U.S. Department of the Interior
U.S. Geological Survey

MINERAL COMMODITY SUMMARIES 2006

Abrasives
Aluminum
Antimony
Arsenic
Asbestos
Barite
Bauxite
Beryllium
Bismuth
Boron
Bromine
Cadmium
Cement
Cesium
Chromium
Clays
Cobalt
Columbium
Copper
Diamond
Diatomite
Feldspar
Fluorspar
Gallium
Garnet
Gemstones
Germanium
Gold
Graphite
Gypsum
Hafnium
Helium
Indium
Iodine
Iron Ore
Iron and Steel
Kyanite
Lead
Lime
Lithium
Magnesium
Manganese
Mercury
Mica
Molybdenum
Nickel
Nitrogen
Peat
Perlite
Phosphate Rock
Platinum
Potash
Pumice
Quartz Crystal
Rare Earths
Rhenium
Rubidium
Salt
Sand and Gravel
Scandium
Selenium
Silicon
Silver
Soda Ash
Sodium Sulfate
Stone
Strontium
Sulfur
Talc
Tantalum
Tellurium
Thallium
Thorium
Tin
Titanium
Tungsten
Vanadium
Vermiculite
Yttrium
Zinc
Zirconium

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U.S. DEPARTMENT OF THE INTERIOR
GALE A. NORTON, Secretary

U.S. GEOLOGICAL SURVEY
P. PATRICK LEAHY, Acting Director

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INSTANT INFORMATION

Information about the U.S. Geological Survey, its programs, staff, and products is available from the Internet at URL <http://www.usgs.gov> or by contacting the Earth Science Information Center at 1-888-ASK-USGS.

This publication has been prepared by the Minerals Information Team. Information about the Team and its products is available from the Internet at URL <http://minerals.usgs.gov/minerals> or by writing to Chief Scientist, Minerals Information Team, 988 National Center, Reston, VA 20192.

KEY PUBLICATIONS

Minerals Yearbook—These annual publications review the mineral industries of the United States and foreign countries. They contain statistical data on minerals and materials and include information on economic and technical trends and developments. The three volumes that make up the Minerals Yearbook are—Volume I, Metals and Minerals; Volume II, Area Reports, Domestic; and Volume III, Area Reports, International.

Mineral Commodity Summaries—Published on an annual basis, this report is the earliest Government publication to furnish estimates covering nonfuel mineral industry data. Data sheets contain information on the domestic industry structure, Government programs, tariffs, and 5-year salient statistics for more than 90 individual minerals and materials.

Mineral Industry Surveys—These periodic statistical and economic reports are designed to provide timely statistical data on production, distribution, stocks, and consumption of significant mineral commodities. The surveys are issued monthly, quarterly, or at other regular intervals.

Metal Industry Indicators—This monthly publication analyzes and forecasts the economic health of five metal industries (primary metals, steel, primary aluminum, aluminum mill products, and copper) using leading and coincident indexes.

Nonmetallic Mineral Products Industry Indexes—This monthly publication analyzes the leading and coincident indexes for the nonmetallic mineral products industry (NAICS 327).

Materials Flow Studies—These publications describe the flow of materials from source to ultimate disposition to help better understand the economy, manage the use of natural resources, and protect the environment.

Recycling Reports—These materials flow studies illustrate the recycling of metal commodities and identify recycling trends.

Historic Commodity Reviews—These periodic reports provide compilations of statistics on production, trade, and use of more than 60 mineral commodities during the past 100 years.

WHERE TO OBTAIN PUBLICATIONS

- *Mineral Commodity Summaries* and the *Minerals Yearbook* are sold by the U.S. Government Printing Office, Superintendent of Documents. Orders are accepted over the Internet at URL <http://bookstore.gpo.gov/index.html>, by telephone toll free (866) 512-0800; Washington, DC area (202) 512-1800, by Fax (202) 512-2250, or through the mail (Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954).

- All current and many past publications are available in PDF format (and some are available in XLS format) through URL <http://minerals.usgs.gov/minerals>.

INTRODUCTION

Each chapter of the 2006 edition of the U.S. Geological Survey (USGS) Mineral Commodity Summaries (MCS) includes information on events, trends, and issues for each mineral commodity as well as discussions and tabular presentations on domestic industry structure, Government programs, tariffs, 5-year salient statistics, and world production and resources. The MCS is the earliest comprehensive source of 2005 mineral production data for the world. More than 90 individual minerals and materials are covered by 2-page synopses.

The principal sources for the reserves and reserve base information provided for most mineral commodities are trade journals and Government reports from Australia, Brazil, Canada, Chile, China, Germany, India, Japan, Mexico, Morocco, Peru, South Africa, the United Kingdom, and the United States.

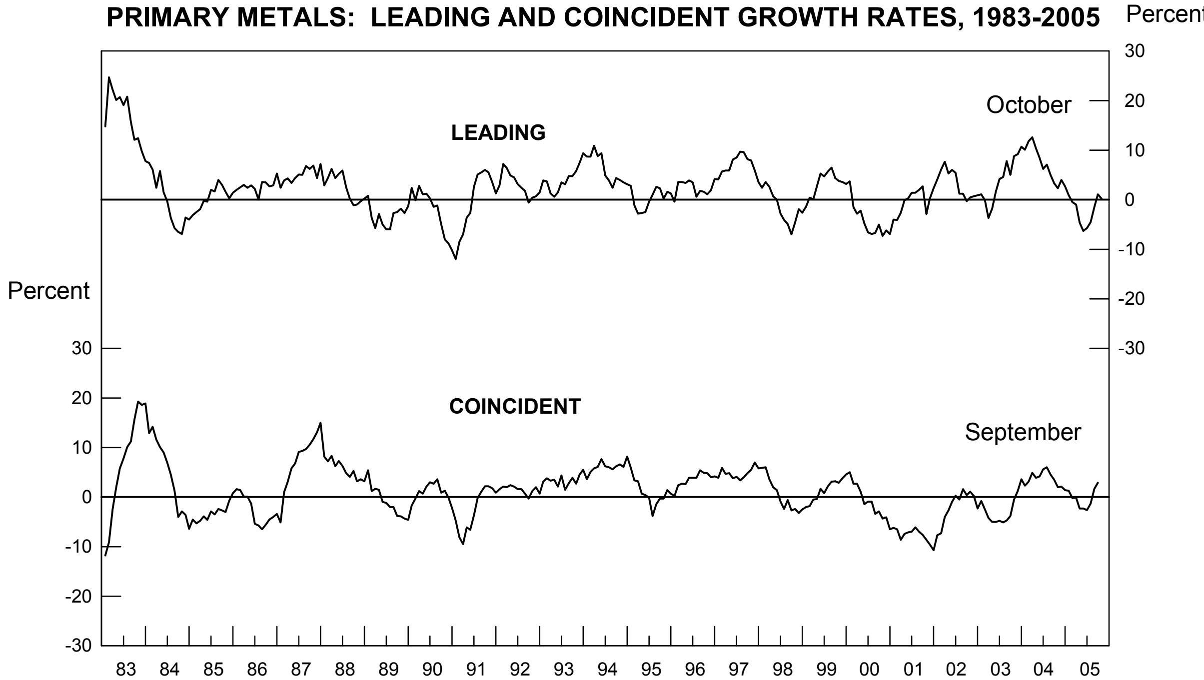
The "Significant Events, Trends, and Issues" section is an overview of domestic and international events affecting minerals that are important to the U.S. economy. Of particular note in 2005 was the increase in value of about 13% compared with that of 2004 for minerals and mineral materials mined in the United States. Asian economies grew rapidly (China's increase in gross domestic product was estimated at about 9% and India's was just over 7%) and played increasingly important roles as both producers and consumers of minerals and materials. Many mineral-producing companies reported significant profits, owing to near-record prices for some metals as well as increased production for many mineral commodities. Worldwide expenditures for exploration for nonferrous metals were expected to surpass $5 billion, close to the previous nominal peak of $5.2 billion in 1997. The year began and ended with natural disasters (the tsunami in Southeast Asia and hurricanes in the U.S. Gulf Coast region) that had damaging effects on mineral operations and transportation facilities, and placed increased demands on production of mineral raw materials needed for reconstruction.

Abbreviations and units of measure, and definitions of selected terms used in the report, are in Appendix A and Appendix B, respectively. A resource/reserve classification for minerals, based on USGS Circular 831 (published with the U.S. Bureau of Mines) is Appendix C, and a directory of USGS minerals information country specialists and their responsibilities is Appendix D.

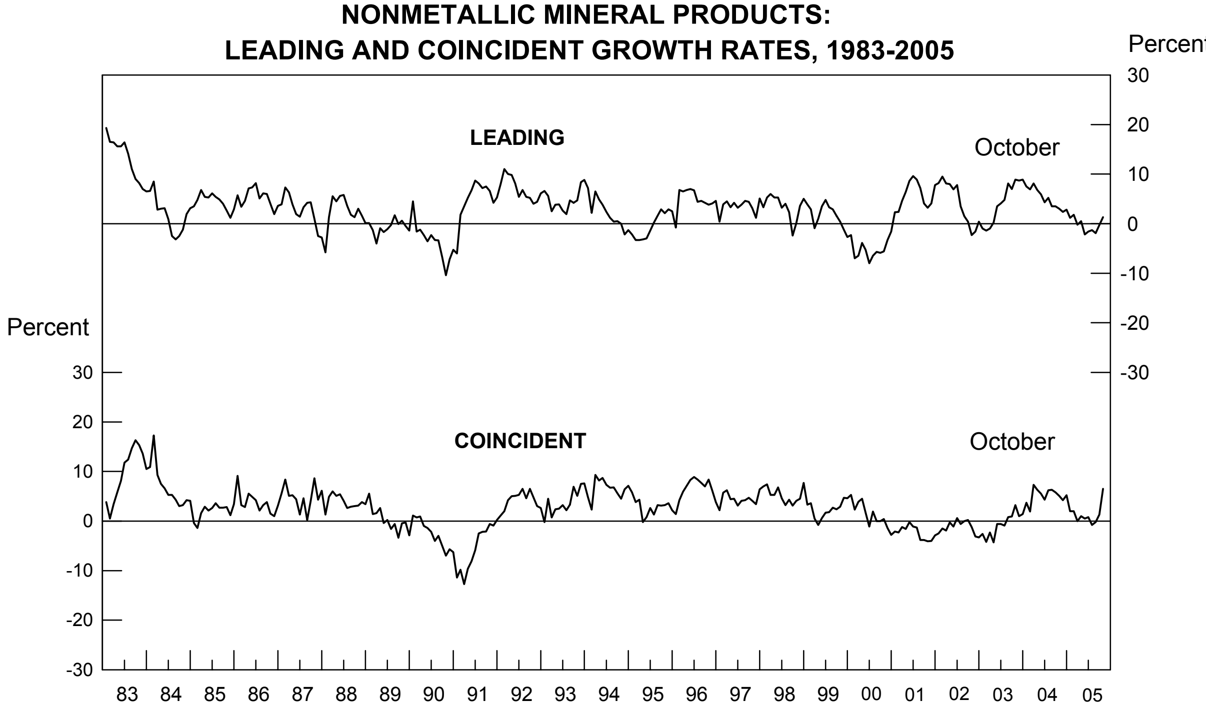
The USGS continually strives to improve the value of its publications to users. Constructive comments and suggestions by readers of the MCS 2006 are welcomed.

GROWTH RATES OF LEADING AND COINCIDENT INDEXES FOR MINERAL PRODUCTS

PRIMARY METALS: LEADING AND COINCIDENT GROWTH RATES, 1983-2005



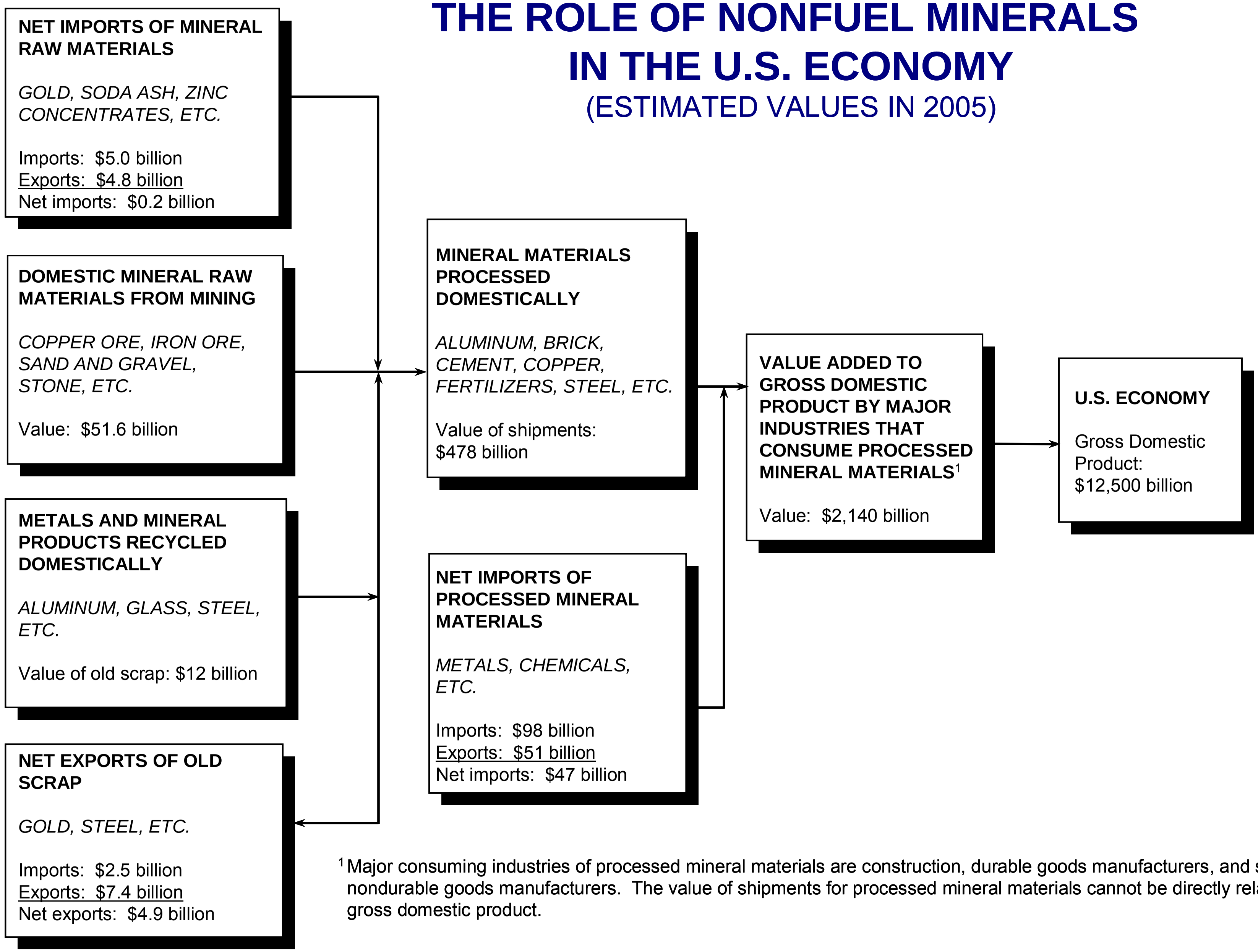
NONMETALLIC MINERAL PRODUCTS:
LEADING AND COINCIDENT GROWTH RATES, 1983-2005



The leading indexes historically give signals several months in advance of major changes in the corresponding coincident index, which measures current industry activity. The growth rates, which can be viewed as trends, are expressed as compound annual rates based on the ratio of the current month's index to its average level during the preceding 12 months.

Sources: U.S. Geological Survey, *Metal Industry Indicators* and *Nonmetallic Mineral Products Industry Indexes.*

THE ROLE OF NONFUEL MINERALS IN THE U.S. ECONOMY
(ESTIMATED VALUES IN 2005)



[1] Major consuming industries of processed mineral materials are construction, durable goods manufacturers, and some nondurable goods manufacturers. The value of shipments for processed mineral materials cannot be directly related to gross domestic product.

Sources: U.S. Geological Survey and U.S. Department of Commerce.

2005 U.S. NET IMPORT RELIANCE FOR SELECTED NONFUEL MINERAL MATERIALS

Commodity	Percent	Major Import Sources (2001-04)[1]
ARSENIC (trioxide)	100	China, Morocco, Chile, Mexico
ASBESTOS	100	Canada
BAUXITE and ALUMINA	100	Jamaica, Australia, Guinea, Suriname
COLUMBIUM (niobium)	100	Brazil, Canada, Estonia, China
FLUORSPAR	100	China, South Africa, Mexico
GRAPHITE (natural)	100	China, Mexico, Canada, Brazil
INDIUM	100	China, Canada, Japan, Russia
MANGANESE	100	South Africa, Gabon, Australia, China
QUARTZ CRYSTAL (industrial)	100	Brazil, Germany, Madagascar, Canada
RARE EARTHS	100	China, France, Japan, Austria
RUBIDIUM	100	Canada
STRONTIUM	100	Mexico, Germany
THALLIUM	100	Belgium, Russia, Netherlands, France
THORIUM	100	France
VANADIUM	100	Czech Republic, Canada, South Africa, Swaziland
YTTRIUM	100	China, Netherlands, Japan, Austria
GALLIUM	99	China, France, Japan, Russia
GEMSTONES	99	Israel, India, Belgium
BISMUTH	95	Belgium, Mexico, China, United Kingdom
TIN	93	Peru, China, Bolivia, Indonesia
PLATINUM	91	South Africa, United Kingdom, Germany, Canada
TANTALUM	91	Australia, Canada
STONE (dimension)	88	Italy, India, Canada, Spain
DIAMOND (natural industrial stone)	84	Ireland, Russia, Switzerland, Belgium
ANTIMONY	82	China, Mexico, Belgium, South Africa
BARITE	82	China, India
IODINE	82	Chile, Japan, Netherlands
RHENIUM	81	Chile, Kazakhstan, Germany
POTASH	80	Canada, Belarus, Russia, Germany
COBALT	78	Finland, Norway, Russia, Canada
PALLADIUM	78	Russia, South Africa, United Kingdom, Belgium
TUNGSTEN	70	China, Canada, Germany, Portugal
CHROMIUM	69	South Africa, Kazakhstan, Zimbabwe, Russia
TITANIUM MINERAL CONCENTRATES	63	South Africa, Australia, Canada, Ukraine
MAGNESIUM METAL	61	Canada, Russia, China, Israel
TITANIUM (sponge)	60	Kazakhstan, Japan, Russia
SILVER	57	Mexico, Canada, Peru, Chile
MAGNESIUM COMPOUNDS	56	China, Canada, Australia, Austria
PEAT	55	Canada
NICKEL	54	Canada, Russia, Norway, Australia
SILICON	52	Brazil, South Africa, Canada, Venezuela
ZINC	52	Canada, Mexico, Peru
ALUMINUM	47	Canada, Russia, Venezuela, Brazil
DIAMOND (dust, grit and powder)	43	Ireland, China, Ukraine, Russia
NITROGEN (fixed), AMMONIA	41	Trinidad and Tobago, Canada, Russia
COPPER	40	Canada, Chile, Peru, Mexico
GARNET (industrial)	40	Australia, India, China, Canada
VERMICULITE	35	South Africa, China
MICA, scrap and flake (natural)	32	Canada, India, China, Finland
GYPSUM	29	Canada, Mexico, Spain, Dominican Republic
CEMENT	25	Canada, Thailand, China, Venezuela
PERLITE	24	Greece
SULFUR	23	Canada, Mexico, Venezuela
PUMICE	22	Greece, Italy, Turkey
SALT	21	Canada, Chile, Mexico, The Bahamas
IRON and STEEL	15	Canada, European Union, Mexico, Brazil
GOLD	8	Canada, Peru, Colombia, Brazil
IRON and STEEL SLAG	8	Canada, France, Italy, Japan
PHOSPHATE ROCK	7	Morocco
IRON ORE	4	Canada, Brazil, Chile, Australia
TALC	3	China, Canada, France, Japan
FELDSPAR	2	Mexico, Turkey
LIME	1	Canada, Mexico

[1]In descending order of import share

SIGNIFICANT EVENTS, TRENDS, AND ISSUES[1]

The Mineral Sector of the U.S. Economy

Minerals are fundamental to the U.S. economy, contributing to the real gross domestic product (GDP) at several levels—basic (mining), intermediate (processing), and manufacturing. The estimated growth rate for the real GDP of the United States for 2005 was 3.6%. The nominal GDP was about $12.5 trillion. Housing starts were up more than 4% for the year, and the unemployment rate decreased to about 5.1% in 2005 from 5.5% in 2004. The prime interest rate increased from 5.25% at the beginning of the year to 7.25% at the end of the year.

The value of minerals mined in the United States in 2005 rose significantly because of increased unit price for some metals—particularly molybdenum—and significantly increased production for some industrial minerals, mainly cement, construction sand and gravel, and crushed stone. Production of 10 mineral commodities was worth more than $1 billion each in the United States in 2005. These were crushed stone, portland cement, construction sand and gravel, copper, molybdenum, gold, iron ore, lime, salt, and phosphate rock, listed in decreasing order of value. Two major factors drove mining and mineral production in opposite directions. High fuel costs tended to reduce profitability, and in some cases caused lower production, whereas strong demand from China—especially for copper, iron, and molybdenum—led to increasing prices and output.

Overall Performance

The estimated value of all mineral materials processed in the United States during 2005 totaled $478 billion, 8% more than in 2004 (p. 5). The total value of U.S. raw nonfuel mineral production alone was about $51.6 billion (p. 5), $6 billion (13%) more than in 2004. The value of metals accounted for about 32% of the total, an increase of about 33% compared with the value of metal mine production in 2004. The value of industrial minerals mine production increased by nearly 6%.

The value of net imports of raw and processed mineral materials during 2005 increased by about 6% from the 2004 level. The unit values and tonnages of many metal exports were up significantly, and the overall value of mineral exports increased by 21% to about $56 billion. The United States is increasingly reliant on foreign sources for raw and processed mineral materials (p. 6). Imports of raw and processed mineral materials increased by more than 14% from the previous year's level to a value of about $103 billion. As in recent years, aluminum, copper, and steel were among the leading imports in terms of value. The value of imports of metal ore and concentrates and raw industrial minerals was about $5 billion; the value of exports was about $4.8 billion.

The construction industry led the demand for mineral materials. The value of new highway construction increased by 12% to $67 billion in part because of the reauthorization of the Transportation Equity Act for the 21st Century on August 10, 2005. Housing starts are estimated to have increased by more than 4% to about 2 million units for 2005, based on data through October 2005 from the U.S. Census Bureau. This trend is supported by the continuation of low mortgage rates. Construction accounted for most of the consumption of clay, cement, glass, sand and gravel, crushed and dimension stone, and steel. Production of aggregates (crushed stone and sand and gravel) in 2005 was estimated to be about 3% more than in 2004. It is estimated that aggregates production will increase by 4% in 2006 based on expected infrastructure use. Light vehicle sales remained at about the same level in 2005 as in 2004, and the automobile industry continued to use large quantities of steel and other metals as well as glass and plastics (tables 1, 2). About 35% of domestically produced aluminum is used in the transportation sector.

Estimated value of U.S. metal mine production in 2005 was more than $16 billion, about 33% more than that of 2004. Principal value of mine production in 2005 was from copper (26%), molybdenum (25%), gold (21%), iron ore (14%), zinc (6%), and lead (3%). Production of these six metals composed 95% of the total value of U.S. metal mine output. Metals with the largest increases in value of mine production were molybdenum (189%), titanium (rutile) (63%), copper (25%), zinc (18%), and iron ore (10%); these increases more than offset a decline in the value of palladium metal (15%). The value of gold production (lode and placer), about $3.4 billion, increased slightly.

Molybdenum contributed significantly to the increase in value of U.S. metal production. The price of molybdenum rose to almost $40 per pound, an increase of more than seven times its relatively stable historical price. Worldwide, about two-thirds of molybdenum production is a byproduct of copper production, so when steel industry demand for molybdenum increased, molybdenum production did not increase proportionately, resulting in supply shortages and price volatility. The supply situation was exacerbated when molybdenum production in China dropped somewhat because of mine closures for environmental and health and safety reasons. China is ranked as the world's third leading molybdenum-producing nation; there it is a principal mine product rather than a byproduct.

Worldwide iron ore prices increased more than 70% in 2005 as the rate of consumption increased faster than the rate of production. China was a major factor affecting the growth of the international iron ore industry. China increased its activity in overseas joint ventures, rapidly increased imports of iron ore, and continued high domestic production of low-grade ores. Major iron ore-mining companies reinvested the unusually large profits that accrued from the higher prices in exploration and mine development. Increased production capacity will enable firms to increase or meet increased production requirements, which will continue to be dominated by China.

[1]Staff, U.S. Geological Survey.

TABLE 1.—U.S. MINERAL INDUSTRY TRENDS

	2001	2002	2003	2004	2005[e]
Total mine production:[1]					
Metals	8,530	8,200	8,500	12,300	16,300
Industrial minerals	29,800	29,700	30,900	33,300	35,200
Coal	19,600	19,700	19,200	22,200	22,300
Employment:[2]					
Coal mining	63	63	59	59	64
Metal mining	25	21	20	20	22
Industrial minerals, except fuels	83	80	78	82	86
Chemicals and allied products	562	532	525	520	514
Stone, clay, and glass products	427	399	375	387	385
Primary metal industries	447	396	370	363	363
Average weekly earnings of production workers:[3]					
Coal mining	957	934	964	1,029	1,075
Metal mining	866	879	957	1,034	1,002
Industrial minerals, except fuels	744	748	771	789	834
Chemicals and allied products	736	760	784	820	831
Stone, clay, and glass products	619	647	665	688	700
Primary metal industries	724	750	768	800	816

[e]Estimated.

[1]Million dollars.

[2]Thousands of production workers.

[3]Dollars.

Sources: U.S. Geological Survey, U.S. Department of Energy, U.S. Department of Labor.

TABLE 2.—U.S. MINERAL-RELATED ECONOMIC TRENDS

	2001	2002	2003	2004	2005[e]
Gross domestic product (billion dollars)	10,128	10,470	10,971	11,734	12,500
Industrial production (2002=100):					
Total index	100	100	101	105	108
Manufacturing	100	100	101	105	109
Nonmetallic mineral products	100	100	100	105	107
Primary metals:	99	100	98	103	100
Iron and steel	100	100	99	108	101
Aluminum	91	100	95	100	101
Nonferrous metals (except aluminum)	98	100	100	101	99
Chemicals	94	100	100	103	103
Mining:	104	100	100	100	97
Coal	104	100	97	101	101
Oil and gas extraction	102	100	99	97	92
Metals	109	100	94	94	100
Nonmetallic minerals	102	100	101	106	108
Capacity utilization (percent):					
Total industry	76	75	76	79	80
Mining:	90	87	88	88	87
Metals	79	75	72	72	77
Nonmetallic minerals	84	82	83	87	88
Housing starts (thousands)	1,600	1,710	1,850	1,950	2,040
Light vehicle sales (thousands)[1]	14,200	13,500	13,300	13,500	13,500
Highway construction, value, put in place (billion dollars)	59	59	59	60	67

[e]Estimated.

[1]Excludes imports.

Sources: U.S. Department of Commerce, Federal Reserve Board, Autodata Corp., and U.S. Department of Transportation.

World consumption of finished steel products was estimated to increase in 2005 by 5.0%, according to the International Iron and Steel Institute. The Organisation for Economic Co-operation and Development (OECD) expected world steel demand to increase by about 5%, driven by the continuing strong growth in Chinese demand. Steel consumption in China was expected to increase by nearly 11%. Increasing energy costs may dampen the demand for steel, as it did in 1973 and 1979 when oil prices rose dramatically. Declining demand during 2006 coupled with expanding capacity may result in a capacity surplus. Such a surplus would exert downward pressure on prices.

U.S. domestic pig iron and steel production decreased in 2005 by about 20% and 6%, respectively. Shipments of steel mill products were about the same in 2005 as in 2004. Imports of steel mill products decreased about 7% in 2005 compared with those of 2004, and U.S. net import reliance as a percentage of apparent consumption exceeded an estimated 15%, the highest level in 3 years.

Domestic primary aluminum production decreased slightly in 2005 because of cutbacks attributed to increased energy and alumina costs. Most of the production decreases continued to take place in the Pacific Northwest. Domestic smelters operated at about two-thirds of rated or engineered capacity. Net imports for consumption increased 14%, filling the supply deficit created by increased consumption and decreased domestic production. World primary aluminum production continued to increase as capacity expansions outside the United States were brought online. Although world production of bauxite and alumina increased compared with that of 2004, increased demand and a limited supply caused spot prices for metallurgical-grade alumina to rise significantly.

The estimated value of domestic copper mine production rose by about 25% in 2005, although output was lower than that in 2004. Copper prices trended upward throughout the year, and the Commodity Exchange Inc. (New York) (COMEX) spot price reached a record-high monthly average of $1.90 per pound in October. Despite a more than 3% estimated growth in world production of refined copper, production was insufficient to meet global demand through at least the first 3 quarters of 2005.

Estimated world use of lead rose by between 3% and 4% in 2005. The main driver behind this growth, as it had been for several years, was greater use of lead in China for vehicle fleet expansion and for telecommunications and information technology. Global mine production was projected to increase by approximately 4% in 2005. The world refined lead production, however, was approximately 1% less than world consumption, and a minor production deficit was forecast to continue into 2006.

World zinc consumption in 2005 exceeded world refined zinc production, and London Metal Exchange (LME) stocks were drawn down by more than 200,000 metric tons. This led to increased zinc prices in 2005, and similar supply and demand conditions are expected to continue well into 2006.

Domestic gold mine production in 2005 was estimated to be about 3% less than the level of 2004, but still high enough to make the United States the third leading gold-producing nation after Australia and South Africa. In 2005, mines in the United States produced approximately 1,300 metric tons of silver with an estimated value of $295 million. Approximately 99% of domestic silver was produced as a byproduct from base-metal ores and from precious-metal ores. Silver prices have increased because of investor interest and the use of silver in an ever-growing list of industrial applications. In 2005, silver prices averaged $7.15 per troy ounce, which surpassed 2004's high of $6.69 and 1987's high of $6.99. Prices rose to more than $8.00 per troy ounce in November.

The Stillwater and East Boulder Mines in south-central Montana are the only primary producers of platinum-group metals (PGMs) in the United States. These mines milled more than 1.2 million metric tons of ore and recovered more than 14,000 kilograms of palladium and 4,000 kilograms of platinum in 2005. Small quantities of PGMs were also recovered as byproducts of copper refining by companies in Texas and Utah. Palladium prices fell in 2005 because of weak demand and oversupply. Meanwhile, the platinum price continued to climb for the fourth year in a row because of a perceived shortage of stocks and production. With a short supply, the price of rhodium surged to a 5-year high.

U.S. production of mineral fertilizers increased for the second consecutive year. Output of phosphate rock and potash increased in order to supply domestic and export consumers' needs for plant nutrients. Fixed nitrogen output decreased and continued to be well below plant capacity, notwithstanding high ammonia prices, because of the high costs for natural gas and the lower price of available imports. Fertilizer consumption at the farm level of three major nutrients, nitrogen, phosphates, and potash, increased slightly, but total harvested hectares was essentially unchanged. The long-term projections of the U.S. Department of Agriculture for planting of eight major field crops were for a relatively stable 100 million hectares through its 2015 forecast period.

In 2005, 19 States each produced more than $1 billion worth of nonfuel mineral commodities. These States were, in descending order, Arizona, Nevada, California, Utah, Texas, Florida, Minnesota, Georgia, Colorado, Michigan, Missouri, Pennsylvania, Alaska, Wyoming, Illinois, New Mexico, Ohio, New York, and Alabama; their production accounted for about 74% of the U.S. total output value (table 3).

In fiscal year 2005, the Defense Logistics Agency (DLA) sold $432 million of excess mineral materials from the National Defense Stockpile (NDS). Additional detailed information can be found in the "Government Stockpile" sections in the mineral commodity reports that follow.

TABLE 3.—VALUE OF NONFUEL MINERAL PRODUCTION IN THE UNITED STATES AND PRINCIPAL NONFUEL MINERALS PRODUCED IN 2005[p, 1]

State	Value (thousands)	Rank	Percent of U.S. total	Principal minerals, in order of value
Alabama	$1,010,000	19	1.95	Cement (portland), stone (crushed), lime, sand and gravel (construction), cement (masonry).
Alaska	1,370,000	13	2.65	Zinc, lead, gold, silver, sand and gravel (construction).
Arizona	4,730,000	1	9.17	Copper, molybdenum concentrates, sand and gravel (construction), cement (portland), stone (crushed).
Arkansas	523,000	32	1.01	Stone (crushed), bromine, cement (portland), sand and gravel (construction), lime.
California	3,530,000	3	6.84	Sand and gravel (construction), cement (portland), boron minerals, stone (crushed), diatomite.
Colorado	1,770,000	9	3.43	Molybdenum concentrates, sand and gravel (construction), cement (portland), gold, stone (crushed).
Connecticut[2]	140,000	42	0.27	Stone (crushed), sand and gravel (construction), stone (dimension), clays (common), gemstones (natural).
Delaware[2]	21,800	50	0.04	Sand and gravel (construction), magnesium compounds, gemstones (natural).
Florida	2,590,000	6	5.03	Phosphate rock, stone (crushed), cement (portland), sand and gravel (construction), cement (masonry).
Georgia	1,790,000	8	3.47	Clays (kaolin), stone (crushed), clays (fuller’s earth), cement (portland), sand and gravel (construction).
Hawaii	71,100	47	0.14	Stone (crushed), sand and gravel (construction), gemstones (natural).
Idaho	893,000	21	1.73	Molybdenum concentrates, phosphate rock, sand and gravel (construction), silver, cement (portland).
Illinois	1,140,000	15	2.21	Stone (crushed), cement (portland), sand and gravel (construction), sand and gravel (industrial), lime.
Indiana	789,000	25	1.53	Stone (crushed), cement (portland), sand and gravel (construction), lime, cement (masonry).
Iowa	604,000	28	1.17	Cement (portland), stone (crushed), sand and gravel (construction), lime, gypsum (crude).
Kansas	822,000	24	1.59	Cement (portland), helium (Grade-A), salt, stone (crushed), helium (crude).
Kentucky	645,000	27	1.25	Stone (crushed), lime, cement (portland), sand and gravel (construction), clays (common).
Louisiana	356,000	37	0.69	Salt, sand and gravel (construction), stone (crushed), sand and gravel (industrial), clays (common).
Maine	124,000	43	0.24	Sand and gravel (construction), cement (portland), stone (crushed), cement (masonry), stone (dimension).
Maryland	507,000	33	0.98	Stone (crushed), cement (portland), sand and gravel (construction), stone (dimension), cement (masonry).
Massachusetts[2]	208,000	39	0.40	Stone (crushed), sand and gravel (construction), lime, stone (dimension), clays (common).
Michigan	1,690,000	10	3.28	Iron ore (usable shipped), cement (portland), sand and gravel (construction), stone (crushed), salt.
Minnesota[2]	2,070,000	7	4.01	Iron ore (usable shipped), sand and gravel (construction), stone (crushed), sand and gravel (industrial), stone (dimension).
Mississippi	202,000	40	0.39	Sand and gravel (construction), stone (crushed), clays (fuller’s earth), cement (portland), clays (bentonite).
Missouri	1,680,000	11	3.25	Stone (crushed), cement (portland), lead, lime, sand and gravel (construction).
Montana	866,000	22	1.68	Molybdenum concentrates, copper, platinum metal, palladium metal, sand and gravel (construction).
Nebraska[2]	116,000	44	0.23	Cement (portland), sand and gravel (construction), stone (crushed), sand and gravel (industrial), lime.
Nevada	3,640,000	2	7.06	Gold, sand and gravel (construction), copper, lime, stone (crushed).
New Hampshire[2]	75,100	46	0.15	Sand and gravel (construction), stone (crushed), stone (dimension), gemstones (natural).

See footnotes at end of table.

TABLE 3.—VALUE OF NONFUEL MINERAL PRODUCTION IN THE UNITED STATES AND PRINCIPAL NONFUEL MINERALS PRODUCED IN 2005[p, 1]—Continued

State	Value (thousands)	Rank	Percent of U.S. total	Principal minerals, in order of value
New Jersey[2]	$365,000	36	0.71	Stone (crushed), sand and gravel (construction), sand and gravel (industrial), greensand marl, peat.
New Mexico	1,120,000	16	2.17	Copper, potash, molybdenum concentrates, sand and gravel (construction), cement (portland).
New York	1,080,000	18	2.09	Stone (crushed), salt, sand and gravel (construction), cement (portland), wollastonite.
North Carolina	846,000	23	1.64	Stone (crushed), phosphate rock, sand and gravel (construction), sand and gravel (industrial), feldspar.
North Dakota	51,300	48	0.10	Sand and gravel (construction), lime, stone (crushed), clays (common), sand and gravel (industrial).
Ohio	1,080,000	17	2.10	Stone (crushed), sand and gravel (construction), salt, lime, cement (portland).
Oklahoma	555,000	31	1.08	Stone (crushed), cement (portland), sand and gravel (construction), sand and gravel (industrial), gypsum (crude).
Oregon	398,000	35	0.77	Sand and gravel (construction), stone (crushed), cement (portland), diatomite, perlite (crude).
Pennsylvania	1,410,000	12	2.74	Stone (crushed), cement (portland), sand and gravel (construction), lime, cement (masonry).
Rhode Island[2]	37,000	49	0.07	Sand and gravel (construction), stone (crushed), sand and gravel (industrial), gemstones (natural).
South Carolina[2]	580,000	29	1.13	Stone (crushed), cement (portland), cement (masonry), sand and gravel (construction), clays (kaolin).
South Dakota	216,000	38	0.42	Cement (portland), sand and gravel (construction), stone (crushed), gold, stone (dimension).
Tennessee	696,000	26	1.35	Stone (crushed), cement (portland), sand and gravel (construction), clays (ball), sand and gravel (industrial).
Texas	2,610,000	5	5.06	Cement (portland), stone (crushed), sand and gravel (construction), lime, salt.
Utah	2,870,000	4	5.56	Molybdenum concentrates, copper, gold, cement (portland), sand and gravel (construction).
Vermont[2]	88,200	45	0.17	Stone (crushed), stone (dimension), sand and gravel (construction), talc (crude), gemstones (natural).
Virginia	962,000	20	1.86	Stone (crushed), sand and gravel (construction), cement (portland), lime, zirconium concentrates.
Washington	562,000	30	1.09	Sand and gravel (construction), cement (portland), stone (crushed), zinc, gold.
West Virginia	170,000	41	0.33	Stone (crushed), cement (portland), lime, sand and gravel (industrial), cement (masonry).
Wisconsin[2]	472,000	34	0.92	Sand and gravel (construction), stone (crushed), lime, sand and gravel (industrial), stone (dimension).
Wyoming	1,200,000	14	2.33	Soda ash, clays (bentonite), helium (Grade-A), cement (portland), sand and gravel (construction).
Undistributed	238,000	XX	0.46	
Total	51,600,000	XX	100.00	

[p]Preliminary. XX Not applicable.

[1]Data are rounded to three significant digits; may not add to totals shown.

[2]Partial total; excludes values that must be concealed to avoid disclosing company proprietary data. Concealed values included with "Undistributed."

Under the authority of the Defense Production Act of 1950, the U.S. Geological Survey advises the DLA on acquisition and disposals of NDS mineral materials. At the end of the fiscal year, mineral materials valued at almost $1.41 billion remained in the stockpile.

Outlook

According to the OECD, global economic growth was exceptionally vigorous in 2005 despite high oil prices and may continue if oil prices, exchange rates, and other factors do not change abruptly. The OECD regarded the quick resumption of the production of oil and other commodities in the U.S. Gulf Coast region after Hurricanes Katrina, Rita, and Wilma as an indication of the U.S. economy's resilience and likely continued growth at least in the near term. But the OECD also viewed the growing trade surpluses in China and Japan, coupled with trade and current account deficits and low savings rates in the United States, as potentially leading to a disruption of the international economy (Cotis, 2005§[2]).

The overall U.S. trade deficit reached a record high of $68.9 billion in October, an increase of 24% compared with that of October 2004, according to the Bureau of Economic Analysis (U.S. Department of Commerce, Bureau of Economic Analysis, 2005§). Profits and value increased significantly in U.S. mining and mineral processing industries.

Significant International Events

Economic Conditions

The global economic expansion that began in 2003 continued through 2005. If 2004 was the year that the world awoke to the possibilities of rapid economic growth in China and other developing countries, 2005 may be remembered as the year the world began to adjust to the realities of that growth.

