware (including surgical tools), automobile parts, and aircraft components.

Source: International Aluminium Institute, *Terms and Definitions*, March 2009.

FIGURE 5 During 2004–08, the transportation industry was the largest aluminum consumer



Sources: Bray, "Aluminum," 2008; Plunkert, "Aluminum," 2005.

Consumption

During 2004–08, apparent U.S. consumption of unwrought aluminum varied, rising during the first two years of this period before dropping 5 percent because of the economic downturn and depressed demand. Consumption in 2008 was one percent less than in 2004 (8.4 million MT and 8.5 million MT respectively) (table 6).

Demand changes also influenced the mix of domestic and imported aluminum used in the United States. In 2004, domestic producers of unwrought aluminum supplied 61 percent of U.S. apparent consumption, a figure that rose to 67 percent in 2008. Although the domestic producers' share of apparent consumption increased from 2004–08, the overall trend in the past 10 years is that the domestic producers' share has been declining; in 1999, 71 percent of U.S. aluminum consumption was supplied by domestic production.[65] According to industry sources, when the economy is stagnant and demand for aluminum decreases, the domestic producers' share of apparent consumption tends to increase. The price for aluminum and the cost to ship the metal to the United States dictate the amount of aluminum imported. When the demand and price for aluminum decreases, it is not cost-efficient for foreign companies to export the metal into the U.S. market. Therefore, domestic producers gain more market share in the United States. Conversely, when

[65] Bray, "Aluminum," 2006–2007; Plunkert, "Aluminum," 2003–2005; and compiled from official statistics of the U.S. Department of Commerce.

aluminum demand and price grow, imports will gain more market share.[66] This long-term trend reflects the cost advantages enjoyed by many foreign producers.

Factors Affecting Demand

Transportation

Transportation represents the largest market for aluminum in the United States. In 2004, it accounted for 37 percent of domestic, unwrought aluminum shipments, compared to 33 percent in 2008. The automotive and light truck industries are the most important segments for aluminum within the transportation sector, particularly for ingot made from scrap aluminum.[67] In 2006, 57 percent of all automotive aluminum was sourced from recycled metal.[68] More than one half of all engine blocks manufactured in North America are currently made from recycled aluminum, a trend that is projected to continue.[69] Furthermore, all aluminum die-casting applications and approximately 35 percent of extruded shapes are sourced from scrap.[70] In turn, more than 85 percent of post-consumer automotive aluminum scrap (old scrap) and virtually all post-manufacturing automotive aluminum scrap (new scrap) are recycled.[71]

Since the automotive market accounts for a significant amount of unwrought aluminum consumption (both primary and secondary), the health of the aluminum market is directly tied to that of the automotive industry. From 2004–08, automotive production decreased by 27 percent, from 11.6 million units to 8.4 million units, resulting in a significant decrease in demand for aluminum die castings for auto parts. [72] Furthermore, there has reportedly been an increase by U.S. automotive companies to source from offshore providers of auto parts, including Mexico and China.[73]

Aluminum also plays a key role in the production of aerospace equipment, railway equipment, and seagoing vessels because of the metal's light weight and resistance to corrosion. For example, aluminum is the primary material used in aircraft construction, accounting for about 80 percent of an aircraft's unladen weight. Since the metal resists corrosion, some airlines do not paint their planes; this saves several hundred kilograms in aircraft weight, reducing fuel consumption and emissions while increasing the aircraft's payload. Aluminum alloys can also withstand the extraordinary pressures and stresses of high-altitude flying. Currently, there are around 5,300 commercial passenger aircraft and thousands of light aircraft and helicopters in operation globally. Demand for commercial aircraft is forecasted to rise by around 60 percent over the next decade.[74]

Aluminum is the preferred metal for railroad and rail freight cars as well as for urban subway cars. Aluminum's corrosion rate is one twenty-fifth that of high-resistance steel. For example, steel coal cars must be rebuilt after approximately 15 years because of

[66] Industry official, interview by Commission staff, December 8, 2009.
[67] The automotive and light truck industry is also a key producer of scrap.
[68] Aluminum Association, (accessed on various dates).
[69] Bray, "Aluminum," February 2009.
[70] Industry official, interview by Commission staff, May 4, 2009.
[71] Aluminum Association, (accessed on various dates).
[72] *Automotive Yearbook*, Wards Auto, 2006–09.
[73] Industry official, interview by Commission staff, May 4, 2009.
[74] International Aluminum Institute, *Story of Aluminum*, (accessed on various dates).

accelerated corrosion caused by sulfur, while aluminum is virtually unaffected.[75] Aluminum is also used to make parts for various kinds of seagoing vessels. Currently, about 50 percent of motors on boats are made of aluminum. Fitting passenger liners with aluminum outboard motors helps reduce weight and permits greater fuel efficiency than using steel counterparts.[76]

Containers and Packaging

Demand in the containers and packaging industry has been stable and is an important end market for the aluminum industry. In 2004, the containers and packaging industry accounted for 22 percent of domestic unwrought aluminum shipments, rising to 26 percent in 2008. The containers and packaging industry is both a large consumer of ingot from scrap and a key producer of scrap. In 2007, used aluminum cans accounted for 40 percent of the post-consumer scrap used domestically. The U.S. recycling rate for used aluminum beverage cans was 54 percent in 2008, a 3 percentage point increase since 2004.[77] (The peak recycling rate for used beverage cans was 67 percent in 1997.)[78] While roughly 100 billion aluminum beverage cans are used each year in the United States, the aluminum can market has remained relatively flat since consumption peaked in 1999. Meanwhile, aluminum producers are trying to update the design, shape, and size of beverage containers to ward off substitutes. For example, plastic is beginning to take an increasing share of this market segment, and steel (tin) producers are also trying to reclaim market share through innovation.[79]

Construction

The construction industry (residential and commercial) accounted for 16 percent of domestic unwrought aluminum consumption in 2004, compared to approximately 14 percent in 2008. Weaker demand during 2007–08 was directly related to declines in housing demand. New housing starts declined 36 percent, from approximately 1.4 million in 2007 to 900,000 in 2008.[80] In 2008, the commercial construction market was still growing by 10 percent, which helped offset the decline in demand for aluminum in the residential market. However, in 2009, the commercial construction market also began to shrink and could no longer offset declining residential demand.[81] Nevertheless, aluminum consumption by this market is expected to continue to grow in the long term.[82]

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[75] Ibid.

[76] Ibid.

[77] Aluminum Association, "U.S. Aluminum Beverage Can Recycling," July 13, 2009.

[78] Bray, "Aluminum," February 2009.

[79] *JOM*, "Worldwide Aluminum Economy: The Current State of the Industry," November 2007.

[80] U.S. Department of Commerce, Bureau of the Census, *Housing Starts: U.S. and Regions*, June 16, 2009.

[81] Industry official, telephone interview with Commission staff, April 30, 2009.

[82] Ninety percent of sheet and coil used for construction is made from secondary aluminum, while 35 percent of extruded aluminum and 10 percent of lithographic sheet is made from secondary aluminum. Industry official, interview by Commission staff, May 4, 2009.

Substitutability

Aluminum has gained significant market share in the construction, packaging, and transportation industries. However, the potential for substitutability with other materials has put pressure on aluminum. Competing materials are challenging aluminum in most major applications, including packaging (plastics), automotive (magnesium, high-strength low-alloy steel, and plastic composites), aerospace (carbon composites and titanium), and building products (plastics and composites). For example, aluminum faces growing competition in the auto parts market from magnesium, which is lighter than aluminum and has already taken market share in certain applications.[83]

Nevertheless, aluminum maintains strong advantages. Unlike many of the competing materials, aluminum can be reused in applications (e.g., beverage cans,[84] airframes, and building products) repeatedly, without degradation of the chemical and mechanical properties from its original state. Another key advantage of aluminum is the metal's strength-to-weight ratio, which provides reduced fuel consumption and GHG emissions when substituted for heavier metals like steel. This is especially true in the transportation industry, where aluminum permits production of lighter weight, more fuel-efficient vehicles.[85]

U.S. TRADE

Overview

The United States accounts for a relatively small share of total global unwrought aluminum exports, and its domestic production does not satisfy domestic demand. In 2008, for example, U.S. imports accounted for 14 percent of total global imports, while U.S. exports accounted for 2 percent of total global exports.[86] During the period under study, the U.S. trade deficit for unwrought primary and secondary aluminum decreased by 18 percent, from 3 million MT in 2004 to 2.5 million MT in 2008. Canada, Russia, and Mexico accounted, on average, for 80 percent of total trade with the United States during the period, and in 2008, Russia and Canada accounted for 89 percent of the deficit (2.2 million MT).