Economic growth in China continued to be strong. China's economy (GDP) grew at an annual rate greater than 9% in each of the first three quarters of the year. Despite talk of trying to slow growth (Wall Street Journal, 2005a), the Central Bank has not increased interest rates since October 2004 (Brown and Lee, 2005). China tried to control overproduction through tax policy (Mining Journal, 2005c) and environmental laws (Wonacott, 2005).

China's rapid economic growth has involved additions to infrastructure, increased investment in manufacturing facilities, and initial development of a consumer society. This led to increased mineral consumption, and higher mineral prices (Fuerbringer, 2005) because of fixed capacities and high levels of capacity utilization (Prof. J.E. Tilton, Colorado School of Mines, oral commun., December 14, 2005). For a number of mineral commodities, particularly bauxite, copper, iron ore, and petroleum, China is dependent upon imports to meet its needs.

The processing of raw materials has required new facilities, but in some cases the Government warned of excess capacity. Much of the new aluminum capacity was built without committed sources of alumina or power. As a result many of the new facilities are only marginally profitable. As a result, 2 million metric tons of capacity is not being used. Continued success of China's aluminum industry may depend upon doubling power capacity, which will require expanded production of coal, and increased environmental costs (Pottinger, Stecklow, and Fialka, 2004).

The size and rate of growth of the Chinese economy has been difficult to measure. The recently completed census, which raised GDP for 2004 to 16.0 from 13.7 trillion Yuan, implies China's recent growth rate has been understated (Areddy, 2005). The restated GDP makes some weaknesses in the Chinese economy, such as nonperforming bank loans and the high rate of consumption of energy relative to GDP, appear less troubling. Shortage of energy, especially petroleum, presents a potential limit to Chinese development, which needs energy for a growing manufacturing sector and petroleum to fuel a growing fleet of private automobiles. Although restatement of its GDP reduces some of China's challenges, it exacerbates others such as the perception that China should allow its currency to float against other currencies (Dickie, 2005§).

Economic growth was significant in other developing countries with large populations, most notably India. After growing 6.9% from April 2004 to March 2005, India's GDP grew at an annual rate of more than 8% in the second and third quarters of 2005. Although the best known sectors of India's economy are its information and services sectors, growth in the manufacturing sector has been especially noteworthy. Investment in production and capital goods is growing (Chidambaram, 2005), as are exports (Wall Street Journal, 2005c). Although India's economic development has been slower than China's, both countries face many similar challenges but possess different technical capabilities and resources. Although India's consumption of raw materials is lower than China's, its consumption of commodities such as steel is expected to increase during the next 10 years (Bhattacharya, 2005). Like China, India lacks copper and petroleum resources and relies on coal as its main source of energy. Unlike China, India has abundant resources of bauxite and iron ore. These similarities and differences create opportunities for both cooperation and competition between China and India. India is already China's second leading source for imported iron ore, but with Indian consumption of steel forecast to increase, some Indian steelmakers with plans for expansions (Ramsurya, 2005) opposed an iron ore mine and steel plant that would produce steel for export (Barta and Bellman, 2005).

India faces a shortage of electric power that is limiting economic growth. Like China, India needs to double power production to maintain economic growth (Yaidyanathan, 2005). India's oil production has not changed in recent years. As a result, India's state-owned oil company has pursued a number of foreign oil projects, including the building of pipelines from Iran and Burma (Solomon and King, 2005; Bhaumik, 2005§). India also has bid on foreign oil leases and companies. Many of these bids were, however won by China's state-owned oil companies. This contributed to a growing rivalry between the two countries especially after the China National Petroleum Company outbid an Indian joint venture for PetroKazakhstan (Pottinger, Chazan, and Larkin, 2005). The competition for PetroKazakhstan followed proposals for the two countries to cooperate on oil purchases (Ramesh, 2005). These proposals finally bore some fruit when the two countries agreed to jointly pursue Syrian oil assets (Oster and Larkin, 2005).

Buoyed by high prices for mineral and energy commodities, Russia's economy grew more than 7% per year in 2003 and 2004. Economic growth slowed to an annual rate less than 6% during the first half of 2005 but rebounded to 7% per year in the third quarter. Foreign investors have raised concerns about Russia's legal and

[2]References that include a section mark (§) are found in the Internet References Cited section.

economic systems, increased state-ownership of mineral resource companies, and the new subsoil law that restricts bidding on "strategic" mineral resources to majority-owned Russian firms. The law applies to oilfields in the Barents Sea, the Timan-Pechora and Yamal-Nenets regions, the Far East (White, 2005), and to some mineralized areas such as the Sukhoi Log gold and the Udokan copper* deposits (Demyanenko, 2005§). Russia released data on diamond and nickel production for the first time, and Russia's President promised to strengthen legal and banking systems, provide greater protection for property rights, and more clearly define rules governing foreign investment. However, progress in enacting reforms has been slow (Chazan 2005a, b). A rumored sale of Norilsk Nickel to state-owned Alrosa could rekindle concerns about Government ownership of mineral and energy resources (Metals Insider, 2005i§). Attempts by Gazprom to greatly increase the price of natural gas exported to the Ukraine is causing European leaders to question dependence on Russian gas (Finn, 2006). Russia has played an important role as a source of oil and other mineral resources to meet growing global consumption; significant reductions in Russian output could further constrain tight mineral and energy supplies.

In the United States, the economy grew at an annual rate of 3.8% in the first quarter, 3.3% in the second quarter, and 4.1% in the third quarter. However, concerns about the health of the U.S. economy remain. Chief among these are the trade deficit and the effects of high oil prices. The trade deficit has resulted in large transfers of dollars to trading partners, especially to China (McKinnon and Phillips, 2005).

Europe's economic growth slowed in 2005. Europe also had a growing trade deficit with China. High oil prices and competition with China for export markets contributed to Europe's economic problems but some observers cited Chinese competition in Europe's domestic markets as a bigger problem (Walker, 2005). Other analysts attributed Europe's high unemployment and slow economic growth to its welfare state and high levels of government spending (Carney, 2005).

Japan's economy began to grow again in 2004 and continued to grow in 2005. China's growing economy and increasing influence raised tensions between the two countries. Some were based on old animosities; others concerned territorial claims and potential energy resources (Lilley, 2005). The development of China's economy and manufacturing base presents challenges for Japan. Growth of China's steel industry and its emergence as an exporter caused Japanese steelmakers to revise their business strategies (Shimamura, 2005).

Review of Selected Mineral Markets

The price of gold was slightly more than $420 per troy ounce in early January of 2005; by December it reached $500 per troy ounce. Demand for gold jewelry was at record levels in the first half of the year (Mining Journal, 2005g). However, gold producers face growing opposition from environmental groups. A series of articles in the New York Times highlighted opposition to gold mining (Perlez and Johnson, 2005). World gold production was expected to increase to 2,450 metric tons in 2005 from 2,430 metric tons in 2004. Production in South Africa continued to decline. Several operators considered closing operations (Mining Journal, 2005f, h). Mine closures can threaten the profitability of adjacent mines because of increased pumping costs.

The price of aluminum was slightly more than $1,800 per metric ton ($0.82 per pound) early in 2005 and rose to almost $2,200 per metric ton (about $1.00 per pound) in December. LME and COMEX stocks of aluminum, which had dropped from more than 1.6 million metric tons in early 2004 to less than 750,000 metric tons at the end of 2004, dropped further in 2005, ending the year at slightly more than 700,000 metric tons. World primary aluminum production was expected to increase to 31.2 million metric tons in 2005 from 29.8 million metric tons in 2004. China was the leading producer with primary production in 2005 expected to increase more than 8% to about 7.2 million metric tons. Russia's production of primary aluminum was expected to increase slightly to about 3.65 million metric tons in 2005.

Analysts expect global aluminum consumption to increase by 4% to 5% per year between 2005 and 2010. China was the leading consumer of aluminum with consumption of 6.25 million metric tons per year, or 4.8 kilograms per capita, in 2004. China's consumption is expected to grow 9% per year and to exceed 16 million metric tons, or 12.4 kilograms per capita by 2015. Idle capacity in China could satisfy part of the projected increase but additional capacity will be required especially given expected closures of European and North American smelters (Metals Insider, 2005a§, I§).

Copper began 2005 at slightly less than $3,100 per metric ton ($1.41 per pound) and rose to more than $4,450 per metric ton ($2.00 per pound) in December, in response to increased Chinese consumption. Stocks (LME and COMEX), which dropped from about 700,000 metric tons in early 2004 to less than 100,000 metric tons at yearend, then remained at less than 100,000 metric tons throughout 2005. These data do not include Chinese stocks, which were about 300,000 metric tons in October (Metals Insider, 2005h§). World mine production of copper was expected to increase to 14.9 million metric tons in 2005, although a number of copper-producing countries, including Chile, Kazakhstan, Peru, and the United States, reported lower production through the third quarter of the year (Metals Insider, 2005c§, f§, g§, j§, k§).

Mine developments and expansions are expected to raise copper production during the next several years. In Chile, Corporación Nacional del Cobre de Chile (Codelco) plans to expand the El Teniente and Sur Mines and to finish constructing the Hales Mine. Codelco had discussions with China Minmetals concerning development of the Gaby deposit (Mining Journal, 2005e). BHP Billiton Ltd. is considering expanding the Olympic Dam Mine in Australia to produce 1 million metric tons per year of copper in concentrate (Metals Insider, 2005b§). Phelps Dodge Corp. announced that a deal for the Tenke Fungurume copper-cobalt project in Congo (Kinshasa) has been finalized and production will begin in 2008 (Engineering and Mining Journal, 2005).

Iron ore prices increased more than 70% in April as Chinese steel production continued to increase (Mining Journal, 2005i). World iron ore production was expected to increase to 1.52 billion metric tons in 2005 from 1.34 billion metric tons in 2004, and steel production was expected to increase to 1.09 billion metric tons in 2005 from 1.02 billion metric tons in 2004. China's steel capacity exceeded domestic consumption and raised concerns about excess capacity (Oster, 2005). In October, China's leading steel industry group encouraged members to cut output by 5% in the fourth quarter (Metals Insider, 2005e§), and Chinese officials reportedly will reduce plant investment to limit excess capacity (Metals Insider, 2005d§). High raw material prices are expected to reduce profits of steel companies. Companies that own resources of iron ore and coking coal are likely to have an advantage in controlling costs under current conditions.

Consumption of stainless steel increased in the first half of 2005, but decreased in the second half of the year. The price of nickel began the year at about $14,000 per metric ton ($6.35 per pound) and rose to more than $17,700 per metric ton ($8.00 per pound) in May. Prices had fallen to around $12,500 per ton ($5.67 per pound) in early December as LME and COMEX stocks rose to almost 250,000 metric tons.

Mergers and Acquisitions

In March, Cleveland-Cliffs Inc acquired ownership of Portman, Australia's third leading iron-ore producer (Cleveland-Cliffs Inc, 2005). BHP Billiton acquired WMC (Mining Journal, 2005a) and Noranda Inc. merged with Falconbridge Ltd. In October, Falconbridge agreed to a takeover by Inco Ltd. (Mining Journal, 2005b). In December, the board of directors of Placer Dome Inc. recommended acceptance of an offer from Barrick Gold Corp. (TSC Staff, 2005§). The merged firm will be the world's leading gold producer.

Two proposed acquisitions involved Chinese firms. In 2004, Fortescue Metals Group Ltd., China Metallurgical Construction Corp., and China Harbor Engineering Group reportedly reached agreements to finance and construct an iron ore mine and supporting infrastructure. In April, reports circulated of a dispute between Fortescue and China Metallurgical concerning China Metallurgical's desire to acquire an interest in Fortescue (Mining Journal, 2005d). The second proposal was a bid by Chinese oil producer CNOOC Ltd., which is a largely state-owned firm, to buy American oil producer Unocal Corp. The Chinese bid raised fundamental trade and national security issues for U.S. policymakers and created widespread debate throughout the U.S. Government and business community (King, Hitt, and Ball, 2005; Wall Street Journal, 2005b). In July, CNOOC dropped its offer citing intense political pressure as the reason that it failed to secure a deal (Pottinger and others, 2005).

Recent industry mergers are expected to create financially stronger entities that are better able to fund exploration and development needed to meet the growing consumption of minerals. The mergers, however, have reduced the number of large mining companies and are creating high levels of capacity concentration in some industries, which could reduce competition among producers.

Exploration

Spending on global nonferrous mineral exploration was expected to increase by 34% to $5.1 billion in 2005. This would be just shy of the record $5.2 billion spent on exploration in 1997. All regions saw increases in planned exploration with the largest percentage increases taking place in Europe, Latin America, and Africa. Latin America was expected to receive the largest expenditures, followed by Canada, Africa, Europe, Australia, the United States, and the Pacific region. Junior firms accounted for almost one-half of planned expenditures (Metals Economics Group, 2005§).

Environment/Sustainability

In 2004, the world became aware of China's growing economy and its growing consumption of minerals. Prominent environmentalists are recognizing the implications of that growth (Balfour, 2005§; Brown, 2005§). Perhaps the largest challenge of economic growth in developing countries is increased consumption of fossil fuels. Developing countries were not assigned emissions targets under the Kyoto Protocol and developed countries are having difficulty meeting their treaty obligations (Carlisle and Ball, 2005). Nevertheless, there is a growing acceptance, even in the United States, that greenhouse gases need to be reduced (Wall Street Journal, 2005d).

Outlook

A much debated topic in 2005 was the long-term outlook for metals prices. A number of analysts have argued that metal markets are in the beginning of a "supercycle" in which metal prices can be expected to appreciate for a long time. Other analysts have disputed the idea of a long period of rising prices arguing that long-term prices of commodities fall because of the development of cost-reducing technologies and normal economic forces that lead production to rise with increasing prices (Christian, 2005). Prices of a number of mineral commodities did rise in real terms for almost 30 years following World War II. The outcome of this debate will have a significant effect on the world economy and the minerals industries in the coming years.

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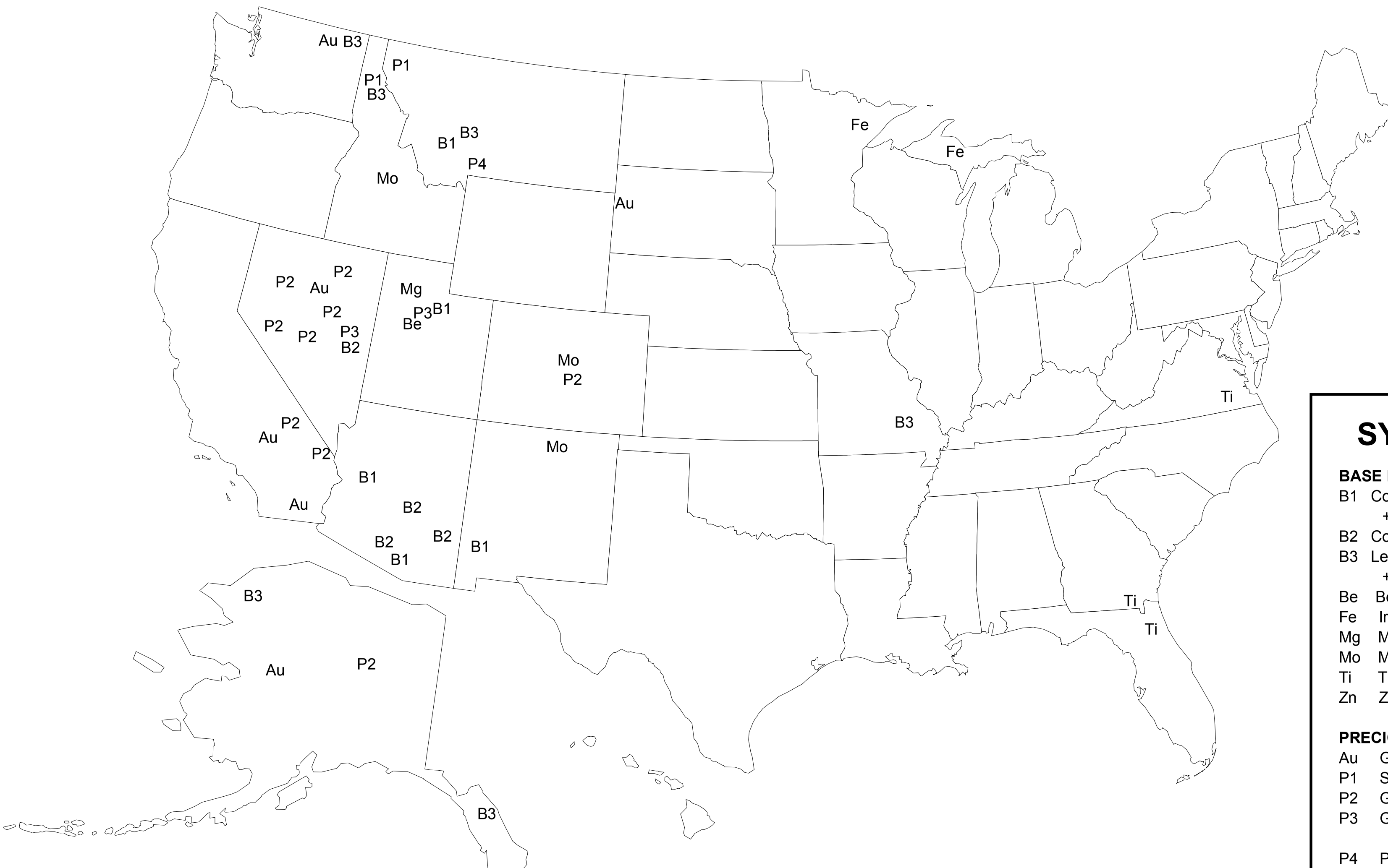
*Corrected on April 7, 2006.

MAJOR METAL-PRODUCING AREAS



SYMBOLS

BASE METALS

B1 Copper and molybdenum +/- gold, silver
B2 Copper +/- gold, silver
B3 Lead, zinc +/- copper +/- gold +/- silver
Be Beryllium
Fe Iron
Mg Magnesium
Mo Molybdenum
Ti Titanium minerals
Zn Zinc

PRECIOUS METALS

Au Gold
P1 Silver +/- base metals
P2 Gold and silver
P3 Gold and silver +/- base metals
P4 Platinum and palladium

MAJOR INDUSTRIAL MINERAL-PRODUCING AREAS—PART I

SYMBOLS

Ba	Barite	Mica	Mica
B	Borates	O	Olivine
Br	Bromine	Peat	Peat
Dia	Diatomite	P	Phosphate
Gar	Garnet	K	Potash
Gyp	Gypsum	Pyrp	Pyrophyllite
He	Helium	Salt	Salt
Irz	Ilmenite, rutile, and zircon	NaC	Soda ash
		NaS	Sodium sulfate
I	Iodine	S	Sulfur
Ky	Kyanite	Talc	Talc
MgCp	Magnesium compounds	Vm	Vermiculite
		Wol	Wollastonite
		Zeo	Zeolites

MAJOR INDUSTRIAL MINERAL-PRODUCING AREAS—PART II

SYMBOLS

BC	Ball clay
Bent	Bentonite
Clay	Common clay
DS	Dimension stone
FC	Fire clay
Fel	Feldspar
Ful	Fuller's earth
IS	Industrial sand
Ka	Kaolin
Li	Lithium carbonate
Per	Perlite
Pum	Pumice and pumicite

ABRASIVES (MANUFACTURED)

(Fused aluminum oxide and silicon carbide)
(Data in metric tons unless otherwise noted)

Domestic Production and Use: Fused aluminum oxide was produced by two companies at three plants in the United States and Canada. Production of regular-grade fused aluminum oxide had an estimated value of $3.57 million, and production of high-purity fused aluminum oxide was estimated to have a value of more than $4.14 million. Silicon carbide was produced by two companies at two plants in the United States. Domestic production of crude silicon carbide had an estimated value of about $22.4 million. Bonded and coated abrasive products accounted for most abrasive uses of fused aluminum oxide and silicon carbide.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production,[1] United States and Canada (crude):					
Fused aluminum oxide, regular	50,000	20,000	20,000	20,000	10,000
Fused aluminum oxide, high-purity	10,000	10,000	5,000	5,000	5,000
Silicon carbide	40,000	30,000	35,000	35,000	35,000
Imports for consumption (U.S.):					
Fused aluminum oxide	203,000	187,000	164,000	232,000	276,000
Silicon carbide	133,000	165,000	169,000	209,000	199,000
Exports (U.S.):					
Fused aluminum oxide	8,950	10,300	11,800	13,900	14,800
Silicon carbide	10,500	13,600	13,200	13,900	12,200
Consumption, apparent (U.S.):					
Fused aluminum oxide	NA	NA	NA	NA	NA
Silicon carbide	NA	181,000	189,000	230,000	222,000
Price, dollars per ton United States and Canada:					
Fused aluminum oxide, regular	302	271	279	323	371
Fused aluminum oxide, high-purity	530	494	514	544	640
Silicon carbide	603	532	529	614	600
Net import reliance[2] as a percentage of apparent consumption (U.S.)					
Fused aluminum oxide	NA	NA	NA	NA	NA
Silicon carbide	NA	83	82	85	84

Recycling: Up to 30% of fused aluminum oxide may be recycled, and about 5% of silicon carbide is recycled.

Import Sources (2001-04): Fused aluminum oxide, crude: China, 69%; Canada, 16%; Venezuela, 14%; and other, 1%. Fused aluminum oxide, grain: China, 48%; Canada, 11%; Germany, 11%; Brazil, 9%; and other, 21%. Silicon carbide, crude: China, 76%; Venezuela, 7%; The Netherlands, 5%; Russia, 4%; and other, 8%. Silicon carbide, grain: China, 36%; Brazil, 23%; Venezuela, 9%; Norway, 7%; and other, 25%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Fused aluminum oxide, crude	2818.10.1000	Free.
Fused aluminum oxide, grain	2818.10.2000	1.3% ad val.
Silicon carbide, crude	2849.20.1000	Free.
Silicon carbide, grain	2849.20.2000	0.5% ad val.

Depletion Allowance: None.

Government Stockpile: During the first three quarters of 2005, the Department of Defense sold 6,224 tons of fused aluminum oxide abrasive grain from the National Defense Stockpile for $2.2 million.

Stockpile Status—9-30-05[3]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Fused aluminum oxide, grain	6,224	1,715	6,224	5,443	1,076

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ABRASIVES (MANUFACTURED)

Events, Trends, and Issues: Imports and higher operating costs continued to challenge producers in the United States and Canada. Foreign competition, particularly from China, is expected to persist and further curtail production in North America.

World Production Capacity:

	Fused aluminum oxide capacity		Silicon carbide capacity	
	2004	2005[e]	2004	2005[e]
United States and Canada	60,400	60,400	42,600	42,600
Argentina	—	—	5,000	5,000
Australia	50,000	50,000	—	—
Austria	60,000	60,000	—	—
Brazil	50,000	50,000	43,000	43,000
China	600,000	700,000	455,000	455,000
France	40,000	40,000	16,000	16,000
Germany	80,000	80,000	36,000	36,000
India	40,000	40,000	5,000	5,000
Japan	25,000	25,000	60,000	60,000
Mexico	—	—	45,000	45,000
Norway	—	—	80,000	80,000
Venezuela	—	—	30,000	30,000
Other countries	80,000	80,000	190,000	190,000
World total (rounded)	1,090,000	1,190,000	1,010,000	1,010,000

World Resources: Although domestic resources of raw materials for the production of fused aluminum oxide are rather limited, adequate resources are available in the Western Hemisphere. Domestic resources are more than adequate for the production of silicon carbide.

Substitutes: Natural and manufactured abrasives, such as garnet or metallic abrasives, can be substituted for fused aluminum oxide and silicon carbide in various applications.

[e]Estimated. NA Not available. — Zero.
[1]Rounded to the nearest 5,000 tons to protect proprietary data.
[2]Defined as imports – exports + adjustments for Government and industry stock changes.
[3]See Appendix B for definitions.

ALUMINUM[1]

(Data in thousand metric tons of metal unless otherwise noted)

Domestic Production and Use: In 2005, 6 companies operated 15 primary aluminum smelters; 4 smelters continued to be temporarily idled. Based upon published market prices, the value of primary metal production was $4.8 billion. Aluminum consumption was centered in the East Central United States. Transportation accounted for an estimated 39% of domestic consumption; the remainder was used in packaging, 28%; building, 14%; consumer durables, 6%; electrical, 6%; and other, 7%.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production:					
Primary	2,637	2,707	2,703	2,516	2,500
Secondary (from old scrap)	1,210	1,170	1,070	1,160	1,100
Imports for consumption	3,740	4,060	4,130	4,720	5,600
Exports	1,590	1,590	1,540	1,820	2,300
Consumption, apparent[2]	6,230	6,320	6,130	6,590	6,800
Price, ingot, average U.S. market (spot), cents per pound	68.8	64.9	68.1	84.0	88.0
Stocks:					
Aluminum industry, yearend	1,300	1,320	1,400	1,470	1,550
LME, U.S. warehouses, yearend[3]	28	45	207	116	150
Employment, number[4]	71,200	61,700	58,000	56,900	56,000
Net import reliance[5] as a percentage of apparent consumption	38	39	38	44	47

Recycling: In 2005, aluminum recovered from purchased scrap was about 3 million tons, of which about 63% came from new (manufacturing) scrap and 37% from old scrap (discarded aluminum products). Aluminum recovered from old scrap was equivalent to about 16% of apparent consumption.

Import Sources (2001-04): Canada, 58%; Russia, 17%; Venezuela, 5%; Brazil, 3%; and other, 17%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Unwrought (in coils)	7601.10.3000	2.6% ad val.
Unwrought (other than aluminum alloys)	7601.10.6000	Free.
Waste and scrap	7602.00.0000	Free.

Depletion Allowance: Not applicable.[1]

Government Stockpile: None.

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ALUMINUM

Events, Trends, and Issues: Domestic primary aluminum production decreased slightly owing to cutbacks attributed to increased energy and alumina costs. Most of the production decreases continued to take place in the Pacific Northwest. Domestic smelters operated at about two-thirds of rated or engineered capacity.

Net imports for consumption increased 14%, filling the supply deficit created by increased demand and decreased domestic production. Canada and Russia accounted for approximately two-thirds of total imports. U.S. exports also increased in 2005. Canada, China, and Mexico, in descending order, received more than three-fourths of total U.S. exports.

The price of primary aluminum fluctuated through September 2005, but was generally higher than that of 2004. In January, the average monthly U.S. market price for primary ingot quoted by Platts Metals Week was 89.8 cents per pound; it reached a high of 96.9 cents per pound in March; and in September, the price was 86.5 cents per pound. Prices on the London Metal Exchange (LME) followed the trend of U.S. market prices. The monthly average LME cash price for September was 83.4 cents per pound.

World primary aluminum production continued to increase as capacity expansions outside the United States were brought onstream. Inventories of metal held by producers, as reported by the International Aluminium Institute, increased through the end of August to about 3.4 million tons from 3.2 million tons at yearend 2004. Inventories of primary aluminum metal held by the LME decreased slightly during the year to 512 thousand tons at the end of September from 693 thousand tons at yearend 2004.

World Smelter Production and Capacity:

	Production		Yearend capacity	
	2004	2005[e]	2004	2005[e]
United States	2,516	2,500	3,700	3,700
Australia	1,900	1,920	1,910	1,930
Brazil	1,460	1,470	1,450	1,470
Canada	2,590	2,800	2,790	3,010
China	6,670	7,200	8,260	9,250
Mozambique	547	550	542	554
Norway	1,320	1,350	1,320	1,380
Russia	3,590	3,650	3,640	3,760
South Africa	863	830	850	858
Venezuela	624	620	646	650
Other countries	7,710	8,300	8,510	8,900
World total (rounded)	29,800	31,200	33,600	35,500

World Resources: Domestic aluminum requirements cannot be met by domestic bauxite resources. Domestic nonbauxitic aluminum resources are abundant and could meet domestic aluminum demand. However, no processes for using these resources have been proven economically competitive with those now used for bauxite. The world reserve base for bauxite is sufficient to meet world demand for metal well into the 21st century.

Substitutes: Copper can replace aluminum in electrical applications; magnesium, titanium, and steel can substitute for aluminum in structural and ground transportation uses. Composites, steel, and wood can substitute for aluminum in construction. Glass, paper, plastics, and steel can substitute for aluminum in packaging.

[e]Estimated.
[1]See also Bauxite and Alumina.
[2]Domestic primary metal production + recovery from old aluminum scrap + net import reliance.
[3]Includes aluminum alloy.
[4]Alumina and aluminum production workers (North American Industry Classification System—3313). Source: U.S. Department of Labor, Bureau of Labor Statistics.
[5]Defined as imports – exports + adjustments for Government and industry stock changes.

ANTIMONY

(Data in metric tons of antimony content unless otherwise noted)

Domestic Production and Use: There was no domestic mine production of antimony in 2005. The only domestic source of antimony, a silver mine that produced antimony as a byproduct, closed early in 2001 with no output in that year. Primary antimony metal and oxide was produced by one company in Montana, using foreign feedstock. Secondary antimony was recovered, mostly in alloy form, at lead smelters; its value, based on the price of antimony metal, was about $17 million. The estimated distribution of antimony uses was as follows: flame retardants, 55%; transportation, including batteries, 18%; chemicals, 10%; ceramics and glass, 7%; and other, 10%.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production:					
Mine (recoverable antimony)	—	—	—	—	—
Smelter:					
Primary	9,100	W	W	W	W
Secondary	5,380	5,350	5,600	6,310	6,110
Imports for consumption	37,900	28,500	26,700	33,500	31,400
Exports of metal, alloys, oxide, and waste and scrap[1]	7,610	4,250	3,680	3,810	3,200
Shipments from Government stockpile	4,620	4,630	2,070	—	—
Consumption, apparent[2]	42,000	34,500	32,000	39,500	34,100
Price, metal, average, cents per pound[3]	65	88	108	130	145
Stocks, yearend	4,990	5,060	6,320	2,790	3,000
Employment, plant, number[e]	40	35	30	30	10
Net import reliance[4] as a percentage of apparent consumption	87	84	83	84	82

Recycling: Traditionally, the bulk of secondary antimony has been recovered as antimonial lead, most of which was generated by and then consumed by the battery industry. Changing trends in that industry in recent years, however, have generally reduced the amount of secondary antimony produced; the trend to low-maintenance batteries has tilted the balance of consumption away from antimony and toward calcium as an additive.

Import Sources (2001-04): Metal: China, 73%; Mexico, 10%; Hong Kong, 6%; and other, 11%. Ore and concentrate: China, 69%; Austria, 13%; Australia, 5%; Mexico, 1%; and other, 12%. Oxide: China, 40%; Mexico, 35%; Belgium, 11%; South Africa, 10%; and other, 4%. Total: China, 49%; Mexico, 30%; Belgium, 8%; South Africa, 7%; and other, 6%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Ore and concentrates	2617.10.0000	Free.
Antimony and articles thereof, including waste and scrap	8110.00.0000	Free.
Antimony oxide	2825.80.0000	Free.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: None.

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ANTIMONY

Events, Trends, and Issues: In 2005, antimony production from domestic source materials was derived entirely from the recycling of lead-acid batteries. Recycling supplied only a minor portion of estimated domestic consumption. In recent years, the number of primary antimony smelters has been reduced, as smelters in New Jersey and Texas were closed in 2004. Only one smelter in Montana continues to make antimony products.

The price of antimony started the year at about $1.35 per pound and rose steadily to about $1.45 per pound during March; during June, it had risen to about $1.60 per pound, and by mid-September, had increased to $1.85 per pound. The price continued to rise through early fall.

During 2005, antimony use in the United States and most other antimony-consuming countries increased. On the supply side, major world producers, especially in China, continued to experience production constraints. This led to a world supply deficit, helping to fuel price rises.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[5]	Reserve base[5]
	2004	2005[e]		
United States	—	—	80,000	90,000
Bolivia	3,000	2,500	310,000	320,000
China	100,000	105,000	790,000	2,400,000
Russia (recoverable)	NA	NA	350,000	370,000
South Africa	5,300	5,300	44,000	200,000
Tajikistan	2,000	1,800	50,000	150,000
Other countries	2,800	2,200	150,000	330,000
World total (rounded)	113,000	117,000	1,800,000	3,900,000

World Resources: U.S. resources of antimony are mainly in Alaska, Idaho, Montana, and Nevada. Principal identified world resources are in Bolivia, China, Mexico, Russia, and South Africa. Additional antimony resources may occur in Mississippi Valley-type lead deposits in the Eastern United States.

Substitutes: Compounds of chromium, tin, titanium, zinc, and zirconium substitute for antimony chemicals in paint, pigments, and enamels. Combinations of cadmium, calcium, copper, selenium, strontium, sulfur, and tin can be used as substitutes for hardening lead. Selected organic compounds and hydrated aluminum oxide are widely accepted substitutes as flame retardants.

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data. — Zero.
[1]Gross weight, for metal, alloys, waste, and scrap.
[2]Domestic mine production + secondary production from old scrap + net import reliance.
[3]New York dealer price for 99.5% to 99.6% metal, c.i.f. U.S. ports.
[4]Defined as imports - exports + adjustments for Government and industry stock changes.
[5]See Appendix C for definitions.

ARSENIC

(Data in metric tons of arsenic unless otherwise noted)

Domestic Production and Use: Arsenic has not been produced in the United States since 1985, and therefore, imported arsenic trioxide and arsenic metal have satisfied domestic needs. Arsenic was mainly imported as arsenic trioxide for use in the production of chromated copper arsenate (CCA) wood preservatives. Arsenic trioxide was also used in fertilizers, fireworks, herbicides, and insecticides. Arsenic metal was used as an alloying element in ammunition and solders, as an antifriction additive to metals used for bearings, and as an alloying element to strengthen lead-acid storage battery grids. The electronics industry required high-purity arsenic (99.9999% pure) for gallium-arsenide semiconductors for telecommunication, solar cells, and space research. The value of arsenic compounds and metal consumed domestically in 2005 was estimated to be about $7 million.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Imports for consumption:					
Metal	1,030	880	990	870	700
Compounds	23,900	18,800	20,800	6,150	7,500
Exports, metal	57	100	173	220	200
Estimated consumption[1]	24,900	19,600	21,600	6,800	8,000
Value, cents per pound, average:[2]					
Metal (China)	75	120	87	88	107
Trioxide (China)	42	44	45	49	41
Trioxide (Mexico)	28	33	34	32	32
Net import reliance[3] as a percentage of estimated consumption	100	100	100	100	100

Recycling: Arsenic-containing electronic components such as relays, switches, and circuit boards are disposed of at hazardous waste sites, and the metal is not reclaimed. Arsenic contained in process water at wood treatment plants was reused. Arsenic contained in gallium-arsenide scrap from the manufacture of semiconductor devices was reprocessed for arsenic recovery. No arsenic was recovered from arsenical residues and dusts at domestic nonferrous smelters.

Import Sources (2001-04): Metal: China, 81%; Japan, 15%; Hong Kong, 2%; and other, 2%. Trioxide: China, 59%; Morocco, 22%; Chile, 7%; Mexico, 5%; and other, 7%.

Tariff: **Item**	**Number**	**Normal Trade Relations 12-31-05**
Metal	2804.80.0000	Free.
Trioxide	2811.29.1000	Free.
Sulfide	2813.90.1000	Free.
Acid	2811.19.1000	2.3% ad val.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

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ARSENIC

Events, Trends, and Issues: Domestic arsenic trioxide imports, mainly from China, and consumption declined drastically during 2004 owing to the voluntary decision by the wood-preserving industry to stop using CCA as a wood preservative for deck materials and outdoor residential use by yearend 2003. CCA-treated wood, which may still be sold for nonresidential application, is preferred because of lower cost and known performance. Human health concerns, increased regulation, and the use of alternative wood preservative treatments, as well as the use of concrete or plasticized wood products, will affect the long-term demand for arsenic. Global government and university research into the human health effects of arsenic in ground water and mine drainage, as well as releases of arsenic from buried World War I ammunition, Civil War-era cemeteries, and coal-burning powerplant emissions, is expected to continue. Exposure to arsenic reportedly may affect breathing and heart rhythm, and high levels of arsenic in ground water increase the risk for bladder cancer. Research continues on the use of arsenic trioxide in the treatment of leukemia.

World Production, Reserves, and Reserve Base:

	Production (arsenic trioxide)		Reserves and reserve base[4] (arsenic content)
	2004	2005[e]	
Belgium	1,000	1,000	
Chile	8,000	13,000	World reserves and reserve base are thought to be about 20 and 30 times, respectively, annual world production. The reserve base for the United States is estimated to be 80,000 tons.
China	30,000	30,000	
France	1,000	1,000	
Kazakhstan	1,500	1,000	
Mexico	1,800	2,500	
Peru	3,500	3,400	
Russia	1,500	1,500	
Other countries	1,200	1,200	
World total (rounded)	49,500	54,600	

World Resources: Arsenic is obtained from roasting arsenopyrite, the most abundant ore mineral of arsenic, and may also be obtained from copper, gold, and lead smelter flue dusts. Arsenic resources are contained in copper ores, commonly as enargite and associated alteration products, realgar and orpiment, in northern Peru and the Philippines; copper-gold ores in Chile; and gold occurrences in Canada. Global resources of copper and lead contain approximately 11 million tons of arsenic.

Substitutes: Substitutes for CCA in wood preservation include alkaline copper quaternary, ammoniacal copper quaternary, ammoniacal copper zinc arsenate, copper azole, and copper citrate. Silver-containing biocides are being considered as an alternative wood preservative treatment, especially in humid areas. Concrete, steel, plasticized wood scrap, or plastic composites may also be substituted for CCA-treated wood.

[e]Estimated.
[1]Estimated to be the same as net imports.
[2]Calculated from U.S. Census Bureau import data.
[3]Defined as imports – exports + adjustments for Government and industry stock changes.
[4]See Appendix C for definitions.

ASBESTOS

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: There has been no asbestos mining in the United States since 2002 so the United States is totally dependent on imports to meet manufacturing needs. Asbestos consumption in the United States was estimated to be 30% for roofing products, 30% for coatings and compounds, and 40% for other applications.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production (sales), mine	5	3	—	—	—
Imports for consumption	13	7	5	3	2
Exports[1]	22	7	3	2	1
Shipments from Government stockpile excesses	—	—	—	—	—
Consumption, estimated	13	7	5	3	2
Price, average value, dollars per ton[2]	210	160	220	255	255
Stocks, producer, yearend	NA	NA	NA	—	—
Employment, mine and mill, number	15	15	2	—	—
Net import reliance[3] as a percentage of estimated consumption	100	100	100	100	100

Recycling: None.

Import Sources (2001-04): Canada, 93%; and other, 7%.

Tariff: Item	**Number**	**Normal Trade Relations 12-31-05**
Asbestos	2524.00.0000	Free.

Depletion Allowance: 22% (Domestic), 10% (Foreign).

Government Stockpile: None.

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ASBESTOS

Events, Trends, and Issues: Domestic use of asbestos declined because the industry continues to be affected by liability issues and public opposition to the use of asbestos. Congressional activity during the year focused on establishing a trust fund from which to compensate workers suffering from asbestos-related health disease. The size and exact means of funding of trust continued to be debated. The Mine Safety and Health Administration continued to review its proposed reduction of the 8-hour time-weighted average permissible exposure level to 0.1 fiber per cubic centimeter from 2.0 fibers per cubic centimeter for asbestos.

Exports and imports declined to an estimated 690 tons and 2,400 tons, respectively. Consumption declined to an estimated 2,400 tons from 3,450 tons in 2004. Exports of asbestos were from stocks. All the asbestos used in the United States was chrysotile. Canada remained the leading supplier of asbestos for domestic consumption.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[4]	Reserve base[4]
	2004	2005[e]		
United States	—	—	Small	Large
Brazil	195	195	Moderate	Moderate
Canada	200	240	Large	Large
China	355	360	Large	Large
Kazakhstan	347	350	Large	Large
Russia	875	875	Large	Large
Zimbabwe	150	100	Moderate	Moderate
Other countries	110	80	Moderate	Large
World total (rounded)	2,230	2,200	Large	Large

World Resources: The world has 200 million tons of identified resources. The U.S. resources are large, but are composed mostly of short-fiber asbestos, whose use is more limited than long-fiber asbestos in asbestos-based products.

Substitutes: Numerous materials substitute for asbestos in products. The substitutes include calcium silicate, carbon fiber, cellulose fiber, ceramic fiber, glass fiber, steel fiber, wollastonite, and several organic fibers, such as aramid, polyethylene, polypropylene, and polytetrafluoroethylene. Several nonfibrous minerals or rocks, such as perlite, serpentine, silica, and talc, are considered to be possible asbestos substitutes for products in which the reinforcement properties of fibers were not required. No single substitute was as versatile as asbestos.

[e]Estimated. NA Not available. — Zero.

[1]Probably includes nonasbestos materials and reexports.

[2]Average price for Group 7 Canadian chrysotile, ex-mine.

[3]Defined as imports – exports + adjustments for Government and industry stock changes; however, imports account for all domestic consumption.

[4]See Appendix C for definitions.

BARITE

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: Barite sales by domestic producers totaled about 500,000 tons in 2005 valued at about $18 million, a decrease in production of about 6% from 2004. The majority of production came from three major mines in Nevada followed by a significantly smaller sales volume from a single mine in Georgia. In 2005, an estimated 2.8 million tons of ground barite was sold by crushers and grinders from five States from domestic production and imports. Nearly 95% of the barite sold in the United States was used as a weighting agent in gas and oil well drilling fluids. Shipments from Nevada crushers and grinders went mostly to the Colorado and Wyoming gas drilling industry. These two States produced about 13% of total U.S. natural gas in 2005. Between late October 2004 and late October 2005, the combined rig count in these two States increased from 143 to 174. The imports to the Louisiana and Texas ports went primarily to offshore drilling operations in the Gulf of Mexico and to onshore operations in Texas, Louisiana, New Mexico, and Oklahoma. The Gulf of Mexico and these four States account for about 70% of natural gas production in the United States and represent the major regional market for barite.

Barite is used as a filler, extender, or weighting agent in products such as paints, plastics, and rubber. Some specific uses include its use in brake and clutch pads for automobiles, automobile paint primer for metal protection and gloss, and to add weight to rubber mudflaps on trucks and to the cement jacket around petroleum pipelines under water. In the metal casting industry, barite is part of the mold-release compounds. Because barite significantly blocks X-ray and gamma-ray emissions, it is used as aggregate in high-density concrete for radiation shielding around X-ray units in hospitals, nuclear powerplants, and university nuclear research facilities. Ultrapure barite consumed as liquid is used as a contrast medium in medical X-ray examinations. It is the raw material for barium chemicals, such as barium carbonate, which is an ingredient in faceplate glass in the cathode-ray tubes of televisions and computer monitors.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Sold or used, mine	400	420	468	532	500
Imports for consumption:					
Crude barite	2,470	1,510	1,620	1,960	2,350
Ground barite	6	5	([1])	5	12
Other	35	31	33	34	20
Exports	45	47	44	70	90
Consumption, apparent[2] (crude and ground)	2,870	1,920	2,080	2,460	2,790
Consumption[3] (ground and crushed)	2,670	1,980	2,230	2,440	2,800
Price, average value, dollars per ton, f.o.b. mine	27.60	28.90	29.70	35.10	35.60
Employment, mine and mill, number[e]	340	320	340	340	340
Net import reliance[4] as a percentage of apparent consumption	86	78	77	78	82

Recycling: None.

Import Sources (2001-04): China, 89%; India, 8%; and other, 3%.

Tariff: **Item**	**Number**	**Normal Trade Relations 12-31-05**
Crude barite	2511.10.5000	$1.25/t.
Ground barite	2511.10.1000	Free.
Oxide, hydroxide, and peroxide	2816.40.2000	2% ad val.
Other chlorides	2827.39.4500	4.2% ad val.
Other sulfates	2833.27.0000	0.6% ad val.
Other nitrates	2834.29.5000	3.5% ad val.
Carbonate	2836.60.0000	2.3% ad val.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

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BARITE

Events, Trends, and Issues: The direct impact of Hurricanes Katrina and Rita on barite grinding facilities in the Gulf of Mexico region was relatively small. The majority of the grinding plants in Louisiana and Texas were shutdown (mostly as a result of power outages) for periods ranging from a few days to a week. One Louisiana plant, however, did suffer more extensive damage, but was expected to be repaired and back in production by the end of November. The hurricanes did cause damage to drill rigs operating in the Gulf of Mexico, but nationwide the rig count as of the latter part of October 2005 had risen to 1,480 (an increase of 229 compared with the same time period in 2004). This large increase in drill rigs exploring for oil and gas was the result of high oil and gas prices, which temporarily rose even higher in the aftermath of the hurricanes.

Fueled by the dramatic increase in oil and gas prices, the increase in domestic exploration (especially for natural gas) has followed suit. The total U.S. rig count has increased by more than 70% in the past 3 years, and this increased drilling activity has pushed domestic barite production up by 19% and imports of crude barite up by 56% during the same period. During the same 3-year period, the international rig count (excluding the United States) has increased by 22%.

China is the leading exporter of barite and has for many years been the low-cost supplier in world markets. However, from late 2003 to September 2005, Chinese barite prices increased by more than 40%, and prices of the other major exporting countries (India and Morocco) rose similarly. The factors that pushed up Chinese prices were high ocean freights, port congestion, problems with internal freight logistics, and the lowering of the tax rebate on barite exports.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[5]	Reserve base[5]
	2004	2005[e]		
United States	532	500	25,000	55,000
Algeria	48	48	9,000	15,000
Brazil	55	55	2,100	5,000
Bulgaria	95	95	NA	NA
China	3,900	3,900	62,000	360,000
France	82	82	2,000	2,500
Germany	110	94	1,000	1,500
India	[6]723	1,000	53,000	80,000
Iran	204	210	NA	NA
Korea, North	70	70	NA	NA
Mexico	300	290	7,000	8,500
Morocco	357	360	10,000	11,000
Russia	60	60	2,000	3,000
Thailand	125	210	9,000	15,000
Turkey	120	135	4,000	20,000
United Kingdom	60	60	100	600
Vietnam	101	100	NA	NA
Other countries	296	350	14,000	160,000
World total (rounded)	7,240	7,620	200,000	740,000

World Resources: In the United States, identified resources of barite are estimated to be 150 million tons, and hypothetical resources include an additional 150 million tons. The world's barite resources[5] in all categories are about 2 billion tons, but only about 740 million tons is identified.

Substitutes: In the drilling mud market, alternatives to barite include celestite, ilmenite, iron ore, and synthetic hematite that is manufactured in Germany. None of these substitutes, however, has had a major impact on the barite drilling mud industry.

[e]Estimated. NA Not available.
[1]Less than ½ unit.
[2]Sold or used by domestic mines – exports + imports.
[3]Domestic and imported crude barite sold or used by domestic grinding establishments.
[4]Defined as imports – exports + adjustments for Government and industry stock changes.
[5]See Appendix C for definitions.
[6]Data are for fiscal year ending March 31 of the year shown.

BAUXITE AND ALUMINA[1]

(Data in thousand metric dry tons unless otherwise noted)

Domestic Production and Use: Nearly all bauxite consumed in the United States was imported; of the total, more than 90% was converted to alumina. Of the total alumina used, about 90% went to primary aluminum smelters and the remainder went to nonmetallurgical uses. Annual alumina capacity was 5.75 million tons, with all four Bayer refineries operating during the year. Domestic bauxite was used in the production of nonmetallurgical products, such as abrasives, chemicals, and refractories.

Salient Statistics—United States:[2]	2001	2002	2003	2004	2005[e]
Production, bauxite, mine	NA	NA	NA	NA	NA
Imports of bauxite for consumption[3]	8,670	7,710	8,860	10,500	10,400
Imports of alumina[4]	3,100	3,010	2,310	1,650	1,700
Exports of bauxite[3]	88	52	89	75	75
Exports of alumina[4]	1,250	1,270	1,090	1,230	1,200
Shipments of bauxite from Government stockpile excesses[3]	3,640	297	1,710	66	—
Consumption, apparent, bauxite and alumina (in aluminum equivalents)[5]	3,670	2,860	2,580	2,810	2,800
Price, bauxite, average value U.S. imports (f.a.s.) dollars per ton	23	20	19	22	25
Stocks, bauxite, industry, yearend[3]	1,740	1,280	3,830	3,120	2,500
Net import reliance,[6] bauxite and alumina, as a percentage of apparent consumption	100	100	100	100	100

Recycling: None.

Import Sources (2001-04):[7] Bauxite: Jamaica, 37%; Guinea, 32%; Brazil, 12%; Guyana, 11%; and other, 8%. Alumina: Australia, 53%; Suriname, 26%; Jamaica, 10%; and other, 11%. Total: Jamaica, 26%; Australia, 22%; Guinea, 19%; Suriname, 10%; and other, 23%.

Tariff: Import duties on bauxite and alumina were abolished in 1971 by Public Law 92-151. Duties can be levied only on such imports from nations with nonnormal trade relations. However, all countries that supplied commercial quantities of bauxite or alumina to the United States during the first 8 months of 2005 had normal-trade-relations status.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile:

Stockpile Status—9-30-05[8]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Bauxite, metal grade:					
Jamaica-type	—	2,840	—	2,030	—
Suriname-type	—	11	—	—	—
Bauxite, refractory-grade	—	6	—	68	—

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BAUXITE AND ALUMINA

Events, Trends, and Issues: Increased demand and limited supply caused spot prices for metallurgical-grade alumina, as published by Metal Bulletin, to rise dramatically by the end of the third quarter. The published price range began the year at $390 to $420 per ton of alumina. By the middle of March, the price range had increased to $440 to $460 per ton. The price range then began a downward slide that lasted through early August to a range of $400 to $420 per ton, before rebounding to $470 to $500 per ton at the end of September.

In October, domestic alumina refineries closed temporarily in preparation for two major storms that struck the Gulf Coast of the United States. The storms either missed the plants completely or caused only minor damage, and the plants were back onstream within a few days.

World production of bauxite and alumina increased compared with that of 2004. Based on production data from the International Aluminium Institute, world alumina production during the first 2 quarters of 2005 increased 2% compared with that for the same period in 2004.

World Bauxite Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[9]	Reserve base[9]
	2004	2005[e]		
United States	NA	NA	20,000	40,000
Australia	56,600	58,000	5,700,000	7,700,000
Brazil	18,500	18,000	1,900,000	2,500,000
China	15,000	17,000	700,000	2,300,000
Greece	2,440	2,200	600,000	650,000
Guinea	16,000	16,000	7,400,000	8,600,000
Guyana	1,500	1,500	700,000	900,000
India	11,300	14,000	770,000	1,400,000
Jamaica	13,300	14,000	2,000,000	2,500,000
Kazakhstan	4,700	4,600	350,000	360,000
Russia	6,000	6,000	200,000	250,000
Suriname	4,050	4,500	580,000	600,000
Venezuela	5,500	5,500	320,000	350,000
Other countries	4,070	3,900	3,400,000	4,000,000
World total (rounded)	159,000	165,000	25,000,000	32,000,000

World Resources: Bauxite resources are estimated to be 55 to 75 billion tons, located in South America (33%), Africa (27%), Asia (17%), Oceania (13%), and elsewhere (10%). Domestic resources of bauxite are inadequate to meet long-term U.S. demand, but the United States and most other major aluminum-producing countries have essentially inexhaustible subeconomic resources of aluminum in materials other than bauxite.

Substitutes: Bauxite is the only raw material used in the production of alumina on a commercial scale in the United States. However, the vast U.S. resources of clay are technically feasible sources of alumina. Other domestic raw materials, such as anorthosite, alunite, coal wastes, and oil shales, offer additional potential alumina sources. Although it would require new plants using new technology, alumina from these nonbauxitic materials could satisfy the demand for primary metal, refractories, aluminum chemicals, and abrasives. Synthetic mullite, produced from kyanite and sillimanite, substitutes for bauxite-base refractories. Although more costly, silicon carbide and alumina-zirconia substitute for bauxite-base abrasives.

[e]Estimated. NA Not available. — Zero.

[1]See also Aluminum. As a general rule, 4 tons of dried bauxite is required to produce 2 tons of alumina, which, in turn, provides 1 ton of primary aluminum metal.

[2]Includes U.S. Virgin Islands.

[3]Includes all forms of bauxite, expressed as dry equivalent weights.

[4]Calcined equivalent weights.

[5]The sum of U.S. bauxite production and net import reliance.

[6]Defined as imports – exports + adjustments for Government and industry stock changes (all in aluminum equivalents). Treated as separate commodities, the net import reliance equaled 100% for bauxite and 9% for alumina in 2005. For the years 2001-04, the net import reliance was 100% for bauxite and ranged from 7% to 29% for alumina.

[7]Aluminum equivalents.

[8]See Appendix B for definitions.

[9]See Appendix C for definitions.

BERYLLIUM

(Data in metric tons of beryllium content unless otherwise noted)

Domestic Production and Use: A company in Utah mined bertrandite ore, which it converted, along with imported beryl and beryl from the National Defense Stockpile, into beryllium hydroxide. Some of the beryllium hydroxide was shipped to a company plant in Ohio, where it was converted into beryllium alloys, metal, and oxide, and some was sold to other companies. Beryllium consumption of 70 tons was valued at about $15 million, based on the estimated unit value for beryllium-copper master alloy. Nearly one-half of beryllium use was estimated to be in computer and telecommunications products, and the remainder was in aerospace and defense applications, appliances, automotive electronics, industrial components, and other applications.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production, mine shipments[e]	100	80	85	90	90
Imports for consumption[1]	242	141	163	85	120
Exports[2]	150	165	269	217	210
Government stockpile releases[3]	90	90	33	106	70
Consumption:					
Apparent[4]	297	156	57	69	70
Reported, ore	170	120	140	130	NA
Unit value, average annual, beryllium-copper master alloy, dollars per pound contained beryllium[5]	75	123	113	125	100
Stocks, ore, consumer, yearend	100	90	45	40	NA
Net import reliance[6] as a percentage of apparent consumption	66	49	E	E	E

Recycling: Beryllium was recycled mostly from new scrap generated during the manufacture of beryllium products. Detailed data on the quantities of beryllium recycled are not available, but may represent as much as 10% of apparent consumption.

Import Sources (2001-04): Beryllium contained in ores and concentrates, oxide and hydroxide, unwrought metal (including powders), beryllium articles, waste and scrap, and beryllium-copper master alloy: Kazakhstan, 22%; Russia, 21%; Germany, 16%; Japan, 14%; and other, 27%.

Tariff: Item	Number	Normal Trade Relations[7] 12-31-05
Beryllium ores and concentrates	2617.90.0030	Free.
Beryllium oxide and hydroxide	2825.90.1000	3.7% ad val.
Beryllium-copper master alloy	7405.00.6030	Free.
Beryllium:		
Unwrought powders	8112.12.0000	8.5% ad val.
Waste and scrap	8112.13.0000	Free.
Other	8112.19.0000	5.5% ad val.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: The Defense Logistics Agency, U.S. Department of Defense, had a goal of retaining 45 tons of hot-pressed beryllium powder in the National Defense Stockpile. Disposal limits for beryllium materials in the fiscal year 2006 Annual Materials Plan were unchanged from those of fiscal year 2005.

Stockpile Status—9-30-05[8]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Beryl ore (11% BeO)	130	34	130	[9]145	10
Beryllium-copper master alloy	—	28	—	[9]44	—
Beryllium metal:					
Vacuum-cast	41	28	41	36	27
Hot-pressed powder	155	—	110	—	—

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BERYLLIUM

Events, Trends, and Issues: During the first half of 2005, U.S. beryllium demand for defense applications was reduced owing to a shift in military funds to support operations in the Middle East, which resulted in delayed funding for some military applications that used beryllium. Demand from two major market sectors (automotive electronics and computers and telecommunications) was weak. Demand from other market sectors, including aerospace, the oil and gas industry, and plastic tooling applications, was stronger than that during the first half of 2004. Shipments of beryllium mirror blanks for the James Webb space telescope were completed during the year.

In China, a newly constructed beryllium refinery began operations. The refinery, which is the second such refinery in China, was designed to produce 100 tons per year of beryllium oxide and 1,000 tons per year of beryllium-copper master alloy.

Because of the toxic nature of beryllium, various international, national, and state guidelines and regulations have been established regarding beryllium in air, water, and other media. Industry must maintain careful control over the quantity of beryllium dust, fumes, and mists in the workplace. Plants are required to install and maintain pollution-control equipment. Harmful effects are prevented by maintaining clean workplaces; requiring the use of safety equipment, such as personal respirators; collecting dust, fumes, and mists at the source; establishing medical programs; and implementing other procedures to provide safe working conditions. Control of potential health hazards adds to the final cost of beryllium products.

World Mine Production, Reserves, and Reserve Base: Recent analysis has indicated that mine production in Kazakhstan and Russia ceased in the 1990s.

	Mine production[e] 2004	Mine production[e] 2005
United States	90	90
China	20	20
Mozambique	3	3
Other countries	1	1
World total	114	114

Reserves and reserve base[10]

The United States has very little beryl that can be economically handsorted from pegmatite deposits. The Spor Mountain area, Utah, an epithermal deposit, contains a large reserve base of bertrandite, which was being mined. Proven bertrandite reserves in Utah total about 16,000 tons of contained beryllium. World beryllium reserves and reserve base are not sufficiently well delineated to report consistent figures for all countries.

World Resources: World resources in known deposits of beryllium have been estimated to be more than 80,000 tons. About 65% of these resources is in nonpegmatite deposits in the United States; the Spor Mountain and Gold Hill areas in Utah and the Seward Peninsula area in Alaska account for most of the total.

Substitutes: Because the cost of beryllium is high compared with that of other materials, it is used in applications in which its properties are crucial. Graphite, steel, and titanium may be substituted for beryllium metal in some applications, and phosphor bronze may be substituted for beryllium-copper alloys, but these substitutions can result in substantial loss in performance. In some applications, aluminum nitride may be substituted for beryllium oxide.

[e]Estimated. E Net exporter. NA Not available. — Zero.
[1]Series revised; includes estimated beryllium content of imported ores and concentrates, oxide and hydroxide, unwrought metal (including powders), beryllium articles, waste and scrap, and beryllium-copper master alloy.
[2]Series revised; includes estimated beryllium content of exported unwrought metal (including powders), beryllium articles, and waste and scrap.
[3]Change in total inventory level from prior yearend inventory; includes committed and uncommitted inventories.
[4]The sum of U.S. mine shipments and net import reliance.
[5]Calculated from gross weight and customs value of imports; beryllium content estimated to be 4%.
[6]Defined as imports – exports + adjustments for Government and industry stock changes; see footnotes 1 and 2.
[7]No tariff for Canada or Mexico. Tariffs for other countries for some items may be eliminated under special trade agreements.
[8]See Appendix B for definitions.
[9]Actual quantity limited to remaining inventory.
[10]See Appendix C for definitions.

BISMUTH

(Data in metric tons of bismuth content unless otherwise noted)

Domestic Production and Use: The United States ceased production of primary refined bismuth in 1997 and is thus highly import dependent for its supply. A small amount of bismuth is recycled by some domestic firms. Bismuth is contained in some lead ores mined domestically, but the bismuth-containing residues are not processed domestically and may be exported. The value of bismuth consumed was approximately $20 million. About 46% of the bismuth was used in fusible alloys, solders, and ammunition cartridges; 29% in metallurgical additives; 24% in pharmaceuticals and chemicals; and 1% in other uses.

The Safe Drinking Water Act Amendment of 1996 required that all new and repaired fixtures and pipes for potable water supply be lead-free after August 1998. Bismuth use in water meters and fixtures is one particular application that has increased in recent years. An application with major growth potential is the use of zinc-bismuth alloys to achieve thinner and more uniform galvanization. Bismuth was also used domestically in the manufacture of ceramic glazes, crystal ware, and pigments; as an additive to free-machining steels; and as an additive to malleable iron castings.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production, refinery	—	—	—	—	—
Imports for consumption, metal	2,220	1,930	2,320	1,980	2,150
Exports, metal, alloys, and scrap	541	131	108	109	100
Consumption, reported	2,200	2,320	2,120	2,420	2,370
Price, average, domestic dealer, dollars per pound	3.74	3.14	2.87	3.22	3.83
Stocks, yearend, consumer	95	111	279	117	110
Net import reliance[1] as a percentage of apparent consumption	95	95	95	95	95

Recycling: All types of bismuth-containing alloy scrap were recycled and contributed about 10% of U.S. bismuth consumption, or 240 tons.

Import Sources (2001-04): Belgium, 31%; Mexico, 26%; China, 23%; United Kingdom, 9%; and other, 11%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Bismuth and articles thereof, including waste and scrap	8106.00.0000	Free.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: None.

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BISMUTH

Events, Trends, and Issues: Owing to its unique properties, bismuth has a wide variety of applications including use in free-machining steels, brass, pigments, and solders, as nontoxic replacements for lead; in pharmaceuticals including bismuth subsalicylate, the active ingredient in over-the-counter stomach remedies; in the foundry industry, as an additive to enhance metallurgical quality; in the construction field, as a triggering mechanism for fire sprinklers; and in holding devices for grinding optical lenses. Currently, researchers in the European Union, Japan, and the United States are investigating possibilities for bismuth in lead-free solders. Researchers are looking at liquid lead-bismuth coolants for use in nuclear reactors. Work is proceeding toward developing a bismuth-containing metal polymer bullet.

The price of bismuth remainded relatively stable in the $3.40 to $3.65 per pound range through July before rising to the $4.10 to $4.40 per pound range by the end of September owing to increased demand. The estimated average annual bismuth price for 2005 rose about 19% above that for 2004.

Around the world, there were several bismuth exploration activities that seemed promising: in Canada, an exploration firm announced that its cobalt-gold-bismuth deposit in the Northwest Territories was undergoing a feasibility study and that an agreement was reached to sell all of its eventual bismuth production to an undisclosed firm; another Canadian exploration firm announced increased expenditures to develop its property in Vietnam that contains bismuth, fluorspar, and tungsten.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[2]	Reserve base[2]
	2004	2005[e]		
United States	W	W	9,000	14,000
Bolivia	60	60	10,000	20,000
Canada	145	200	5,000	30,000
China	2,500	2,500	240,000	470,000
Kazakhstan	150	150	5,000	10,000
Mexico	1,100	1,100	10,000	20,000
Peru	1,000	1,000	11,000	42,000
Other countries	160	160	39,000	74,000
World total (rounded)	5,100	5,200	330,000	680,000

World Resources: Bismuth, at an estimated 8 parts per billion by weight, is the 69th element in order of abundance in the Earth's crust and is about twice as abundant as gold. World reserves of bismuth are usually based on bismuth content of lead resources because bismuth production is most often a byproduct of processing lead ores; in China, bismuth production is a byproduct of tungsten and other metal ore processing. Bismuth minerals rarely occur in sufficient quantities to be mined as principal products; the Tasna Mine in Bolivia and a mine in China are the only mines that produced bismuth from a bismuth ore. The Tasna Mine has been on standby status since the mid-1990s awaiting a significant rise in the metal price. Several bismuth-containing deposits are in varying stages of mining feasibility review. These polymetallic deposits include NICO in Canada, Nui Phao in Vietnam, and Bonfim in Brazil.

Substitutes: Bismuth can be replaced in pharmaceutical applications by alumina, antibiotics, and magnesia. Titanium dioxide-coated mica flakes and fish scale extracts are substitutes in pigment uses. Indium can replace bismuth in low-temperature solders. Resins can replace bismuth alloys for holding metal shapes during machining, and glycerine-filled glass bulbs can replace bismuth alloys in triggering devices for fire sprinklers. Free-machining alloys can contain lead, selenium, or tellurium as a replacement for bismuth.

Bismuth, on the other hand, is an environmentally friendly substitute for lead in plumbing and many other applications, including fishing weights, hunting ammunition, lubricating greases, and soldering alloys.

[e]Estimated. W Withheld to avoid disclosing company proprietary data. — Zero.
[1]Defined as imports – exports + adjustments for Government and industry stock changes.
[2]See Appendix C for definitions.

BORON

(Data in thousand metric tons of boric oxide (B_2O_3) unless otherwise noted)

Domestic Production and Use: The estimated value of boric oxide contained in minerals and compounds produced in 2005 was $483 million. Domestic production of boron minerals, primarily as sodium borates, was by three companies in southern California. The leading producer operated an open pit tincal and kernite mine and associated compound plants. The company planned to expand boric acid production capacity. The project was valued at $44 million. The majority of the remaining output was produced using saline brines as the raw material. A third company that previously processed calcium and calcium sodium borates was idle after a flood washed out the main road. A fourth company was idle during most of 2003 and all of 2004 and 2005. Principal consumption of boron minerals and chemicals was in the production of glass by firms in the North Central and the Eastern United States. The estimated distribution pattern for boron compounds consumed in the United States in 2004 was glass and ceramics, 70%; soaps and detergents, 5%; fire retardants, 4%; agriculture, 2%; and other, 19%.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production[1]	536	543	605	637	657
Imports for consumption, gross weight:					
Borax	1	([2])	([2])	([2])	65
Boric acid	56	49	47	49	49
Colemanite	35	32	24	21	98
Ulexite	109	125	80	110	70
Exports, gross weight:					
Boric acid	85	84	70	61	168
Colemanite	NA	5	23	18	—
Refined sodium borates	221	150	131	135	33
Consumption:					
Apparent	482	492	532	509	649
Reported	347	359	366	385	NA
Price, dollars per ton, granulated pentahydrate borax in bulk, carload, works[3]	376	376	400-425	400-425	400-425
Stocks, yearend[4]	NA	NA	NA	NA	NA
Employment, number	1,300	1,300	1,300	1,300	1,300
Net import reliance[5] as a percentage of apparent consumption	E	E	E	E	E

Recycling: Insignificant.

Import Sources (2001-04): Boric acid: Turkey, 57%; Chile, 31%; Peru, 5%; Russia, 3%; and other, 4%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Borates:		
Refined borax:		
Anhydrous	2840.11.0000	0.3% ad val.
Other	2840.19.0000	0.1% ad val.
Other	2840.20.0000	3.7% ad val.
Perborates:		
Sodium	2840.30.0010	3.7% ad val.
Other	2840.30.0050	3.7% ad val.
Boric acids	2810.00.0000	1.5% ad val.
Natural borates:		
Sodium	2528.10.0000	Free.
Other:		
Calcium	2528.90.0010	Free.
Other	2528.90.0050	Free.

Depletion Allowance: Borax, 14% (Domestic and foreign).

Government Stockpile: None.

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BORON

Events, Trends, and Issues: The United States was the world's leading producer of refined boron compounds during 2005, and about one-half of domestic production was exported. U.S. processed products had fewer impurities and were produced with lower emissions than in other countries. The U.S. industry produced boron minerals with a higher productivity per worker hour than those produced in other countries. It was reported that a leading indicator for demand for refined borates was a strong housing market. The demand for housing decreased at yearend 2005.

A new ulexite mine opened in Olacapato, Salta Province, Argentina. The ulexite is transported 180 kilometers (km) to the City of Saltato where a boric acid plant was constructed to produce 400 tons per month. A second stage was under construction to increase the production to 1,000 tons per month.

A Chilean company extracted ulexite from Salarde Uyumi in southwest Potosi, Bolivia. Bolivia's Mining and Hydrocarbons Ministry rescinded the mining concessions in June 2005. The Chilean company had to wait 6 months before taking action to assess the value of the claim through the World Bank's International Center for the Settlement of Investment Disputes. The company filed charges against the Bolivian Government in 2005.

A new colemanite mine opened in 2004 in northern Chile 85 km from Calaman City at Salar de Tara. It produced granulated fertilizer ulexite; 32% B_2O_3 (10% B) for bulk blending or direct agricultural application and ground ulexite 30% to 40% B_2O_3 under 1 millimeter (mm) and concentrate 50% to 60% B_2O_3 under 0.5 mm. A major producer in Chile was looking for buyers for its borate-producing subsidiary. Ulexite from the Salar of Ascotan was produced to manufacture boric acid.

A subsidiary of an Italian company produced ulexite and inyoite 80 km from Arequipa, Peru. The open pit mine operates 6 months per year because of the rainy season. Estimated reserves were 10 million tons. Ulexite from the mine is transported to a boric acid plant in Rio Seco.

Exported U.S. borate materials competed with borax, boric acid, colemanite, and ulexite primarily from Turkey, the leading producer of boron ore in the world.

World Production, Reserves, and Reserve Base:[6]

	Production—all forms		Reserves[7]	Reserve base[7]
	2004	2005[e]		
United States	1,210	1,230	40,000	80,000
Argentina	560	550	2,000	9,000
Bolivia	110	100	NA	NA
Chile	401	600	NA	NA
China	135	140	25,000	47,000
Iran	3	3	1,000	1,000
Kazakhstan	30	30	NA	NA
Peru	9	10	4,000	22,000
Russia	500	500	40,000	100,000
Turkey	1,450	1,700	60,000	150,000
World total (rounded)	4,410	4,860	170,000	410,000

World Resources: Large domestic reserves of boron materials occur in California, chiefly in sediments and their contained brines. Extensive resources also occur in Turkey. Small deposits are being mined in South America. At current levels of consumption, world resources are adequate for the foreseeable future.

Substitutes: Substitution for boron materials is possible in such applications as soaps, detergents, enamel, and insulation. In soaps, sodium and potassium salts of fatty acids are the usual cleaning and emulsion agents. Borates in detergents can be replaced by chlorine bleach or enzymes. Some enamels can use other glass-producing substances, such as phosphates. Insulation substitutes include cellulose, foams, and mineral wools.

[e]Estimated. E Net exporter. NA Not available. — Zero.
[1]Minerals and compounds sold or used by producers; includes both actual mine production and marketable products.
[2]Less than ½ unit.
[3]Chemical Market Reporter.
[4]Stocks data are not available and are assumed to be zero for net import reliance and apparent consumption calculations.
[5]Defined as imports – exports + adjustments for Government and industry stock changes.
[6]Gross weight of ore in thousand metric tons.
[7]See Appendix C for definitions.

BROMINE

(Data in thousand metric tons of bromine content unless otherwise noted)

Domestic Production and Use: The quantity of bromine sold or used in the United States from three companies operating in Arkansas and Michigan accounted for 100% of elemental bromine production. Arkansas, with six plants, led the Nation in bromine production, and bromine was the leading mineral commodity in terms of value produced in the State. In Michigan, bromine was produced as a byproduct of magnesium compounds production. Three bromine companies in the United States accounted for more than one-third of world production.

A major domestic company reported that bromine is used in the manufacture of, dyes, fire retardants, insect repellents, oilfield completion fluids, pharmaceuticals, perfumes, photographic chemicals, water-treatment chemicals, and other chemicals. Other products included intermediate chemicals for the manufacture of products and bromide solutions used alone or in combination with other chemicals.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production[1]	212	222	216	222	212
Imports for consumption, elemental bromine and compounds[2]	16	7	7	10	10
Exports, elemental bromine and compounds	11	13	13	8	9
Consumption, apparent[3]	214	216	210	220	224
Price, cents per kilogram, bulk, purified bromine	67.0	99.2	72.0	75.5	81.0
Employment, number	1,700	1,700	1,700	1,500	1,200
Net import reliance[4] as a percentage of apparent consumption	—	—	E	E	([5])

Recycling: Some bromide solutions were recycled to obtain elemental bromine and prevent the solutions from being disposed of as hazardous waste. This recycled bromine is not included in the virgin bromine production reported by the companies, but is included in data collected by the U.S. Census Bureau.

Import Sources (2001-04): Israel, 93%; China, 2%; Indonesia, 2%; and other, 3%.

Tariff: **Item**	**Number**	**Normal Trade Relations 12-31-05**
Bromine	2801.30.2000	5.5% ad val.
Bromides and bromide oxides	2827.59.5000	3.6% ad val.
Bromochloromethane	2903.49.1000	Free.
Ammonium, calcium, or zinc bromide	2827.59.2500	Free.
Decabromodiphenyl and octabromodiphenyl oxide	2909.30.0700	5.5% ad val.
Ethylene dibromide	2903.30.0500	5.5% ad val.
Hydrobromic acid	2811.19.3000	Free.
Potassium bromate	2829.90.0500	Free.
Potassium or sodium bromide	2827.51.0000	Free.
Sodium bromate	2829.90.2500	Free.
Tetrabromobisphenol A	2908.10.2500	5.5% ad val.
Vinyl bromide, methylene dibromide	2903.30.1520	Free.

Depletion Allowance: Brine wells, 5% (Domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: Israel and the United States were the largest producers of bromine in the world. Approximately 90% of Israel's production was for export, accounting for about 80% of international trade in bromine and bromine compounds to more than 100 countries. Exports from Israel were used to produce bromine compounds at a plant in the Netherlands for export to other countries.

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BROMINE

Great Lakes Chemical Corporation, a major domestic producer of bromine and bromine compounds, experienced a fatality at the El Dorado, AR, plant after the worker was exposed to methyl bromide. The accident occurred after a valve used in venting was modified during replacement of adjacent valves venting the gas to an emergency exhaust stack rather than to a recovery unit.[6]

Great Lakes merged with Crompton Corporation to become Chemtura Corporation, the third-largest publicly traded U.S. specialty chemical firm by revenues on July 1. Cumulative savings were expected to total $10 million in 2005, $100 million in 2006, and $150 million in 2007. The 7,300 workforce will be reduced by 8%, resulting in 600 fewer jobs worldwide during the next 3 years.[7]

Price increases for many bromine compounds were announced reflecting the rising market value of the bromine and to cover major increases in the costs of energy, raw materials, regulatory compliance, and transportation.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[8]	Reserve base[8]
	2004	2005[e]		
United States[1]	222	212	11,000	11,000
Azerbaijan	2	2	300	300
China	42	43	130	3,500
France	2	2	1,600	1,600
Germany	0.5	0.5	([9])	([9])
India	1.5	1.5	([10])	([10])
Israel	206	210	([11])	([11])
Italy	0.3	0.3	([10])	([10])
Japan	20	20	([12])	([12])
Jordan	20	50	([11])	([11])
Spain	0.1	0.1	1,400	1,400
Turkmenistan	0.15	0.15	700	700
Ukraine	3	3	400	400
United Kingdom	35	35	([12])	([12])
World total (rounded)	560	580	Large	Large

World Resources: Resources of bromine are virtually unlimited. The Dead Sea, in the Middle East, is estimated to contain 1 billion tons of bromine. Seawater contains about 65 parts per million of bromine, or an estimated 100 trillion tons. Bromine is also recovered from seawater as a coproduct during evaporation to produce salt.

Substitutes: Chlorine and iodine may be substituted for bromine in a few chemical reactions and for sanitation purposes. There are no comparable substitutes for bromine in various oil and gas well completion and packer applications that do not harm the permeability of the production zone and that control well "blowouts." Because plastics have a low ignition temperature, alumina, magnesium hydroxide, organic chlorine compounds, and phosphorous compounds can be substituted for bromine as fire retardants in some uses. Bromine compounds and bromine acting as a synergist with other materials are used as fire retardants in plastics such as those found in electronics.

[e]Estimated. E Net exporter. — Zero.
[1]Sold or used by U.S. producers.
[2]Imports calculated from items shown in Tariff section.
[3]Includes recycled product.
[4]Defined as imports – exports + adjustments for Government and industry stock changes.
[5]Less than ½ unit.
[6]El Dorado News-Times, 2005, Great Lakes finds likely cause of methyl bromide release: El Dorado News-Times, May 25, p. A1, A3.
[7]Chemtura Corporation, 2005, Crompton Corporation and Great Lakes Chemical finalize merger, become "Chemtura" Corporation: Middlebury, CT, Chemtura Corporation, press release, July 1, 2 p.
[8]See Appendix C for definitions.
[9]From waste bitterns associated with potash production.
[10]From waste bitterns associated with solar salt.
[11]From the Dead Sea.
[12]From seawater.

CADMIUM

(Data in metric tons of cadmium content unless otherwise noted)

Domestic Production and Use: Two companies in the United States produced cadmium in 2005. One company in Tennessee produced cadmium metal as a byproduct of smelting and refining zinc metal from imported sulfide ores, while another company in Pennsylvania produced cadmium metal from cadmium-containing scrap, mainly from spent nickel-cadmium (NiCd) batteries. Based on the average New York dealer price, U.S. cadmium metal production was valued at about $1.82 million in 2005. Between 2001 and 2005, domestic consumption of cadmium metal declined by about 35% in response to environmental concerns. Cadmium use in batteries amounted to 81% of apparent consumption. The remaining 19% was distributed as follows: pigments, 10%; coatings and plating, 7%; stabilizers for plastics, 1.5%; and nonferrous alloys and other, 0.5%.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production, refinery[1]	680	700	670	550	550
Imports for consumption, metal	107	25	18	38	35
Exports of metal, alloys, scrap	272	168	558	132	200
Shipments from Government stockpile excesses	34	693	80	—	—
Consumption, apparent	659	561	530	496	430
Price, metal, average annual:[2]					
Dollars per kilogram	0.50	0.64	1.31	1.20	3.31
Dollars per pound	0.23	0.29	0.59	0.55	1.50
Stocks, yearend, producer and distributor	1,090	1,750	1,460	1,420	1,380
Net import reliance[3] as a percentage of apparent consumption	E	E	E	E	E

Recycling: Cadmium is recovered from spent NiCd batteries, copper-cadmium alloy scrap, some complex nonferrous alloy scrap, and cadmium-containing dust from electric arc furnaces (EAF). The amount of cadmium recycled was not disclosed. In 2005, the U.S. steel industry generated about 0.7 million tons of EAF dust, typically containing 0.003% to 0.07% cadmium.

Import Sources (2001-04): Metal:[4] Mexico, 46%; Australia, 31%; Canada, 12%; Belgium, 8%; and other, 3%.

Tariff: **Item**	**Number**	**Normal Trade Relations[5] 12-31-05**
Cadmium sulfide	2830.30.0000	3.1% ad val.
Pigments and preparations based on cadmium compounds	3206.30.0000	3.1% ad val.
Unwrought cadmium and powders	8107.20.0000	Free.
Cadmium waste and scrap	8107.30.0000	Free.
Cadmium other	8107.90.0000	4.4% ad val.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: None.

Events, Trends, and Issues: During the past decade, increased environmental awareness has resulted in regulatory pressure to reduce or even eliminate the use of cadmium in many developed countries. In the United States, Federal and State environmental agencies regulate industrial releases of cadmium and other heavy metals. The U.S. Environmental Protection Agency (EPA) identified cadmium as a persistent and bioaccumulative toxic pollutant. The European Union is evaluating a proposal to ban, with some exemptions, NiCd batteries containing more than 0.002% cadmium beginning on January 1, 2008, and to increase the fraction of spent industrial and portable rechargeable batteries collected. Declining production of cadmium metal in developed countries was offset by increased production in China and other developing countries where manufacturing of NiCd batteries was increasing. Although demand for cadmium in traditional uses such as pigments and stabilizers is decreasing, potential new uses for cadmium in the electronics sector are emerging. For example, in 2005, researchers in Berkeley, California, synthesized ultrathin photovoltaic films comprised of cadmium selenide (CdSe) and cadmium telluride (CdTe) nanocrystals. If the efficiencies of these films for converting sunlight to electricity can be improved, and manufacturing becomes economically viable, solar cells could become an important market for cadmium. One use would be to generate electricity in remote arid areas where supplies of oil and natural gas are not readily available. Such new electronic demand for cadmium could partially absorb the cadmium projected to be available from the forecast growth in zinc refining. Increased demand for cadmium could encourage recycling, while simultaneously discouraging stockpiling of cadmium-bearing jarosite and other wastes at zinc refineries.

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CADMIUM

In 2003, the European Union adopted a set of environmental regulations that are having a profound impact on electronics and semiconductor manufacturing worldwide. One particular directive in this set—The Restriction of the Use of Hazardous Substances (RoHS)—prohibits the incorporation of cadmium and other heavy metals in most electrical and electronic equipment sold in the European Union after July 1, 2006. Cadmium plating of electronic components is exempt from RoHS. In 2005, the Environment Council of the European Union adopted a directive that bans the sale of certain types of portable NiCd batteries. NiCd batteries are restricted to use in alarm and emergency systems, cordless power tools, and medical equipment.

World Refinery Production, Reserves, and Reserve Base:

	Refinery production		Reserves[6]	Reserve base[6]
	2004	2005[e]		
United States	550	550	90,000	270,000
Australia	350	460	110,000	300,000
Belgium	120	120	—	—
Canada	1,888	1,400	55,000	100,000
China	2,800	3,000	90,000	380,000
Germany	640	420	6,000	8,000
India	489	500	3,000	5,000
Japan	2,233	2,400	10,000	15,000
Kazakhstan	1,900	2,300	50,000	100,000
Korea, Republic of	2,100	2,200	—	—
Mexico	1,600	1,600	35,000	40,000
Peru	532	600	12,000	13,000
Russia	950	1,050	16,000	30,000
Other countries	2,650	1,410	120,000	540,000
World total (rounded)	18,800	18,000	600,000	1,800,000

World Resources: The bulk of the cadmium being recovered is associated with ores of sphalerite (ZnS). Estimated world identified resources of cadmium were about 6 million tons based on identified zinc resources of 1.9 billion tons containing about 0.3% cadmium. Zinc-bearing coals of the Central United States and Carboniferous age coals of other countries also contain large subeconomic resources of cadmium.

Substitutes: Lithium-ion and nickel-metal hydride batteries are replacing NiCd batteries in some applications. However, the higher cost of these substitutes restricts their use in less expensive products. Except where the surface characteristics of a coating are critical (e.g., fasteners for aircraft), coatings of zinc or vapor-deposited aluminum can be substituted for cadmium in many plating applications. Cerium sulfide is used as a replacement for cadmium pigments, mostly in plastics.