U.S. Imports

While the United States imports alumina and domestically smelts the material into aluminum, the United States also depends on imports of unwrought aluminum, which directly compete with aluminum produced domestically, to satisfy demand (appendix B). Since primary aluminum companies are globalized, U.S. producers such as Rio Tinto Alcan and Alcoa also have plants abroad, where they smelt and/or fabricate aluminum to ship to the United States. The imported aluminum is worked into semifinished products

[83] *JOM*, "Worldwide Aluminum Economy: The Current State of the Industry," November 2007.

[84] The recycling rate of aluminum beverage cans is twice that of polyethylene terephthalate (PET) bottles (50–52 percent in comparison to 24 to 25 percent).

[85] Industry official, interview by Commission staff, May 4, 2009.

[86] Official statistics of the U.S. Department of Commerce.

and sold to end markets such as the transportation, construction, and packaging industries and further fabricated into an end product.

During 2004–08, U.S. imports of unwrought aluminum fell by 15 percent from 3.3 million MT to approximately 2.8 million MT (table 12), due in part to decreased domestic demand for the metal. In 2008, Canada was the dominant source of these imports, accounting for 2 million MT (71 percent), followed by Russia (288,036 MT, or 10 percent) and Venezuela (104,000 MT, or 4 percent) (figure 6). Other significant sources of U.S. imports of unwrought aluminum include Argentina, Brazil, the United Arab Emirates, and Australia.[87]

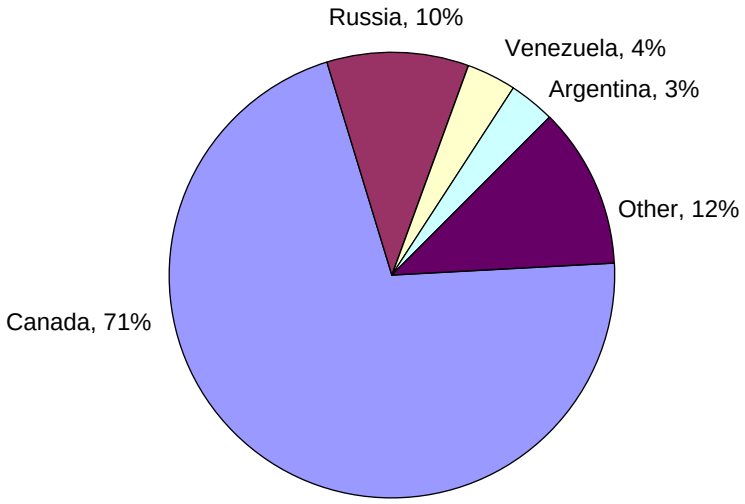
[87] Ibid.

TABLE 12 HTS 7601: U.S. imports for consumption of unwrought aluminum, by country, 2004–08

Country	2004	2005	2006	2007	2008
	Quantity (thousand MT)				
Canada	1,685	1,936	1,981	1,931	2,001
Russia	932	825	669	436	288
Venezuela	149	149	135	64	104
Argentina	76	66	59	55	90
Brazil	231	195	128	80	82
United Arab Emirates	54	79	100	108	80
Australia	65	64	58	56	40
Mexico	2	0	4	22	32
New Zealand	38	41	32	41	24
China	14	68	63	38	22
Subtotal	3,246	3,423	3,229	2,831	2,764
All other countries	73	269	241	125	47
Grand total	3,319	3,692	3,470	2,956	2,811
	Value (million $)				
Canada	3,119	3,784	5,313	5,403	5,527
Russia	1,630	1,579	1,691	1,200	799
Venezuela	258	287	319	162	282
Argentina	116	127	155	158	259
United Arab Emirates	102	164	266	317	241
Brazil	408	368	332	225	226
Mexico	3	0	15	106	131
Australia	123	135	152	159	117
New Zealand	69	85	84	117	69
China	25	136	157	107	63
Subtotal	5,853	6,665	8,484	7,954	7,714
All other countries	148	534	630	355	139
Grand total	6,001	7,199	9,114	8,309	7,853
	Unit Value ($/MT)				
Canada	1,851	1,954	2,682	2,797	2,763
Russia	1,748	1,915	2,526	2,751	2,765
Venezuela	1,733	1,927	2,360	2,533	2,724
Argentina	1,530	1,922	2,609	2,862	2,876
Brazil	1,767	1,893	2,595	2,803	2,742
United Arab Emirates	1,872	2,069	2,676	2,946	2,999
Australia	1,889	2,096	2,611	2,854	2,941
Mexico	1,885	1,737	3,451	4,720	4,070
New Zealand	1,830	2,078	2,649	2,856	2,900
China	1,799	1,987	2,510	2,838	2,886
Grand total	1,808	1,950	2,626	2,811	2,794

Source: Compiled from official statistics of the U.S. Department of Commerce.

FIGURE 6 Canada accounted for the largest share of U.S. aluminum imports in 2008



Source: Compiled from official statistics of the U.S. Department of Commerce.

U.S. Exports

Since U.S. producers focus principally on the large domestic market, it is not surprising that U.S. exports of unwrought aluminum are relatively small (generally accounting for approximately 6 percent of production) as well as minimal in comparison to total global exports (2 percent in 2008) (appendix C). During 2004–08, however, U.S. exports of unwrought aluminum increased by 10 percent, from 323,147 MT to 354,737 MT (table 13). Most exports were to Mexico and Canada, which accounted for 86 percent of total U.S. exports in 2008 (54 percent and 32 percent respectively) (figure 7).[88] U.S. exports to Mexico tend to be shipped to aluminum foundries where the ingot is recast into auto parts, primarily for the Canadian and U.S. markets.[89] Similarly, ingot shipped to Canada is further fabricated and some may be shipped back to the United States for use in various end markets.

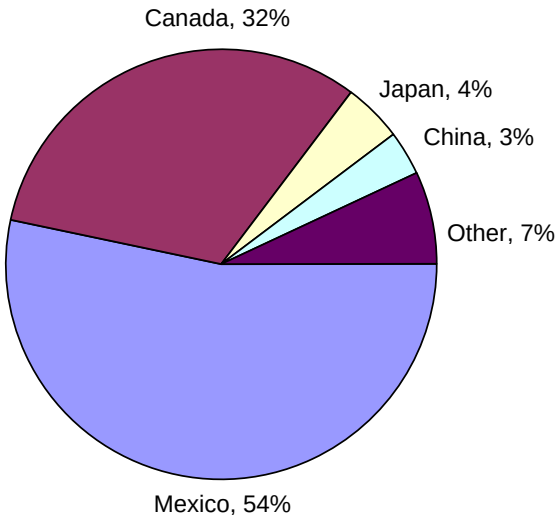
[88] Ibid.
[89] Industry official, telephone interview with Commission staff, April 30, 2009.

TABLE 13 HTS 7601: U.S. exports of unwrought aluminum, by country, 2004–08

Country	2004	2005	2006	2007	2008
	Quantity (thousand MT)				
Mexico	159	200	215	196	189
Canada	146	137	133	127	113
Japan	5	5	10	18	16
China	1	1	4	4	12
South Korea	1	1	1	1	6
Colombia	2	4	7	4	3
Germany	0	1	1	3	3
Australia	0	1	0	0	2
United Kingdom	1	0	0	1	1
Belgium	0	1	2	0	1
Subtotal	315	351	373	354	346
All other countries	8	6	12	19	9
Grand total	323	357	385	373	355
	Value (million $)				
Mexico	283	371	530	530	535
Canada	275	278	345	341	313
Japan	15	20	35	45	50
China	2	3	14	9	27
Germany	1	7	3	12	12
Hong Kong	1	1	4	2	11
Colombia	4	8	15	9	9
South Korea	4	4	3	3	8
Australia	1	2	1	1	6
United Kingdom	3	3	2	3	6
Belgium	1	2	11	5	5
Subtotal	590	699	963	960	982
All other countries	18	17	41	51	14
Grand total	608	716	1,004	1,011	996
	Unit Value ($/MT)				
Mexico	1,774	1,859	2,468	2,707	2,826
Canada	1,881	2,028	2,586	2,689	2,759
Japan	2,867	3,718	3,444	2,489	3,157
China	2,528	3,099	3,879	2,523	2,333
South Korea	3,147	2,907	3,875	3,536	1,221
Colombia	1,874	1,805	2,191	2,425	2,541
Germany	3,256	6,507	4,892	3,752	4,343
Australia	4,870	3,292	3,895	4,484	3,391
United Kingdom	4,128	7,956	5,255	4,752	5,193
Belgium	2,931	3,107	7,212	9,522	5,246
Grand total	1,882	2,004	2,606	2,710	2,808

Source: Compiled from official statistics of the U.S. Department of Commerce.

FIGURE 7 Mexico accounted for the largest share of U.S. aluminum exports in 2008



Source: Compiled from official statistics of the U.S. Department of Commerce.

U.S. and Foreign Trade Measures

U.S. Tariff Measures

The U.S. Government imposes tariffs on imports of specific types of unwrought aluminum. During 2005–09, the Normal Trade Relations tariffs imposed by the United States on aluminum remained unchanged (ranging from free of duty to 2.6 percent ad valorum), as did duties imposed on imported aluminum ores and concentrates, unwrought aluminum, and scrap aluminum. The vast majority of U.S. imports enter free of duty (appendix D).

U.S. Government Trade-related Investigations

There have been no U.S. International Trade Commission (USITC) antidumping or countervailing duty investigations regarding unwrought aluminum. However, in 2004, the USITC conducted an anti-dumping investigation on certain aluminum plate (HTS 7606.12.30) imported from South Africa. In its final determination in November 2004, the USITC found that the U.S. industry was not materially injured or threatened with material injury by reason of unfairly traded imports of aluminum plate from South Africa.[90]

Foreign Tariff Measures

Table 14 shows the tariff rates imposed in major markets on imports of aluminum ores and concentrates, unwrought aluminum, and aluminum scrap. For the most part, U.S. exports face low or relatively low tariffs in most major consuming markets.

[90] USITC, *Aluminum Plate from South Africa*, November 18, 2004.

TABLE 14 Duty rates by Harmonized Tariff Schedule (HTS)

	HTS			
Country	2606.00	7601.10	7601.20	7602.00
Australia	0	0	0	0
Brazil	2	6	6	0
Canada	0	0	0	0
China	0	5	7	1.50
Colombia	5	5	5	5
European Union	0	3	6	0
Hong Kong	0	0	0	0
India	2	5	5	0
Indonesia	5	0	0	0
Israel	0	0	0	0
Japan	0	0	0	0
Korea	0	1	1.7	0
Malaysia	0	0	0	0
Mexico	3.5[a]	0	0	0
Russia	5	10	10	10
Thailand	1	1	1	1
Ukraine	0	0	0	0
United Arab Emirates	5	5	5	0

Source: UNCTAD, Trade Analysis and Information System, (accessed on various dates).

[a] Since Mexico is a part of the North American Free Trade Agreement, there are no duties on the Mexican imports of these products from the United States.

FOREIGN INDUSTRY PROFILES

Foreign Industry

During 2004–08, primary aluminum was produced in roughly 40 countries (appendix E).[91] China, Russia, Canada, and the United States (in descending order) accounted for more than half of world production (51 percent in 2004 and 58 percent in 2008) (table 15). During those five years, world primary aluminum production increased by 30 percent, from 29.9 million MT in 2004 to 39 million MT in 2008. The increase in primary aluminum production was due mostly to a 98 percent increase in Chinese production in response to strong domestic demand, rising from approximately 6.7 million MT in 2004 to 13.2 million MT in 2008.[92] Global production is projected to reach around 60 million MT by 2020, and Asian suppliers, specifically China, are anticipated to contribute to about 63 percent of the increase.[93]

[91] Bray, "Aluminum," February 2009; Plunkert, "Aluminum," 2004.

[92] Ibid.

[93] *JOM*, "Worldwide Aluminum Economy: The Current State of the Industry," November 2007.

TABLE 15 World primary aluminum production, 2004 and 2008

Countries	Production			
	2004		2008(p)	
	Thousand (MT)	% of total	Thousand (MT)	% of total
China	6,670	22.3	13,200	33.8
Russia	3,590	12.0	3,800	9.7
Canada	2,590	8.7	3,120	8.0
United States	2,516	8.4	2,658	6.8
Australia	1,890	6.3	1,970	5.1
Brazil	1,460	4.9	1,660	4.3
Norway	1,320	4.4	1,360	3.5
India	861	2.9	1,310	3.4
United Arab Emirates	683	2.3	910	2.3
South Africa	866	2.9	811	2.1
Subtotal	22,446	75.1	30,799	79.0
Other	7,454	24.9	8,201	21.0
World total	29,900	100.0	39,000	100.0

Source: Bray, "Aluminum," February 2009.

p = preliminary figures except for the United States.

While information on global scrap recovery is not available, the secondary aluminum industry has also grown in certain countries. Some countries, such as Mexico that do not have a developed primary smelting industry may import unwrought aluminum as well as process recovered aluminum scrap into ingot to help satisfy domestic consumption. In addition, consumption of secondary aluminum has increased in countries with relatively high energy prices and abundant scrap resources, such as in the European Union and Japan.[94]

With the notable exception of companies in China, the global aluminum industry has undergone significant consolidation in recent years. One important development came in late March 2007, when Rusal Ltd., Sual Group, and Glencore International merged to form United Company RUSAL (RUSAL), which is headquartered in Russia and maintains global production operations. In October 2007, Rio Tinto acquired Alcan, which is headquartered in the United Kingdom with global production locations.[95] At the end of 2007, three companies (Rio Tinto Alcan, Alcoa, and United Company RUSAL) accounted for approximately 42 percent of world primary output, up from approximately 37 percent at the end of 2000.[96]

The availability of electrical power is an important factor in determining where companies will establish or expand primary smelters. According to an industry official, electrical power must not only be competitively priced, but also be available in sufficient supply for at least 20 years to justify the substantial capital investment needed to build a new aluminum smelter and the supporting infrastructure.[97] Consequently, the ideal sites for new smelters reportedly are in areas with both abundant energy supplies and a

[94] *World Metal Statistics*, World Bureau of Metal Statistics, December 2005 and March 2009.
[95] Larkin, *Metals: Industrial*, February 19, 2009, 18.
[96] Larkin, *Metals: Industrial*, February 19, 2009, 18; and Datamonitor Group, *Global: Aluminum*, September 2008.
[97] Industry official, interview by Commission staff, May 4, 2009.

relatively small population base to compete for that pool of energy.[98] An exception is China, where remarkable demand growth and government participation have contributed to a dramatically expanding industry.