[e]Estimated. E Net exporter. — Zero.
[1]Cadmium metal and oxide produced as a byproduct of lead-zinc refining plus metal from recycling.
[2]Average New York dealer price for 99.95% purity in 5-short-ton lots. Source: Platts Metals Week.
[3]Defined as imports – exports + adjustments for Government and industry stock changes.
[4]Combined imports of cadmium metal, including unwrought and wrought metal, metal powders, and waste and scrap.
[5]No tariff for Canada and Mexico for items shown.
[6]See Appendix C for definitions.

CEMENT

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: In 2005, almost 93 million tons of portland cement and about 5 million tons of masonry cement were produced at 113 plants in 37 States; cement was also produced at 2 plants in Puerto Rico. Sales prices increased significantly during the year. The value of cement production, excluding Puerto Rico, was about $8 billion, and the value of total sales (including imported cement) was about $10 billion. Most of the cement was used to make concrete, worth at least $48 billion. Imported cement and clinker (to make cement) accounted for about 25% of the cement sold; total imports rose significantly, owing to very high demand coupled with production shortfalls. Clinker, the main intermediate product in cement manufacture, was produced at 107 plants, with a combined apparent annual capacity of about 103 million tons. Including several facilities that only ground clinker produced elsewhere, total finished cement (grinding) capacity was about 115 million tons. Texas, California, Pennsylvania, Missouri, Michigan, and Alabama, in descending order, were the six leading producing States and accounted for about one-half of U.S. production. About 75% of cement sales went to ready-mixed concrete producers, 14% to concrete product manufacturers, 6% to contractors (mainly road paving), 3% to building materials dealers, and 2% to other users.

Salient Statistics—United States:[1]	2001	2002	2003	2004	2005[e]
Production:					
Portland and masonry cement[2]	88,900	89,732	92,843	97,434	97,500
Clinker	78,451	81,517	81,882	86,658	87,000
Shipments to final customers, includes exports	113,136	108,778	112,929	120,731	124,000
Imports of hydraulic cement for consumption	23,694	22,198	21,015	25,396	29,000
Imports of clinker for consumption	1,782	1,603	1,808	1,630	2,800
Exports of hydraulic cement and clinker	746	834	837	818	800
Consumption, apparent[3]	112,810	110,020	114,090	121,910	125,800
Price, average mill value, dollars per ton	76.50	76.00	75.00	79.50	84.00
Stocks, cement, yearend	6,600	7,680	6,610	6,710	6,600
Employment, mine and mill, number[e]	18,000	18,100	18,100	18,000	18,000
Net import reliance[4] as a percentage of apparent consumption	21	20	20	21	25

Recycling: Cement kiln dust is routinely recycled to the kilns, which also can burn a variety of waste fuels and recycled raw materials such as slags and fly ash. Fly ash and granulated blast furnace slag also can be incorporated in blended cements and in the cement paste in concrete. Cement is not directly recycled, but there is recycling of some concrete for use as aggregate.

Import Sources (2001-04):[5] Canada, 22%; Thailand, 14%; China, 9%; Venezuela, 7%; and other, 48%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Cement clinker	2523.10.0000	Free.
White portland cement	2523.21.0000	Free.
Other portland cement	2523.29.0000	Free.
Aluminous cement	2523.30.0000	Free.
Other hydraulic cement	2523.90.0000	Free.

Depletion Allowance: Not applicable. Certain raw materials for cement production have depletion allowances.

Government Stockpile: None.

Events, Trends, and Issues: The devastating hurricanes that hit the Gulf States in August, September, and October were ultimately expected to lead to large local increases in cement consumption, but served to constrain demand and cement deliveries in the fourth quarter. Absent these events, overall cement consumption for 2005 would likely have been 4 million to 5 million tons higher, mostly from imports. Elsewhere in the country, consumption was expected to remain at record-high levels, spurred by continued low interest rates and increased public sector (transportation infrastructure) spending resulting from the signing of the $286.5 billion SAFETEA bill. Imports were more readily available in 2005, owing to better ship availability and easing of shipping costs. Shortages of cement continued to be widely reported, and these fueled petitions to eliminate or reduce antidumping duties on imported Mexican cement; imports of cement from Mexico in 2005 were almost double those in 2004, despite the duties.

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CEMENT

A number of environmental issues, especially its large carbon dioxide emissions, potentially affect the cement industry. Carbon dioxide reduction strategies by the cement industry were aimed at lowering emissions per ton of cement product rather than by plant. These strategies included installation of more fuel-efficient kiln technologies, partial substitution of noncarbonate sources of calcium oxide in the kiln raw materials, and partial substitution of supplementary cementitious materials (SCM) additives, such as pozzolans, for portland cement in the finished cement products and in concrete. The United States lags behind many foreign countries in the use of SCM. Because SCM do not require the energy-intensive clinker manufacturing (kiln) phase of cement production, their use reduces the unit monetary and environmental costs of the cement component of concrete.

Fossil fuel cost increases were of continued concern to the cement industry; even in times of cement shortages, the industry found it difficult to fully pass on the cost increases to the customers. Some cement companies burn waste materials in their kilns as a low-cost substitute for fossil fuels. Cement kilns can be an effective and benign way of destroying such wastes. The viability of the practice and the type of waste burned hinge on current and future environmental regulations and their associated costs. The trend appears to be toward increased use of waste fuels.

World Production and Capacity:

	Cement production		Yearend clinker capacity[e]	
	2004	**2005[e]**	**2004**	**2005**
United States (includes Puerto Rico)	99,000	99,100	105,000	106,000
Brazil	[e]38,000	39,000	45,000	45,000
China	934,000	1,000,000	850,000	850,000
Egypt	[e]28,000	27,000	35,000	35,000
France	21,000	20,000	22,000	22,000
Germany	32,000	32,000	31,000	31,000
India	[e]125,000	130,000	150,000	150,000
Indonesia	[e]36,000	37,000	42,000	42,000
Iran	[e]30,000	32,000	33,000	35,000
Italy	[e]38,000	38,000	46,000	46,000
Japan	67,400	66,000	76,000	74,000
Korea, Republic of	53,900	50,000	62,000	62,000
Mexico	35,000	36,000	40,000	40,000
Russia	[e]43,000	45,000	65,000	65,000
Saudi Arabia	23,200	24,000	24,000	24,000
Spain	46,800	48,000	40,000	40,000
Thailand	35,600	40,000	50,000	50,000
Turkey	38,000	38,000	35,000	35,000
Vietnam	25,300	27,000	20,000	22,000
Other countries (rounded)	381,000	392,000	330,000	346,000
World total (rounded)	2,130,000	2,220,000	2,100,000	2,120,000

World Resources: Although individual company reserves are subject to exhaustion, cement raw materials, especially limestone, are geologically widespread and abundant, and overall shortages are unlikely in the future.

Substitutes: Virtually all portland cement is used either in making concrete or mortars and, as such, competes in the construction sector with concrete substitutes such as aluminum, asphalt, clay brick, rammed earth, fiberglass, glass, steel, stone, and wood. A number of materials, especially fly ash and ground granulated blast furnace slag, develop good hydraulic cementitious properties (the ability to set and harden under water) by reacting with the lime released by the hydration of portland cement. These pozzolanic and similar materials are increasingly being used as partial substitutes for portland cement in some concrete applications.

[e]Estimated.
[1]Portland plus masonry cement unless otherwise noted. Excludes Puerto Rico.
[2]Includes cement made from imported clinker.
[3]Production of cement (including from imported clinker) + imports (excluding clinker) – exports – changes in stocks.
[4]Defined as imports (revised to include clinker) – exports + adjustments for Government (nil) and industry stock changes.
[5]Hydraulic cement and clinker.

CESIUM

(Data in kilograms of cesium content unless otherwise noted)

Domestic Production and Use: Cesium is not mined in the United States. Pollucite, the principal ore mineral of cesium, is imported as concentrate from Canada by one company in the United States. There are occurrences of pollucite in pegmatites in South Dakota and Maine. Because of its high density, the main use of cesium is in the production of specialty, high-density drilling fluids used in the global oil and gas exploration industry. Cesium is an important component in the U.S. Naval Observatory's atomic clocks that are accurate to a few hundred trillionths of a second. For example, the returning U.S. space shuttles are tracked by jet aircraft whose positions are synchronized using cesium atomic clocks. Global positioning satellites, Internet and cell phone transmissions, and missile guidance systems also depend on the accuracy of cesium atomic clocks. Cesium is also used in DNA separation techniques, infrared detectors, night vision devices, photoelectric cells, and traffic controls. A reactor-produced radioactive isotope of cesium, cesium-137, may be used in cancer treatment, specifically brachytherapy, where an encapsulated cesium-137 source is placed within the body. Cesium-137 is also used in industrial gauges, mining and geophysical instruments, and for sterilization of food, sewage, and surgical equipment.

Salient Statistics—United States: Cesium production, consumption, import, and export data are not available, and world mine production and U.S. consumption data have not been available since the late 1980s. There is no trading of the metal and no official market price. Annual consumption is estimated to be a few thousand kilograms. Several companies publish their prices for cesium and cesium compounds, and these prices have remained relatively stable for several years. In 2005, as in 2004, one company offered 1-gram ampoules of 99.8% (metals basis) cesium for $41.30 each and 99.98% (metals basis) cesium for $54.30. The price for 50 grams of 99.8% (metals basis) cesium was $542.00, and 100 grams of 99.98% (metals basis) cesium was priced at $1,489.00.

Recycling: None.

Import Sources (2001-04): The United States is 100% import reliant, and Canada is the chief source of cesium imported by the United States.

Tariff:

Item	Number	Normal Trade Relations 12-31-05
Alkali metals, other	2805.19.9000	5.5% ad val.
Chlorides, other	2827.39.5000	3.7% ad val.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

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CESIUM

Events, Trends, and Issues: Unless the cesium market changes enough to make domestic occurrences economic, the United States will continue to depend on Canada for cesium. Its high cost and reactivity limit the applications of cesium metal. No environmental or human health issues have been associated with stable cesium. Cesium, when used in specialty drilling muds or cesium formate fluids, is readily biodegradable and has minimal environmental impact. The International Atomic Energy Agency and other sources have indicated that radioactive materials such as cesium-137 may be used in radiological dispersion devices or "dirty bombs."

World Mine Production, Reserves, and Reserve Base: Data on resources and mine production of cesium are either limited or not available. Estimates of reserves and reserve base are based on occurrences of pollucite that is mined as a byproduct with other pegmatite minerals, specifically the lithium mineral lepidolite. Pegmatites are exceptionally coarse-grained granitic rocks. Pollucite, which is a hydrated aluminosilicate mineral, may form in association with lithium-rich, lepidolite-bearing or petalite-bearing zoned pegmatites. Commercial concentrates of pollucite may contain about 20% cesium by weight. The Canadian deposit contains approximately 300,000 tons of pollucite that grades 24% Cs_2O. The next largest deposit thought to be potentially economic is in Zimbabwe.

	Reserves[1]	Reserve base[1]
Canada	70,000,000	73,000,000
Namibia	—	9,000,000
Zimbabwe	—	23,000,000
Other countries	NA	NA
World total (rounded)	70,000,000	110,000,000

World Resources: World resources of cesium have not been estimated. Cesium may be associated with lithium-bearing pegmatites worldwide; cesium resources have been found in pegmatites in Namibia and Zimbabwe. Cesium occurrences are also known in brines in Chile and China and in geothermal systems in Germany, India, and Tibet.

Substitutes: The physical properties of cesium and its compounds are similar to those of rubidium and its compounds, and they may be used interchangeably in many applications.

NA Not available. — Zero.
[1]See Appendix C for definitions.

CHROMIUM

(Data in thousand metric tons, gross weight unless otherwise noted)

Domestic Production and Use: In 2005, the United States consumed about 11% of world chromite ore production in various forms of imported materials, such as chromite ore, chromium chemicals, chromium ferroalloys, and chromium metal. Imported chromite was consumed by one chemical firm to produce chromium chemicals. Consumption of chromium ferroalloys and metal was predominantly for the production of stainless and heat-resisting steel and superalloys, respectively. The value of chromium material consumption was about $397 million.

Salient Statistics—United States:[1]	2001	2002	2003	2004	2005[e]
Production, from scrap	141	174	180	168	170
Imports for consumption	239	263	317	326	330
Exports	43	29	46	35	40
Government stockpile releases	9	62	83	94	90
Consumption:					
Reported (excludes scrap)	208	241	245	268	270
Apparent[2] (includes scrap)	344	479	532	555	550
Unit value, average annual import (dollars per metric ton):					
Chromite ore (gross weight)	61	60	54	114	110
Ferrochromium (chromium content)	709	646	835	1,320	1,300
Chromium metal (gross weight)	6,116	5,767	5,272	5,815	5,800
Stocks, yearend, held by U.S consumers	17	8	10	8	10
Net import reliance[3] as a percentage of apparent consumption	60	61	67	70	69

Recycling: In 2005, chromium contained in reported stainless steel scrap receipts accounted for 29% of apparent consumption.

Import Sources (2001-04): Chromium contained in chromite ore and chromium ferroalloys and metal: South Africa, 53%; Kazakhstan, 29%; Zimbabwe, 8%; Russia, 5%; and other, 5%.

Tariff:[4] Item	Number	Normal Trade Relations 12-31-05
Ore and concentrate	2610.00.0000	Free.
Ferrochromium:		
Carbon more than 4%	7202.41.0000	1.9% ad val.
Carbon more than 3%	7202.49.1000	1.9% ad val.
Other:		
Carbon more than 0.5%	7202.49.5010	3.1% ad val.
Other	7202.49.5090	3.1% ad val.
Ferrochromium silicon	7202.50.0000	10% ad val.
Chromium metal:		
Unwrought powder	8112.21.0000	3% ad val.
Waste and scrap	8112.22.0000	Free.
Other	8112.29.0000	3% ad val.

Depletion Allowance: 23% (Domestic), 15% (Foreign).

Government Stockpile: The Defense Logistics Agency, U.S. Department of Defense, implemented the Annual Materials Plan for fiscal year (FY) 2005, which was in effect until September 30, 2005. Quantity available for sale was to be limited to sales authority or inventory. The Agency reported sales in FY 2005 of 81,040 tons of high-carbon ferrochromium, 49,296 tons of refractory-grade chromite ore, 42,754 tons of chemical-grade chromite ore, 11,573 tons of low-carbon ferrochromium, and 279 tons of chromium metal. Ferrochromium silicon and metallurgical-grade chromite ore stocks have been exhausted. The last of the ferrochromium silicon stocks were shipped in June 2002; metallurgical-grade chromite ore, in December 2003. At the current rate of disposal, chemical grade chromite ore stock will be exhausted in FY 2006; refractory grade chromite ore, FY 2006; high-carbon ferrochromium, FY 2009; low-carbon ferrochromium, FY 2020; and chromium metal, FY 2027.

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CHROMIUM

Stockpile Status—9-30-05[5]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005	Average chromium content
Chromite ore:						
Chemical-grade	—	3.6	—	90.7	42.8	28.6%
Refractory-grade	—	71.6	—	90.7	49.3	[e]23.9%
Ferrochromium:						
High-carbon	327	0.89	327	[6]99.8	81.0	71.4%
Low-carbon	176	4.7	176	([6])	11.6	71.4%
Chromium metal	6.21	0.2	6.21	0.454	0.279	100%

Events, Trends, and Issues: The rising cost of ferrochromium production and a strengthening South African rand, along with increased demand for ferrochromium and limited supply of stainless steel scrap, caused the price of ferrochromium to reach historically high levels in 2005. As yearend approached, ferrochromium prices declined in the second and third quarters; supply was abundant, as stainless steel producers (except in China, which was starting up newly installed production capacity) announced production cutbacks of about 1 million tons, and the South African rand weakened with respect to the U.S. dollar. World stainless steel production, the source of ferrochromium demand, is expected to continue to increase. China's importance as a consumer of raw materials increased owing to its strong economic growth in 2003 and 2004 and the expansion of stainless steel production capacity in 2004 and 2005. The high price of ferrochromium permitted China and India, two of the world's higher-cost ferrochromium producers, to continue to export that metal commodity to the world market. The cost of nickel reached a 16-year high. High chromium and nickel prices resulted in higher stainless steel prices, which stimulated the use of less costly stainless steel grades, other metals, or nonmetallic materials. If stainless users shift to less costly stainless grades, nickel demand would fall without depressing chromium demand. If stainless consumers shift to other alloys, metals, or materials, demand for both chromium and nickel would decrease. Near the end of 2005, both world stainless steel production and the nickel-containing ratio of that production were less than those of 2004, an indication that consumers are shifting to less-costly stainless steel grades. In 2006 or 2007, when China's stainless steel production capacity has been projected to exceed its demand, China's current suppliers (Asian and European countries) will have to export their production to other countries, a situation that could result in abundant supply.

World Mine Production, Reserves, and Reserve Base:

	Mine production[7] 2004	Mine production[7] 2005[e]	Reserves[8] (shipping grade)[9]	Reserve base[8] (shipping grade)[9]
United States	—	—	—	NA
India	2,950	3,000	25,000	57,000
Kazakhstan	3,270	3,300	290,000	470,000
South Africa	7,630	8,000	160,000	270,000
Other countries	3,620	3,700	NA	NA
World total (rounded)	17,500	18,000	NA	NA

World Resources: World resources are greater than 12 billion tons of shipping-grade chromite, sufficient to meet conceivable demand for centuries. About 95% of the world's chromium resources is geographically concentrated in Kazakhstan and southern Africa; U.S. chromium resources are mostly in the Stillwater Complex in Montana.

Substitutes: Chromium has no substitute in stainless steel, the leading end use, or in superalloys, the major strategic end use. Chromium-containing scrap can substitute for ferrochromium in metallurgical uses.

[e]Estimated. NA Not available. — Zero.
[1]Data in thousand metric tons of contained chromium unless otherwise noted.
[2]Calculated consumption of chromium; equal to production (from mines and scrap) + imports – exports + stock adjustments.
[3]Defined as imports – exports + adjustments for Government and industry stock changes.
[4]In addition to the tariff items listed, certain imported chromium materials (see United States Code, title 26, sections 4661, 4662, and 4672) are subject to excise tax.
[5]See Appendix B for definitions.
[6]Disposal plan for ferrochromium without distinction between high-carbon and low-carbon ferrochromium; total included in high-carbon.
[7]Mine production units are thousand metric tons, gross weight, of marketable chromite ore.
[8]See Appendix C for definitions. Reserves and reserve base data are not comparable between countries because the criteria used to determine the resources of India (Indian Bureau of Mines), Kazakhstan (open literature reports in trade journals and at conferences), and South Africa (JORC compliant, company annual reports) were different.
[9]Shipping-grade chromite ore is deposit quantity and grade normalized to 45% Cr_2O_3.

CLAYS

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: In 2005, clay and shale production was reported in 41 States. About 240 companies operated approximately 810 clay pits or quarries. The leading 20 firms supplied about 47% of the tonnage and 77% of the value for all types of clay sold or used in the United States. Domestic producers estimated that sales or use will be about 42 million tons valued at $1.70 billion in 2005. Major uses for specific clays were estimated to be as follows: ball clay—35% floor and wall tile, 26% sanitaryware, and 39% other uses; bentonite—24% foundry sand bond, 23% absorbents, 21% drilling mud, 15% iron ore pelletizing, and 17% other uses; common clay—58% brick, 17% cement, 15% lightweight aggregate, and 10% other uses; fire clay—54% refractories and 46% other uses; fuller's earth—78% absorbent uses and 22% other uses; and kaolin—66% paper and 34% other uses.

Salient Statistics—United States:[1]	**2001**	**2002**	**2003**	**2004**	**2005**[e]
Production, mine:					
Ball clay	1,100	1,120	1,310	1,220	1,320
Bentonite	3,970	3,970	3,770	4,060	4,430
Common clay	23,200	23,000	23,100	24,600	25,500
Fire clay[2]	383	446	345	307	262
Fuller's earth	2,890	2,730	3,610	3,260	3,170
Kaolin	8,110	8,010	7,680	7,760	7,200
Total[3]	39,600	39,300	40,000	41,200	41,900
Imports for consumption:					
Artificially activated clay and earth	21	27	21	25	12
Kaolin	114	158	224	205	280
Other	13	32	34	21	28
Total[3]	148	217	279	251	320
Exports:					
Ball clay	174	127	139	107	115
Bentonite	628	722	721	915	740
Fire clay[2]	238	251	285	332	375
Fuller's earth	146	60	48	49	56
Kaolin	3,440	3,350	3,520	3,640	3,620
Clays, not elsewhere classified	337	449	416	586	431
Total[3]	4,970	4,960	5,130	5,630	5,340
Consumption, apparent	34,800	34,600	35,100	35,800	36,900
Price, average, dollars per ton:					
Ball clay	42	42	43	44	40
Bentonite	48	45	44	44	40
Common clay	6	6	6	7	7
Fire clay	20	24	28	28	29
Fuller's earth	92	90	96	101	98
Kaolin	108	119	122	121	130
Stocks, yearend[4]	NA	NA	NA	NA	NA
Employment, number:[e]					
Mine	1,400	1,350	1,320	1,250	1,270
Mill	5,800	5,200	5,000	4,980	5,000
Net import reliance[5] as a percentage of apparent consumption	E	E	E	E	E

Recycling: Insignificant.

Import Sources (2001-04): Brazil, 71%; Mexico, 7%; United Kingdom, 7%; Canada, 4%; and other, 11%.

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CLAYS

Tariff: Item	Number	Normal Trade Relations 12-31-05
Kaolin and other kaolinitic clays, whether or not calcined	2507.00.0000	Free.
Bentonite	2508.10.0000	Free.
Fuller's and decolorizing earths	2508.20.0000	Free.
Fire clay	2508.30.0000	Free.
Common blue and other ball clays	2508.40.0010	Free.
Other clays	2508.40.0050	Free.
Chamotte or dina's earth	2508.70.0000	Free.
Activated clays and earths	3802.90.2000	2.5% ad val.
Expanded clays and mixtures	6806.20.0000	Free.

Depletion Allowance: Ball clay, bentonite, fire clay, fuller's earth, and kaolin, 14% (Domestic and foreign); clay used in the manufacture of common brick, lightweight aggregate, and sewer pipe, 7.5% (Domestic and foreign); clay used in the manufacture of drain and roofing tile, flower pots, and kindred products, 5% (Domestic and foreign); clay used for alumina and aluminum compounds, 22% (Domestic).

Government Stockpile: None.

Events, Trends, and Issues: Domestic sales or use of clays is estimated to be 41.9 million tons in 2005, up from 41.2 million tons in 2004. Imports for consumption increased to an estimated 320,000 tons. The major sources of imported clay were Brazil (kaolin), Canada (bentonite), Mexico (activated clay), and the United Kingdom (kaolin). Exports decreased to 5.34 million tons. Major markets for exported clays, by descending order of tonnage, were Canada, Netherlands, Japan, Republic of Korea, Australia, Mexico, and Italy.

World Mine Production, Reserves, and Reserve Base:[6] Reserves and reserve base are large in major producing countries, but data are not available.

	Mine production					
	Bentonite		Fuller's earth		Kaolin	
	2004	2005[e]	2004	2005[e]	2004	2005[e]
United States (sales)	4,060	4,430	3,260	3,170	7,760	7,200
Brazil (beneficiated)	200	200	—	—	2,100	2,200
Commonwealth of Independent States (crude)	750	750	—	—	6,240	6,250
Czech Republic (crude)	175	220	—	—	4,000	4,000
Germany (sales)	405	405	500	500	3,750	3,750
Greece (crude)	950	1,000	—	—	60	60
Italy	500	500	30	30	10	10
Korea, Republic of (crude)	—	—	—	—	2,780	2,800
Mexico	470	565	155	130	800	655
Spain	150	150	840	850	350	350
Turkey	850	900	—	—	400	500
United Kingdom (sales)	—	—	140	140	2,400	2,400
Other countries	1,990	1,590	465	580	13,800	14,300
World total (rounded)	10,500	10,700	5,390	5,400	44,500	44,500

World Resources: Resources of all clays are extremely large.

Substitutes: Alternatives, such as calcium carbonate and talc, are available for filler and extender applications.

[e]Estimated. E Net exporter. NA Not available. — Zero.
[1]Excludes Puerto Rico.
[2]Refractory uses only.
[3]Data may not add to totals shown because of independent rounding.
[4]Data on stocks are not available and are assumed to be zero for apparent consumption and net import reliance calculations.
[5]Defined as imports – exports + adjustments for Government and industry stock changes.
[6]See Appendix C for definitions.

COBALT

(Data in metric tons of cobalt content unless otherwise noted)

Domestic Production and Use: The United States did not mine or refine cobalt in 2005; however, negligible amounts of byproduct cobalt were produced as intermediate products from some mining operations. U.S. supply comprised imports, stock releases, and secondary materials, such as cemented carbide scrap, spent catalysts, and superalloy scrap. There were two domestic producers of extra-fine cobalt powder: one produced powder from imported primary metal and another produced powder from cemented carbide scrap. In addition to the powder producers, seven companies were known to produce cobalt compounds. Nearly 70 industrial consumers were surveyed on a monthly or annual basis. Data reported by these consumers indicate that approximately 43% of U.S. cobalt use was in superalloys, which are used mainly in aircraft gas turbine engines; 9% was in cemented carbides for cutting and wear-resistant applications; 22% was in various other metallic uses; and the remaining 26% was in a variety of chemical uses. The total estimated value of cobalt consumed in 2005 was $350 million.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production:					
Mine	—	—	—	—	—
Secondary	2,810	2,750	2,130	2,300	2,400
Imports for consumption	9,410	8,450	8,080	8,720	10,500
Exports	3,210	2,080	2,710	2,510	2,700
Shipments from Government stockpile excesses	3,050	524	2,380	1,630	1,000
Consumption:					
Reported (includes secondary)	9,540	7,880	7,590	8,450	9,000
Apparent[1] (includes secondary)	11,800	9,830	10,000	9,920	11,000
Price, average annual spot for cathodes, dollars per pound	10.55	6.91	10.60	23.93	15.80
Stocks, industry, yearend	1,330	1,140	1,010	1,240	1,440
Net import reliance[2] as a percentage of apparent consumption	76	72	79	77	78

Recycling: In 2005, cobalt contained in purchased scrap represented an estimated 27% of cobalt reported consumption.

Import Sources (2001-04): Cobalt contained in metal, oxide, and salts: Finland, 18%; Norway, 18%; Russia, 17%; Canada, 10%; and other, 37%.

Tariff: Item	Number	Normal Trade Relations[3] 12-31-05
Unwrought cobalt, alloys	8105.20.3000	4.4% ad val.
Unwrought cobalt, other	8105.20.6000	Free.
Cobalt mattes and other intermediate products; cobalt powders	8105.20.9000	Free.
Cobalt waste and scrap	8105.30.0000	Free.
Wrought cobalt and cobalt articles	8105.90.0000	3.7% ad val.
Chemical compounds:		
Cobalt oxides and hydroxides	2822.00.0000	0.1% ad val.
Cobalt sulfates	2833.29.1000	1.4% ad val.
Cobalt chlorides	2827.34.0000	4.2% ad val.
Cobalt carbonates	2836.99.1000	4.2% ad val.
Cobalt acetates	2915.23.0000	4.2% ad val.
Cobalt ores and concentrates	2605.00.0000	Free.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: Sales of National Defense Stockpile cobalt began in March 1993. Disposal limits for cobalt materials in the fiscal year 2006 Annual Materials Plan were unchanged from those of fiscal year 2005.

Stockpile Status—9-30-05[4]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Cobalt	1,570	239	1,570	2,720	1,120

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COBALT

Events, Trends, and Issues: The availability of refined cobalt worldwide increased during the first half of 2005 compared with that of the first half of 2004, as world refinery production was higher and shipments of cobalt from the National Defense Stockpile continued to contribute to supply. Cobalt prices trended downward during the first 10 months of 2005, reflecting adequate supply to meet demand.

In recent years, exports of cobalt-rich ores from Congo (Kinshasa) to refineries mainly in China have helped to balance cobalt supply and demand. Future export of these ores could be affected by declining cobalt prices, which could make their export less economical, and by efforts by the Government of Congo (Kinshasa) to require that cobalt ores be processed before being exported.

Health, safety, and environmental issues are becoming increasingly significant to metals such as cobalt. The European Commission's new chemicals policy, if implemented as proposed, would affect all suppliers of cobalt materials to the European market by requiring them to collect and submit risk assessment data on each material produced in or imported into the European Union.

World Mine Production, Reserves, and Reserve Base: Reserves and reserve base estimates for Australia were revised downward from those previously published based on information reported by the Government of Australia. Reserves estimate for Canada was revised downward based on information reported by major Canadian nickel sulfide ore producers.

	Mine production		Reserves[5]	Reserve base[5]
	2004	2005[e]		
United States	—	—	NA	860,000
Australia	6,700	6,600	1,300,000	1,600,000
Brazil	1,400	1,400	35,000	40,000
Canada	5,200	5,700	130,000	350,000
Congo (Kinshasa)	16,000	16,000	3,400,000	4,700,000
Cuba	3,600	3,600	1,000,000	1,800,000
Morocco	1,600	1,600	20,000	NA
New Caledonia[6]	1,400	1,400	230,000	860,000
Russia	4,700	5,000	250,000	350,000
Zambia	10,000	9,000	270,000	680,000
Other countries	1,800	2,100	200,000	1,500,000
World total (rounded)	52,400	52,400	7,000,000	13,000,000

World Resources: Identified cobalt resources of the United States are estimated to be about 1 million tons. Most of these resources are in Minnesota, but other important occurrences are in Alaska, California, Idaho, Missouri, Montana, and Oregon. With the exception of resources in Idaho and Missouri, any future cobalt production from these deposits would be as a byproduct of another metal. Identified world cobalt resources are about 15 million tons. The vast majority of these resources are in nickel-bearing laterite deposits, with most of the rest occurring in nickel-copper sulfide deposits hosted in mafic and ultramafic rocks in Australia, Canada, and Russia, and in the sedimentary copper deposits of Congo (Kinshasa) and Zambia. In addition, millions of tons of hypothetical and speculative cobalt resources exist in manganese nodules and crusts on the ocean floor.

Substitutes: In most applications, substitution of cobalt would result in a loss in product performance. Potential substitutes include barium or strontium ferrites, neodymium-iron-boron, or nickel-iron alloys in magnets; nickel, cermets, or ceramics in cutting and wear-resistant materials; nickel-base alloys or ceramics in jet engines; nickel in petroleum catalysts; rhodium in hydroformylation catalysts; cobalt-manganese-nickel in lithium-ion batteries; and cerium, iron, lead, manganese, or vanadium in paints.

[e]Estimated. NA Not available. — Zero.
[1]The sum of U.S. secondary production, as estimated from consumption of purchased scrap, and net import reliance.
[2]Defined as imports – exports + adjustments for Government and industry stock changes.
[3]No tariff for Canada or Mexico. Tariffs for other countries for some items may be eliminated under special trade agreements.
[4]See Appendix B for definitions.
[5]See Appendix C for definitions.
[6]Overseas territory of France.

COLUMBIUM (NIOBIUM)

(Data in metric tons of columbium content unless otherwise noted)

Domestic Production and Use: No significant U.S. columbium mine production has been reported since 1959. Domestic columbium resources are of low grade, some mineralogically complex, and most are not commercially recoverable. Five companies produced ferrocolumbium and columbium compounds, metal, and other alloys from imported columbium minerals, oxides, and ferrocolumbium. Consumption was mainly as ferrocolumbium by the steel industry and as columbium alloys and metal by the aerospace industry. Major end-use distribution of reported columbium consumption was as follows: carbon steels, 30%; high-strength low-alloy steels, 22%; superalloys, 20%; alloy steels, 14%; stainless and heat-resisting steels, 13%; and other, 1%. The estimated value of reported columbium consumption, in the form of ferrocolumbium and nickel-columbium alloy, in 2005, was $110 million.

Salient Statistics—United States:[1]	2001	2002	2003	2004	2005[e]
Production, mine	—	—	—	—	—
Imports for consumption:					
Mineral concentrates[e]	277	273	181	167	157
Columbium metal and alloys[e]	1,050	673	743	940	1,370
Columbium oxide[e]	1,360	654	585	633	770
Ferrocolumbium[e]	4,480	4,030	4,080	5,180	5,130
Exports, concentrate, metal, alloys[e]	83	111	143	196	303
Government stockpile releases[e, 2]	57	19	182	112	64
Consumption, reported, ferrocolumbium[e, 3]	4,230	3,150	3,650	3,940	3,640
Consumption, apparent	7,140	5,540	5,630	6,830	7,180
Price:					
Columbite, dollars per pound[4]	NA	NA	NA	NA	NA
Ferrocolumbium, dollars per pound[5]	6.88	6.60	6.58	6.56	6.58
Net import reliance[6] as a percentage of apparent consumption	100	100	100	100	100

Recycling: Columbium was recycled when columbium-bearing steels and superalloys were recycled; scrap recovery specifically for columbium content was negligible. The amount of columbium recycled is not available but may be as much as 20% of apparent consumption.

Import Sources (2001-04): Brazil, 77%; Canada, 10%; Estonia, 4%; China, 3%; and other, 6%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Columbium ores and concentrates	2615.90.6030	Free.
Columbium oxide	2825.90.1500	3.7% ad val.
Ferrocolumbium:		
Less than 0.02% of P or S, or less than 0.4% of Si	7202.93.4000	5.0% ad val.
Other	7202.93.8000	5.0% ad val.
Columbium, unwrought:		
Waste and scrap	8112.92.0500	Free.
Alloys, metal, powders	8112.92.4000	4.9% ad val.
Columbium, other	8112.99.0100	4.0% ad val.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: For fiscal year 2005, the Defense National Stockpile Center (DNSC), Defense Logistics Agency, disposed of 55 tons of columbium contained in columbium-tantalum mineral concentrates (no columbium value was obtained, as the columbium was contained within tantalum minerals) and about 9 tons of vacuum grade columbium metal valued at about $304,000 from the Defense National Stockpile. The DNSC's ferrocolumbium inventory was exhausted in fiscal year 2001, and its columbium carbide inventory was exhausted in fiscal year 2002. The DNSC announced maximum disposal limits for fiscal year 2006 of about 254 tons[7] of columbium contained in columbium concentrates and about 9 tons[7] of columbium metal ingots.

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COLUMBIUM (NIOBIUM)

Stockpile Status—9-30-05[8]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Columbium:					
Carbide powder	—	—	—	—	—
Concentrates	190	—	190	254	—
Ferrocolumbium	—	—	—	—	—
Metal	19	3	19	9	9

Events, Trends, and Issues: Columbium ferroalloys domestic demand in steelmaking remained strong, columbium demand in superalloys (mostly for aircraft engine components) increased compared with that of 2004, and overall apparent consumption rose about 4%. Columbium imports increased about 7% compared with those of 2004; Brazil accounted for about 84% of the quantity and about 79% of the value. Overall exports rose substantially owing to a more than doubling of ferrocolumbium exports to Canada, from about 140 tons in 2004 to about 330 tons in 2005. The published price for standard-grade (steelmaking-grade) ferrocolumbium was quoted at a range of $6.45 to $6.70 per pound of columbium content. Public information on current prices for other columbium products was not available. According to industry sources, the price for columbium oxide, columbium metal, other columbium chemicals, and various columbium alloys is variable and depends on product specifications, volume, and processing considerations. Pricing is normally established by negotiation between buyer and seller.

World Mine Production, Reserves, and Reserve Base:

	Mine production 2004	Mine production 2005[e]	Reserves[9]	Reserve base[9]
United States	—	—	—	Negligible
Australia	200	200	29,000	NA
Brazil	29,900	29,900	4,300,000	5,200,000
Canada	3,450	3,400	110,000	NA
Congo (Kinshasa)	52	52	NA	NA
Ethiopia	6	6	NA	NA
Mozambique	130	110	NA	NA
Namibia	1	1	NA	NA
Nigeria	170	170	NA	NA
Rwanda	63	63	NA	NA
Uganda	8	2	NA	NA
Other countries[10]	NA	NA	NA	NA
World total (rounded)	34,000	33,900	4,400,000	5,200,000

World Resources: World resources are more than adequate to supply projected needs. Most of the world's identified resources of columbium occur mainly as pyrochlore in carbonatite deposits and are outside the United States. The United States has approximately 150,000 tons of columbium resources in identified deposits, all of which were considered uneconomic at 2005 prices for columbium.

Substitutes: The following materials can be substituted for columbium, but a performance or cost penalty may ensue: molybdenum and vanadium as alloying elements in high-strength low-alloy steels; tantalum and titanium as alloying elements in stainless and high-strength steels; and ceramics, molybdenum, tantalum, and tungsten in high-temperature applications.

[e]Estimated. NA Not available. — Zero.
[1]Revisions principally based on reevaluation of import and export data.
[2]Net quantity (uncommitted inventory).
[3]Includes nickel columbium.
[4]Average of yearend trade journal reported prices, per pound of contained pentoxides for material having a Nb_2O_5 to Ta_2O_5 ratio of 10 to 1.
[5]Average of yearend trade journal reported prices, per pound of contained columbium, standard (steelmaking) grade.
[6]Defined as imports – exports + adjustments for Government and industry stock changes.
[7]Actual quantity limited to remaining sales authority; additional legislative authority is required.
[8]See Appendix B for definitions.
[9]See Appendix C for definitions.
[10]Bolivia, Burundi, China, Russia, Zambia, and Zimbabwe also produce (or are believed to produce) columbium mineral concentrates, but available information is inadequate to make reliable estimates of output levels.

COPPER

(Data in thousand metric tons of copper content unless otherwise noted)

Domestic Production and Use: Domestic mine production in 2005 fell nominally to 1.15 million tons and was valued at about $4.3 billion. The principal mining States, in descending order of production, Arizona, Utah, New Mexico, Nevada, and Montana, accounted for 99% of domestic production; copper was also recovered at mines in two other States. Although copper was recovered at 24 mines operating in the United States, 14 mines accounted for more than 99% of production. Three primary smelters, 4 electrolytic and 3 fire refineries, and 13 solvent extraction-electrowinning facilities operated during the year. Refined copper and direct-melt scrap were consumed at about 30 brass mills; 15 rod mills; and 500 foundries, chemical plants, and miscellaneous consumers. Copper and copper alloy products were used in building construction, 49%; electric and electronic products, 21%; transportation equipment, 11%; industrial machinery and equipment, 9%; and consumer and general products, 10%.[1]

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production:					
Mine	1,340	1,140	1,120	1,160	1,150
Refinery:					
Primary	1,630	1,440	1,250	1,260	1,180
Secondary	172	70	53	55	55
Copper from all old scrap	316	208	206	186	190
Imports for consumption:					
Ores and concentrates	46	72	27	23	([2])
Refined	991	927	882	807	920
Unmanufactured	1,400	1,230	1,140	1,060	1,140
Exports:					
Ores and concentrates	45	23	9	24	110
Refined	23	26	93	118	45
Unmanufactured	556	506	703	789	820
Consumption:					
Reported refined	2,620	2,370	2,290	2,410	2,270
Apparent unmanufactured[3]	2,500	2,610	2,430	2,550	2,290
Price, average, cents per pound:					
Domestic producer, cathode	76.9	75.8	85.2	133.9	169
London Metal Exchange, high-grade	71.6	70.7	80.7	130.0	165
Stocks, yearend, refined, held by U.S. producers, consumers, and metal exchanges	952	1,030	657	134	70
Employment, mine and mill, thousands	8.2	7.0	6.8	7.0	7.0
Net import reliance[4] as a percentage of apparent consumption	22	37	40	43	40

Recycling: Old scrap, converted to refined metal and alloys, provided 190,000 tons of copper, equivalent to 8% of apparent consumption. Purchased new scrap, derived from fabricating operations, yielded 750,000 tons of contained copper; about 88% of the copper contained in new scrap was consumed at brass or wire-rod mills. Of the total copper recovered from scrap (including aluminum- and nickel-base scrap), brass mills recovered 73%; copper smelters and refiners, 5%; ingot makers, 10%; and miscellaneous manufacturers, foundries, and chemical plants, 12%. Copper in all old and new, refined or remelted scrap contributed about 30% of the U.S. copper supply.

Import Sources (2001-04): Unmanufactured: Canada, 31%; Chile, 28%; Peru, 21%; Mexico, 9%; and other, 11%. Refined copper accounted for 75% of unwrought copper imports.

Tariff: Item	Number	Normal Trade Relations[5] 12-31-05
Copper ores and concentrates	2603.00.0000	1.7¢/kg lead content.
Unrefined copper; anodes	7402.00.0000	Free.
Refined and alloys; unwrought	7403.00.0000	1.0% ad val.
Copper wire (rod)	7408.11.6000	3.0% ad val.

Depletion Allowance: 15% (Domestic), 14% (Foreign).

Government Stockpile: The stockpile of about 20,000 tons of refined copper was liquidated in 1993. The stockpile of about 8,100 tons of brass was liquidated in 1994. Details on inventories of beryllium-copper master alloys (4% beryllium) can be found in the section on beryllium.

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COPPER

Events, Trends, and Issues: Copper prices trended upward throughout the year, and the COMEX spot price reached a record-high monthly average of $1.90 per pound in October. Despite a more than 3% estimated growth in world production of refined copper, production was insufficient to meet global demand, and the refined copper production deficit that had developed during the preceding 2 years continued through at least the first 3 quarters of 2005. Global inventories of refined copper held in metal exchange warehouses continued their downward trend, falling below 100,000 tons during the third quarter of the year. This shortfall occurred despite a decline in global consumption, which, according to estimates compiled by the International Copper Study Group,[6] declined slightly for the first 7 months of 2005 compared with that for the same period in 2004. Strong growth in China and India was more than offset by reduced use by other significant consumers. Global mine production fell short of its anticipated growth owing to production shortfalls in the United States and South America, and mine capacity utilization fell to its lowest level in recent years. New capacity and increased capacity utilization was expected to reverse the global production deficit, and a modest production surplus was anticipated for 2006.

In the United States, mine output fell to about 1,150,000 tons owing to unusually heavy spring rains, equipment shortages, and a strike by workers at one major producer that began in July and extended through the second week in November. Subsequent to the start of the strike, the company declared Chapter 11 Bankruptcy. Year-on-year U.S. consumption of refined copper fell during the first 9 months of 2005 owing to weaker demand and a surge in imports of wire rod in the first half of 2005. U.S. mine and refinery production were expected to increase in 2006 following settlement of the strike and the expected startup of a new electrowinning facility by yearend 2005.

World Mine Production, Reserves, and Reserve Base: Official reserves data reported by Poland may include properties being considered for future development.

	Mine production		Reserves[7]	Reserve base[7]
	2004	2005[e]		
United States	1,160	1,150	35,000	70,000
Australia	854	930	24,000	43,000
Canada	564	580	7,000	20,000
Chile	5,410	5,320	140,000	360,000
China	620	640	26,000	63,000
Indonesia	840	1,050	35,000	38,000
Kazakhstan	461	400	14,000	20,000
Mexico	406	420	27,000	40,000
Peru	1,040	1,000	30,000	60,000
Poland	531	530	30,000	48,000
Russia	675	675	20,000	30,000
Zambia	427	450	19,000	35,000
Other countries	1,610	1,750	60,000	110,000
World total (rounded)	14,600	14,900	470,000	940,000

World Resources: A recent assessment of U.S. copper resources indicated 550 million tons of copper in identified (260 million tons) and undiscovered resources (290 million tons), more than double the previous estimate.[8] By extension, global land-based resources are expected to be much larger than the previously published estimate of 1.6 billion tons. Resources in deep-sea nodules were estimated to contain 700 million tons of copper.

Substitutes: Aluminum substitutes for copper in power cables, electrical equipment, automobile radiators, and cooling/refrigeration tube; titanium and steel are used in heat exchangers; optical fiber substitutes for copper in some telecommunications applications; and plastics substitute for copper in water pipe, drain pipe, and plumbing fixtures.

[e]Estimated.
[1]Some electrical components are included in each end use. Distribution for 2004 by Copper Development Association, 2005.
[2]Less than ½ unit.
[3]Defined as primary refined production + copper from old scrap converted to refined metal and alloys + refined imports – refined exports ± changes in refined stocks. In 2001, 2002, 2003, 2004, and 2005, general imports of 1,200,000 tons, 1,060,000 tons, 687,000 tons, 704,000 tons, and 900,000 tons, respectively, were used to calculate apparent consumption.
[4]Defined as imports – exports + adjustments for Government and industry stock changes for refined copper.
[5]No tariff for Canada and Mexico for items shown. Tariffs for other countries for some items may be eliminated under special trade agreements.
[6]International Copper Study Group, 2005, July 2005 data: Lisbon, Portugal, International Copper Study Group press release, October 13, 1 p.
[7]See Appendix C for definitions.
[8]U.S. Geological Survey National Mineral Resource Assessment Team, 2000, 1998 assessment of undiscovered deposits of gold, silver, copper, lead, and zinc in the United States: U.S. Geological Survey Circular 1178, 21 p.

DIAMOND (INDUSTRIAL)

(Data in million carats unless otherwise noted)

Domestic Production and Use: In 2005, domestic production was estimated to be approximately 252 million carats, and the United States remained the world's leading market for industrial diamond. All domestic output was synthetic grit and powder. Two firms, one in Pennsylvania and the other in Ohio, accounted for all of the production. Nine firms produced polycrystalline diamond from diamond powder. Four companies recovered used industrial diamond as one of their principal operations. The following industry sectors were the major consumers of industrial diamond: computer chip production, construction, machinery manufacturing, mining services (drilling for mineral, oil, and gas exploration), stone cutting/polishing, and transportation systems (infrastructure and vehicles). Stone cutting and highway building and repair consumed most of the industrial stone. About 98% of the U.S. industrial diamond market now uses synthetic industrial diamond because its quality can be controlled and its properties can be customized to fit specific requirements.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Bort, grit, and dust and powder; natural and synthetic:					
Production:					
Manufactured diamond[e]	202	219	236	252	252
Secondary	10	5.7	4.7	4.6	4.6
Imports for consumption	281	185	250	240	289
Exports[1]	88	82	74	86	95
Sales from Government stockpile excesses	—	—	—	—	—
Consumption, apparent	405	328	417	411	451
Price, value of imports, dollars per carat	0.31	0.34	0.26	0.25	0.28
Net import reliance[2] as a percentage of apparent consumption	48	31	42	38	43
Stones, natural:					
Production:					
Mine	([3])	—	—	—	—
Secondary	([3])	([3])	([3])	([3])	([3])
Imports for consumption[4]	2.5	2.0	1.8	1.8	2.3
Exports[1]	1.0	1.1	0.3	0.5	—
Sales from Government stockpile excesses	0.5	0.4	0.4	0.4	—
Consumption, apparent	2.2	1.6	2.1	2.1	2.7
Price, value of imports, dollars per carat	3.54	5.43	3.09	7.77	12.55
Net import reliance[2] as a percentage of apparent consumption	91	88	91	80	84

Recycling: In 2005, the amount of diamond bort, grit, and dust and powder recycled was estimated to be 4.58 million carats. Lower prices of newly produced industrial diamond appear to be reducing the number and scale of diamond stone recycling operations. In 2005, it was estimated that 424,000 carats of diamond stone were recycled.

Import Sources (2001-04): Bort, grit, and dust and powder; natural and synthetic: Ireland, 34%; China, 27%; Ukraine, 13%; Russia, 7%; and other, 19%. Stones, primarily natural: Ireland, 32%; Russia, 15%; Switzerland, 15%; Belgium, 8%; and other, 30%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Miners' diamond, carbonados	7102.21.1010	Free.
Other	7102.21.1020	Free.
Industrial diamond, natural advanced	7102.21.3000	Free.
Industrial diamond, natural not advanced	7102.21.4000	Free.
Industrial diamond, other	7102.29.0000	Free.
Grit or dust and powder	7105.10.0000	Free.

Depletion Allowance: 14% (Domestic and foreign).

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DIAMOND (INDUSTRIAL)

Government Stockpile:

Stockpile Status—9-30-05[5]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Industrial stones	0.520	—	0.520	0.400	—

Events, Trends, and Issues: The United States will continue to be the world's leading market for industrial diamond into the next decade and will remain a significant producer and exporter of industrial diamond as well. Increase in U.S. demand for industrial diamond is likely to continue in the construction sector as the United States builds and repairs the Nation's highway system. Industrial diamond coats the cutting edge of saws used to cut cement in highway construction and repair work. One U.S. company has developed a chemical vapor deposition (CVD) method of growing nearly 100%-pure diamond. One research group has developed a CVD method which is even faster and uses microwave plasma technology. The greatest potential for CVD diamond will be in computing, where it will be able to function as a semiconductor at much higher speeds and temperatures than silicon.

World demand for diamond grit and powder will continue growing. Demand for synthetic diamond grit and powder is expected to be greater than for natural diamond material. Constant-dollar prices of synthetic diamond products probably will continue to decline as production technology becomes more cost effective; the decline is even more likely if competition from low-cost producers in China and Russia continues increasing.

World Mine Production, Reserves, and Reserve Base:[6]

	Mine production		Reserves[7]	Reserve base[7]
	2004	2005[e]		
United States	([3])	([3])	NA	NA
Australia	11.3	22.7	90	230
Botswana	7.8	7.5	130	225
China	1.0	0.1	10	20
Congo (Kinshasa)	22	22	150	350
Russia	14.2	10.4	40	65
South Africa	8.7	9	70	150
Other countries	2	2	85	210
World total (rounded)	67	74	580	1,250

World Resources: Natural diamond resources have been discovered in more than 35 countries. Natural diamond accounts for about 10% of all industrial diamond used, while synthetic diamond accounts for the remainder. At least 15 countries have the technology to produce synthetic diamond.

Substitutes: Materials that can compete with industrial diamond in some applications include manufactured abrasives, such as cubic boron nitride, fused aluminum oxide, and silicon carbide. Synthetic diamond rather than natural diamond is used for about 90% of industrial applications.

[e]Estimated. NA Not available. — Zero.
[1]Reexports no longer are combined with exports because increasing amounts of U.S. reexports obscure apparent consumption rates.
[2]Defined as imports – exports + adjustments for Government and industry stock changes.
[3]Less than ½ unit.
[4]May include synthetic miners' diamond.
[5]See Appendix B for definitions.
[6]Natural industrial diamond only. Note, however, that synthetic diamond production far exceeds natural industrial diamond output. Worldwide production of manufactured industrial diamond totaled at least 614 million carats in 2001; the leading producers included Ireland, Japan, Russia, and the United States.
[7]See Appendix C for definitions.

DIATOMITE

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: In 2005, domestic production of diatomite was estimated at 635,000 tons with an estimated processed value of $168 million, f.o.b. plant. Production was from 7 companies with 12 processing facilities in 4 States. Nevada and California were the principal producing States and accounted for about 78% of U.S. production in 2005. Estimated end uses of diatomite were filter aids, 68%; absorbents, 13%; fillers, 13%; and other (mostly cement manufacture and thermal insulation), 6%.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005**[e]
Production[1]	644	624	599	620	635
Imports for consumption	([2])	([2])	([2])	1	1
Exports	148	128	136	143	144
Consumption, apparent	496	496	463	478	492
Price, average value, dollars per ton, f.o.b. plant	256	270	255	258	264
Stocks, producer, yearend[e]	36	36	36	36	36
Employment, mine and plant, number[e]	1,000	1,000	1,000	1,000	1,000
Net import reliance[3] as a percentage of apparent consumption	E	E	E	E	E

Recycling: None.

Import Sources (2001-04): France, 60%; Italy, 20%; Spain, 11%; Mexico, 7%; and other, 2%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Siliceous fossil meals, including diatomite	2512.00.0000	Free.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

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DIATOMITE

Events, Trends, and Issues: The amount of domestically produced diatomite sold or used in 2005 increased slightly compared with that of 2004. Filtration (including the purification of beer, liquors, and wine and the cleansing of greases and oils) continued to be the largest end use for diatomite, also known as diatomaceous earth (D.E.). Other applications include the removal of microbial contaminants, such as bacteria, protozoa, and viruses, in public water systems, and the filtration of human blood plasma. D.E. filter aids have been successfully deployed in about 200 locations throughout the United States for the treatment of potable water. Emerging applications for diatomite include pharmaceutical processing and use as an insecticide that is nontoxic to humans.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[4]	Reserve base[4]
	2004	2005[e]		
United States[1]	620	635	250,000	500,000
China	390	400	110,000	410,000
Commonwealth of Independent States	80	80	NA	13,000
Czech Republic	30	35	4,500	4,800
Denmark[5] (processed)	233	234	NA	NA
France	75	75	NA	2,000
Japan	130	130	NA	NA
Mexico	70	60	NA	2,000
Peru	35	35	2,000	5,000
Romania	30	30	NA	NA
Spain	35	36	NA	NA
Other countries	202	200	550,000	NA
World total (rounded)	1,930	1,950	920,000	Large

World Resources: World resources of crude diatomite are adequate for the foreseeable future, but the need for diatomite to be near markets because of transportation costs encourages development of new sources for the material.

Substitutes: Many materials can be substituted for diatomite. However, the unique properties of diatomite assure its continuing use in many applications. Expanded perlite and silica sand compete for filtration. Synthetic filters, notably ceramic, polymeric, or carbon membrane filters and filters made with cellulose fibers, are also becoming competitive as filter media. Alternate filler materials include talc, ground silica sand, ground mica, clay, perlite, vermiculite, and ground limestone. For thermal insulation, materials such as various clays, special brick, mineral wool, expanded perlite, and exfoliated vermiculite can be used.

[e]Estimated. E Net exporter. NA Not available.
[1]Processed ore sold and used by producers.
[2]Less than ½ unit.
[3]Defined as imports – exports + adjustments for Government and industry stock changes.
[4]See Appendix C for definitions.
[5]Includes sales of moler production.

FELDSPAR

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: U.S. feldspar production in 2005 had an estimated value of about $44 million. The three leading producers accounted for about two-thirds of the production, with six other companies supplying the remainder. Operations in North Carolina provided more than 40% of the output; facilities in Virginia, California, Oklahoma, Georgia, Idaho, and South Dakota, in estimated descending order of production, produced the remainder. Feldspar processors reported coproduct recovery of mica and silica sand.

Feldspar is ground to about 20 mesh for glassmaking and to 200 mesh or finer for most ceramic and filler applications. It was estimated that feldspar shipments went to at least 30 States and to foreign destinations, including Canada and Mexico. In pottery and glass, feldspar functions as a flux. The estimated 2005 end-use distribution of domestic feldspar was glass, 65%, and pottery and other, 35%.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production, marketable[e]	800	790	800	770	760
Imports for consumption	6	5	8	21	25
Exports	5	10	9	10	12
Consumption, apparent[e]	801	785	799	781	773
Price, average value, marketable production, dollars per ton[e]	55	54	54	57	58
Stocks, producer, yearend[1]	NA	NA	NA	NA	NA
Employment, mine and preparation plant, number[e]	400	400	400	400	400
Net import reliance[2] as a percentage of apparent consumption	([3])	E	E	1	2

Recycling: There is no recycling of feldspar by producers; however, glass container producers use cullet (recycled glass), thereby reducing feldspar consumption.

Import Sources (2001-04): Mexico, 58%; Turkey, 41%; and other, 1%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Feldspar	2529.10.0000	Free.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

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FELDSPAR

Events, Trends, and Issues: Glass, including beverage containers and insulation for housing and building construction, continued to be the leading end use of feldspar in the United States. U.S. shipments of glass containers in the first 8 months were about the same as in the comparable period of 2004, according to the U.S. Census Bureau.

Feldspar use in tile and vitreous sanitaryware was reflected in housing construction. U.S. housing starts for the first 8 months were about 6% higher than in the same period of 2004, according to the U.S Census Bureau.

China has had major growth in the production of tile, sanitaryware, and tableware and has had significant impact on world markets in the last several years. Other countries in Europe or in neighboring Asian countries which directly compete in this sector, especially in lower cost products, have experienced loss of market share. Countries such as Indonesia, the Philippines, and Sri Lanka have been seeking state protection, such as tariff increases.[4]

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves and reserve base[5]
	2004	2005[e]	
United States[e]	770	760	Quantitative estimates of reserves and reserve base are not available.
Colombia	100	100	
Czech Republic	400	450	
Egypt	350	350	
France	650	650	
Germany	450	500	
India	150	150	
Iran	200	200	
Italy	2,500	2,500	
Korea, Republic of	480	550	
Mexico	350	370	
Poland	300	320	
Portugal	120	120	
Spain	450	450	
Thailand	825	1,000	
Turkey	1,900	2,000	
Venezuela	150	175	
Other countries	955	900	
World total (rounded)	11,100	11,500	

World Resources: Identified and hypothetical resources of feldspar are more than adequate to meet anticipated world demand. Quantitative data on resources of feldspar existing in feldspathic sands, granites, and pegmatites generally have not been compiled. There is ample geologic evidence that resources are large, although not always conveniently accessible to the principal centers of consumption.

Substitutes: Feldspar can be replaced in some of its end uses by clays, electric furnace slag, feldspar-silica mixtures, pyrophyllite, spodumene, or talc. Imported nepheline syenite, however, was the major alternative material.

[e]Estimated. E Net exporter. NA Not available.
[1]Change in stocks assumed to be zero for apparent consumption and net import reliance calculations.
[2]Defined as imports – exports + adjustments for Government and industry stock changes.
[3]Less than ½ unit.
[4]King, Laura, 2005, Asian Ceramics: Industrial Minerals, no. 452, May, p. 49-51.
[5]See Appendix C for definitions.

FLUORSPAR

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: There was little or no domestic mining of fluorspar in 2005. Some byproduct calcium fluoride was recovered from industrial waste streams, although data are not available on exact quantities. Material purchased from the National Defense Stockpile or imported was screened and dried for resale to customers. Domestically, about 87% of reported fluorspar consumption went into the production of hydrofluoric acid (HF) in Louisiana and Texas and aluminum fluoride in Texas. HF is the primary feedstock for the manufacture of virtually all organic and inorganic fluorine-bearing chemicals and is also a key ingredient in the processing of aluminum and uranium. The remaining 13% of the reported fluorspar consumption was as a flux in steelmaking, in iron and steel foundries, primary aluminum production, glass manufacture, enamels, welding rod coatings, cement production, and other uses or products. An estimated 49,000 tons of fluorosilicic acid (equivalent to about 86,000 tons of 92% fluorspar) was recovered from phosphoric acid plants processing phosphate rock. Fluorosilicic acid was used primarily in water fluoridation, either directly or after processing into sodium silicofluoride.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production:					
Finished, all grades[1]	NA	—	—	—	—
Fluorspar equivalent from phosphate rock	104	92	94	90	86
Imports for consumption:					
Acid grade	495	466	533	546	550
Metallurgical grade	27	28	34	53	50
Total fluorspar imports	522	494	567	599	600
Fluorspar equivalent from hydrofluoric acid plus cryolite	176	182	180	197	208
Exports[2]	21	24	31	21	23
Shipments from Government stockpile	65	23	75	62	22
Consumption:					
Apparent[3]	543	477	589	691	600
Reported	536	588	616	673	634
Stocks, yearend, consumer and dealer[4]	221	245	206	105	104
Employment, mine and mill, number	5	—	—	—	—
Net import reliance[5] as a percentage of apparent consumption	100	100	100	100	100

Recycling: A few thousand tons per year of synthetic fluorspar is recovered primarily from uranium enrichment, but also from petroleum alkylation and stainless steel pickling. Primary aluminum producers recycled HF and fluorides from smelting operations. HF is recycled in the petroleum alkylation process.

Import Sources (2001-04): China, 63%; South Africa, 19%; Mexico, 15%; and other, 3%.

Tariff: Item	**Number**	**Normal Trade Relations 12-31-05**
Acid grade (97% or more CaF_2)	2529.22.0000	Free.
Metallurgical grade (less than 97% CaF_2)	2529.21.0000	Free.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: During fiscal year 2005, the Defense National Stockpile Center (DNSC) sold about 47,800 tons (52,700 short dry tons) of metallurgical grade and 10,000 tons (11,000 short dry tons) of acid grade from the Defense National Stockpile. Under the proposed fiscal year 2006 Annual Materials Plan, the DNSC will be authorized to sell 54,400 tons (60,000 short dry tons) of metallurgical grade and 10,900 tons (12,000 short dry tons) of acid grade, although actual quantities will be limited to remaining inventory.

Stockpile Status—9-30-05[6]

Material	**Uncommitted inventory**	**Committed inventory**	**Authorized for disposal**	**Disposal plan FY 2005**	**Disposals FY 2005**
Acid grade	5	5	5	11	53
Metallurgical grade	40	47	40	54	10

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FLUORSPAR

Events, Trends, and Issues: Tiberon Minerals Ltd. announced the completion of the final feasibility study for the Nui Phao tungsten-fluorspar project in Vietnam. The study concluded that the project could successfully produce more than 210,000 tons per year of fluorspar, 4,700 tons per year of tungsten, and quantities of bismuth, copper, and gold. In addition, the Vietnamese Government granted the project a mining license, which allows Tiberon and its partners to proceed with financing, construction, and startup of the mining operation, which is scheduled for early 2008.[7]

There were spot shortages of fluorosilicic acid for water fluoridation during the summer, which resulted in higher prices. The shortages were caused by the ongoing shutdown (expected to close in December 2005) of U.S. Agri-Chemicals Corp.'s phosphoric acid plant in Fort Meade, FL, and by increased demand from communities starting up new fluoridation programs (especially in California).[8] In previous years, the Fort Meade plant had produced about 15% of U.S. annual production of fluorosilicic acid and accounted for an even higher percentage of the amount sold for water fluoridation.

There continues to be concern among environmental groups and some scientists over the possible health effects of fluorides, especially on certain age groups. In response to research that appears to offer evidence for the carcinogenicity of fluoride in young boys, a coalition of U.S. Environmental Protection Agency (EPA) unions has requested a moratorium on the national program of the U.S. Public Health Service to fluoridate all U.S. public water supplies. In a related fluoride issue, environmental groups have petitioned the EPA to retract the recently finalized fluoride pesticide tolerances on food. The rule pertains to the fluoride-based pesticide, sulfuryl fluoride, which is used as a pesticide in the structural fumigation industry, but has now been approved as a fumigant to replace the ozone-depleting chemical, methyl bromide, in the food processing, grain milling, and stored commodity industries.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[9, 10]	Reserve base[9, 10]
	2004	2005[e]		
United States	—	—	NA	6,000
China	2,700	2,700	21,000	110,000
France	90	95	10,000	14,000
Kenya	108	110	2,000	3,000
Mexico	808	750	32,000	40,000
Mongolia	295	350	12,000	16,000
Morocco	81	85	NA	NA
Namibia	[11]105	[11]112	3,000	5,000
Russia	170	170	Moderate	18,000
South Africa	275	275	41,000	80,000
Spain	140	140	6,000	8,000
Other countries	290	290	110,000	180,000
World total (rounded)	5,060	5,080	230,000	480,000

World Resources: Identified world fluorspar resources were approximately 500 million tons of contained fluorspar. The quantity of fluorine present in phosphate rock deposits is enormous. Current U.S. reserves of phosphate rock are estimated to be 1.0 billion tons, which at 3.5% fluorine would contain 35 million tons of fluorine, equivalent to about 72 million tons of fluorspar. World reserves of phosphate rock are estimated to be 18 billion tons, equivalent to 630 million tons of fluorine and 1.29 billion tons of fluorspar.

Substitutes: Olivine and/or dolomitic limestone have been used as substitutes for fluorspar. Byproduct fluorosilicic acid from phosphoric acid production has been used as a substitute in aluminum fluoride production, and also has the potential to be used as a substitute in HF production.

[e]Estimated. NA Not available. — Zero.
[1]Shipments.
[2]Exports are all general imports reexported or National Defense Stockpile material exported.
[3]Excludes fluorspar equivalent of fluorosilicic acid, hydrofluoric acid, and cryolite.
[4]Industry stocks for three leading consumers, fluorspar distributors, and National Defense Stockpile material committed for sale pending shipment.
[5]Defined as imports – exports + adjustments for Government and industry stock changes.
[6]See Appendix B for definitions.
[7]Tiberon Minerals Ltd., 2005, Press releases, accessed August 31, 2005, via URL http://www.tiberon.com/pressreleases.html.
[8]McCoy, Michael, 2005, Fluoride shortfall: Chemical and Engineering News, v. 83, no. 40, October 3, p. 12.
[9]See Appendix C for definitions.
[10]Measured as 100% calcium fluoride.
[11]Data are in wet tons.

GALLIUM

(Data in kilograms of gallium content unless otherwise noted)

Domestic Production and Use: No domestic primary gallium recovery was reported in 2005. One company in Utah recovered and refined gallium from scrap and impure gallium metal, and one company in Oklahoma refined gallium from impure metal. Imports of gallium, which supplied most of U.S. gallium consumption, were valued at about $4 million. Gallium arsenide (GaAs) and gallium nitride (GaN) electronic components represented about 98% of domestic gallium consumption. About 46% of the gallium consumed was used in integrated circuits. Optoelectronic devices, which include light-emitting diodes (LEDs), laser diodes, photodetectors, and solar cells, represented 36% of gallium demand. The remaining 18% was used in research and development, specialty alloys, and other applications. Optoelectronic devices were used in areas such as aerospace, consumer goods, industrial equipment, medical equipment, and telecommunications. Integrated circuits were used in defense applications, high-performance computers, and telecommunications.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production, primary	—	—	—	—	—
Imports for consumption	27,100	13,100	14,300	19,400	16,000
Exports	NA	NA	NA	NA	NA
Consumption:					
Reported	27,700	18,600	20,100	21,500	21,000
Apparent	NA	NA	NA	NA	NA
Price, yearend, dollars per kilogram, 99.99999%-pure[1]	[2]640	530	411	494	512
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, refinery, number[e]	20	20	20	20	20
Net import reliance[3] as a percentage of reported consumption[e]	99	99	99	99	99

Recycling: Old scrap, none. Substantial quantities of new scrap generated in the manufacture of GaAs-base devices were reprocessed.

Import Sources (2001-04): China, 39%; France, 19%; Japan, 9%; Russia, 9%; and other, 24%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Gallium metal	8112.92.1000	3.0% ad val.
Gallium arsenide wafers, undoped	2851.00.0010	2.8% ad val.
Gallium arsenide wafers, doped	3818.00.0010	Free.

Depletion Allowance: Not applicable.

Government Stockpile: None.

Events, Trends, and Issues: Imports of gallium and GaAs continued to supply almost all U.S. demand for gallium and were slightly lower than those in 2004.

Japan’s supply of gallium was expected to increase slightly from 134 metric tons in 2004 to 136 metric tons in 2005. Production was estimated to be 9 metric tons; recycled scrap, 82 metric tons; and imports, 45 metric tons. Included in the imports was 11.5 metric tons of 99%-pure gallium from the Republic of Korea and Taiwan; this is most likely recycled scrap. Imports have been declining since 2001 when an overestimation of demand led to a buildup in stocks. China, with 13 metric tons, was projected to be the largest gallium supplier to Japan. A small (1%) growth in demand for gallium from 2004 to 2005 was expected to be from higher demand for GaAs at the expense of gallium phosphide (GaP). Although LEDs represent 50% of the market for compound semiconductors in Japan, the mix has shifted away from GaP-base LEDs to GaAs-base LEDs.

Gallium prices increased during 2005. At the beginning of the year, 99.99%-pure gallium was estimated to be selling at $275 to $325 per kilogram. This price range rose to $300 to $350 per kilogram in April. By midyear, the price had risen to about $400 per kilogram. The high-purity gallium (99.9999% to 99.99999%) price range was estimated to be $500 to $600 per kilogram, which had been stable though most of 2005.

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GALLIUM

Consolidation of companies continued in GaAs device and LED production sectors. Several large U.S. firms divested themselves of their GaAs device manufacturing operations. In addition, two of the leading LED producers in Taiwan merged to create the largest LED producer in the country. Research in academia, government, and private industry continued to develop GaN production methods that would reduce costs and yield high-quality products.

Market analysts predicted that the world market for semi-insulating GaAs substrates would increase from 14 million square inches in 2004 to 20 million square inches in 2009. Although many companies had planned to switch GaAs substrate production from 4-inch diameter to 6-inch diameter in 2003, 4-inch-diameter material sales still accounted for about 50% of the market in 2005. The cellular telephone market was expected to continue to remain the dominant application for GaAs-base components.

The market for high-brightness LEDs was expected to nearly double from 2004 to 2009. Growth was expected to be in automotive headlamps, backlights for liquid crystal displays and television monitors, and general illumination (the interior and exterior lighting of homes and buildings). High-brightness LEDs, however, were not expected to achieve significant use in general illumination applications until costs are reduced.

World Production, Reserves, and Reserve Base:[4] Data on world production of primary gallium are unavailable because data on the output of the few producers are considered to be proprietary. However, in 2005, world primary production was estimated to be about 63 metric tons, about 5% higher than that in 2004. China, Germany, Japan, and Ukraine were the leading producers; countries with smaller output were Hungary, Russia, and Slovakia. Refined gallium production was estimated to be about 91 metric tons; this figure includes some scrap refining. France was the leading producer of refined gallium, using as feed material crude gallium produced in Germany. Japan and the United States were the other large gallium-refining countries. Gallium was recycled from new scrap in Germany, Japan, the United Kingdom, and the United States. World primary gallium production capacity in 2005 was estimated to be 160 metric tons; refinery capacity, 140 tons; and recycling capacity, 68 tons.

Gallium occurs in very small concentrations in ores of other metals. Most gallium is produced as a byproduct of treating bauxite, and the remainder is produced from zinc-processing residues. Only part of the gallium present in bauxite and zinc ores is recoverable, and the factors controlling the recovery are proprietary. Therefore, an estimate of current reserves that is comparable to the definition of reserves of other minerals cannot be made. The world bauxite reserve base is so large that much of it will not be mined for many decades; hence, most of the gallium in the bauxite reserve base cannot be considered to be available in the short term.

World Resources: Assuming that the average content of gallium in bauxite is 50 parts per million (ppm), U.S. bauxite resources, which are mainly subeconomic deposits, contain approximately 15 million kilograms of gallium. About 2 million kilograms of this metal is present in the bauxite deposits in Arkansas. Some domestic zinc ores contain as much as 50 ppm gallium and, as such, could be a significant resource. World resources of gallium in bauxite are estimated to exceed 1 billion kilograms, and a considerable quantity could be present in world zinc reserves. The foregoing estimates apply to total gallium content; only a small percentage of this metal in bauxite and zinc ores is economically recoverable.

Substitutes: Liquid crystals made from organic compounds are used in visual displays as substitutes for LEDs. Researchers also are working to develop organic-base LEDs that may compete with GaAs in the future. Indium phosphide components can be substituted for GaAs-base infrared laser diodes in some specific-wavelength applications, and GaAs competes with helium-neon lasers in visible laser diode applications. Silicon is the principal competitor for GaAs in solar cell applications. GaAs-base integrated circuits are used in many defense-related applications because of their unique properties, and there are no effective substitutes for GaAs in these applications. GaAs in heterojunction bipolar transistors is being challenged in some applications by silicon-germanium.

[e]Estimated. NA Not available. — Zero.
[1]Estimated average values of U.S. imports for 99.9999%- and 99.99999%-pure gallium.
[2]Source: American Metal Market.
[3]Defined as imports – exports + adjustments for Government and industry stock changes.
[4]See Appendix C for definitions.

GARNET (INDUSTRIAL)[1]

(Data in metric tons of garnet unless otherwise noted)

Domestic Production and Use: Garnet for industrial use was mined in 2005 by three firms, one in Idaho and two in New York. The estimated value of crude garnet production was about $3.05 million, while refined material sold or used had an estimated value of $10.0 million. Major end uses for garnet were abrasive blasting media, 35%; waterjet cutting, 30%; water filtration, 15%; abrasive powders, 10%; and other end uses, 10%.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production (crude)	52,700	38,500	29,200	28,400	28,400
Sold by producers	46,200	37,500	33,100	30,400	30,400
Imports for consumption[e]	23,000	23,000	30,800	36,500	33,200
Exports[e]	10,000	10,400	11,000	10,900	13,300
Consumption, apparent[e]	59,300	56,300	83,200	58,600	50,300
Price, range of value, dollars per ton[2]	50-2,000	50-2,000	50-2,000	50-2,000	50-2,000
Stocks, producer[e]	50,000	43,800	13,600	11,000	11,000
Employment, mine and mill, number[e]	220	200	180	160	160
Net import reliance[3] as a percentage of apparent consumption	22	33	60	48	40

Recycling: Small amounts of garnet reportedly are recycled.

Import Sources (2001-04):[e] Australia, 39%; India, 26%; China, 18%; Canada, 12%; and other, 5%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Emery, natural corundum, natural garnet, and other natural abrasives, crude	2513.20.1000	Free.
Emery, natural corundum, natural garnet, and other natural abrasives, other than crude	2513.20.9000	Free.
Natural abrasives on woven textile	6805.10.0000	Free.
Natural abrasives on paper or paperboard	6805.20.0000	Free.
Natural abrasives sheets, strips, disks, belts, sleeves, or similar form	6805.30.1000	Free.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

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GARNET (INDUSTRIAL)

Events, Trends, and Issues: During 2005, U.S. garnet consumption decreased 14%, while domestic production of crude garnet concentrates remained the same as that of 2004. In 2005, imports were estimated to have decreased 9% compared with 2004, and exports were estimated to have increased more than 21% from those of 2004. The 2005 estimated domestic sales of garnet remained at about the same level as sales of 2004. In 2005, the United States was a net importer. Garnet imports have displaced U.S. production in the domestic market, with Australia, Canada, China, and India being major garnet suppliers.

The garnet market is very competitive. To increase profitability, garnet mines will have to produce other salable minerals (in addition to garnet) from the same deposits.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[4]	Reserve base[4]
	2004	2005[e]		
United States	28,400	28,400	5,000,000	25,000,000
Australia	150,000	155,000	1,000,000	7,000,000
China	28,000	29,000	Moderate to Large	Moderate to Large
India	64,000	65,000	90,000	5,400,000
Other countries	31,800	34,800	6,500,000	20,000,000
World total (rounded)	302,000	312,000	Moderate	Large

World Resources: World resources of garnet are large and occur in a wide variety of rocks, particularly gneisses and schists. Garnet also occurs as contact-metamorphic deposits in crystalline limestones, pegmatites, serpentinites, and vein deposits. In addition, alluvial garnet is present in many heavy-mineral sand and gravel deposits throughout the world. Large domestic resources of garnet also are concentrated in coarsely crystalline gneiss near North Creek, NY; other significant domestic resources of garnet occur in Idaho, Maine, Montana, New Hampshire, North Carolina, and Oregon. In addition to the United States, major garnet deposits exist in Australia, China, and India, where they are mined for foreign and domestic markets; deposits in Russia and Turkey also have been mined in recent years, primarily for internal markets. Additional garnet resources are located in Canada, Chile, Czech Republic, Pakistan, South Africa, Spain, Thailand, and Ukraine; small mining operations have been reported in most of these countries.

Substitutes: Other natural and manufactured abrasives can substitute to some extent for all major end uses of garnet. In many cases, however, the substitutes would entail sacrifices in quality or cost. Fused aluminum oxide and staurolite compete with garnet as a sandblasting material. Ilmenite, magnetite, and plastics compete as filtration media. Diamond, corundum, and fused aluminum oxide compete for lens grinding and for many lapping operations. Emery is a substitute in nonskid surfaces. Finally, quartz sand, silicon carbide, and fused aluminum oxide compete for the finishing of plastics, wood furniture, and other products.

[e]Estimated.
[1]Excludes gem and synthetic garnet.
[2]Includes both crude and refined garnet; most crude concentrate is $50 to $150 per ton, and most refined material is $150 to $450 per ton.
[3]Defined as imports – exports + adjustments for industry stock changes.
[4]See Appendix C for definitions.

GEMSTONES[1]

(Data in million dollars unless otherwise noted)

Domestic Production and Use: The combined value of U.S. natural and synthetic gemstone output increased by 29% in 2005 from that of 2004. The value of natural gemstones production decreased by 4% during 2005. Domestic gemstone production included agates, amber, beryl, coral, garnet, jade, jasper, opal, pearl, quartz, sapphire, shell, topaz, tourmaline, turquoise, and many other gem materials. In decreasing order, Tennessee, Arizona, Oregon, California, Idaho, Montana, Arkansas, and Nevada produced 84% of U.S. natural gemstones. The value of laboratory-created (synthetic) gemstones production increased by more than 44% during the year, owing to increases in the production of moissanite and of laboratory-created and cultured diamonds. Laboratory-created gemstones were manufactured by five firms in North Carolina, Florida, Massachusetts, Michigan, and Arizona, in decreasing order of production. Major gemstone uses were jewelry, carvings, and gem and mineral collections.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production:[2]					
Natural[3]	14.9	12.6	12.5	14.5	13.9
Laboratory-created (synthetic)	24.7	18.1	33.4	30.7	44.3
Imports for consumption	11,300	12,900	13,600	15,400	16,900
Exports, including reexports[4]	4,320	4,880	5,490	7,230	8,580
Consumption, apparent[5]	7,020	8,050	8,160	8,220	8,380
Price	Variable, depending on size, type, and quality				
Employment, mine, number[e]	1,200	1,200	1,200	1,200	1,200
Net import reliance[6] as a percentage of apparent consumption	99	99	99	99	99

Recycling: Insignificant.

Import Sources (2001-04 by value): Israel, 50%; India, 20%; Belgium, 18%; and other, 12%. Diamond imports accounted for 94% of the total value of gem imports.

Tariff: **Item**	**Number**	**Normal Trade Relations 12-31-05**
Diamonds, unworked or sawn	7102.31.0000	Free.
Diamond, ½ carat or less	7102.39.0010	Free.
Diamond, cut, more than ½ carat	7102.39.0050	Free.
Precious stones, unworked	7103.10.2000	Free.
Precious stones, simply sawn	7103.10.4000	10.5% ad val.
Rubies, cut	7103.91.0010	Free.
Sapphires, cut	7103.91.0020	Free.
Emeralds, cut	7103.91.0030	Free.
Other precious stones, cut but not set	7103.99.1000	Free.
Other precious stones	7103.99.5000	10.5% ad val.
Imitation precious stones	7018.10.2000	Free.
Synthetic cut, but not set	7104.90.1000	Free.
Pearls, natural	7101.10.0000	Free.
Pearls, cultured	7101.21.0000	Free.
Pearls, imitation, not strung	7018.10.1000	4.0% ad val.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: The National Defense Stockpile (NDS) does not contain an inventory of gemstones. However, a very small portion of the industrial diamond stone inventory is of near-gem quality. Additionally, the beryl and quartz crystal inventories contain some gem-quality material that could be used by the gem industry. The U.S. Department of Defense is currently selling some NDS materials that may be near-gem quality.

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GEMSTONES

Events, Trends, and Issues: In 2005, the U.S. market for unset gem-quality diamonds was estimated to have exceeded $14.6 billion, accounting for more than an estimated 35% of world demand. The domestic market for natural, unset nondiamond gemstones was estimated to be about $859 million. The United States is expected to dominate global gemstone consumption throughout this decade.

Canada's Ekati Mine completed its sixth full year in 2004, with diamond production of 4.08 million carats. The Diavik Diamond Mine completed its second full year in 2004, with diamond production of 7.57 million carats. Diamond exploration is continuing in Canada, and many new deposits have been found. Canada produced about 14% of the world's natural gemstone diamond production in 2004.

The success of Canadian diamond mines has stimulated interest in whether there are also commercially feasible diamond deposits in the United States. Currently, there are no operating commercial diamond mines in the United States. Australian and Canadian companies are now conducting diamond exploration in Alaska and Minnesota.

World Mine Production,[7] Reserves, and Reserve Base: Mine production in 2005 for Angola, Australia, the Central African Republic, Guinea, Namibia, Sierra Leone, South Africa, and Tanzania increased, while production for Botswana, Canada, and Ghana decreased based on submissions from country sources.

	Mine production	
	2004	2005[e]
United States	([9])	([9])
Angola	5,400	6,300
Australia	9,280	20,600
Botswana	23,300	23,000
Brazil	500	500
Canada	12,600	11,700
Central African Republic	250	300
China	250	250
Congo (Kinshasa)	6,000	6,000
Ghana	800	640
Guinea	468	550
Guyana	450	450
Namibia	2,000	2,100
Russia	21,400	21,400
Sierra Leone	309	360
South Africa	5,780	6,000
Tanzania	305	370
Other countries[10]	300	300
World total (rounded)	89,400	101,000

Reserves and reserve base[8]

World reserves and reserve base of diamond-bearing deposits are substantial. No reserves or reserve base data are available for other gemstones.

World Resources: Most diamond-bearing ore bodies have a diamond content that ranges from less than 1 carat per ton to about 6 carats per ton. The major gem diamond reserves are in southern Africa, Australia, Canada, and Russia.

Substitutes: Plastics, glass, and other materials are substituted for natural gemstones. Synthetic gemstones (manufactured materials that have the same chemical and physical properties as gemstones) are common substitutes. Simulants (materials that appear to be gems, but differ in chemical and physical characteristics) also are frequently substituted for natural gemstones.