China

China's influence on the global aluminum industry and market has been significant; it is the world's largest consumer and producer by far of unwrought aluminum from primary and secondary sources. In 2008, China accounted for 33 percent of global primary aluminum production compared to 24 percent in 2004.[99] Furthermore, China's role in the global marketplace has expanded significantly as state-owned Aluminum Corporation of China (Chalco) has emerged as one of the leading global bauxite, alumina, and aluminum producers.[100] Chalco has subsidiaries located worldwide and in 2008, the company's revenue amounted to $11.2 billion.[101]

Industry analysts consider China's supply of and demand for aluminum to be a key factor in determining whether the global aluminum supply surplus of 2008–09 will expand or contract in 2010.[102] Since aluminum supply was greater than demand in late 2008, which put downward pressure on the price of the metal, China's State Reserves Bureau (SRB) purchased 300,000 MT of aluminum at a price of $1,800 per MT in December 2008 to reduce the available supply on the market. Half of the order was filled by Chalco and the balance by seven other Chinese aluminum producers. There were also discussions about increasing the order size to 1 million MT.[103]

In 2007, China's primary unwrought aluminum market was valued at $33.4 billion, accounting for 78 percent[104] of the Asia-Pacific market. During 2004–08, Chinese aluminum consumption increased by over 100 percent from 7.4 million MT to 15.1 million MT (table 16). The significant increase in Chinese unwrought consumption was driven, in part, by the rapidly expanding Chinese transportation and construction markets.[105] Demand in China is expected to continue to grow strongly due to a continued construction boom, growth in the Chinese transportation and packaging markets, and rising demand in wire and cable applications.

[98] Ibid.

[99] Bray "Aluminum," February 2009; Plunkert, "Aluminum," 2003.

[100] "Datamonitor Group, *China: Aluminum*, September, 2008, 3.

[101] Aluminum Corporation of China, *Annual Report 2008*, 2010.

[102] Larkin, *Metals: Industrial*, February 19, 2009, 17.

[103] Mason, "China Begins Buying Metal in Rescue Bid," December 23, 2008; Jennemann, "Sluggish Aluminum Market Unfazed by China Buys," December 29, 2008.

[104] In comparison, India is also a major producer of aluminum and generated 10 percent of the regional market's aggregate value in 2008.

[105] Datamonitor Group, China: Aluminum, September, 2008, 3 and 14.

TABLE 16 China: unwrought aluminum production, trade, and apparent consumption, 2004–08 (thousand MT)

	2004	2005	2006	2007	2008
Production:					
Primary	6,670.0	7,800.0	9,360.0	12,600.0	13,200.0
Secondary recovery	1,389.0	1,950.0	2,150.0	2,750.0	([a])
Total	8,059.0	9,750.0	11,510.0	15,350.0	13,200.0
Imports for consumption:					
Unwrought aluminum	1,033.4	637.0	512.0	282.1	260.1
Exports:					
Unwrought aluminum	1,684.4	1,318.6	1,212.2	545.6	841.3
Apparent consumption	7,408.0	9,068.4	10,809.8	15,086.5	([a])

Sources: Aluminum Association, (accessed on various dates), Bray, "Aluminum," November 2009; Global Trade Information Service, World Trade Atlas Database (accessed various dates).

[a] Unavailable.

From 2004–07, Chinese aluminum production increased by 90 percent, from 8.1 million MT to 15.4 million MT.[106] During the same timeframe, Chinese exports of unwrought aluminum decreased. However, China is still a net exporter of unwrought aluminum and accounted for 4 percent of total world exports in 2008. The country's main export markets for unwrought aluminum in 2008 were South Korea (265,415 MT) and Japan (240,789 MT).[107]

Chinese unwrought aluminum imports have decreased by 75 percent, from 1 million MT in 2004 to 260,102 MT in 2008 while imports of aluminum scrap have increased by 80 percent, from 1.2 million MT to 2.2 million MT.[108] During 2004–08 China's global market share in the downstream aluminum industry grew. Domestic unwrought aluminum production and remelted scrap supplied by Chinese imports are fabricated into semi-finished and finished products such as plates, sheet, and strip; bars, rods, and profiles; foil; and tubes and pipes. Collectively, exports of these downstream products have increased by 137 percent from 2004–08.[109]

Unlike its Western counterparts, the Chinese aluminum industry is highly fragmented. Chalco and 10 other leading companies account for less than 50 percent of domestic primary aluminum production;[110] more than 100 competitors produce the remainder. Chalco is also the only Chinese company that mines bauxite and refines it into alumina. Other Chinese smelters are dependent on Chalco for their alumina supplies since the only alternative is to import alumina, which is costly for smaller smelters.[111] Also, unlike Western-based companies, many Chinese companies produce only commodity metal and do not supplement their portfolios by manufacturing downstream semi-finished aluminum products. Market entry is reportedly easier in China because the level of

[106] Bray, "Aluminum," November 2009.

[107] Global Trade Information Service, World Trade Atlas Database (accessed various dates).

[108] Aluminum Association, (accessed on various dates), *World Metal Statistics*, December 2005 and March 2009.

[109] Global Trade Information Service, World Trade Atlas Database (accessed various dates).

[110] Chalco comprises 22 percent of total Chinese primary aluminum production volume.

[111] From 2003-07, alumina production increased by 219 percent, from 6.1 million MT in 2003 to 19.5 million MT in 2007.

capital required for establishing an aluminum smelting plant is generally much lower than in Western countries.[112]

The Chinese government has been implementing policies to foster consolidation in the industry by eliminating small, inefficient smelters and supporting the expansion of modern, large-scale smelters. However, due to the numerous agencies involved, there is reportedly no comprehensive government policy toward the aluminum industry. Industry response to the government measures has been mixed, and legislation reportedly has accomplished little to slow the influx of smaller, inefficient producers that have entered the Chinese market (table 17).[113]

TABLE 17 Chinese government policies for the aluminum industry

Government agency	Policies implemented
National Development and Reform Commission (NDRC)	• In December 2005, the NDRC announced new policies to regulate production by strengthening enforcement of industry entrance standards: o The NDRC curbed bank loans, land approvals, and halted construction of new production facilities in the aluminum smelting sector. o In 2006, measures such as minimum production thresholds and industry entrance standards were instituted. o Regulations require that new smelter projects be located in regions with adequate power supplies. o Guidelines were released in 2005 and 2006 emphasizing consolidation among aluminum fabricators, technology innovation, and upgrades in the sector, as well as developing high-value added aluminum alloy products. • In 2007, the NDRC sought to slow capacity expansion by prohibiting local governments from granting rebates to smelters of the tariffs they are paying for electrical power use.
Ministry of Commerce (MOC) and General Administration of Customs (GAC)	• In 2004, the MOC and GAC announced a prohibition on imports of alumina for smelters with a capacity below 1 million MT per year that export unwrought aluminum. • Stringent controls were introduced for official approval of permits for construction of new smelters that intend to import alumina and export aluminum. • Aluminum smelters and trading firms are required to possess a permit for importing alumina. Only 20 firms hold such permits, including Chalco.

Sources: Datamonitor Group, *China: Aluminum,* September 2008; Teo, "China Bans More Projects in Wider Crackdown on Metals," December 21, 2005; Teo, "China Planning to Trim Alumina Import Tax," December 14, 2005; USITC, *The Effects of Increasing Chinese Demand on Global Commodity Markets,* June 2006, 3-8; and Wong, "Asian Juggernaut Looks to Gently Cool Down Growth Engine," January 12, 2004.

Chinese costs associated with aluminum production reportedly are high. Despite reportedly lower energy costs than the United States,[114] the generation and transmission

[112] Datamonitor Group, *China: Aluminum*, September 2008.

[113] *Aluminum International Today*, "Aluminium Production: A Chinese Puzzle," July/August 2005.

[114] *The China Post*, "China Electricity Prices May Decline on Lower Tariffs," January 15, 2009.

of electricity in China is expensive because electrical grids and power lines are not synchronized. Nonetheless, China still has certain comparative advantages in aluminum production. For example, China has the third largest bauxite reserves worldwide.[115]

Russia

Russia is the world's second largest producer of primary aluminum. During 2004–08, Russian primary aluminum production increased by 16 percent (table 18), even though its market share slid. In 2008, Russia produced 10 percent (3.8 million MT) of global primary aluminum in comparison to 12 percent in 2004 (3.6 million MT). Russia has a competitive advantage in aluminum production because of its relatively low cost of electricity. In comparison, the cost of electricity in the United States and Canada is almost three times higher than in Russia.[116] Furthermore, Russia is able to produce primary aluminum close to its alumina supplies.[117]

Russia's unwrought aluminum production significantly exceeds its domestic demand. Although Russia's exports decreased by 5 percent during 2004–08, from 3.9 million MT to 3.7 million MT, Russia is the world's largest net exporter of aluminum. In 2008, Japan (1.2 million MT), the United States (1 million MT), and Turkey (412,192 MT) were Russia's largest markets for primary exports. In 2008, Russian exports of unwrought aluminum to these three countries accounted for 70 percent of total Russian exports.[118]

The secondary aluminum industry in Russia is not as developed as the primary industry. Most of the scrap recovered in Russia is sent abroad for processing, reportedly because Russian scrap remelting facilities tend to use obsolete, inefficient equipment and consume large quantities of fuel to remelt scrap even though output is low.[119]

[115] China is also a leading importer of alumina because its domestic mining of the ore does not satisfy domestic demand. Furthermore, a significant amount of the bauxite mined in China is considered low-quality.

[116] Ustenko, "Russia's Accession into WTO: A Case Study of the Aluminum Industry," March, 2002.

[117] *World Metal Statistics*, World Bureau of Metal Statistics, December 2005 and March 2009.

[118] Global Trade Information Service, World Trade Atlas Database (accessed various dates).

[119] Burstein, and Grishaev, "Secondary Aluminum in Russia," July–August 2003.

TABLE 18 Russia: unwrought aluminum production, trade, and apparent consumption, 2004–08 (thousand MT)

	2004	2005	2006	2007	2008
Production:					
Primary	3,590.0	3,650.0	3,720.0	3,960.0	3,800.0
Secondary recovery	([a])	([a])	([a])	([a])	([a])
Total known production	3,590.0	3,650.0	3,720.0	3,960.0	3,800.0
Imports for consumption:					
Unwrought aluminum	36.5	17.1	17.7	16.2	24.8
Exports:					
Unwrought aluminum	3,917.7	4,119.5	4,476.3	3,948.6	3,707.5
Apparent consumption	([a])	([a])	([a])	([a])	([a])

Sources: Global Trade Information Service, World Trade Atlas Database (accessed various dates); Bray, "Aluminum," November 2009.

Note: Information pertaining to secondary recovery is not available; therefore apparent consumption cannot be determined.

[a] Unavailable.

The largest Russian producer of aluminum is RUSAL, which is also the world's third largest producer of primary aluminum, accounting for nearly 13 percent of the global primary, unwrought market by volume.[120] As noted, RUSAL was created in 2007 as the result of the merger of Russian Aluminum, Siberian-Ural Aluminum (Sual) Holdings, and the alumina operations of Swiss trading company Glencore.[121] The merger left Russia with a single primary aluminum producer.

Canada

Canada is the world's third-largest producer of unwrought aluminum, generating 8 percent of worldwide production in 2008 (table 21). As Canadian production far exceeds Canadian consumption, Canada is also a major net exporter of unwrought aluminum. During 2004–08, Canadian unwrought aluminum exports increased by 12 percent, from approximately 2.2 million MT to 2.5 million MT.[122]

Since most aluminum producing companies in the United States have subsidiaries or affiliate companies in Canada, a significant amount of trade between both countries is between firms. While Canada is the second largest market for U.S. unwrought aluminum exports, the United States is a large net importer of unwrought aluminum from Canada. Canada also further fabricates a large share of the aluminum it imports and domestically produces. Consequently, the United States is also a net importer of fabricated aluminum products from Canada, including aluminum bars, rods, and profiles; aluminum wire; and aluminum plates, sheet and strip, which are made from Canadian-produced ingot.[123]

Rio Tinto Alcan, Alcoa Canada Primary Metals (Alcoa), and Hydro Aluminum (Hydro)–through its partnership with Aluminerie Alouette–operate 11 Canadian aluminum smelters, 10 of which are located in Quebec due to the ample hydroelectric power

[120] Datamonitor Group, *Global: Aluminum*, September 2008.

[121] Sixty-six percent of UC Rusal is owned by Rusal shareholders, 22 percent by Sual shareholders, and 12 percent by Glencore shareholders. Shares will be sold to the public in 2010.

[122] Aluminum Association, http://www.aluminum.org (accessed on various dates); compiled from official statistics of the U.S. Department of Commerce.

[123] Compiled from official statistics of the U.S. Department of Commerce.

available in the St. Lawrence Seaway area. The aluminum industry in Canada is vertically integrated and closely tied with the industry in the United States.[124] For example, Rio Tinto Alcan has an aluminum smelter in the United States. Conversely, Alcoa is headquartered in the United States, but has three aluminum smelters in Canada as well as facilities for downstream production.[125] Hydro Aluminum owns a 20 percent interest in the Aluminerie Alouette primary aluminum plant (Canada) and has facilities that produce semi-fabricated aluminum in the United States.[126]

Australia

Australia is the world's fifth largest producer of primary aluminum and the largest producer of both bauxite and alumina.[127] In 2008, Australia produced 5 percent of global primary aluminum in comparison to 6 percent in 2004 (table 19). During 2004–08, Australian production of primary aluminum increased by 4 percent, from 1.89 million MT to 1.97 million MT.[128]

While most aluminum-related exports from Australia are in the form of bauxite and alumina, Australia is also a net exporter of unwrought aluminum. From 2004 to 2008, Australian exports of unwrought aluminum grew by 10 percent, from 1.5 million MT to 1.7 million MT. In 2008, Japan (645,824 MT), South Korea (229,742 MT), and Thailand (216,922 MT) were Australia's largest export markets for primary aluminum, accounting for 65 percent of Australian exports.[129]

TABLE 19 Australia: unwrought aluminum production, trade, and apparent consumption, 2004–08 (thousand MT)

	2004	2005	2006	2007	2008
Production:					
Primary	1,890	1,900	1,930	1,960	1,970
Secondary recovery	88	73	78.2	([a])	([a])
Total known production	1,978.00	1,973.00	2,008.20	1,960	1,970
Imports for consumption:					
Unwrought aluminum	7	5	5	3	3
Exports:					
Unwrought aluminum	1,534	1,585	1,618	1,652	1,679
Apparent consumption	451	393	395	([a])	([a])

Sources: Global Trade Information Service, World Trade Atlas Database (accessed various dates); World Metal Statistics, World Bureau of Metal Statistics, December 2005 and March 2009; and Bray, "Aluminum," November 2009.

[a] Unavailable.

The Australian primary aluminum industry is heavily export-oriented, highly concentrated, and vertically integrated. While relatively low electricity costs and the

[124] With the exception of the auto industry, Canada does not have much downstream production activity. Industry official, telephone interview with Commission staff, April 30, 2009.

[125] Rio Tinto Alcan, http://www.riotintoalcan.com (accessed various dates).

[126] Hydro Aluminum North America, http://www.hydro.com (accessed various dates).

[127] In 2007, Australia accounted for 25 percent of global alumina production. Bray, "Bauxite and Alumina," November 2008.

[128] *World Metal Statistics*, World Bureau of Metal Statistics, December 2005 and March 2009.