[e]Estimated.
[1]Excludes industrial diamond and garnet. See Diamond (Industrial) and Garnet (Industrial).
[2]Estimated minimum production.
[3]Includes production of freshwater shell.
[4]Reexports account for about 78% of the totals.
[5]If reexports were not considered, apparent consumption would be significantly greater.
[6]Defined as imports – exports and reexports + adjustments for Government and industry stock changes.
[7]Data in thousands of carats of gem diamond.
[8]See Appendix C for definitions.
[9]Less than ½ unit.
[10]In addition to countries listed, Cote d'Ivoire, Gabon, Guyana, India, Indonesia, Liberia, and Venezuela are known to produce gem diamonds.

GERMANIUM

(Data in kilograms of germanium content unless otherwise noted)

Domestic Production and Use: The value of domestic refinery production of germanium, based upon an estimated 2005 producer price, was $2.7 million. Germanium production in the United States comes from either the refining of imported germanium compounds or industry-generated scrap. The production series for refined germanium was revised significantly downward to avoid double-counting of material imported in chemical form and directly consumed or consumed in the production of other germanium compounds. Germanium was recovered from zinc concentrates produced at two domestic zinc mines, one in Alaska and the other in Washington that were exported to Canada for processing. Another mine in Tennessee produced germanium-rich zinc concentrates until its closure in mid-2003.

A germanium refinery in Utica, NY, produced germanium tetrachloride for optical fiber production. Another refinery in Oklahoma produced refined germanium compounds for the production of fiber optics, infrared devices, and substrates for electronic devices. Six companies account for most of the U.S. germanium consumption. The major end uses for germanium, worldwide, were estimated to be polymerization catalysts, 31%; fiber-optic systems, 24%; infrared optics, 23%; electronics/solar electric applications, 12%; and other (phosphors, metallurgy, and chemotherapy), 10%. Domestically, these end uses varied and were estimated to be fiber-optic systems, 40%; infrared optics, 30%; electronics/solar electric applications, 20%; and other (phosphors, metallurgy, and chemotherapy), 10%. Germanium is not used in polymerization catalysts in the United States.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production, refinery[e]	5,400	4,900	4,700	4,400	4,500
Total imports[1]	15,200	19,900	15,500	24,400	23,400
Total exports[1]	31,400	20,100	6,200	13,800	26,500
Shipments from Government stockpile excesses	5,730	681	1,760	7,190	5,000
Consumption, estimated	28,000	28,000	20,000	25,000	27,000
Price, producer, yearend, dollars per kilogram:					
Zone refined	890	620	380	600	610
Dioxide, electronic grade	575	400	245	400	405
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, plant[2] number[e]	90	85	65	65	65
Net import reliance[3] as a percentage of estimated consumption	NA	NA	NA	NA	NA

Recycling: Worldwide, about 35% of the total germanium consumed is produced from recycled materials. During the manufacture of most electronic and optical devices, more than 60% of the germanium metal used is routinely recycled as new scrap. Little domestic germanium returns as old scrap because there is a low unit use of germanium in most electronic and infrared devices. Because new European directives on Waste Electrical and Electronic Equipment (WEEE) mandate the recycling of electronics, the supply of old scrap within the European Union is expected to increase.

Import Sources (2001-04):[4] Canada, 28%; China, 22%; Belgium, 21%; Russia, 8%; and other, 21%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Germanium oxides	2825.60.0000	3.7% ad val.
Waste and scrap	8112.30.3000	Free.
Metal, unwrought	8112.30.6000	2.6% ad val.
Metal, wrought	8112.30.9000	4.4% ad val.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile:

Stockpile Status—9-30-05[5]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Germanium	30,036	—	30,036	8,000	4,870

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GERMANIUM

Events, Trends, and Issues: For 2004, an estimated 87 metric tons of germanium was produced worldwide, with Canada and China the leading producers (29% and 27%, respectively), while world consumption was estimated to be 88 metric tons. This slight deficit continued and grew some in 2005. The germanium supply-demand balance was projected to continue in a deficit at least through 2007. Recycling of new scrap continued to increase and remained a significant supply factor, as the primary supply of germanium was well below the level of consumption. Supply capacity, which is defined as availability of primary material, recyclable waste material, and processing facilities, was expected to meet future demand. Also, there has been some renewed interest in the recovery of germanium from coal fly ash in areas outside of China and Russia.

Demand for germanium increased in 2005 because of the growth of fiber-optic use in the Far East, the increased use of germanium-base infrared lenses for night-vision applications in luxury cars, and the continued demand for military night vision equipment. Germanium consumption as a catalyst for polyethylene terephthalate (PET) production has remained stable.

A new use is the potential replacement of gallium arsenide by silicon-germanium (SiGe) in wireless telecommunications devices. SiGe chips combine the high-speed properties of germanium with the low-cost, well-established production techniques of the silicon-chip industry. A tarnish-proof sterling silver alloy, trademarked Argentium, requires 1.2% germanium. The recent rise in energy cost has improved the economics of solar panels, a potential major new use of germanium. Research continued on germanium-on-insulator substrates as a replacement for silicon on miniaturized chips and on germanium-base solid-state light-emitting diodes (LEDs).

Germanium has little or no effect upon the environment because it usually occurs only as a trace element in ores and carbonaceous materials and is used in very small quantities in commercial applications.

World Refinery Production, Reserves, and Reserve Base:

	Refinery production[e]		Reserves[6]	Reserve base[6]
	2004	2005		
United States	4,400	4,500	450,000	500,000
Other countries	82,600	85,500	NA	NA
World total	87,000	90,000	NA	NA

World Resources: The available resources of germanium are associated with certain zinc and lead-zinc-copper sulfide ores. Significant amounts of germanium are contained in ash and flue dust generated in the combustion of certain coals for power generation. Reserves and reserve base figures exclude germanium contained in coal ash.

Substitutes: A new titanium-base catalyst for PET production was used in Asia at the beginning of 2005. Silicon is less expensive and can be substituted for germanium in certain electronic applications. Although some metallic compounds that contain gallium, indium, selenium, and tellurium can be substituted for germanium, it is more reliable than competing materials in many high-frequency and high-power electronics applications and is more economical as a substrate for some LED applications. Zinc selenide and germanium glass substitute for germanium metal in infrared applications systems but often at the expense of performance.

[e]Estimated. NA Not available. — Zero.

[1]In addition to the gross weight of wrought and unwrought germanium and waste and scrap, this series was revised to include estimated germanium dioxide metal content. This series does not include germanium tetrachloride and other germanium compounds for which data are not available.

[2]Employment related to primary germanium refining is indirectly related to zinc refining.

[3]Defined as imports – exports + adjustments for Government and industry stock changes.

[4]Imports are based on the gross weight of wrought and unwrought germanium and waste and scrap; includes estimated germanium dioxide metal content; does not include germanium tetrachloride and other germanium compounds for which data are not available.

[5]See Appendix B for definitions.

[6]See Appendix C for definitions.

GOLD

(Data in metric tons[1] of gold content unless otherwise noted)

Domestic Production and Use: Gold was produced at about 50 major lode mines, a dozen or more large placer mines (nearly all in Alaska), and numerous smaller placer mines (mostly in Alaska and in the Western States). In addition, a small amount of domestic gold was recovered as a byproduct of processing base metals, chiefly copper. Thirty mines yielded more than 99% of the gold produced in the United States. In 2005, the value of mine production was about $3.4 billion. Commercial-grade refined gold came from about 2 dozen producers. A few dozen companies, out of several thousand companies and artisans, dominated the fabrication of gold into commercial products. U.S. jewelry manufacturing was heavily concentrated in New York, NY, and Providence, RI; areas with lesser concentrations include California, Florida, and Texas. Estimated uses were jewelry and arts, 85%; electrical and electronics, 6%; dental and other, 9%.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production:					
Mine	335	298	277	258	250
Refinery:					
Primary	191	196	194	222	230
Secondary (new and old scrap)	83	78	89	92	100
Imports[2]	194	217	249	283	315
Exports[2]	489	257	352	257	290
Consumption, reported	179	163	183	185	195
Stocks, yearend, Treasury[3]	8,140	8,140	8,140	8,140	8,140
Price, dollars per ounce[4]	272	311	365	411	440
Employment, mine and mill, number[5]	9,500	7,600	7,300	7,550	7,600
Net import reliance[6] as a percentage of apparent consumption	E	E	E	8	8

Recycling: 100 tons of new and old scrap, equal to about 50% of reported consumption, was recycled in 2005.

Import Sources (2001-04):[2] Canada, 50%; Peru, 16%; Colombia, 13%; Brazil, 8%; and other, 13%.

Tariff: Most imports of unwrought gold, including bullion and doré, enter the United States duty free.

Depletion Allowance: 15% (Domestic), 14% (Foreign).

Government Stockpile: The U.S. Department of the Treasury maintains stocks of gold (see salient statistics above), and the U.S. Department of Defense administers a Governmentwide secondary precious-metals recovery program.

Events, Trends, and Issues: Domestic gold mine production in 2005 was estimated to be about 3% less than the level of 2004, but high enough to make the United States the third largest gold-producing nation, after Australia and South Africa. Domestic mine output continued to be dominated by Nevada, where production accounted for more than 83% of the U.S. total. For the second time since 1987, the United States was a net importer of gold in 2005.

The continued rise in costs at South African gold mines, owing to the strengthening of the rand, caused several mines to curtail expansion operations and reduce gold production. Gold mining in Indonesia recovered from the mine closures caused by landslides in late 2003.

Gold Exchange-Traded Funds (ETFs) have gained popularity with investors. Traditional gold investments have perceived difficulties in access, insurance, high markups, and storage. The investor can purchase gold ETF shares through a stockbroker without worrying about these problems. Each share represents one-tenth of an ounce of allocated gold.

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GOLD

During the first 9 months of 2005, the Engelhard Corporation's daily price of gold ranged from a low of about $412 per troy ounce in February to a high of about $475 per troy ounce at the end of September. For most of the year, however, this price averaged about $430. The Central Bank Gold Agreement II, which started on September 27, 2004, has not released the exact sales limits.

World Mine Production, Reserves, and Reserve Base: Reserves and reserve base data for the "Other countries" category excluded some countries for which reliable data were not available.

	Mine production		Reserves[7]	Reserve base[7]
	2004	2005[e]		
United States	258	250	2,700	3,700
Australia	259	254	5,000	6,000
Canada	129	115	1,300	3,500
China	215	225	1,200	4,100
Indonesia	93	140	1,800	2,800
Peru	173	175	3,500	4,100
Russia	169	165	3,000	3,500
South Africa	341	300	6,000	36,000
Other countries	794	830	17,000	26,000
World total (rounded)	2,430	2,450	42,000	90,000

Of the estimated 152,000 tons of all gold ever mined, about 15% is thought to have been lost, used in dissipative industrial uses, or otherwise was unrecoverable or unaccounted for. Of the remaining 129,000 tons, central banks hold an estimated 33,000 tons as official stocks, and about 96,000 tons is privately held as bullion, coin, and jewelry.

World Resources: An assessment of U.S. gold resources indicated 33,000 tons of gold in identified (15,000 tons) and undiscovered resources (18,000 tons).[8] Nearly one-quarter of the gold in undiscovered resources was estimated to be contained in porphyry copper deposits. The gold resources in the United States, however, are only a small portion of global gold resources.

Substitutes: Base metals clad with gold alloys are widely used in electrical/electronic products and jewelry to economize on gold; many of these products are continually redesigned to maintain high-utility standards with lower gold content. Generally, palladium, platinum, and silver may substitute for gold.

[e]Estimated. E Net exporter.

[1]Metric ton (1,000 kilograms) = 32,150.7 troy ounces.

[2]Refined bullion, doré, ores, concentrates, and precipitates.

Excludes:

a. Waste and scrap.
b. Official monetary gold.
c. Gold in fabricated items.
d. Gold in coins. In 1991, the last year for which estimates are available, net imports amounted to 3.5 tons.
e. Net bullion flow (in tons) to market from foreign stocks at the New York Federal Reserve Bank: 259.5 (2001), 39.6 (2002), 29.9 (2003), 3.0 (2004), and 0.0 (2005, estimate).

[3]Includes gold in Exchange Stabilization Fund. Stocks were valued at the official price of $42.22 per troy ounce.

[4]Engelhard Corporation's average gold price quotation for the year.

[5]Data from Mine Safety and Health Administration.

[6]Defined as imports – exports + adjustments for Government and industry stock changes.

[7]See Appendix C for definitions.

[8]U.S. Geological Survey National Mineral Resource Assessment Team, 2000, 1998 assessment of undiscovered deposits of gold, silver, copper, lead, and zinc in the United States: U.S. Geological Survey Circular 1178, 21 p.

GRAPHITE (NATURAL)

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: Although natural graphite was not produced in the United States in 2005, approximately 100 U.S. firms, primarily in the Northeastern and Great Lakes regions, used it for a wide variety of applications. The major uses of natural graphite in 2005 were refractory applications, 26%; batteries, foundry operations, and lubricants, 21%; brake linings, 12%; and other uses (including steelmaking), 41%.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005**[e]
Production, mine	—	—	—	—	—
Imports for consumption	52	45	52	64	60
Exports	24	22	22	46	23
Consumption, apparent[1]	28	24	30	18	37
Price, imports (average dollars per ton at foreign ports):					
Flake	520	529	619	485	578
Lump and chip (Sri Lankan)	1,360	1,220	2,270	2,420	2,730
Amorphous	131	137	152	177	197
Stocks, yearend	NA	NA	NA	NA	NA
Net import reliance[2] as a percentage of apparent consumption	100	100	100	100	100

Recycling: Refractory brick and linings, alumina-graphite refractories for continuous metal castings, magnesia-graphite refractory brick for basic oxygen and electric arc furnaces, and insulation brick led the way in recycling of graphite products. The market for recycled refractory graphite material is growing with material being recycled into products, such as brake linings and thermal insulation.

Recovering high-quality flake graphite from steelmaking kish is technically feasible, but not practiced at the present time. Abundance of graphite in the world market and continuing low prices inhibit increased recycling efforts. Information on the quantity and value of recycled graphite is not available.

Import Sources (2001-04): China, 40%; Mexico, 22%; Canada, 19%; Brazil, 6%; and other, 13%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Crystalline flake (not including flake dust)	2504.10.1000	Free.
Other	2504.90.0000	Free.

Depletion Allowance: 22% (Domestic lump and amorphous), 14% (Domestic flake), and 14% (Foreign).

Government Stockpile:

Stockpile Status—9-30-05[3]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Sri Lanka, amorphous lump	—	51	—	—	—
Malagasy, crystalline flake	56	675	56	—	632

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GRAPHITE (NATURAL)

Events, Trends, and Issues: Graphite was near supply-demand balance in 2005. Flake graphite imports were from China and Canada (in descending order of tonnage), imports of graphite lump and chip were from Mexico; and amorphous graphite imports were from Mexico and China (in descending order of tonnage). Use of natural graphite in lubrication applications only increased slightly because of changes in requirements for lubricants and in processing technologies. Advances in thermal technology and acid-leaching techniques that enable the production of higher purity graphite powders are likely to lead to development of new applications for graphite in high-technology fields. Such innovative refining techniques have enabled the use of improved graphite in carbon-graphite composites, electronics, foils, friction materials, and special lubricant applications. Flexible graphite product lines, such as graphoil (a thin graphite cloth), probably will be the fastest growing market. Large-scale fuel-cell applications are being developed that could consume as much graphite as all other uses combined.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[4]	Reserve base[4]
	2004	2005[e]		
United States	—	—	—	1,000
Brazil	62	60	360	1,000
Canada	25	25	([5])	([5])
China	700	700	64,000	220,000
Czech Republic	10	10	11,400	13,000
India	120	130	800	3,800
Korea, North	30	12	([5])	([5])
Madagascar	2	15	940	960
Mexico	8	15	3,100	3,100
Norway	2	2	([5])	([5])
Sri Lanka	3	3	([5])	([5])
Turkey	1	1	([5])	([5])
Ukraine	8	8	([5])	([5])
Zimbabwe	10	10	([5])	([5])
Other countries	1	1	5,100	44,000
World total (rounded)	982	992	86,000	290,000

World Resources: Domestic resources are relatively small, but the rest of the world's inferred reserve base exceeds 800 million tons of recoverable graphite.

Substitutes: Manufactured graphite powder, scrap from discarded machined shapes, and calcined petroleum coke compete for use in iron and steel production. Finely ground coke with olivine is a potential competitor in foundry facing applications. Molybdenum disulfide competes as a dry lubricant but is more sensitive to oxidizing conditions.

[e]Estimated. NA Not available. — Zero.
[1]Defined as imports – exports.
[2]Defined as imports – exports + adjustments for Government and industry stock changes. Data on changes in stocks were not available and were assumed to be zero in the calculations.
[3]See Appendix B for definitions.
[4]See Appendix C for definitions.
[5]Reserves and reserve base for this country are included with "Other countries."

GYPSUM

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: In 2005, domestic production of crude gypsum was estimated to be 17.5 million tons with a value of about $128 million. The leading crude gypsum-producing States were, in descending order, Oklahoma, Texas, Nevada, Iowa, California, Arkansas, and Indiana, which together accounted for 82% of total output. Overall, 20 companies produced gypsum at 46 mines in 20 States, and 9 companies calcined gypsum at 62 plants in 29 States. Almost 88% of domestic consumption, which totaled approximately 37.9 million tons, was accounted for by manufacturers of wallboard and plaster products. Approximately 3.3 million tons for cement production, 1.1 million tons for agricultural applications, and small amounts of high-purity gypsum for a wide range of industrial processes, such as smelting and glassmaking, accounted for the remaining tonnage. At the beginning of 2005, the capacity of operating wallboard plants in the United States was about 40 billion square feet[1] per year.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production:					
Crude	16,300	15,700	16,700	17,200	17,500
Synthetic[2]	6,820	9,900	8,300	9,040	9,300
Calcined[3]	19,100	18,600	20,400	25,500	26,000
Wallboard products (million square feet[1])	29,500	29,900	33,300	35,400	36,000
Imports, crude, including anhydrite	8,270	7,970	8,300	10,100	11,200
Exports, crude, not ground or calcined	161	295	341	149	150
Consumption, apparent[4]	31,100	32,700	33,000	36,200	37,900
Price:					
Average crude, f.o.b. mine, dollars per ton	8.44	7.31	6.90	7.21	7.31
Average calcined, f.o.b. plant, dollars per ton	16.81	18.42	20.01	19.64	21.10
Stocks, producer, crude, yearend	1,500	1,500	1,500	1,500	1,500
Employment, mine and calcining plant, number[e]	6,000	5,900	5,900	5,900	5,900
Net import reliance[5] as a percentage of apparent consumption	27	26	25	28	29

Recycling: A portion of the more than 4 million tons of gypsum waste that was generated by wallboard manufacturing, wallboard installation, and building demolition was recycled. The recycled gypsum was used chiefly for agricultural purposes and for the manufacture of new wallboard. Other potential markets for recycled gypsum waste are in athletic field marking, cement production as a stucco additive, grease absorption, sludge drying, and water treatment.

Import Sources (2001-04): Canada, 68%; Mexico, 22%; Spain, 8%; Dominican Republic 1%; and other, 1%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Gypsum; anhydrite	2520.10.0000	Free.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: The U.S. gypsum industry was stable during 2005, though hurricanes caused increased demand in the South and Southeast. Several companies began constructing new plants and expanding existing plants in 2005. This new capacity will increase the consumption of synthetic gypsum produced by scrubbing emissions from coal-fired electric powerplants.

Domestic housing starts and commercial construction were both slightly higher in 2005 compared with 2004. The net result was a small overall gypsum production increase for the year. Increasing demand for gypsum depends principally on the strength of the construction industry—particularly in the United States, where about 95% of the gypsum consumed is used for wallboard products, building plasters, and the manufacture of portland cement. Road building and repair will continue to spur gypsum consumption in the cement industry. The construction of large wallboard plants designed to use synthetic gypsum will increase the substitution of synthetic for natural gypsum as the new plants become operational.

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GYPSUM

World Mine Production, Reserves, and Reserve Base:

	Mine production 2004	Mine production 2005[e]	Reserves[6]	Reserve base[6]
United States	17,200	17,500	700,000	Large
Australia	4,000	4,000		
Austria	1,000	1,000		
Brazil	1,500	1,550	1,300,000	Large
Canada	9,340	9,500	450,000	Large
China	7,000	7,500		
Egypt	2,000	2,000		
France	3,500	3,500		
Germany	1,750	1,750		
India	2,350	2,400		
Iran	13,000	11,000		
Italy	1,200	1,200	Reserves and reserve base are large in major producing countries, but data are not available.	
Japan	5,800	5,800		
Mexico	7,000	7,000		
Poland	1,300	1,300		
Russia	700	800		
Spain	11,500	7,500		
Thailand	8,000	8,000		
United Kingdom	1,500	1,500		
Uruguay	1,130	1,100		
Other countries	8,250	16,000		
World total (rounded)	109,000	110,000	Large	Large

World Resources: Domestic resources are adequate but unevenly distributed. Large imports from Canada augment domestic supplies for wallboard manufacturing in the United States, in regions where there are no significant gypsum deposits. Imports from Mexico augment domestic supplies for wallboard manufacturing along portions of the western U.S. seaboard. Large gypsum deposits occur in the Great Lakes region, midcontinental region, and several Western States. Foreign resources are large and widely distributed; more than 90 countries produce gypsum. Iran is second to the United States in production and supplies much of the gypsum needed for construction and reconstruction in the Middle East. Spain is the largest European producer and supplies both crude gypsum and gypsum products to much of Western Europe. Increased wallboard use in Asia and new gypsum product plants in Thailand and India caused increased production in those countries.

Substitutes: In such applications as stucco and plaster, cement and lime may be substituted; brick, glass, metallic or plastic panels, and wood may be substituted for wallboard. Gypsum has no practical substitute in the manufacturing of portland cement. Synthetic gypsum generated by various industrial processes, including flue gas desulfurization of smokestack emissions, is very important as a substitute for mined gypsum in wallboard manufacturing, cement production, and agricultural applications (in descending tonnage order). In 2005, synthetic gypsum accounted for 24% of the total domestic gypsum supply.

[e]Estimated.
[1]The standard unit used in the U.S. wallboard industry is square feet. Multiply square feet by 9.29×10^{-2} to convert to square meters.
[2]Data refer to the amount sold or used, not produced.
[3]From domestic crude.
[4]Defined as crude + total synthetic reported used + net import reliance.
[5]Defined as imports – exports + adjustments for industry stock changes.
[6]See Appendix C for definitions.

HELIUM

(Data in million cubic meters of contained helium gas[1] unless otherwise noted)

Domestic Production and Use: During 2005, the estimated value of Grade-A helium (99.995% or better) extracted domestically by private industry was about $350 million. Ten industry plants (six in Kansas and four in Texas) extracted helium from natural gas and produced only a crude helium product that varied from 50% to 80% helium. Ten industry plants (four in Kansas, and one each in Texas, Colorado, New Mexico, Oklahoma, Utah, and Wyoming) extracted helium from natural gas and produced an intermediate process stream of crude helium (about 70% helium and 30% nitrogen) and continued processing the stream to produce a Grade-A helium product. Six industry plants (four in Kansas, one in Oklahoma, and one in Texas) accepted a crude helium product from other producers and the Bureau of Land Management (BLM) pipeline and purified it to a Grade-A helium product. Estimated 2005 domestic consumption of 85 million cubic meters (3.1 billion cubic feet) was used for cryogenic applications, 28%; for pressurizing and purging, 26%; for welding cover gas, 20%; for controlled atmospheres, 13%; leak detection, 4%; breathing mixtures, 2%; and other, 7%.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Helium extracted from natural gas[2]	87	87	87	86	84
Withdrawn from storage[3]	45	40	35	44	50
Grade-A helium sales	132	127	122	130	134
Imports for consumption	—	—	—	—	—
Exports[4]	43.0	40.0	41.0	44.9	49.4
Consumption, apparent[4]	88.9	87.6	80.7	85.1	84.6
Employment, plant, number[e]	325	325	325	325	325
Net import reliance[5] as a percentage of apparent consumption	E	E	E	E	E

Price: The Government price for crude helium was $1.965 per cubic meter ($54.50 per thousand cubic feet) in fiscal year (FY) 2005. The price for the Government-owned helium is mandated by the Helium Privatization Act of 1996 (Public Law 104-273). The estimated price range for private industry's Grade-A gaseous helium was about $2.42 to $2.63 per cubic meter ($67 to $73 per thousand cubic feet), with some producers posting surcharges to this price.

Recycling: In the United States, helium used in large-volume applications is seldom recycled. Some low-volume or liquid boiloff recovery systems are used. In Western Europe and Japan, helium recycling is practiced when economically feasible.

Import Sources (2001-04): None.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Helium	2804.29.0010	3.7% ad val.

Depletion Allowance: Allowances are applicable to natural gas from which helium is extracted, but no allowance is granted directly to helium.

Government Stockpile: Under the Public Law 104-273, the BLM manages the Federal Helium Program, which includes all operations of the Cliffside helium storage reservoir and the Government's crude helium pipeline system. The BLM no longer supplies Federal agencies with Grade-A helium. Private firms that sell Grade-A helium to Federal agencies are required to purchase a like amount of crude helium (in-kind) from the BLM.

In FY 2005, privately owned companies purchased nearly 6.9 million cubic meters (247 million cubic feet) of in-kind crude helium. In addition to this, the privately owned companies also purchased 21.9 million cubic meters (790 million cubic feet) of open market sales helium. During FY 2005, BLM's Amarillo Field Office, Helium Operations (AMFO) accepted about 16.7 million cubic meters (603 million cubic feet) of private helium for storage and redelivered nearly 72.5 million cubic meters (2.613 billion cubic feet). As of September 30, 2005, 27.8 million cubic meters (1.0 billion cubic feet) of helium was owned by private firms.

Stockpile Status—9-30-05[6]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Helium	717.2	16.6	717.2	63.8	28.8

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HELIUM

Events, Trends, and Issues: During FY 2005, a number of companies including all the major helium producers again announced helium price increases of 8% to 15%. They stated that helium price increases were required to offset increases in crude helium, electric power, natural gas, labor, fuel, distribution, and transportation costs. In addition to price increases, some of the companies implemented surcharges and eliminated discounts on monthly charges for helium tube trailers. It is anticipated that the cost of helium will continue to rise along with increasing production costs as U.S. helium reserves are depleted. Even with escalating helium prices, it is expected that helium demand will continue to grow slowly at about 2.5% to 3.5% per year. Based on helium export totals through July 2005, calendar year 2005 exports are expected to increase by 8% to 10% from 2004 exports. During FY 2005, the AMFO conducted two open market helium sales. Sales of helium for the two open market offers totaled 21.9 million cubic meters (790 million cubic feet). The two overseas helium projects at Skikda, Algeria, and Qatar are still scheduled to come onstream by the end of 2005 or early 2006. The Skikda helium expansion project, designed to increase helium production capacity by 16.6 million cubic meters (600 million cubic feet) per year, will come onstream at about one-half capacity of about 8.3 million cubic meters (300 million cubic feet). The Qatar project, a new helium extraction facility, will have a helium production capacity of 8.3 million cubic meters (300 million cubic feet) per year.

World Production, Reserves, and Reserve Base:

	Production		Reserves[8]	Reserve base[8]
	2004	2005[e]		
United States (extracted from natural gas)	86	84	3,600	[9]8,400
United States (from Cliffside Reserve)	44	50	—	—
Algeria	16	17	1,900	8,400
Canada	NA	NA	NA	2,000
China	NA	NA	NA	1,100
Poland	3	3	32	280
Qatar	NA	NA	NA	10,000
Russia	5	6	1,700	6,700
Other countries	NA	NA	NA	2,800
World total (rounded)	154	160	NA	39,700

World Resources: The identified helium resources of the United States were estimated to be about 8.5 billion cubic meters (305 billion cubic feet) as of January 1, 2003. This includes 0.87 billion cubic meters (31.4 billion cubic feet) of helium stored in the Cliffside Field Government Reserve (these resources are included in the Reserves and Reserve base figures above), 3.7 billion cubic meters (133 billion cubic feet) of helium in helium-rich natural gas (0.30% helium or more) from which helium is currently being extracted, and 3.1 billion cubic meters (112 billion cubic feet) in helium-lean natural gas (less than 0.30% helium). The Hugoton (Kansas, Texas, and Oklahoma), Panhandle West, Panoma, Riley Ridge, and Cliffside Fields are currently depleting gasfields and contain an estimated 3.6 billion cubic meters (130 billion cubic feet) of helium. Future helium supplies will probably come from known helium-rich natural gas with little fuel value and from helium-lean gas resources.

Helium resources of the world exclusive of the United States were estimated to be about 31.1 billion cubic meters (1.121 trillion cubic feet). The locations and volumes of the major deposits, in billion cubic meters, are Qatar, 10; Algeria, 8; Russia, 7; Canada, 2; and China, 1. As of December 31, 2005, AMFO had analyzed more than 21,600 gas samples from 26 countries and the United States in a program to identify world helium resources.

Substitutes: There is no substitute for helium in cryogenic applications if temperatures below –429° F are required. Argon can be substituted for helium in welding, and hydrogen can be substituted for helium in some lighter-than-air applications in which the flammable nature of hydrogen is not objectionable. Hydrogen is also being investigated as a substitute for helium in deep-sea diving applications below 1,000 feet.

[e]Estimated. E Net exporter. NA Not available. — Zero.
[1]Measured at 101.325 kilopascals absolute (14.696 psia) and 15° C, 27.737 cubic meters of helium = 1 Mcf of helium at 70° F and 14.7 psia.
[2]Helium from both Grade-A and crude helium.
[3]Extracted from natural gas in prior years (injected in parentheses).
[4]Grade-A helium.
[5]Defined as imports – exports + adjustments for Government and industry stock changes.
[6] See Appendix B for definitions.
[7]Team Leader, Resources Evaluation, Bureau of Land Management Amarillo Field Office, Helium Operations, Amarillo, TX.
[8]See Appendix C for definitions.
[9]All domestic measured and indicated helium resources in the United States.

INDIUM

(Data in metric tons unless otherwise noted)

Domestic Production and Use: Indium was not recovered from ores in the United States in 2005. Indium-containing zinc concentrates produced in Alaska were exported to Canada for processing. Two companies, one in New York and the other in Rhode Island, produced indium metal and indium products by upgrading lower grade imported indium metal. High-purity indium shapes, alloys, and compounds were also produced from imported indium by several additional firms.

Thin-film coatings, which are used in applications such as for electroluminescent lamps and for liquid crystal displays (LCDs) in flat panel video screens, continued to be the leading end use. Indium semiconductor compounds were used in infrared detectors, high-speed transistors, and high-efficiency photovoltaic devices. Major uses were coatings, 70%; electrical components and semiconductors, 12%; solders and alloys, 12%; and research and other, 6%. The estimated value of primary indium metal consumed in 2005, based upon the annual average price, was about $93 million.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production, refinery	—	—	—	—	—
Imports for consumption[1]	79	112	123	143	150
Exports	[e]10	[e]10	NA	NA	NA
Consumption, estimated	65	85	90	100	115
Price, annual average, dollars per kilogram (99.97% indium)	120	97	170	643	810
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, number	NA	NA	NA	NA	NA
Net import reliance[2] as a percentage of estimated consumption	100	100	100	100	100

Recycling: In the United States, only small amounts of indium scrap were recycled in 2005. The reason for the low recycling rate is the lack of domestic infrastructure for collecting indium-containing products. Recycling of indium could expand significantly in the United States if the current price of indium is sustained or continues to increase. Indium tin oxide (ITO) use is highly inefficient, as only about 15% of ITO is consumed to make LCDs; the rest is scrap. The major problem in recycling the ITO scrap is the high cost associated with the process. The process takes about 12 weeks from collection of scrap to fabrication of secondary indium products. A recycler may have millions of dollars worth of indium in the recycling loop at any one time. A large increase in ITO scrap could be difficult for the recycling industry to handle because of large capital costs, environmental restrictions, and storage space.

Import Sources (2001-04):[1] China, 47%; Canada, 21%; Japan, 13%; Russia, 5%; and other, 14%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Unwrought indium, including powder	8112.92.3000	Free.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

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INDIUM

Events, Trends, and Issues: Estimated domestic indium consumption rose about 15% from that in 2004. Continued strong sales of flat-panel displays and other LCD products increased global consumption of ITO, mostly in Japan, the Republic of Korea, the Philippines, and Taiwan. The indium price continued its remarkable rise into the fall of 2005. Although the short-range outlook for indium demand remained positive, market supply remained questionable because of its heavy dependence on the strength of zinc production. With the increasing capacity of ITO refineries and LCD plants in Japan, the Republic of Korea, the Philippines, and Taiwan, and with China opening new ITO refineries and LCD plants, the availability of primary indium feedstock will be further reduced. Recycling efforts, especially in Japan, have done much to offset shortages in supply and to alleviate price pressures.

World Refinery Production, Reserves, and Reserve Base:

	Refinery production		Reserves[3]	Reserve base[3]
	2004	2005[e]		
United States	—	—	300	600
Belgium	30	30	([4])	([4])
Canada	50	50	1,000	2,000
China	200	250	280	1,300
France	10	10	([4])	([4])
Germany	10	9	NA	NA
Japan	70	70	100	150
Peru	5	6	100	150
Russia	15	15	200	300
Other countries	15	15	800	1,500
World total (rounded)	405	455	2,800	6,000

World Resources: Indium is a rare element and ranks 61st in abundance in the Earth's crust at an estimated 240 parts per billion by weight. This makes it about three times more abundant than silver or mercury.

Indium occurs predominantly in the zinc-sulfide ore mineral, sphalerite. The average indium content of zinc deposits from which it is recovered ranges from less than 1 part per million to 100 parts per million. Although the geochemical properties of indium are such that it occurs with other base metals—copper, lead, and tin—and to a lesser extent with bismuth, cadmium, and silver, most deposits of these metals are subeconomic for indium.

Vein stockwork deposits of tin and tungsten host the highest known concentrations of indium. However, the indium from this type of deposit is usually difficult to process economically. Other major geologic hosts for indium mineralization include volcanic-hosted massive sulfide deposits, sediment-hosted exhalative massive sulfide deposits, polymetallic vein-type deposits, epithermal deposits, active magmatic systems, porphyry copper deposits, and skarn deposits.

Substitutes: Indium has substitutes in many, perhaps most, of its uses; however, the substitutes usually lead to losses in production efficiency or product characteristics. Silicon has largely replaced germanium and indium in transistors. Although more expensive, gallium can be used in some applications as a substitute for indium in several alloys. In glass-coating applications, silver-zinc oxides or tin oxides can be used. Although technically inferior, zinc-tin oxides can be used in LCDs. Another possible substitute for indium glass coating is transparent carbon nanotubes, which are untested in mass production of LCDs. Indium phosphide can be substituted by gallium arsenide in solar cells and in many semiconductor applications. Hafnium can replace indium alloys in nuclear reactor control rods.

[e]Estimated. NA Not available. — Zero.
[1]Imports for consumption are based on U.S. Department of Commerce, U.S. Treasury, and U.S. International Trade Commission data for unwrought indium and waste and scrap (includes indium powder after 2002).
[2]Defined as imports – exports + adjustments for Government and industry stock changes; exports were assumed to be no greater than the difference between imports and consumption.
[3]Estimate based on the indium content of zinc ores. See Appendix C for definitions.
[4]Reserves and reserve base for this country and other European nations are included with "Other countries."

IODINE

(Data in thousand kilograms elemental iodine unless otherwise noted)

Domestic Production and Use: Iodine produced in 2005 from three companies operating in Oklahoma accounted for 100% of the elemental iodine value estimated to be about $19 million. The operation at Woodward, OK, continued production of iodine from subterranean brines. A second company operated a miniplant in Kingfisher County, OK, using waste brine associated with oil. A third company continued production at Vici, OK, for domestic use and export. Of the consumers that participate in the annual survey, 20 plants reported consumption of iodine in 2004. Major consumers were located in the Eastern United States. Strong demand increased the price of iodine as demand increased for liquid crystal display screens for computers and televisions. The average value of iodine imports through September was $16.11 per kilogram. Establishing an accurate end-use pattern for iodine was difficult because intermediate iodine compounds were marketed before reaching their final end uses. Estimated world consumption of iodine was 25,500 metric tons.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production	1,290	1,420	1,090	1,130	1,240
Imports for consumption, crude content	5,030	6,200	5,800	5,700	6,370
Exports	1,460	1,430	1,600	1,270	979
Shipments from Government stockpile excesses	83	25	361	245	444
Consumption:					
Apparent	4,730	6,520	5,240	5,560	7,080
Reported	3,560	4,540	3,930	4,070	NA
Price, average c.i.f. value, dollars per kilogram, crude	13.94	12.70	11.81	13.38	16.11
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, number	30	30	30	30	30
Net import reliance[1] as a percentage of apparent consumption	74	77	81	81	82

Recycling: Small amounts of iodine were recycled, but no data are reported.

Import Sources (2001-04): Chile, 66%; Japan, 31%; Netherlands, 1%; and other, 2%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Iodine, crude	2801.20.0000	Free.
Iodide, calcium or copper	2827.60.1000	Free.
Iodide, potassium	2827.60.2000	2.8% ad val.
Iodides and iodide oxides, other	2827.60.5000	4.2% ad val.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: In October, the Defense National Stockpile Center announced the fiscal year 2006 Annual Materials Plan would include sales of 454 tons (1,000,000 pounds) of crude iodine.

Stockpile Status—9-30-05[2]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Stockpile-grade	680	—	680	454	444

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IODINE

Events, Trends, and Issues: Chile was the leading producer of iodine in the world. Iodine was a coproduct from surface mineral deposits used to produce nitrate fertilizer. Two of the leading iodine companies in the world are located in Chile. Japan was the second leading producer, and its production was associated with gas brines.

The Defense National Stockpile Center issued a DLA-IODINE-005 Basic Ordering Agreement (BOA) for crude iodine. The BOA solicits offers for the sale of 454 metric tons (1,000,000 pounds) of crude iodine in fiscal year 2006, with quarterly sales of approximately 113,400 kilograms (250,000 pounds). Awards were subject to the certification of the Drug Enforcement Administration. The iodine offered for sale was located at New Haven, IN, and was of Chilean, Japanese, and unknown origin.

Atacama Minerals planned to double iodine production at the Aguas Blancas Mine in northern Chile. The decision followed the company's 50% acquisition of Atacama Minerals Chile, its partner in the project, from ACF Minera, for $11.2 million. The mine currently produces 720 tons per year. The expansion was expected to cost about $10 million and to take between 16 to 18 months.[3]

Sociedad Química y Minera de Chile S.A. (SQM) forecasted that iodine demand will grow at 5% to 6% per year. A $350 million expansion was to be carried out during the next 3 years for iodine, nitrates, and lithium. This will result in an increase of 1,000 tons per year of iodine.[4]

Exposure to perchlorate, which inhibits iodine uptake, has the biologic potential to cause hypothyroidism and, in pregnant women, to severely damage the fetus and the newborn. Concern for perchlorate detected in ground water in many parts of the United States and recent detection in vegetable and dairy food products has resulted in studies of perchlorate that have yielded contradictory results. It was recommended that future studies should consider the genetic makeup of the participants, actual perchlorate exposure levels, and individual iodine uptake and excretion levels.[5]

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[6]	Reserve base[6]
	2004	2005[e]		
United States	1,130	1,240	250,000	550,000
Azerbaijan	300	300	170,000	340,000
Chile	15,600	16,200	9,000,000	18,000,000
China	550	550	4,000	120,000
Indonesia	75	75	100,000	200,000
Japan	6,500	7,200	4,900,000	7,000,000
Russia	300	300	120,000	240,000
Turkmenistan	250	300	170,000	350,000
Uzbekistan	2	2	NA	NA
World total (rounded)	24,700	26,200	15,000,000	27,000,000

World Resources: In addition to the reserve base, seawater contains 0.05 part per million iodine, or approximately 34 million tons. Seaweeds of the Laminaria family are able to extract and accumulate up to 0.45% iodine on a dry basis. Although not as economical as the production of iodine as a byproduct of gas, nitrate, and oil, the seaweed industry represented a major source of iodine prior to 1959 and remains a large resource.

Substitutes: Bromine and chlorine could be substituted for most of the biocide, colorant, and ink uses of iodine, although they are usually considered less desirable than iodine. Antibiotics and boron are also substitutes for iodine as biocides. Salt crystals and finely divided carbon may be used for cloud seeding. There are no substitutes for iodine in some animal feed, catalytic, nutritional, pharmaceutical, and photographic uses.