[129] Global Trade Information Service, World Trade Atlas Database (accessed various dates).

close proximity of alumina refineries to bauxite mines might make the market appealing for new entrants, in practice the market is dominated by major global players, including Rio Tinto, Alcan, Norsk Hydro, Alcoa, and BHP Billiton.[130]

Australia has a comparative advantage in primary aluminum production because of its vast bauxite resources. The country currently has five operating bauxite mines, seven alumina refineries, and six aluminum smelters. While Australian aluminum production is essentially at full capacity, alumina production levels have been increasing. During 2003–07, alumina production increased by 3 percent, rising from 16.5 million MT to 18.8 million MT.[131] Alumina production is expected to continue to grow as more capacity comes online and major investment projects are completed in response to rising global demand.[132]

Emerging Global Competitors

Countries in Sub-Saharan Africa (SSA), the Middle East, and Europe have been actively expanding their primary aluminum industries. South Africa and Mozambique have emerged as important countries for expansion due to the availability of abundant energy resources, modern port facilities, and low production costs. In 2008, South Africa and Mozambique each accounted for almost 3 percent of worldwide primary aluminum production.[133]

In 2008, South Africa was the world's tenth largest producer of primary aluminum and Mozambique was the world's fourteenth-largest producer. During 2004–08, South African primary aluminum production decreased by 6 percent, from 866,000 MT to 811,000 MT while Mozambique's fell by 2 percent, from 549,000 MT to 536,000 MT. The decrease is a result of the economic downturn and problems with electricity, which began in late 2007. During 2004–07, aluminum production in South Africa was steadily increasing until 2008, when production decreased by 11 percent from the previous year.[134]

However, while South Africa and Mozambique have become significant primary aluminum producers, further expansion will likely be restrained until issues concerning power shortages, availability, and pricing are remedied.[135] BHB Billiton Ltd., an Australian natural resources company that is a primary aluminum producer in South Africa and Mozambique, has had to curtail production in both countries.[136]

The Middle East accounted for approximately 2 percent of global primary aluminum production in 1980, but by 2015, the region is expected to account for upwards of

[130] Datamonitor Group, *Asia-Pacific – Aluminum*, August 15, 2007.
[131] Bray, "Bauxite and Alumina," November 2009; Plunkert, "Bauxite and Alumina," 2004.
[132] Australian Aluminum Council, "Sustainability Report," 2007.
[133] Ibid.
[134] Bray, "Aluminum," 2006–2008; Plunkert, "Aluminum," 2003–2005.
[135] Growth in the South African economy and infrastructure has resulted in the demand for electricity exceeding supply, causing power outages throughout the country. Furthermore, since Eskom, the South African power company, supplies electricity to the Mozambique smelter, aluminum production has been affected in the country as well. Swerski, "Lights out on South Africa Boom?" May 19, 2008.
[136] Swindells, "BHP's Aluminum Output Hit by Power Firm Failures," January 19, 2007.

20 percent.[137] The United Arab Emirates (UAE) is emerging as a key producer of primary aluminum in the region. The UAE's primary aluminum production grew by 33 percent during 2004–08, from 683,000 MT to 910,000 MT. In 2008, the UAE accounted for 2 percent of worldwide aluminum production.[138] The UAE is currently the world's eighth-largest producer of primary aluminum. The UAE made significant expansions to its annual aluminum smelting capacity during 2004–08, drawing on its significant reserves of natural gas for fuel. The Dubai Aluminum Co. Ltd. (Dubal) recently expanded annual capacity by 66,000 MT, bringing total annual capacity to 950,000 MT. The expansion has made Dubal the world's seventh largest aluminum company. Dubal is building a 1.4 million MT aluminum smelter in Abu Dhabi which is to be completed in 2010[139] and has indicated that it hopes to raise its annual aluminum capacity to 2.5 million MT by 2015.[140]

Bahrain's primary aluminum smelting capacity has also grown substantially. Bahrain is currently the world's ninth-largest producer of primary aluminum. From 2004–08, primary production in Bahrain grew by 63 percent, from 532,000 MT to 865,000 MT. In 2008, Bahrain accounted for 2 percent of world aluminum production.[141] Similar to the UAE, Bahrain has also drawn on its natural-gas reserves as the energy source to generate the electricity necessary to operate its primary aluminum smelters.[142] Aluminum Bahrain (Alba) has grown to be one of the largest primary aluminum producers in the world, with a capacity of 870,000 MT. Alba hopes to expand its facility; however, this will depend on an agreement to secure imported long-term gas supplies as Bahrain's own resources are becoming depleted.[143]

Oman's primary aluminum smelting capacity has also shown strong recent growth. Sohar Aluminum Co. LLC, a joint venture between Rio Tinto, Oman Oil Co., and the Abu Dhabi Electricity and Water Authority, announced in April 2009 that it reached its full production level of 360,000 MT per year.[144] Meanwhile, Qatar has also entered the primary aluminum smelting industry. A primary aluminum smelter, built as a joint venture between Qatar Petroleum and Hydro (Norway), is expected to be online by the end of 2009 and will have a capacity of 585,000 MT. Once online, production capacity will increase to 609,000 MT. Furthermore, there is space allocated for expansion of the facility which will bring capacity to over 1 million MT.[145]

Iceland's aluminum production capacity has grown significantly in recent years. During 2004–08, Icelandic aluminum production increased by 190 percent, from 271,000 MT to 787,000 MT. In 2008, Iceland accounted for 2 percent of world aluminum production.[146] Iceland's primary smelters benefit from abundant local supplies of low-cost electricity from hydroelectric and geothermal sources. Iceland currently operates three aluminum smelters and is in process of building its fourth, which will be run by Nordural, a wholly

[137] Jennemann, "Middle East Aluminum Steps to the Fore," April 29, 2009.
[138] Bray, "Aluminum," 2006–2008; Plunkert, "Aluminum," 2003–2005
[139] *Metal Bulletin*, "Dubal, Mubadala Signs Deal to Build Big Aluminum Smelter," February 12, 2007.
[140] *Metal Bulletin*, "Dubal Commissions Additional Capacity," March 6, 2008.
[141] Ibid.
[142] Jennemann, "Output starts at Oman's Sohar Aluminum," June 12, 2008.
[143] *Metal Bulletin*, "Middle East Magnet," September 24, 2009.
[144] Ibid.
[145] Ibid.
[146] Bray, "Bauxite and Alumina," November 2009; Plunkert, "Bauxite and Alumina," 2004.

owned subsidiary of Century Aluminum (U.S.-based).[147] The Nordural plant is to be constructed in four 90,000 MT phases, which will yield 360,000 MT when completed. This first phase of production is slated for completion in 2011.[148]

FOREIGN MARKET PROFILES

Foreign Markets

Although the United States is one of the world's largest producers of unwrought aluminum, U.S. exports are relatively minimal, as domestic production is primarily targeted to meet domestic demand. During 2004–08, U.S. exports of unwrought aluminum accounted for on average 2 percent of worldwide exports (appendix F) and 6 percent of U.S. production. While the United States exports aluminum to several key markets, Mexico and Canada are by far the two largest. Together, Mexico and Canada accounted for 85 percent of total U.S. unwrought aluminum exports in 2008.[149]

Mexico

Partly due to geographical proximity and its lack of primary smelting capacity, Mexico is the largest end market for U.S. exports of unwrought aluminum, accounting for 55 percent of total U.S. exports in 2008 (table 20).[150] During 2004–08, U.S. aluminum exports to Mexico supported, in large part, the North American automotive industry and, in particular, Mexico's automotive parts manufacturers. U.S. exports tend to be ingots that are shipped to Mexican aluminum foundries that melt and recast aluminum into auto parts. Mexico's aluminum industry is not highly integrated with the industry in the United States. Although some of the 150 aluminum foundries in Mexico are U.S. owned, most foundries are Mexican owned and maintain partnerships with U.S. and Canadian companies. The majority of finished products are shipped to Canada and the United States while some finished products are consumed by the growing Mexican automotive industry.[151]

Mexico does not have a significant primary smelting industry. Production statistics available for the period 1995–2003 show that primary aluminum production reached a peak of 66,400 MT in 1997 and has since decreased. In 2003, the last year for which statistics were collected, primary aluminum production shrank to 25,000 MT.[152] Consequently, Mexican consumption is satisfied by imports of unwrought aluminum or scrap that is remelted into unwrought aluminum. U.S. exports of unwrought aluminum to Mexico constituted 53 percent of all U.S. unwrought aluminum exports in 2008.[153]

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[147] *IceNews*, "Special Feature: Another New Aluminum Smelter for Iceland," June 10, 2008.
[148] Nordural, "Investment Agreement Signed for Helguvík Plant," August 18, 2009.
[149] Compiled from official statistics of the U.S. Department of Commerce.
[150] While the United States is Mexico's largest source of unwrought aluminum, Mexico also imports significant quantities of the metal from Venezuela and Canada. Ibid.
[151] Industry official, telephone interview with Commission staff, April 30, 2009.
[152] Aluminum Association, http://www.aluminum.org (accessed on various dates); industry official, telephone interview with Commission staff, April 30, 2009.
[153] Global Trade Information Service, World Trade Atlas Database (accessed various dates).