[e]Estimated. NA Not available.
[1]Defined as imports – exports + adjustments for Government and industry stock changes.
[2]See Appendix B for definitions.
[3]Mining Engineering, 2005, Atacama Minerals to double iodine production at Aguas Blancas: Mining Engineering, v. 57, no. 8, August, p. 17.
[4]Harris, Paul, 2005, SQM looks to future growth: Industrial Minerals, no. 448, January, p. 52-53.
[5]Scinicariello, Franco, Murray, H.E., Smith, Lester, Wilbur, Sharon, and Fowler, B.A., 2005, Review—2005, Individuals respond to perchlorate differently: Environmental Health Perspectives, v. 113, no. 11, November, 14 p.
[6]See Appendix C for definitions.

IRON ORE[1]

(Data in million metric tons of usable ore[2] unless noted)

Domestic Production and Use: In 2005, 95% of the usable ore produced, having an estimated value of $2.3 billion, was shipped from mines in Michigan and Minnesota. Ten iron ore operations with 10 mines, 8 concentration plants, and 8 pelletizing plants were in operation during the year. The mines included 10 open pits and no underground operations. Virtually all ore was concentrated before shipment. Eight mines operated by three companies accounted for greater than 99% of production. The United States produced 4% of the world's iron ore output and also consumed about 4%.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production, usable	46.2	51.6	48.6	54.7	55.0
Shipments	50.6	51.5	46.1	54.9	52.1
Imports for consumption	10.7	12.5	12.6	11.8	13.0
Exports	5.6	6.8	6.8	8.4	11.0
Consumption:					
Reported (ore and total agglomerate)[3]	67.3	59.7	61.6	64.5	62.0
Apparent[4]	62.0	57.0	55.2	[e]58.0	57.0
Price,[5] U.S. dollars per metric ton	23.87	26.04	32.30	37.92	44.00
Stocks, mine, dock, and consuming plant, yearend, excluding byproduct ore[4]	18.0	18.3	17.5	[e]17.6	18.0
Employment, mine, concentrating and pelletizing plant, quarterly average, number	5,020	4,740	4,670	4,410	4,400
Net import reliance[6] as a percentage of apparent consumption (iron in ore)	26	10	12	6	4

Recycling: None (see Iron and Steel Scrap section).

Import Sources (2001-04): Canada, 48%; Brazil, 42%; Chile, 3%; Australia, 3%; and other, 4%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Concentrates	2601.11.0030	Free.
Coarse ores	2601.11.0060	Free.
Fine ores	2601.11.0090	Free.
Pellets	2601.12.0030	Free.
Briquettes	2601.12.0060	Free.
Sinter	2601.12.0090	Free.

Depletion Allowance: 15% (Domestic), 14% (Foreign).

Government Stockpile: None.

Events, Trends, and Issues: Worldwide price increases of greater than 70% in 2005 have resulted from the current imbalance in supply and demand. Major iron-ore-mining companies are reinvesting these windfall profits in exploration and mine development. Increased capacity within the next few years is expected to bring supply back in line with the increasing demand. Iron ore demand growth continues to be dominated by China. In 2005, it is estimated that China increased production of mostly lower grade ores by about 19%. Estimates of Chinese imports of higher grade ores, mostly from Australia and Brazil, show an increase of one-third compared with that of 2004.

International iron ore trade and production of iron ore and pig iron—the key indicators of iron ore consumption—plainly show that iron ore consumption in China is the major factor upon which the growth of the international iron ore industry will depend. China's increasing activity in overseas joint ventures, spiraling imports of iron ore, and continued high domestic production of low-grade ores indicate that iron ore consumption will continue to grow.

In December 2003, a major Chinese steel company purchased a minority interest in an insolvent iron ore producer in northeastern Minnesota. Pellet production continued throughout 2004 with China accepting trade for most of their portion of the production from the majority partner's Canadian affiliate. In 2005, it appears that production increases of the order of 20% in comparison with those of 2004 will be attained by the joint-venture operation.

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IRON ORE

With increased prices and interest by Chinese importers, several small miners are investigating the possibility of opening or reopening lower grade iron ore deposits in Alaska, Arizona, Missouri, Nevada, New Mexico, Tennessee, and Utah.

Research and development testing on a value-added iron product was completed in Minnesota in 2004. The Mesabi Nugget project determined that iron ore pellets produced in Minnesota could be converted to direct-reduced iron nuggets of 96% to 98% iron content using noncoking coals and that the overall process would emit lower levels of pollutants. Permitting activities for a plant to be built either in Minnesota or Indiana progressed during 2005.

U.S. iron ore producers continued to make mine and plant improvements to take advantage of increased profits and an improved steel market. Plant recoveries are being enhanced, pellet plant capacity increased, and alternative fuel systems with reduced air emissions developed at pelletizing plants.

Offsetting some of these operational improvements are increased operating costs, which are negatively impacting U.S. iron ore operations. Fuel costs are substantially higher than projected in the very fuel-intensive iron ore industry. Overall iron ore production may also be affected by a worldwide shortage of heavy-equipment tires, which could impact mining equipment availability. Tire shortages have been exacerbated by recent expansions in the mining industry and increased demand for large tires by China.

World Mine Production, Reserves, and Reserve Base:[7] The iron ore reserve estimates for Australia and Brazil and the reserve base estimate for Brazil have been revised based on new information from those countries.

	Mine production		Crude ore		Iron content	
	2004	2005[e]	Reserves	Reserve base	Reserves	Reserve base
United States	55	55	6,900	15,000	2,100	4,600
Australia	231	280	15,000	40,000	8,900	25,000
Brazil	255	300	23,000	61,000	16,000	41,000
Canada	28	30	1,700	3,900	1,100	2,500
China	310	370	21,000	46,000	7,000	15,000
India	121	140	6,600	9,800	4,200	6,200
Iran	17	17	1,800	2,500	1,000	1,500
Kazakhstan	20	19	8,300	19,000	3,300	7,400
Mauritania	11	11	700	1,500	400	1,000
Mexico	12	12	700	1,500	400	900
Russia	97	95	25,000	56,000	14,000	31,000
South Africa	39	40	1,000	2,300	650	1,500
Sweden	22	23	3,500	7,800	2,200	5,000
Ukraine	66	69	30,000	68,000	9,000	20,000
Venezuela	22	22	4,000	6,000	2,400	3,600
Other countries	37	40	11,000	30,000	6,200	17,000
World total (rounded)	1,340	1,520	160,000	370,000	79,000	180,000

World Resources: World resources are estimated to exceed 800 billion tons of crude ore containing more than 230 billion tons of iron. U.S. resources are estimated to be about 110 billion tons of ore containing about 27 billion tons of iron. U.S. resources are mainly low-grade taconite-type ores from the Lake Superior district that require beneficiation and agglomeration for commercial use.

Substitutes: Iron ore, used directly or converted to pellets, briquettes, or concentrates, is the only source of primary iron. In some operations, ferrous scrap constitutes as much as 7% of the blast furnace feedstock. Scrap is extensively used in steelmaking and in iron and steel foundries, but availability of scrap has become an issue during the past 2 years. Price increases for iron ore of greater than 70% during the past year have reduced the margin between iron ore and scrap prices and, therefore, the relative attractiveness of scrap.

[e]Estimated.
[1]See also Iron and Steel and Iron and Steel Scrap.
[2]Agglomerates, concentrates, direct-shipping ore, and byproduct ore for consumption.
[3]Includes weight of lime, flue dust, and other additives used in producing sinter for blast furnaces.
[4]Information regarding consumer stocks at receiving docks and plants was no longer available after 2003 (these stock changes were estimated).
[5]Estimated from reported value of ore at mines.
[6]Defined as imports – exports + adjustments for Government and industry stock changes.
[7]See Appendix C for definitions.

IRON AND STEEL[1]

(Data in million metric tons of metal unless otherwise noted)

Domestic Production and Use: The iron and steel industry and ferrous foundries produced goods in 2005 valued at about $126 billion. The industry consisted of about 79 companies that produced raw steel at about 122 plants, with combined production capability of about 106 million tons. Indiana accounted for about 22% of total raw steel production, followed by Ohio, 16%, Michigan, 6%, and Pennsylvania, 6%. Pig iron was produced by 9 companies operating integrated steel mills with about 31 blast furnaces in continuous operation. The distribution of steel shipments was estimated as follows: warehouses and steel service centers, 23%; construction, 15%; transportation (predominantly for automotive production), 13%; cans and containers, 3%; and other, 46%. About 1,100 ferrous foundries continued to be importers of pig iron into the United States, mainly from Brazil, Russia, and Ukraine.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Pig iron production[2]	42.1	40.2	40.6	42.3	33.1
Steel production:	90.1	91.6	93.7	99.7	92.4
Basic oxygen furnaces, percent	52.6	49.6	49.0	47.8	44.9
Electric arc furnaces, percent	47.4	50.4	51.0	52.2	55.1
Continuously cast steel, percent	97.2	97.2	97.3	97.1	96.7
Shipments:					
Steel mill products	89.7	90.7	96.1	101	102
Steel castings[3]	0.8	0.7	0.7	0.7	0.7
Iron castings[3]	8.3	7.8	7.5	7.5	7.4
Imports of steel mill products	27.3	29.6	21.0	32.5	30.1
Exports of steel mill products	5.6	5.4	2.5	7.2	8.4
Apparent steel consumption[4]	107	107	107	117	122
Producer price index for steel mill products (1982=100)[5]	101.3	104.8	109.5	147.2	161.3
Steel mill product stocks at service centers yearend[6]	6.9	13.7	12.3	14.4	13.6
Total employment, average, number[7]					
Blast furnaces and steel mills	141,000	140,000	140,000	128,000	120,000
Iron and steel foundries[e]	117,000	116,000	116,000	116,000	115,000
Net import reliance[8] as a percentage of apparent consumption	16	15	10	14	15

Recycling: See Iron and Steel Scrap and Iron and Steel Slag.

Import Sources (2001-04): Canada, 17%; European Union[9], 17%; Mexico, 12%; Brazil, 10%; and other, 44%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Pig iron	7201.10.0000	Free.
Carbon steel:		
Semifinished	7207.12.0050	Free.
Structural shapes	7216.33.0090	Free.
Bars, hot-rolled	7213.20.0000	Free.
Sheets, hot-rolled	7208.39.0030	Free.
Hot-rolled, pickled	7208.27.0060	Free.
Cold-rolled	7209.18.2550	Free.
Galvanized	7210.49.0090	Free.
Stainless steel:		
Semifinished	7218.91.0015	Free.
	7218.99.0015	Free.
Bars, cold-finished	7222.20.0075	Free.
Pipe and tube	7304.41.3045	Free.
Cold-rolled sheets	7219.33.0035	Free.

Depletion Allowance: Not applicable.

Government Stockpile: None.

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IRON AND STEEL

Events, Trends, and Issues: During the first 8 months of 2005, monthly pig iron production fluctuated near 3.0 million tons, and monthly raw steel production fluctuated near 8.5 million tons. Production totals during these periods decreased about 19% for pig iron and 6.1% for steel from those of 2004. Steel production was trending upward during the first 8 months of 2005. Shipments of steel mill products for 2005 were down nearly 11% compared with those of 2004. Imports of steel mill products increased an estimated 3.4% compared with those of 2004, and U.S. net import reliance as a percentage of apparent consumption exceeded an estimated 15%, the highest level since 2002.

The recovery of the global economy that began in late 2003 has been steady and gradual. The International Iron and Steel Institute (IISI) and the Organisation for Economic Co-operation and Development (OECD) estimated a world gross domestic product increase of 3.7% in 2005 compared with that of 2004. The U.S. Congressional Budget Office estimated the economic growth rate in the United States to be 3.7% in 2005 and 3.4% in 2006, with a steady decline to 2.5% through 2015. World consumption of finished steel products was estimated to increase by 3.9% to 5.0% by IISI. The OECD expected world steel demand to increase by about 5%, driven by the continuing strong growth in demand in China, where steel consumption was expected to increase by nearly 11%. However, increasing energy costs, including those of oil, during late 2005 may negatively affect the global steel industry, as happened in 1973 and 1979 when oil prices rose dramatically. Global steel consumption fell by 7.2% in 1975 and 11.6% in 1982, compared with that of the previous year, followed by a 6-year recession. Declining demand during 2006 while capacity expands may result in a capacity surplus.

China continued in 2005 to be the fasted growing economy in the world and the world's leading steel producer and consumer. China's 2005 steel production was an estimated 333 million metric tons, 22% more than that in 2004, but growth was expected to slow in 2006. The China Iron and Steel Association stated that the country's new steel policy will result in significant consolidations of a fragmented steel sector, which should reduce the threat of oversupply from China. China's top 10 steelmakers were expected to control more than 50% of that nation's total steel output by 2010 and more than 70% by 2020.

World Production:

	Pig iron		Raw steel	
	2004	2005[e]	2004	2005[e]
United States	42.3	33.1	99.7	92.4
Brazil	32.9	34	31.2	31.5
China	252	290	272	333
European Union[9]	107	107	*193	186
India	30.8	31	32.0	34
Japan	83.0	83	112	113
Korea, Republic of	28.0	28	47.5	49
Russia	53.1	48	64.3	64.2
Ukraine	31.0	30.3	38.7	42
Other countries	52	63	*158	146
World total (rounded)	712	747	*1,050	1,090

World Resources: Not applicable. See Iron Ore.

Substitutes: Iron is the least expensive and most widely used metal. In most applications, iron and steel compete either with less expensive nonmetallic materials or with more expensive materials having a performance advantage. Iron and steel compete with lighter materials, such as aluminum and plastics, in the motor vehicle industry; aluminum, concrete, and wood in construction; and aluminum, glass, paper, and plastics in containers.

[e]Estimated. *Corrected on March 2, 2006.
[1]Production and shipments data source is the American Iron and Steel Institute; see also Iron Ore and Iron and Steel Scrap.
[2]More than 95% of iron made is transported molten to steelmaking furnaces located at the same site.
[3]U.S Census Bureau.
[4]Defined as steel shipments + imports - exports + adjustments for industry stock changes + adjustment for imports of semifinished steel products.
[5]U.S. Department of Labor, Bureau of Labor Statistics.
[6]Metals Service Center Institute.
[7]U.S. Department of Labor, Bureau of Labor Statistics. Blast furnaces and steel mills: NAICS 33111; Iron and steel foundries: NAICS 33151.
[8]Defined as imports - exports + adjustments for Government and industry stock changes.
[9]European Union membership increased from 15 to 25 as of May 1, 2004.

IRON AND STEEL SCRAP[1]

(Data in million metric tons of metal unless otherwise noted)

Domestic Production and Use: Total value of domestic purchases (receipts of ferrous scrap by all domestic consumers from brokers, dealers, and other outside sources) and exports was estimated to be $12.6 billion in 2005, up about 32% from that of 2004. U.S. apparent steel consumption, an indicator of economic growth, rose to about 122 million tons in 2005. Manufacturers of pig iron, raw steel, and steel castings accounted for 87% of scrap consumption by the domestic steel industry, using scrap together with pig iron and direct-reduced iron to produce steel products for the appliance, construction, container, machinery, oil and gas, transportation, and various other consumer industries. The ferrous castings industry consumed most of the remaining 13% to produce cast iron and steel products, such as motor blocks, pipe, and machinery parts. Relatively small quantities of scrap were used for producing ferroalloys, for the precipitation of copper, and by the chemical industry; these uses collectively totaled less than 1 million tons.

During 2005, raw steel production was an estimated 92.4 million tons, about 7% less than that of 2004; capability utilization was down by 8% from that of 2004. Net shipments of steelmill products were estimated to have been about 102 million tons compared with 101 million tons (revised) for 2004. The domestic ferrous castings industry shipped an estimated 7.4 million tons of all types of iron castings in 2005 and an estimated 0.7 million tons of steel castings.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production:					
Home scrap	18	17	17	14	14
Purchased scrap[2]	55	56	53	60	62
Imports for consumption[3]	3	3	4	5	4
Exports[3]	7	9	11	12	14
Consumption, reported	71	69	61	67	67
Price, average, dollars per metric ton delivered, No. 1 Heavy Melting composite price, Iron Age Average, Pittsburgh, Philadelphia, Chicago	73.84	88.21	108.00	205.00	175
Stocks, consumer, yearend	4.9	5.1	4.4	5.4	4.5
Employment, dealers, brokers, processors, number[4]	37,000	30,000	30,000	30,000	30,000
Net import reliance[5] as a percentage of reported consumption	E	E	E	E	E

Recycling: Recycled iron and steel scrap is a vital raw material for the production of new steel and cast iron products. The steel and foundry industries in the United States have been structured to recycle scrap, and, as a result, are highly dependent upon scrap. The steel industry in North America has been recycling steel scrap for more than 200 years. The automotive recycling industry alone recycled an estimated 17 million vehicles in 2005 through more than 200 car shredders to supply an estimated 13 million tons of shredded steel scrap to the steel industry for recycling. More than 12,000 vehicle dismantlers throughout North America resell parts. In the United States alone, an estimated 67 million tons of steel was recycled in steel mills and foundries in 2005. Recycling of scrap plays an important role in the conservation of energy because the remelting of scrap requires much less energy than the production of iron or steel products from iron ore. Also, consumption of iron and steel scrap by remelting reduces the burden on landfill disposal facilities and prevents the accumulation of abandoned steel products in the environment. Recycled scrap consists of approximately 49% post-consumer (old, obsolete) scrap, 26% prompt scrap (produced in steel-product manufacturing plants), and 25% home scrap (recirculating scrap from current operations).

Import Sources (2001-04): Canada, 60%; United Kingdom, 20%; Sweden, 7%; Russia, 3%; and other, 10%.

Tariff: **Item**	**Number**	**Normal Trade Relations 12-31-05**
Iron and steel waste and scrap:		
No. 1 Bundles	7204.41.0020	Free.
No. 1 Heavy Melting	7204.49.0020	Free.
No. 2 Heavy Melting	7204.49.0040	Free.
Shredded	7204.49.0070	Free.

Depletion Allowance: Not applicable.

Government Stockpile: None.

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IRON AND STEEL SCRAP

Events, Trends, and Issues: Scrap prices fluctuated widely between about $159 per ton and about $247 per ton through 2004 and the first half of 2005. Hot-rolled steel prices increased until late 2004 and then decreased steadily during the next 11 months. The producer price index for steel mill products continued to rise from 101.3 in 2001 to and estimated 161 in 2005. Steelmill capability utilization increased steadily during 2003 and 2004 to a peak of 97.3% in September 2004, before decreasing to 88.4% for the first 5 months of 2005.

Ferrous scrap prices were significantly lower, on average, during the first half of 2005 than in 2004. Composite prices published by Iron Age Scrap Price Bulletin for No. 1 Heavy Melting steel scrap delivered to purchasers in Chicago, Philadelphia, and Pittsburgh averaged about $173 per metric ton during the first half of 2005. As reported by Iron Age Scrap Price Bulletin, the average price for nickel-bearing stainless steel scrap delivered to purchasers in Pittsburgh was about $1,555 per ton in 2005, which was higher than the 2004 average price of $1,450 per ton. Exports of ferrous scrap increased from 11.8 million tons during 2004, mainly to China, Canada, and Turkey, in descending order. Export scrap value increased from $2.9 billion in 2004 to an estimated $3.5 billion in 2005.

In the United States, the primary source of old steel scrap is the automobile. The recycling rate for automobiles in 2004, the latest year for which statistics were available, was 102%. A recycling rate greater than 100% is a result of the steel industry recycling more steel from automobiles than was used in the domestic production of new vehicles. The recycling rates for appliances and steel cans in 2004 were 81% and 62%, respectively. Recycling rates for construction materials in 2004 were about 98% for plates and beams and 63% for rebar and other materials. The recycling rates for appliance, can, and construction steel are expected to increase not only in the United States but also in emerging industrial countries. As environmental regulations increase, recycling becomes more profitable and convenient, and public interest in recycling continues to grow.

On August 29, 2005, Hurricane Katrina caused the closure of the Port of New Orleans and adversely affected steel production and transportation of finished steel products on the Mississippi River. Hydrogen, critical for some steelmaking processes, was in short supply, and barge transportation was disrupted. Steel product imports and exports began passing through the port 2 weeks after closing. New Orleans imports and exports about one-third of steel products passing through Gulf of Mexico ports. The overall long-term impact of the storm was difficult to assess, but the devastation was expected to produce a glut of scrap from demolished buildings and from crippled scrap yards emptying inventories for repair work.

World Mine Production, Reserves, and Reserve Base: Not applicable.

World Resources: Not applicable.

Substitutes: About 1.7 million tons of direct-reduced iron was used in the United States in 2005 as a substitute for iron and steel scrap, down from 2.5 million tons in 2004.

[e]Estimated. E Net exporter.

[1]See also Iron Ore and Iron and Steel.

[2]Receipts – shipments by consumers + exports – imports.

[3]Includes used rails for rerolling and other uses, and ships, boats, and other vessels for scrapping.

[4]Estimated, based on 1992 Census of Wholesale Trade for 2001, and 2002 Census of Wholesale Trade for 2002 through 2005.

[5]Defined as imports – exports + adjustments for Government and industry stock changes.

IRON AND STEEL SLAG

(Data in million metric tons unless otherwise noted)

Domestic Production and Use: Ferrous slags are valuable coproducts of ironmaking and steelmaking. In 2005, about 21 million tons of domestic iron and steel slag, valued at about $326 million[1] (f.o.b.), was consumed. Iron or blast furnace slag accounted for about 60% of the tonnage sold and was worth about $290 million; about 85% of this value was granulated slag. Steel slag, produced from basic oxygen and electric arc furnaces[2] accounted for the remainder. There were 29 slag-processing companies servicing iron and/or steel companies or reprocessing old slag piles at about 130 locations: iron slag at about 40 sites in 14 States and steel slag at about 90 sites in 32 States. Included in these data are a dozen facilities that grind and sell ground granulated blast furnace slag (GGBFS) based on imported unground feed.

The prices listed in the table below are the weighted average for a variety of ferrous slags. Actual prices per ton range from about $0.25 for steel slags in areas where natural aggregates are abundant to about $72 for some GGBFS. The major uses of air-cooled iron slag and for steel slag were as aggregates for asphaltic paving, fill, and road bases, and as a feed for cement kilns. Air-cooled slag also is used as an aggregate for concrete. In contrast, GGBFS is mainly used as a partial substitute for portland cement in concrete mixes and in blended cements. Owing to their low unit values, most slag types are shipped by truck over short distances only (rail and waterborne transportation can be longer). Because it has a much higher unit value, GGBFS can be shipped economically over longer distances.

Salient Statistics—United States:	2001	2002[3]	2003[3]	2004[3]	2005[e, 3]
Production, marketed[1, 4]	16.9	19.1	19.7	21.2	21.0
Imports for consumption	2.6	1.1	1.1	1.0	1.7
Exports	([5])	0.1	0.1	0.1	([5])
Consumption, apparent[6]	19.5	19.1	19.7	21.1	21.0
Price average value, dollars per ton, f.o.b. plant	8.05	[7]15.50	[7]15.00	[7]15.50	[7]15.50
Stocks, yearend	NA	NA	NA	NA	NA
Employment, number[e]	2,700	2,700	2,700	2,700	2,600
Net import reliance[8] as a percentage of apparent consumption	8	5	5	4	8

Recycling: Apart from the large outside markets for slag in the construction sector, some iron and steel slags are returned to the furnaces as ferrous and flux feed. Entrained metal, particularly in steel slag, is routinely recovered during slag processing for return to the furnaces. However, data for such furnace-feed uses are unavailable.

Import Sources (2001-04): Year-to-year import data for ferrous slags show variations in both tonnage and unit value; many past data contain discrepancies. Most of the imported material is unground granulated blast furnace slag. Principal suppliers in recent years have been Brazil, Canada, France, Italy, Japan, South Africa, and Spain. Principal sources, for 2002-04 only, were Canada, 39%; France, 27%; Italy, 23%; Japan, 5%; and other, 6%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Granulated slag	2618.00.0000	Free.
Basic slag	3103.20.0000	Free.
Slag, dross, scale, from manufacture of iron and steel	2619.00.3000	Free.

Depletion Allowance: Not applicable.

Government Stockpile: None.

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IRON AND STEEL SLAG

Events, Trends, and Issues: Air-cooled blast furnace slag is in declining domestic supply owing to depletion of old slag piles and the closure of many blast furnaces over the years for economic and/or environmental reasons. No new blast furnaces are under construction or are planned. Steel slag from integrated works is likewise in decline, but slag from electric arc furnaces (largely fed with steel scrap) remains abundant. Both of these slag types compete with natural aggregates. Demand is growing for GGBFS in concrete; spurred by this demand and the much higher unit sales price for GGBFS, two new granulators have been added in recent years to existing blast furnaces, and a number of grinding facilities at independent sites or at cement plants have been constructed to process imported granulated slag. However, one blast furnace, long equipped with a granulator, was idled—perhaps permanently—at midyear 2005, and one import-based grinding plant for GGBFS was made temporarily inoperable in late August 2005 by a hurricane. Pelletized slag, used mainly as a lightweight aggregate, remains in limited supply. Overall, most of the demand for slag is in large-scale (mostly public-sector) construction projects and fluctuates with levels of construction spending.

World Mine Production, Reserves, and Reserve Base: Slag is not a mined material. Production data for the world are unavailable, but it is estimated that annual world iron and steel slag output is on the order of 220 to 420 million tons, based on typical ratios of slag to crude iron and steel output.

World Resources: Not applicable.

Substitutes: Crushed stone and sand and gravel are common aggregate substitutes in the construction sector. Certain rock types, as well as silica fume and, especially, fly ash, are alternative cementitious additives in blended cements and concrete. As a cement kiln feed, slags (especially steel slag) compete with some of the traditional limestone and other natural (rock) raw materials.

[e]Estimated. NA Not available.
[1]The data (obtained from an annual survey of slag processors) pertain to the quantities of processed slag sold rather than that processed or produced during the year. The data exclude any entrained metal that may be recovered during slag processing and returned to iron and, especially, steel furnaces. Data for such recovered metal were unavailable.
[2]There were very minor sales of open hearth furnace steel slag from stockpiles but no domestic production of this slag type in 2005.
[3]Owing to inclusion of more complete information (especially for granulated slag), data in 2002-05 are not strictly comparable to those of recent previous years.
[4]The data include (2001-05) sales of imported granulated blast furnace slag, either after domestic grinding or still unground, and exclude (2003-05) sales of pelletized slag (proprietary but very small). Overall, blast furnace slag production may be estimated as equivalent to 25% to 30% of crude (pig) iron production and steel furnace slag at about 10% to 15% of crude steel output.
[5]Less than ½ unit.
[6]Defined, for 2001, as production (sales) + imports – exports and, for 2002-05, as total sales of slag (includes that from imported feed) – exports. Calculation is based on unrounded original data.
[7]The higher price in 2002-05 represents more complete data on sales of ground granulated blast furnace slag, which sold for almost $60 per ton, as opposed to air-cooled blast furnace and steel slags, which sold, on average, in the range of about $4 to $7 per ton.
[8]Defined as imports – exports for 2001 and, for 2002-05, as total sales of imported slag – exports of slag. Data are not available to allow adjustments for changes in stocks.

KYANITE AND RELATED MINERALS

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: One firm in Virginia with integrated mining and processing operations produced kyanite from hard-rock open pit mines. Another company produced synthetic mullite in Georgia. Of the kyanite-mullite output, 90% was estimated to have been used in refractories and 10% in other uses. Of the refractory usage, an estimated 60% to 65% was used in ironmaking and steelmaking and the remainder in the manufacture of chemicals, glass, nonferrous metals, and other materials.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production:					
Mine[e]	90	90	90	90	90
Synthetic mullite[e]	40	40	40	40	40
Imports for consumption (andalusite)	3	5	4	4	10
Exports[e]	35	35	35	35	35
Shipments from Government stockpile excesses	—	—	—	0.1	—
Consumption, apparent[e]	98	100	99	99	105
Price, average, dollars per metric ton:					
U.S. kyanite, raw	165	165	NA	NA	NA
U.S. kyanite, calcined	279	279	279	272	272
Andalusite, Transvaal, South Africa	186	191	220	238	238
Stocks, producer	NA	NA	NA	NA	NA
Employment, kyanite mine and plant, number[e]	150	150	150	150	150
Net import reliance[1] as a percentage of apparent consumption	E	E	E	E	E

Recycling: Insignificant.

Import Sources (2001-04): South Africa, 100%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Andalusite, kyanite, and sillimanite	2508.50.0000	Free.
Mullite	2508.60.0000	Free.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile:

Stockpile Status—9-30-05[2]
(Metric tons)

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Kyanite, lump	—	—	—	50	—

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KYANITE AND RELATED MINERALS

Events, Trends, and Issues: The steel industry worldwide continued to be the leading consumer of refractories. According to the International Iron and Steel Institute, world crude steel production for the first 8 months was about 7% higher than in the comparable period of 2004. The three leading producing countries were China with about 31%; Japan, 10%; and the United States, 8%.

Refractory consumers in such countries as China and India were more open to accepting higher performance, higher priced refractory products to obtain improved performance and extended life span of refractories. In India, core refractory consumers were producers of iron and steel and cement. The country was relying to a considerable extent on imported refractories and refractory raw materials. Countries in Asia were facing increases for the price of refractory raw materials from China.[3]

The use of monolithic (unshaped) refractories was becoming more dominant in India and some other Asian nations. In Japan, monolithics were making up about 65% of refractory production.[3]

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves and reserve base[4]
	2004	2005[e]	
United States[e]	90	90	Large in the United States. South Africa reports reserve base of about 51 million tons of aluminosilicates ore (andalusite and sillimanite).
France	65	65	
India	21	22	
South Africa	165	165	
Other countries	8	8	
World total (rounded)	350	350	

World Resources: Large resources of kyanite and related minerals are known to exist in the United States. The chief resources are in deposits of micaceous schist and gneiss mostly in the Appalachian Mountains area and in Idaho. Other resources are in aluminous gneiss in southern California. These resources are not economical to mine at present. The characteristics of kyanite resources in the rest of the world are thought to be similar to those in the United States.

Substitutes: Two types of synthetic mullite (fused and sintered), superduty fire clays, and high-alumina materials are substitutes for kyanite in refractories. Principal raw materials for synthetic mullite are bauxite, kaolin and other clays, and silica sand.

[e]Estimated. E Net exporter. NA Not available. — Zero.
[1]Defined as imports – exports + adjustments for Government and industry stock changes.
[2]See Appendix B for definitions.
[3]Taylor, Lindsey, 2005, Asian refractories steeled for change: Industrial Minerals, no. 456, September, p. 40-45.
[4]See Appendix C for definitions.

LEAD

(Data in thousand metric tons of lead content unless otherwise noted)

Domestic Production and Use: The value of recoverable mined lead in 2005, based on the average U.S. producer price, was $575 million. Six lead mines in Missouri plus lead-producing mines in Alaska, Idaho, Montana, and Washington yielded most of the total. Primary lead was processed at one smelter-refinery in Missouri. Of the 22 plants that produced secondary lead, 14 had annual capacities of 15,000 tons or more and accounted for more than 99% of secondary production. Lead was consumed at about 120 manufacturing plants. The lead-acid battery industry continued to be the principal user of lead, accounting for 85% of the reported U.S. lead consumption for 2005. Lead-acid batteries were primarily used as starting-lighting-ignition (SLI) batteries for automobiles and trucks. Lead-acid batteries were also used as industrial-type batteries for uninterruptible power-supply equipment for computer and telecommunications networks and hospitals; for load-leveling equipment for commercial electrical power system; and as traction batteries used in airline ground equipment, industrial forklifts, mining vehicles, golf carts, etc. About 10% of lead was used in ammunition; casting material; sheets (including radiation shielding), pipes, traps and extruded products; cable covering, calking lead, and building construction; solder; and oxides for glass, ceramics, pigments, and chemicals. The balance was used in ballast and counter weights, brass and bronze, foil, terne metal, type metal, wire, and other undistributed consumption.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production:					
Mine, lead in concentrates	466	451	460	445	440
Primary refinery	290	262	245	148	145
Secondary refinery, old scrap	1,040	1,070	1,120	1,100	1,100
Imports for consumption, lead in concentrates	2	([1])	—	—	—
Exports, lead in concentrates	181	241	253	292	300
Imports for consumption, refined metal, wrought and unwrought	284	218	183	202	287
Exports, refined metal, wrought and unwrought	35	43	123	83	61
Shipments from Government stockpile excesses, metal	41	6	60	42	27
Consumption:					
Reported	1,550	1,440	1,390	1,480	1,540
Apparent[2]	1,640	1,450	1,470	1,440	1,490
Price, average, cents per pound:					
North American Producer	43.6	43.6	43.8	55.1	61.0
London Metal Exchange	21.6	20.5	23.3	40.2	43.4
Stocks, metal, producers, consumers, yearend	100	111	85	59	60
Employment:					
Mine and mill (peak), number[3]	1,100	930	830	880	870
Primary smelter, refineries	400	320	320	240	240
Secondary smelters, refineries	1,600	1,600	1,600	1,600	1,600
Net import reliance[4] as a percentage of apparent consumption	8	E	E	E	E

Recycling: About 1.1 million tons of secondary lead was produced, an amount equivalent to 72% of reported domestic lead consumption. Nearly all of it was recovered from old (post-consumer) scrap.

Import Sources (2001-04): Metal, wrought and unwrought: Canada, 77%; China, 10%; Australia, 4%; Mexico, 4%; and other, 5%.

Tariff: Item	**Number**	**Normal Trade Relations[5] 12-31-05**
Unwrought (refined)	7801.10.0000	2.5% ad val.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile:

Stockpile Status—9-30-05[6]

Material	**Uncommitted inventory**	**Committed inventory**	**Authorized for disposal**	**Disposal plan FY 2005**	**Disposals FY 2005**
Lead	29	—	29	54	27

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LEAD

Events, Trends, and Issues: During 2005, the price of refined lead increased in the U.S. and world markets. The average North American Producer and London Metal Exchange prices for the first 9 months of the year were 60.66 cents per pound and 43.17 cents per pound, respectively. These averages represent a 10% and a 7% increase, respectively, from the annual average prices for 2004. Estimated world use of lead rose by between 3% and 4% in 2005. The main driver behind this world growth, as it had been for several years, was higher use in China for vehicle fleet expansion, production of automotive batteries for export, and investment in telecommunications and information technology. European lead use decreased by about 2%. Global mine production was projected to increase by approximately 4% in 2005. The world refined lead production in 2005 was approximately 1% less than world consumption, and a minor production deficit was forecast to continue into 2006.

U.S. lead mine production in 2005 deceased by about 1% compared with production in 2004. Production of secondary refined lead, mostly derived from spent lead-acid batteries, decreased by about 1%, and U.S. reported consumption of lead increased by about 4%. Through the first half of the year, there was a significant increase in shipments of original equipment and replacement SLI batteries.

The lead-acid battery industry recycled a little more than 99% of the available lead scrap from spent lead-acid batteries during the period 1999 through 2003, according to a report issued by the Battery Council International (BCI) in June 2005. The lead recycling rate ranked higher than that of any other recyclable material. The BCI report tracked lead recycling from spent SLI batteries—used in automobiles, trucks, motorcycles, boats, and garden tractors—as well as spent industrial batteries used in a variety of motive and stationary battery applications.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[7]	Reserve base[7]
	2004	2005[e]		
United States	445	440	8,100	20,000
Australia	678	760	15,000	28,000
Canada	77	77	2,000	9,000
China	950	950	11,000	36,000
India	40	50	NA	NA
Ireland	65	70	NA	NA
Kazakhstan	40	40	5,000	7,000
Mexico	139	143	1,500	2,000
Morocco	65	65	500	1,000
Peru	306	310	3,500	4,000
South Africa	37	40	400	700
Sweden	34	35	500	1,000
Other countries	275	300	19,000	30,000
World total (rounded)	3,150	3,280	67,000	140,000

World Resources: In recent years, significant lead resources have been demonstrated in association with zinc and/or silver or copper deposits in Australia, Canada, China, Ireland, Mexico, Peru, Portugal, and the United States (Alaska). Identified lead resources of the world total more than 1.5 billion tons.

Substitutes: Substitution of plastics has reduced the use of lead in building construction, electrical cable covering, cans, and containers. Aluminum, iron, plastics, and tin compete with lead in other packaging and protective coatings, and tin has replaced lead in solder for new or replacement potable water systems in the United States. In the electronics industry, there has been a move towards lead-free solders with varying compositions of tin, bismuth, silver and copper.

[e]Estimated. E Net exporter. NA Not available; included in Other countries. — Zero.
[1]Less than ½ unit.
[2]Apparent consumption series revised to reflect a total raw material balance. Apparent consumption defined as mine production + secondary refined + imports (concentrates and refined) – exports (concentrates and refined) + adjustments for Government and industry stock changes.
[3]Includes only mines for which lead was the primary product. In 2005, approximately 510 people were employed at zinc mines where lead was a significant byproduct or coproduct.
[4]Defined as imports – exports + adjustments for Government and industry stock changes. Includes trade in both concentrates and refined lead.
[5]No tariff for Mexico and Canada for item shown.
[6]See Appendix B for definitions.
[7]See Appendix C for definitions.

LIME[1]

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: In 2005, 20.0 million metric tons (22.5 million short tons) of quicklime and hydrate was produced (excluding commercial hydrators) in 35 States and Puerto Rico. Production was valued at more than $1.5 billion. Five companies accounted for more than 70% of the total output. Principal producing States, each with production of more than 1 million tons, were Alabama, Kentucky, Missouri, Nevada, Ohio, Pennsylvania, and Texas. These seven States produced about 13.3 million tons (14.7 million short tons), or 65% of the total output. Major markets for lime were steelmaking, flue gas desulfurization, mining, construction, pulp and paper, precipitated calcium carbonate, and water treatment.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production[2]	18,900	17,900	19,200	20,000	20,000
Imports for consumption	115	157	202	232	310
Exports	96	106	98	100	130
Consumption, apparent	19,000	17,900	19,300	20,200	20,200
Quicklime average value, dollars per ton at plant	58.10	59.20	61.40	64.80	72.00
Hydrate average value, dollars per ton at plant	80.70	88.50	84.80	89.80	95.00
Stocks, yearend	NA	NA	NA	NA	NA
Employment, mine and plant, number	5,500	5,400	5,350	5,350	5,300
Net import reliance[3] as a percentage of apparent consumption	([4])	([4])	([4])	1	1

Recycling: Large quantities of lime are regenerated by paper mills. Some municipal water-treatment plants regenerate lime from softening sludge. Quicklime is regenerated from waste hydrated lime in the carbide industry. Data for these sources were not included as production in order to avoid duplication.

Import Sources (2001-04): Canada, 73%; Mexico, 26%; and other, 1%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Quicklime	2522.10.0000	Free.
Slaked lime	2522.20.0000	Free.
Hydraulic lime	2522.30.0000	Free.
Calcined dolomite	2518.20.0000	3% ad. val.

Depletion Allowance: Limestone produced and used for lime production, 14% (Domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: Carmeuse Lime announced plans to improve its production and distribution capabilities by restarting an idle lime kiln at its Black River plant in Kentucky, constructing a new hydrating plant and distribution terminal in South Carolina, and upgrading several existing hydrating plants.[5] In addition, the company announced that capacity improvements at other Carmeuse plants allowed the cessation of production at its Hanover plant in Pennsylvania. The plant will be idled and could be restarted if market demand exceeds the company's supply capacity.[6] Oglebay Norton Co. announced that its wholly owned subsidiary O-N Minerals (formerly Global Stone Corp.) signed an agreement with Western Lime Corp. (West Bend, WI), whereby Western Lime will lease land at O-N Minerals' Port Inland, MI, site and construct a 180,000-metric-ton-per-year lime plant. The plant will produce high-calcium lime for environmental and industrial markets and is expected to operational in 2007.[7] United States Lime & Minerals, Inc. reported that it had entered into a contract to construct a third kiln at its Arkansas Lime Co. plant in Batesville, AR. The project also will include crushing and stone-handling enhancements plus additional product silos and loading facilities.[8] Graymont (PA) Inc. started up its new preheater rotary kiln at its Pleasant Gap, PA, plant in October. A new hydrating plant, additional lime storage, and new loading facilities were also part of the project.[9]

Lime prices continued to rise primarily owing to increased energy costs. Lime companies have announced higher product prices to compensate for rising prices for kiln fuels such as coal, petroleum coke, and natural gas, as well as transportation fuels.

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LIME

World Lime Production and Limestone Reserves and Reserve Base:

	Production 2004	Production 2005[e]	Reserves and reserve base[10]
United States	20,000	20,000	Adequate for all countries listed.
Austria	2,000	2,000	
Brazil	6,500	6,500	
Canada	2,200	2,300	
China	23,500	25,000	
France	3,000	3,000	
Germany	6,700	6,700	
Iran	2,200	2,200	
Italy[11]	3,000	3,000	
Japan (quicklime only)	7,950	8,000	
Mexico	5,700	5,800	
Poland	2,000	2,000	
Russia	8,000	8,000	
South Africa (sales)	1,500	1,600	
United Kingdom	2,000	2,000	
Other countries	29,800	30,000	
World total (rounded)	126,000	128,000	

World Resources: Domestic and world resources of limestone and dolomite suitable for lime manufacture are adequate.