TABLE 20 Mexico: Unwrought aluminum production, trade, and apparent consumption, 2004–08 (thousand MT)

	2004	2005	2006	2007	2008
Production:					
Primary	([a])	([a])	([a])	([a])	([a])
Secondary recovery	519.5	531.1	561.0	216.0	216.0
Total known production	519.5	531.1	561.0	216.0	216.0
Imports for consumption:					
Unwrought aluminum imports from the United States	159.4	199.7	214.7	195.8	189.3
All other unwrought aluminum imports	243.4	207.7	224.8	257.0	270.2
Total	402.8	407.4	439.5	452.8	459.5
Exports:					
Unwrought aluminum	13.6	14.7	22.2	46.3	61.3
Apparent consumption	908.7	923.8	978.3	622.5	614.2

Sources: Compiled from official statistics of the U.S. Department of Commerce, Global Trade Information Service, Inc. World Trade Atlas Database (accessed various dates), and *World Metal Statistics.* World Bureau of Metal Statistics, December 2005 and March 2009.

Note: Primary production data are not available. Consumption rates area as reported by the World Bureau of Metal Statistics.

[a] Unavailable

Canada

Canada is the second largest foreign market for U.S. unwrought aluminum, constituting 32 percent of all U.S. unwrought aluminum exports. From 2004–08, U.S. exports to Canada decreased by 22 percent from 145,969 MT to 113,359 MT (table 21).[154] Since a number of aluminum smelting companies have facilities in the United States and in Canada, ingot and fabricated aluminum move between both countries. However, U.S. exports of ingot tend to occur from states located near Canada,[155] providing a cost-savings on transportation.

[154] Ibid.
[155] Industry official, telephone interview with Commission staff, December 8, 2009.

TABLE 21 Canada: unwrought aluminum production, trade, and apparent consumption, 2004–08 (thousand MT)

	2004	2005	2006	2007	2008
Production:					
Primary	2,592.2	2,894.3	3,051.1	3,082.6	3,118.8
Secondary recovery	185.0	185.0	185.0	185.0	185.0
Total known production	2,777.2	3,079.3	3,236.1	3,267.6	3,303.8
Imports for consumption:					
Unwrought aluminum imports from the United States	145.0	137.3	133.5	126.9	113.4
All other unwrought aluminum imports	20.4	26.0	21.8	12.4	14.3
Total	165.4	163.3	155.3	139.3	127.7
Exports:					
Unwrought aluminum exports to the United States	1,684.1	1,916.5	1,981.4	1,931.9	1,998.8
All other unwrought aluminum exports	548.9	82.5	258.6	435.1	501.2
Total	2,233.0	1,999.0	2,240.0	2,367.0	2,500.0
Apparent consumption	709.6	1,243.6	1,151.4	1,039.9	931.5

Sources: Bray, "Aluminum," November 2009; compiled from official statistics of the U.S. Department of Commerce; Global Trade Information Service, World Trade Atlas Database (accessed various dates); and *World Metal Statistics,* World Bureau of Metal Statistics, December 2005 and March 2009.

Note: Primary production data are not available. Consumption rates area as reported by the World Bureau of Metal Statistics.

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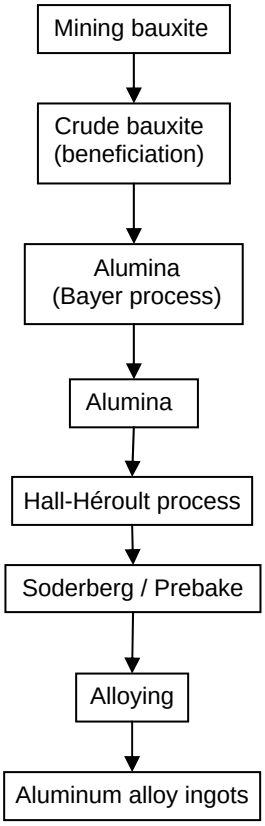
APPENDIX A
Production Process

Production Process

Unwrought aluminum comes from two sources: primary and secondary. Primary aluminum originates from processing bauxite ore into alumina, which in turn is smelted into unwrought aluminum ingot. Bauxite (an aluminum-hydroxide ore) is mined and then transported to a plant where it is beneficiated (crushed, washed, and dried) before being refined into alumina (pure aluminum oxide) and finally into aluminum. Most producers in industrialized countries depend on bauxite and alumina imports to produce aluminum because they lack adequate bauxite reserves. Aluminum from secondary sources comes from scrap which collected and melted in a smelter to form unwrought aluminum.[156]

Primary Aluminum

FIGURE A.1 Primary aluminum production process



Source: USITC, "Aluminum," April 1994, 1–3.

[156] USITC, "Aluminum," April 1994, 1–3.

The Bayer process is the most common process used to refine bauxite into alumina, which is then converted to aluminum with a 4:2:1 average quantity ratio. This process has remained virtually unchanged since its discovery in 1887. The Bayer process produces two types of alumina. In North America, Bayer plants generally produce a coarse-grained, sandy alumina that facilitates the absorption of fluorine emissions. Bayer plants in Europe have historically produced a floury and finer-grained alumina that is not as environmentally friendly; this drawback has prompted conversion of most European plants to produce the coarser-grained alumina.[157]

Smelting of alumina into aluminum is highly energy-intensive, on average, accounting for one-third of all primary aluminum production costs. The Hall-Héroult electrolysis process is currently the only method used to smelt alumina to aluminum. In the past, this method used the mineral cryolite to dissolve alumina into solution. However, due to the inadequate supply of natural cryolite, synthetic sodium aluminum fluoride is now utilized for this process. The Hall-Héroult method passes an electrical current through either prebake or Soderberg carbon anodes to form molten aluminum metal that is collected at the bottom of an electrolytic cell (pot).[158]

There are advantages and disadvantages to either type of anode. The Soderberg method continuously feeds anodes and is less labor-intensive. The prebake process is more energy efficient because the anode is already baked and is more environmentally benign because the potline cells are covered to capture and treat gas emissions. Some smelters have a combination of Soderberg and prebake technologies, but most smelters apply only one these methods.[159]

The molten aluminum metal is removed from the cell using a vacuum siphon technique and then blended or cast into solid forms for transportation to fabrication plants. The smelting process is a continuous process, and a typical pot may produce approximately 14 hundred pounds of aluminum daily.[160]

Secondary Aluminum

The secondary aluminum industry recovers aluminum metal from *old* or *new* scrap. Old scrap is generally discarded durable and nondurable consumer products, such as beverage cans and auto parts. New scrap is the leftovers from processing wrought aluminum and cast products into consumer or industrial products. When scrap aluminum arrives at a secondary smelting plant, it is tested, sorted, shredded, and delacquered. The sorted scrap is remelted in furnaces and alloyed to industry and customer specifications. These specifications are met by mixing various aluminum scrap types and alloying metals based on a computer-controlled blending system.[161]

[157] Ibid.
[158] Ibid.
[159] Ibid.
[160] Ibid.
[161] Larkin, *Metals: Industrial*, February 19, 2009.

APPENDIX B
HTS 2606: Total Imports of Aluminum Ores and Concentrates, by Country, 2004–08

TABLE B.1 HTS 2606: total imports of aluminum ores and concentrates, by country, 2004–08 (thousand MT)

Countries	2004	2005	2006	2007	2008
China	25,735	71,541	319,410	1,040,759	1,643,594
United States	266,403	361,372	388,452	400,910	514,045
Germany	102,935	132,724	109,229	210,225	277,940
Spain	124,171	142,805	160,499	204,046	269,693
Italy	126,182	132,114	132,188	159,849	206,178
Ukraine	146,850	240,691	209,211	175,420	177,922
France	75,486	100,462	98,509	130,647	161,563
Ireland	121,359	131,143	120,839	149,623	151,433
Canada	73,934	93,576	99,663	121,545	138,181
Japan	70,898	70,834	66,789	96,860	134,490
Netherlands	35,253	47,995	37,307	43,922	97,846
Azerbaijan	53,057	67,772	75,373	58,863	85,199
South Korea	19,855	20,340	24,718	18,015	37,408
United Kingdom	18,277	17,773	11,864	9,449	24,336
Argentina	8,757	11,902	11,738	15,685	23,410
Subtotal	1,269,152	1,643,044	1,865,789	2,835,818	3,943,238
Other	361,330	476,234	394,004	462,980	251,114
Total	1,630,482	2,119,278	2,259,793	3,298,798	4,194,352

Source: Global Trade Information Service, World Trade Atlas Database.

APPENDIX C
HTS 2606: Total Exports of Aluminum Ores and Concentrates, by Country, 2004–08

TABLE C.1 HTS 2606: Total exports of aluminum ores and concentrates, by country, 2004–08 (thousand MT)

Countries	2004	2005	2006	2007	2008
Australia	60,849	88,546	101,280	165,670	192,816
Brazil	189,445	229,393	194,440	238,521	293,377
Greece	31,466	35,918	37,586	39,410	51,236
Turkey	152	98	2,911	8,127	9,100
Netherlands	25,935	33,016	12,047	50,021	94,646
Belgium	9,618	10,422	10,134	20,580	23,287
Germany	9,270	8,195	10,410	13,433	18,099
United States	11,143	9,541	6,608	5,920	6,707
Italy	3,020	4,518	2,113	6,539	5,723
France	236	281	1,878	2,021	1,379
United Kingdom	624	2,748	2,681	3,225	4,862
Spain	1,321	1,482	1,643	3,211	4,342
Japan	362	274	2	46	1,358
Argentina	28	0	11	187	1,999
Austria	672	540	657	1,225	1,100
Subtotal	283,292	336,426	283,121	392,466	517,215
All other	228,925	330,196	452,682	851,958	196,989
Total	512,217	666,622	735,803	1,244,424	714,204

Source: Global Trade Information Service, World Trade Atlas Database.

APPENDIX D
Harmonized Tariff Schedule for Aluminum Ores and Concentrates and Unwrought Aluminum

TABLE D.1 Harmonized tariff schedule for aluminum ores and concentrates and unwrought aluminum

			Rates of duty as of January 1, 2008			U.S. imports, 2008	U.S. exports, 2008
			Column 1 rate		Column 2 rate		
			General	Special			
2009 HTS subheading	Description	Unit of quantity	%		% unless specified otherwise	Thousand ($)	
2606.00.00	Aluminum ores and concentrates	t	Free	–	$1/t	483,866	5,661
7601.10.30	Aluminum, not alloyed of uniform cross section throughout its length, the least cross-sectional dimension of which is not greater than 9.5 mm, in coils	kg	2.6	Free (A, AU, BH, CA, D, E, IL, J, JO, MA, MX, OM, P, PE, SG); 0.6 (CL)	18.5	1,271	12,445
7601.10.60	Other	kg	Free		11	4,061,404	236,459
7601.20.30	Aluminum alloys of uniform cross section throughout its length, the least cross-sectional dimension of which is not greater than 9.5 mm, in coils	kg	2.6	Free (A, AU, BH, CA, D, E, IL, J, JO, MA, MX, OM, P, PE, SG); 0.6 (CL)	18.5	4,231	24,766
7601.20.60	Other: containing 25 percent or more by weight of silicon	kg	2.1	Free (A+, AU, BH, CA, D, E, IL, J, JO, MA, MX, OM, P, PE, SG); 0.5 (CL)	25	530	24,766
7601.20.90	Other	kg	Free	–	10.5	3,785,684	697,711
7602.00.00	Aluminum waste and scrap	kg	Free	–	Free	811,185	3,316,733

Source: Official statistics of the U.S. Department of Commerce.

Note: t = ton
Kg = kilogram
A, A+ = Generalized System of Preferences
AU = United States-Australia Free Trade Agreement
BH = United States-Bahrain Free Trade Agreement Implementation Act
CA = North American Free Trade Agreement
MX = Goods of Mexico
CL = United States-Chile Free Trade Agreement
D = African Growth and Opportunity Act
E = Caribbean Basin Economic Recovery Act
IL = United States-Israel Free Trade Area
J = Andean Trade Preference Act or Andean Trade Promotion and Drug Eradication Act
JO = United States-Jordan Free Trade Area Implementation Act
P = Dominican Republic-Central America-United States Free Trade Agreement Implementation Act
MA = United States-Morocco Free Trade Agreement Implementation Act
SG = United States-Singapore Free Trade Agreement
OM = United States-Oman Free Trade Agreement Implementation Act
PE = United States-Peru Trade Promotion Agreement Implementation Act

APPENDIX E
HTS 7601: Total Exports of Unwrought Aluminum, by Country, 2004–08

TABLE E.1 HTS 7601: Total exports of unwrought aluminum, by country, 2004–08 (thousand MT)

Countries	2004	2005	2006	2007	2008
Russia	3,918	4,119	4,476	3,949	3,708
Canada	1,999	2,240	2,367	2,500	2,532
Netherlands	1,477	1,486	1,773	1,869	1,905
Australia	1,534	1,585	1,618	1,652	1,679
Norway	1,484	1,524	1,540	1,610	1,584
China	1,684	1,319	1,212	546	841
Iceland	278	284	303	446	761
Brazil	818	753	842	823	748
South Africa	646	671	601	625	598
Mozambique	0	567	779	614	597
Germany	465	447	451	483	435
USA	323	357	385	373	355
New Zealand	313	319	308	327	303
United Kingdom	315	352	350	299	286
Venezuela	390	403	432	329	282
Subtotal	15,644	16,426	17,437	16,445	16,614
Other	3,520	3,931	3,678	4,306	3,725
Total	19,164	20,357	21,115	20,751	20,339

Source: Global Trade Information Service, World Trade Atlas Database.

APPENDIX F
HTS 7601: Total Imports of Unwrought Aluminum, by Country, 2004–08

TABLE F.1 HTS 7601: Total imports of unwrought aluminum, by country, 2004–08 (thousand MT)

Country	2004	2005	2006	2007	2008
Japan	3,021	2,977	3,036	2,986	3,064
United States	3,319	3,692	3,470	2,956	2,811
Germany	1,858	1,851	2,209	2,295	2,063
Netherlands	1,292	1,329	1,756	2,029	1,992
South Korea	1,197	1,231	1,206	1,190	1,085
Italy	908	901	990	1,089	882
Turkey	327	387	464	572	598
Belgium	747	757	728	754	556
France	517	518	596	597	509
Taiwan	623	523	540	504	504
Mexico	403	407	439	453	460
Norway	356	375	389	508	440
Thailand	1,390	387	418	421	437
Austria	339	297	348	390	374
Spain	329	342	399	456	358
Subtotal	16,626	15,974	16,988	17,200	16,133
Other	4,585	4,206	4,483	4,205	4,072
Total	21,211	20,180	21,471	21,405	20,205

Source: Global Trade Information Service, World Trade Atlas Database.