Substitutes: Limestone is a substitute for lime in many applications, such as agriculture, fluxing, and sulfur removal. Limestone, which contains less reactive material, is slower to react and may have other disadvantages compared with lime depending on the application; however, limestone is considerably less expensive than lime. Calcined gypsum is an alternative material in industrial plasters and mortars. Cement and lime kiln dust and fly ash are potential substitutes for some construction uses of lime. Magnesium hydroxide is a substitute for lime in pH control, and magnesium oxide is a substitute for dolomitic lime as a flux in steelmaking.

[e]Estimated. NA Not available.
[1]Data are for quicklime, hydrated lime, and refractory dead-burned dolomite. Excludes Puerto Rico unless noted.
[2]Sold or used by producers.
[3]Defined as imports – exports + adjustments for Government and industry stock changes; stock changes are assumed to be zero for apparent consumption and net import reliance calculations.
[4]Less than ½ unit.
[5]Carmeuse Lime, 2005, Carmeuse Lime announces plans to upgrade its lime production and distribution network: Pittsburgh, PA, Carmeuse Lime press release, May 5, 1 p.
[6]Carmeuse Lime, 2005, Carmeuse Lime announces the closure of lime production at its Hanover, PA facility: Pittsburgh, PA, Carmeuse Lime press release, June 24, 1 p.
[7]Oglebay Norton Co., 2005, Oglebay Norton announces new lime plant, sale of vessel, and hiring of investment banker to explore sale of marine assets: Cleveland, OH, Oglebay Norton Co. press release, October 6, 2 p.
[8]United States Lime & Minerals, Inc., 2005, United States Lime & Minerals reports third quarter 2005 results: Dallas, TX, United States Lime & Minerals, Inc. press release, October 27, 3 p.
[9]Steve Boucher, Graymont Ltd., written commun., November 3, 2005.
[10]See Appendix C for definitions.
[11]Includes hydraulic lime.

LITHIUM

(Data in metric tons of lithium content unless otherwise noted)

Domestic Production and Use: Chile was the leading lithium chemical producer in the world; Argentina, China, Russia, and the United States also were major producers. Australia, Canada, and Zimbabwe were major producers of lithium ore concentrates. The United States remained the leading consumer of lithium minerals and compounds and the leading producer of value-added lithium materials. Because only one company produced lithium compounds from domestic resources, reported production and value of production data cannot be published. Estimation of value for the lithium mineral compounds produced in the United States is extremely difficult because of the large number of compounds used in a wide variety of end uses and the great variability of the prices for the different compounds.

The use of lithium compounds in ceramics, glass, and primary aluminum production represented more than 60% of estimated domestic consumption. Other major end uses for lithium were in the manufacture of lubricants and greases, primary and secondary (rechargeable) batteries, and in the production of synthetic rubber.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production	W	W	W	W	W
Imports for consumption	1,990	1,920	2,200	2,910	3,310
Exports	1,480	1,620	1,520	1,690	1,020
Consumption:					
Apparent	W	W	W	W	W
Estimated	1,400	1,100	1,400	1,900	3,000
Employment, mine and mill, number[e]	100	100	100	100	100
Net import reliance[1] as a percentage of apparent consumption	≤50%	≤50%	≤50%	>50%	>50%

Recycling: Insignificant, but growing through the recycling of lithium batteries.

Import Sources (2001-04): Chile, 77%; Argentina, 20%; and other, 3%.

Tariff: Item	**Number**	**Normal Trade Relations 12-31-05**
Other alkali metals	2805.19.9000	5.5% ad val.
Lithium oxide and hydroxide	2825.20.0000	3.7% ad val.
Lithium carbonate:		
U.S.P. grade	2836.91.0010	3.7% ad val.
Other	2836.91.0050	3.7% ad val.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: None.

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LITHIUM

Events, Trends, and Issues: The only active lithium carbonate plant in the United States was at a brine operation in Nevada. Subsurface brines have become the dominant raw material for lithium carbonate production worldwide because of lower production costs as compared with the mining and processing costs for hard-rock ores. Two brine operations in Chile dominate the world market; a facility at a brine deposit in Argentina produced lithium carbonate and lithium chloride. Most of the lithium minerals mined in the world were used directly as ore concentrates in ceramics and glass applications rather than feedstock for lithium carbonate and other lithium compounds.

Two companies produced a large array of downstream lithium compounds in the United States from domestic or South American lithium carbonate. A U.S. recycling company produced a small quantity of lithium carbonate from solutions recovered during the recycling of lithium batteries.

The market for lithium compounds with the largest potential for growth is batteries, especially rechargeable batteries. Demand for rechargeable lithium batteries continued to grow for use in video cameras, portable computers and telephones, and cordless tools. Interest in lithium batteries for hybrid electric vehicles, vehicles with an internal combustion engine and a battery-powered electric motor, continued. Commercially available hybrid vehicles do not use lithium batteries, although future models may. Nonrechargeable lithium batteries were used in calculators, cameras, computers, electronic games, watches, and other devices.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[2]	Reserve base[2]
	2004	2005[e]		
United States	W	W	38,000	410,000
Argentina[e]	1,970	2,000	NA	NA
Australia[e]	3,930	4,000	160,000	260,000
Bolivia	—	—	—	5,400,000
Brazil	242	240	190,000	910,000
Canada	707	700	180,000	360,000
Chile	7,990	8,000	3,000,000	3,000,000
China	2,630	2,700	540,000	1,100,000
Portugal	320	320	NA	NA
Russia	2,200	2,200	NA	NA
Zimbabwe	240	240	23,000	27,000
World total (rounded)	[3]20,200	[3]20,400	[4]4,100,000	[4]11,000,000

World Resources: The identified lithium resources total 760,000 tons in the United States and more than 13 million tons in other countries.

Substitutes: Substitutes for lithium compounds are possible in manufactured glass, ceramics, greases, and batteries. Examples are sodic and potassic fluxes in ceramics and glass manufacture; calcium and aluminum soaps as substitutes for stearates in greases; and calcium, magnesium, mercury, and zinc as anode material in primary batteries. Lithium carbonate is not considered to be an essential ingredient in aluminum potlines. Substitutes for aluminum-lithium alloys as structural materials are composite materials consisting of boron, glass, or polymer fibers in engineering resins.

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data. — Zero.
[1]Defined as imports – exports + adjustments for Government and industry stock changes.
[2]See Appendix C for definitions.
[3]Excludes U.S. production.
[4]Excludes Argentina, Portugal, and Russia.

MAGNESIUM COMPOUNDS[1]

(Data in thousand metric tons of magnesium content unless otherwise noted)

Domestic Production and Use: Seawater and natural brines accounted for about 51% of U.S. magnesium compounds production in 2005. Magnesium oxide and other compounds were recovered from seawater by three companies in California, Delaware, and Florida; from well brines by two companies in Michigan; and from lake brines by two companies in Utah. Magnesite was mined by one company in Nevada, brucite was mined by one company in Nevada and one company in Texas, and olivine was mined by two companies in North Carolina and Washington. About 58% of the magnesium compounds consumed in the United States was used for refractories. The remaining 42% was used in agricultural, chemical, construction, environmental, and industrial applications.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production	388	312	329	292	290
Imports for consumption	307	337	332	356	410
Exports	62	66	53	35	30
Consumption, apparent	634	583	608	613	670
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, plant, number[e]	450	450	370	370	370
Net import reliance[2] as a percentage of apparent consumption	39	46	46	52	56

Recycling: Some magnesia-base refractories are recycled, either for reuse as refractory material or for use as construction aggregate.

Import Sources (2001-04): China, 70%; Canada, 9%; Australia, 7%; Austria, 3%; and other, 11%.

Tariff:[3] Item	Number	Normal Trade Relations 12-31-05
Crude magnesite	2519.10.0000	Free.
Dead-burned and fused magnesia	2519.90.1000	Free.
Caustic-calcined magnesia	2519.90.2000	Free.
Kieserite	2530.20.1000	Free.
Epsom salts	2530.20.2000	Free.
Magnesium hydroxide	2816.10.0000	3.1% ad val.
Magnesium chloride	2827.31.0000	1.5% ad val.
Magnesium sulfate (synthetic)	2833.21.0000	3.7% ad val.

Depletion Allowance: Brucite, 10% (Domestic and foreign); dolomite, magnesite, and magnesium carbonate, 14% (Domestic and foreign); magnesium chloride (from brine wells), 5% (Domestic and foreign); and olivine, 22% (Domestic) and 14% (Foreign).

Government Stockpile: None.

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MAGNESIUM COMPOUNDS

Events, Trends, and Issues: One of the two U.S. producers of magnesium chloride in Utah announced that it planned to increase its liquid magnesium chloride capacity by 70% and double its capacity to produce solid magnesium chloride by mid-2006. The company planned to invest $12 million during the next 2 years to expand its magnesium chloride evaporation ponds at the Great Salt Lake, upgrade its production facility, and add rail infrastructure.

The caustic-calcined magnesia producer in Canada mothballed one of its production plants because of high energy costs and increasing maintenance for the aging plant. The 100,000-ton-per-year natural-gas-fired rotary kiln was installed in 1982. The company's other 50,000-ton-per-year vertical shaft kiln, installed in 1997, was running nearly at full capacity. The 60,000-ton-per-year magnesia plant that was opened in Jordan in December 2003 was closed in December 2004 for scheduled maintenance. During the maintenance, other technical problems with the plant's equipment were discovered, and the plant remained closed throughout 2005. After nearly 70 years of production, the sole magnesia producer in the United Kingdom closed in June. It had the capacity to produce 7,000 tons per year of caustic-calcined magnesia and 20,000 tons per year of magnesium hydroxide from dolomite.

A new olivine plant opened in Turkey in 2005 with the capacity to produce 400,000 tons per year of finished product. The new plant brings the total number of olivine producers in Turkey to three, with a total capacity of 700,000 tons per year. A mining license was granted for the olivine deposit in Greenland, and construction of plant infrastructure began in mid-2005. The owner planned to produce 1 million to 2 million tons of olivine per year for the iron- and steelmaking industries.

World Mine Production, Reserves, and Reserve Base:

	Magnesite production		Magnesite reserves and reserve base[4]	
	2004	2005[e]	Reserves	Reserve base
United States	W	W	10,000	15,000
Australia	94	95	100,000	120,000
Austria	202	200	15,000	20,000
Brazil	78	80	45,000	65,000
China	1,340	1,350	380,000	860,000
Greece	144	150	30,000	30,000
India	107	110	14,000	55,000
Korea, North	288	290	450,000	750,000
Russia	346	350	650,000	730,000
Slovakia	287	285	45,000	324,000
Spain	151	150	10,000	30,000
Turkey	1,100	1,100	65,000	160,000
Other countries	140	140	390,000	440,000
World total (rounded)	[5]4,270	[5]4,300	2,200,000	3,600,000

In addition to magnesite, there are vast reserves of well and lake brines and seawater from which magnesium compounds can be recovered.

World Resources: Resources from which magnesium compounds can be recovered range from large to virtually unlimited and are globally widespread. Identified world resources of magnesite total 12 billion tons, and of brucite, several million tons. Resources of dolomite, forsterite, magnesium-bearing evaporite minerals, and magnesia-bearing brines are estimated to constitute a resource in billions of tons. Magnesium hydroxide can be recovered from seawater.

Substitutes: Alumina, chromite, and silica substitute for magnesia in some refractory applications.

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]See also Magnesium Metal.
[2]Defined as imports – exports + adjustments for Government and industry stock changes.
[3]Tariffs are based on gross weight.
[4]See Appendix C for definitions.
[5]Excludes the United States.

MAGNESIUM METAL[1]

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: In 2005, magnesium was produced by one company in Utah by an electrolytic process that recovered magnesium from brines from the Great Salt Lake. Structural uses of magnesium (castings and wrought products) were the leading use for primary magnesium, accounting for 59% of apparent consumption. Magnesium used as a constituent of aluminum-base alloys that were used for packaging, transportation, and other applications accounted for 28% of primary metal use. Desulfurization of iron and steel accounted for 7% of U.S. consumption of primary metal, and other uses were 6%.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production:					
Primary	W	W	W	W	W
Secondary (new and old scrap)	66	74	70	72	70
Imports for consumption	69	88	83	99	90
Exports	20	25	20	12	10
Consumption:					
Reported, primary	96	102	102	122	105
Apparent[2]	120	110	120	140	130
Price, yearend:					
Metals Week, U.S. spot Western, dollars per pound, average	1.25	1.16	1.14	1.58	1.35
Metal Bulletin, European free market, dollars per metric ton, average	1,825	1,930	1,900	1,875	1,650
Stocks, producer and consumer, yearend	W	W	W	W	W
Employment, number[e]	400	400	400	400	400
Net import reliance[3] as a percentage of apparent consumption	44	55	53	61	61

Recycling: In 2005, about 20,000 tons of the secondary production was recovered from old scrap.

Import Sources (2001-04): Canada, 42%; Russia, 22%; China, 16%; Israel, 10%; and other, 10%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Unwrought metal	8104.11.0000	8.0% ad val.
Unwrought alloys	8104.19.0000	6.5% ad val.
Wrought metal	8104.90.0000	14.8¢/kg on Mg content + 3.5% ad val.

Depletion Allowance: Dolomite, 14% (Domestic and foreign); magnesium chloride (from brine wells), 5% (Domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: Final antidumping duty orders on magnesium from China and Russia were published in April. For China, the final duties for magnesium alloy were 49.66% ad valorem for two specific companies and 141.49% ad valorem as the China-wide rate. Magnesium covered under this order is classified under Harmonized Tariff Schedule (HTS) codes 8104.19.0000 and 8104.30.0000. An antidumping duty order was established on magnesium ingot from China in 1995 (108.26% ad valorem), and a separate antidumping duty order was established on granular magnesium from China in 2001 (24.67% and 305.56% ad valorem). For Russia, the antidumping duties were 21.71% ad valorem for one of the two Russian magnesium producers, 18.65% ad valorem for the other Russian producer, and 21.01% for all others. The material covered under this order is classifiable under HTS codes 8104.11.0000, 8104.19.0000, 8104.30.0000, and 8104.90.0000. In May, one of the Russian magnesium producers and a U.S. aluminum producer filed appeals with the U.S. Court of International Trade regarding the antidumping duty rulings. In August, the U.S. magnesium producer filed a scope ruling request with the U.S. Department of Commerce alleging that a magnesium producer in Canada and a recycler in France were remelting magnesium from China and exporting it to the United States as magnesium originating in Canada and France.

The U.S. primary magnesium producer delayed the startup of its previous announced expansion that would have increased production capacity by 11,000 tons per year to 54,000 tons per year. The company cited unfavorable market conditions that did not exist when the expansion was announced as the reason for the delay and that the startup date for the new capacity was indefinite.

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MAGNESIUM METAL

In May, the U.S. Department of Justice, acting at the request of the U.S. Environmental Protection Agency, filed a suit alleging that waste and dust from the U.S. magnesium producer's plant had elevated levels of polychlorinated biphenyls (PCBs). The PCB levels were estimated to be as high as 600 parts per million (ppm). PCB wastes are generally regulated for disposal under the Toxic Substances Control Act at concentrations greater than 50 ppm. The company already was involved in a lawsuit that was brought in 2001 regarding dioxin releases at the plant.

The leading Canadian magnesium producer announced that it would increase production capacity at its magnesium plant in Becancour, Quebec, Canada, with construction beginning in the first quarter of 2005. The company will improve its dehydration process and add four electrolytic cells to bring the total capacity to 58,000 tons per year by the third quarter of 2006.

In China, 40 small magnesium plants closed in the second quarter because of falling prices and environmental concerns. Each of the closed plants was estimated to have a capacity less than 1,000 tons per year of magnesium ingot. The China Magnesium Association expected that an additional 40 plants would be closed by the end of 2005. In addition, some of the larger firms have delayed expansion plans because of low magnesium prices, although two new magnesium plants were planned for Inner Mongolia—one with a capacity of 20,000 tons per year was scheduled to be completed by the beginning of 2006, and the other, with a capacity of 30,000 tons per year, was scheduled for completion in 2007.

In Congo (Brazzaville), construction of a 60,000-ton-per-year magnesium recovery plant in Pointe-Noire was expected to begin by 2007. The magnesium plant would cost $500 million, with an additional investment of $189 million in an associated potash plant and $100 million on turbine rehabilitation by the company's energy subsidiary.

An Australian company planned to begin construction of a new primary magnesium plant in Egypt by early 2006. During the second quarter of 2005, the firm decided to base the bankable feasibility study on magnesite feedstock from Myrtle Springs, South Australia, but it has been evaluating four additional magnesite deposits as potential feed material—two in Saudi Arabia and two in Egypt.

A new Australian company agreed to acquire the Lyons River and Arthur River, Tasmania, magnesite deposits that were owned by a firm which had canceled plans to construct a 95,000-ton-per-year magnesium plant in 2001. The new company was investigating the possibility of a 500,000-ton-per-year magnesia plant using the magnesite resources as a raw material. This would generate cash to develop a magnesium metal project.

World Primary Production, Reserves, and Reserve Base:

	Primary production	
	2004	2005[e]
United States	W	W
Brazil	6	6
Canada	54	50
China	426	450
Israel	28	28
Kazakhstan	18	20
Russia	50	50
Serbia and Montenegro	2	2
World total[5] (rounded)	584	610

Reserves and reserve base[4]

Magnesium metal is derived from seawater, natural brines, dolomite, and other minerals. The reserves and reserve base for this metal are sufficient to supply current and future requirements. To a limited degree, the existing natural brines may be considered to be a renewable resource wherein any magnesium removed by humans may be renewed by nature in a short span of time.

World Resources: Resources from which magnesium may be recovered range from large to virtually unlimited and are globally widespread. Resources of dolomite and magnesium-bearing evaporite minerals are enormous. Magnesium-bearing brines are estimated to constitute a resource in the billions of tons, and magnesium can be recovered from seawater at places along world coastlines.

Substitutes: Aluminum and zinc may substitute for magnesium in castings and wrought products. For iron and steel desulfurization, calcium carbide may be used instead of magnesium.

[e]Estimated. W Withheld to avoid disclosing company proprietary data.
[1]See also Magnesium Compounds.
[2]Rounded to two significant digits to protect proprietary data.
[3]Defined as imports – exports + adjustments for Government and industry stock changes.
[4]See Appendix C for definitions.
[5]Excludes the United States.

MANGANESE

(Data in thousand metric tons gross weight unless otherwise specified)

Domestic Production and Use: Manganese ore containing 35% or more manganese was not produced domestically in 2005. Manganese ore was consumed mainly by eight firms with plants principally in the East and Midwest. Most ore consumption was related to steel production, directly in pig iron manufacture and indirectly through upgrading ore to ferroalloys. Additional quantities of ore were used for such nonmetallurgical purposes as production of dry cell batteries, plant fertilizers and animal feed, and as a brick colorant. Manganese ferroalloys were produced at two smelters, although one operated nominally for 4 months. Construction, machinery, and transportation end uses accounted for about 29%, 12%, and 12%, respectively, of manganese demand. Most of the rest went to a variety of other iron and steel applications. The value of domestic consumption, estimated from foreign trade data, was about $414 million.

Salient Statistics—United States:[1]	2001	2002	2003	2004	2005[e]
Production, mine[2]	—	—	—	—	—
Imports for consumption:					
Manganese ore	358	427	347	451	522
Ferromanganese	251	275	238	429	253
Silicomanganese[3]	269	247	267	422	347
Exports:					
Manganese ore	9	15	18	123	12
Ferromanganese	9	9	11	9	13
Shipments from Government stockpile excesses:[4]					
Manganese ore	37	56	74	392	256
Ferromanganese	2	38	38	49	17
Consumption, reported:[5]					
Manganese ore[6]	425	360	398	441	395
Ferromanganese	266	253	248	315	310
Consumption, apparent, manganese[7]	692	696	643	1,029	760
Price, average value, 46% to 48% Mn metallurgical ore, dollars per mtu contained Mn, c.i.f. U.S. ports	2.44	2.30	2.41	2.89	4.71
Stocks, producer and consumer, yearend:					
Manganese ore[6]	138	151	156	159	189
Ferromanganese	25	21	20	16	15
Net import reliance[8] as a percentage of apparent consumption	100	100	100	100	100

Recycling: Manganese was recycled incidentally as a minor constituent of ferrous and nonferrous scrap; however, scrap recovery specifically for manganese was negligible. Manganese is recovered along with iron from steel slag.

Import Sources (2001-04): Manganese ore: Gabon, 72%; South Africa, 15%; Australia, 9%; Brazil, 2%; and other, 2%. Ferromanganese: South Africa, 49%; France, 11%; China, 7%; Brazil, 6%; and other, 27%. Manganese contained in all manganese imports: South Africa, 35%; Gabon, 23%; Australia, 11%; China, 4%, and other, 27%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Ore and concentrate	2602.00.0040/60	Free.
Manganese dioxide	2820.10.0000	4.7% ad val.
High-carbon ferromanganese	7202.11.5000	1.5% ad val.
Silicomanganese	7202.30.0000	3.9% ad val.
Metal, unwrought	8111.00.4700/4900	14% ad val.

Depletion Allowance: 23% (Domestic), 15% (Foreign).

Government Stockpile: In addition to the quantities shown below, the stockpile contained 159,000 metric tons of nonstockpile-grade metallurgical ore, all of which was authorized for disposal.

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MANGANESE

Stockpile Status—9-30-05[9]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Manganese ore:					
Battery grade	—	18	—	27	23
Chemical grade	31	31	31	36	37
Metallurgical grade	144	—	144	454	453
Ferromanganese, high-carbon	625	38	612	91	50
Electrolytic metal	—	—	—	2	—
Synthetic dioxide	—	3	—	3	3

Events, Trends, and Issues: In 2004, manganese apparent consumption was 60% higher than that of 2003 and at the highest level since 1979. Apparent consumption in 2005 was estimated to be about 26% lower than that of 2004 and was more representative of the levels during the decade preceding 2004. The annual growth rate for manganese ferroalloy consumption usually falls in the range of 1% to 2%, in line with long-term trends in steel production, but through the first 9 months of 2005, domestic steel production was 6% lower than that for the same period in 2004. Manganese alloy spot-market prices decreased as a result of this drop in domestic steel production and stocks buildup. By the end of October 2005, U.S. weekly average spot prices for high-carbon ferromanganese were about two-thirds of those reached during the first half of 2004; medium-carbon ferromanganese and silicomanganese prices were about 50% lower. Domestic manganese ore prices followed the percentage increase in the international price for metallurgical-grade ore set between Japan and major suppliers in early 2005.

World Mine Production, Reserves, and Reserve Base (metal content): Data for reserves and reserve base have been revised upward from those previously published for Australia based on information reported by the Government of Australia; reserves are based on estimates of demonstrated resources.

	Mine production		Reserves[10]	Reserve base[10]
	2004	2005[e]		
United States	—	—	—	—
Australia	1,300	1,340	68,000	130,000
Brazil	[e]1,300	1,300	23,000	51,000
China	[e]900	900	40,000	100,000
Gabon	[e]1,100	1,300	20,000	160,000
India	[e]630	640	93,000	[11]160,000
Mexico	136	136	4,000	9,000
South Africa	1,905	2,200	32,000	[11]4,000,000
Ukraine	810	720	140,000	520,000
Other countries	1,270	1,250	Small	Small
World total (rounded)	[e]9,350	9,790	430,000	5,200,000

World Resources: Land-based resources are large but irregularly distributed; those of the United States are very low grade and have potentially high extraction costs. South Africa accounts for about 80% of the world's identified resources, and Ukraine accounts for about 10%.

Substitutes: Manganese has no satisfactory substitute in its major applications.

[e]Estimated. — Zero.
[1]Manganese content typically ranges from 35% to 54% for manganese ore and from 74% to 95% for ferromanganese.
[2]Excludes insignificant quantities of low-grade manganiferous ore.
[3]Imports more nearly represent amount consumed than does reported consumption; internal evaluation indicates that reported consumption of silicomanganese is considerably understated.
[4]Net quantity, defined as stockpile shipments – receipts.
[5]Manganese consumption should not be estimated as the sum of manganese ore and ferromanganese consumption because so doing would count manganese in ore used to produce ferromanganese twice.
[6]Exclusive of ore consumed at iron and steel plants.
[7]Thousand metric tons, manganese content; based on estimates of average content for all significant components except imports, for which content is reported.
[8]Defined as imports – exports + adjustments for Government and industry stock changes.
[9]See Appendix B for definitions.
[10]See Appendix C for definitions.
[11]Includes inferred resources.

MERCURY

(Data in metric tons of mercury content unless otherwise noted)[1]

Domestic Production and Use: Since 1992, mercury has not been mined as a primary mineral commodity in the United States. Byproduct mercury is recovered from gold-processing precipitates and from the calomel collected from pollution control devices at gold smelters, mainly in Nevada, but production data were not reported. Owing to environmental and human health concerns, mercury use is declining, and nonmercury-bearing products are being substituted for mercury-bearing devices. Mercury is mainly used by the chlorine-caustic soda industry as an electrolyte to separate chlorine from caustic soda. Most of that mercury is recycled in-plant, but some mercury is lost during the chlorine-caustic soda production process, and the Chlorine Institute indicates that replacement mercury is purchased annually. Some mercury-containing chlor-alkali waste, as “amalgam” (not chemically defined), may be exported to Canada or Mexico and landfilled. Mercury is no longer used in batteries and paints manufactured in the United States. Globally, mercury is widely used in artisanal gold mining and may also be used in button-type batteries, cleansers, fireworks, folk medicines, pesticides, and skin-lightening creams and soaps.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production:					
Mine	NA	NA	NA	NA	NA
Secondary	NA	NA	NA	NA	NA
Imports for consumption (gross weight)	100	209	46	50	245
Exports (gross weight)	108	201	287	300	276
Price, average value, dollars per flask, free market	155.00	155.00	170.00	400.00	750.00
Net import reliance[2] as a percentage of apparent consumption[e]	E	NA	E	E	E

Recycling: In 2005, more than 50 companies were listed as mercury recyclers; however, 5 companies account for the majority of secondary production. Secondary mercury (old scrap) is reclaimed from mercury-containing automobile convenience switches, dental amalgam, mercury vapor and fluorescent lamps, and medical equipment; the secondary reservoir of mercury-containing products, however, is shrinking. Mercury may also be reclaimed from barometers, computers, gym flooring, manometers, thermometers, and thermostats. Some of the approximately 3,000 tons of mercury in use and in stocks in the chlorine-caustic soda industry is recycled in-plant (home scrap).

Import Sources (2001-04): Chile, 41%; Australia, 25%; Germany, 18%; Peru, 11%; and other, 5%.

Tariff: **Item**	**Number**	**Normal Trade Relations 12-31-05**
Mercury	2805.40.0000	1.7% ad val.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: The Defense Logistics Agency held an inventory of 4,436 tons at several sites in the United States, though it has indicated that a consolidated storage is the preferred alternative for this inventory. Sales from the National Defense Stockpile remained suspended. An additional 146 tons of mercury was held by the U.S. Department of Energy at Oak Ridge, TN.

Stockpile Status—9-30-05[3]

Material	**Uncommitted inventory**	**Committed inventory**	**Authorized for disposal**	**Disposal plan FY 2005**	**Disposals FY 2005**
Mercury	4,436	—	4,436	—	—

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MERCURY

Events, Trends, and Issues: After several years of relatively stable prices, the average cost of a flask of mercury rose to $750.00 in 2005 from $155.00 in 2002. For a brief period during April 2005, the cost of a flask of mercury was as high as $900.00. This price rise is tied to the global demand for mercury in artisanal mining in response to rising gold prices and to a steadily diminishing supply of mercury that is reclaimed and recycled from end-of-life mercury-containing products that were manufactured during past decades. International, Federal, State, and local governments are concerned about the toxic effects of mercury in the environment. In the United States, legislation such as the Resource Conservation and Recovery Act and the Comprehensive Environmental Response, Compensation, and Liability Act mandates regulation of production, use, generation, treatment, and disposal of products that contain mercury. Regulations and environmental standards are likely to continue as major factors in domestic mercury supply and demand. Domestic byproduct mercury production is expected to continue from gold processing, as is recycling of mercury from an ever-diminishing supply of mercury-containing products. It is anticipated that domestic mercury consumption will continue to decline as mercury-containing products are phased out and nonmercury-containing products are substituted.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[4]	Reserve base[4]
	2004	2005[e]		
United States	NA	NA	—	7,000
Algeria	110	—	2,000	3,000
China	610	500	—	—
Italy	—	—	—	69,000
Kyrgyzstan	300	300	7,500	13,000
Spain	150	150	76,000	90,000
Other countries	170	150	38,000	61,000
World total (rounded)	1,340	1,100	120,000	240,000

World Resources: In the United States, there are mercury occurrences in Alaska, Arkansas, California, Nevada, and Texas. World mercury resources are estimated to be nearly 600,000 tons, mainly in China, Kyrgyzstan, Russia, Slovenia, Spain, and Ukraine. These resources are sufficient for another century or more, especially with declining consumption rates. Byproduct mercury may be produced at copper, gold, lead, and zinc mines worldwide; there are, however, no data on the amount of mercury produced.

Substitutes: Mercury cells are being replaced by diaphragm and membrane cells in the global production of chlorine and caustic soda. Digital instruments, especially digital thermometers, have replaced mercury instruments in many applications. Dentists now use ceramic composites as substitutes for mercury-containing dental amalgam. Mercury-zinc batteries are being replaced by lithium, nickel-cadmium, and zinc-air batteries. Indium compounds substitute for mercury in alkaline batteries, and organic compounds have been substituted for mercury fungicides in latex paint.

[e]Estimated. E Net exporter. NA Not available. — Zero.
[1]Some international data and dealer prices are reported in flasks. One metric ton (1,000 kilograms) = 29.0082 flasks, and 1 flask = 76 pounds, or 34.5 kilograms, or 0.034 ton.
[2]Defined as imports – exports + adjustments for Government and industry stock changes.
[3]See Appendix B for definitions.
[4]See Appendix C for definitions.

MICA (NATURAL), SCRAP AND FLAKE[1]

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: Scrap and flake mica production, excluding low-quality sericite, was estimated to be 74,000 tons in 2005. North Carolina accounted for about 27% of U.S. production. The remaining output came from Georgia, South Carolina, and South Dakota. Scrap mica was recovered principally from mica and sericite schist and as a byproduct from feldspar, kaolin, and industrial sand beneficiation. The majority of domestic production was processed into small particle-size mica by either wet or dry grinding. Primary uses were joint compound, oil-well-drilling additives, paint, roofing, and rubber products. The value of 2005 scrap mica production was estimated to be $12 million. Ground mica sales in 2004 were valued at about $27 million and were expected to decline in value in 2005. There were eight domestic producers of scrap and flake mica.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production:[2, 3]					
Mine	98	81	79	99	74
Ground	89	99	94	98	80
Imports, mica powder and mica waste	32	38	35	42	44
Exports, mica powder and mica waste	9	10	10	10	9
Consumption, apparent[4]	121	106	103	132	109
Price, average, dollars per ton, reported:					
Scrap and flake	82	90	213	155	180
Ground:					
Wet	771	960	938	NA	950
Dry	147	180	205	269	270
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, mine, number[5]	NA	NA	NA	NA	NA
Net import reliance[6] as a percentage of apparent consumption	19	24	24	25	32

Recycling: None.

Import Sources (2001-04): Canada, 45%; India, 25%; China, 20%; Finland, 6%; and other, 4%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Mica powder	2525.20.0000	Free.
Mica waste	2525.30.0000	Free.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: None.

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MICA (NATURAL), SCRAP AND FLAKE

Events, Trends, and Issues: Domestic production of ground mica decreased in 2005. The decrease primarily resulted from lower production in New Mexico. Production in North Carolina in 2005 was estimated to be much lower than that of 2004, while production in Georgia increased substantially. Canada remained the main source of imported phlogopite mica for the United States. The United States remained a major world producer of scrap and flake mica. Imported mica scrap and flake is primarily used for making mica paper and as a filler and reinforcer in plastics.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[7]	Reserve base[7]
	2004	2005[e]		
United States[2]	99	74	Large	Large
Brazil	4	4	Large	Large
Canada	18	18	Large	Large
France	10	10	Large	Large
India	2	2	Large	Large
Korea, Republic of	34	60	Large	Large
Russia	100	100	Large	Large
Other countries	21	25	Large	Large
World total (rounded)	290	290	Large	Large

World Resources: Resources of scrap and flake mica are available in granite, pegmatite, schist, and clay deposits and are considered more than adequate to meet anticipated world demand in the foreseeable future.

Substitutes: Some of the lightweight aggregates, such as diatomite, perlite, and vermiculite, may be substituted for ground mica when used as a filler. Ground synthetic fluorophlogopite, a fluorine-rich mica, may replace natural ground mica for uses that require the thermal and electrical properties of mica.

[e]Estimated. NA Not available.
[1]See also Mica (Natural), Sheet.
[2]Sold or used by producing companies.
[3]Excludes low-quality sericite used primarily for brick manufacturing.
[4]Based on ground mica.
[5]Total employment at mines and mills where mica was produced and processed, excluding feldspar companies with byproduct production. Employees were not assigned to specific commodities in calculating employment.
[6]Defined as imports – exports + adjustments for Government and industry stock changes.
[7]See Appendix C for definitions.

MICA (NATURAL), SHEET[1]

(Data in metric tons unless otherwise noted)

Domestic Production and Use: A minor amount of sheet mica was produced in 2005, incidental to scrap and flake mica production and the mining of a gemstone-bearing pegmatite in Virginia. The domestic consuming industry was dependent upon imports and shipments of U.S. Government stockpile excesses to meet demand for sheet mica. During 2005, an estimated 54 tons of imported unworked mica split block and mica splittings valued at $52,000 was consumed by five companies in four States, mainly in the East and the Midwest. Most was fabricated into parts for electronic and electrical equipment. An additional estimated 1,280 tons of imported worked mica valued at $12.4 million also was consumed.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005**[e]
Production, mine[e]	([2])	([2])	([2])	([2])	([2])
Imports, plates, sheets, strips; worked mica; split block; splittings; other > $1.00/kg	4,290	1,580	1,130	1,400	2,150
Exports, plates, sheets, strips; worked mica; crude and rifted into sheet or splittings > $1.00/kg	1,160	723	1,030	979	2,250
Shipments from Government stockpile excesses	1,860	894	1,280	1,170	124
Consumption, apparent	4,990	1,750	1,390	1,760	[3]—
Price, average value, dollars per kilogram, muscovite and phlogopite mica, reported:					
Block	55	67	67	67	67
Splittings	1.67	1.82	1.74	1.80	1.80
Stocks, fabricator and trader, yearend	NA	NA	NA	NA	NA
Net import reliance[4] as a percentage of apparent consumption	100	100	100	100	E

Recycling: None.

Import Sources (2001-04): India, 50%; Belgium, 16%; China, 9%; Germany, 6%; and other, 19%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Split block mica	2525.10.0010	Free.
Mica splittings	2525.10.0020	Free.
Unworked—other	2525.10.0050	Free.
Plates, sheets, and strips of agglomerated or reconstructed mica	6814.10.0000	2.7% ad val.
Worked mica and articles of mica—other	6814.90.0000	2.6% ad val.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile:

Stockpile Status—9-30-05[5]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Block:					
Muscovite (stained and better)	4.18	7.40	4.18	([6])	3.80
Film, muscovite	—	—	—	([6])	—
Splittings:					
Muscovite	6.82	2.72	6.82	([6])	114
Phlogopite	—	10.7	—	([6])	6.28

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MICA (NATURAL), SHEET

Events, Trends, and Issues: Demand for sheet mica was essentially unchanged in 2005, following an increase in 2004. Imports of worked sheet increased for “plates, sheets, and strips of agglomerated or reconstituted mica,” and declined for “mica, worked, and articles of mica not classified elsewhere.” U.S. imports of split block declined as imports of mica splittings increased. Shipments from the National Defense Stockpile (NDS) declined as remaining stocks decreased. Stocks of muscovite film in the NDS were depleted by fiscal year 2004. Stocks of phlogopite splittings were sold out in fiscal year 2005 and were awaiting shipment. Imports were the principal source of the domestic supply of sheet mica in 2005. Significant stocks of mica previously sold from the NDS to various mica traders and brokers were exported, however, causing the United States to appear to have no apparent consumption. Even though the United States was a net exporter based on apparent consumption, it remained essentially 100% import dependent for its supply of sheet mica. Adjusting for the increased exports of stocks in 2005, by averaging exports from the 3 previous years, a domestic consumption of sheet mica was estimated to be closer to 1,000 tons. Stocks of mica remaining in the NDS declined in 2005, and future supplies are expected to come increasingly from imports, primarily from India and Russia. Prices for imported sheet mica also are expected to increase. Good quality sheet mica remained in short supply. There were no environmental concerns associated with the manufacture and use of mica products.

World Mine Production, Reserves, and Reserve Base:

	Mine production[e]		Reserves[7]	Reserve base[7]
	2004	2005		
United States	([2])	([2])	Very small	Small
India	3,500	3,500	Very large	Very large
Russia	1,500	1,500	Moderate	Large
Other countries	200	200	Moderate	Large
World total	5,200	5,200	Very large	Very large

World Resources: There has been no formal evaluation of world resources of sheet mica because of the sporadic occurrence of this material. Large deposits of mica-bearing rock are known to exist in countries such as Brazil, India, and Madagascar. Limited resources of sheet mica are available in the United States. These domestic resources are uneconomic because of the high cost of hand labor required to mine and process the sheet mica from pegmatites.

Substitutes: Many materials can be substituted for mica in numerous electrical, electronic, and insulation uses. Substitutes include acrylic, Benelex®, cellulose acetate, Delrin®, Duranel® N, fiberglass, fishpaper, Kapton®, Kel F®, Kydex®, Lexan®, Lucite®, Mylar®, nylon, nylatron, Nomex®, Noryl®, phenolics, Plexiglass®, polycarbonate, polyester, styrene, Teflon®, vinyl-PVC, and vulcanized fiber. Mica paper made from scrap mica can be substituted for sheet mica in electrical and insulation applications.

[e]Estimated. E Net exporter. NA Not available. — Zero.
[1]See also Mica (Natural), Scrap and Flake.
[2]Less than ½ unit.
[3]See explanation in the Events, Trends, and Issues section.
[4]Defined as imports – exports + adjustments for Government and industry stock changes.
[5]See Appendix B for definitions.
[6]The total disposal plan for all categories of mica in the National Defense Stockpile is undifferentiated at 454 metric tons (1,000,000 pounds).
[7]See Appendix C for definitions.

MOLYBDENUM

(Data in metric tons of molybdenum content unless otherwise noted)

Domestic Production and Use: In 2005, molybdenum, valued at about $4.1 billion (based on average oxide price), was produced by eight mines. Molybdenum ore was produced at three primary molybdenum mines, one each in Colorado, Idaho, and New Mexico, whereas five copper mines (two in Arizona, one each in Montana, New Mexico, and Utah) recovered molybdenum as a byproduct. Three roasting plants converted molybdenite (MoS_2) concentrate to molybdic oxide, from which intermediate products, such as ferromolybdenum, metal powder, and various chemicals, were produced. Iron and steel, cast and wrought alloy, and superalloy producers accounted for about 75% of the molybdenum consumed.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production, mine	37,600	32,300	33,500	41,500	56,900
Imports for consumption	12,800	11,500	11,900	17,100	23,600
Exports	31,500	23,800	21,900	34,400	45,900
Consumption:					
Reported	15,800	15,300	16,400	17,400	19,200
Apparent	19,600	20,700	26,300	23,900	34,200
Price, average value, dollars per kilogram[1]	5.20	8.27	11.65	29.67	72.07
Stocks, mine and plant concentrates, product, and consumer materials	10,700	10,000	7,200	7,500	7,900
Employment, mine and plant, number	518	489	510	630	810
Net import reliance[2] as a percentage of apparent consumption	E	E	E	E	E

Recycling: Molybdenum in the form of molybdenum metal or superalloys was recovered, but the amount was small. Although molybdenum is not recovered from scrap steel, recycling of steel alloys is significant, and some molybdenum content is reutilized. The amount of molybdenum recycled as part of new and old steel and other scrap may be as much as 30% of the apparent supply of molybdenum.

Import Sources (2001-04): Ferromolybdenum: China, 85%; United Kingdom, 11%; and other, 4%. Molybdenum ores and concentrates: Canada, 41%; Mexico, 39%; Chile, 17%; and other, 3%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Molybdenum ore and concentrates, roasted	2613.10.0000	12.8¢/kg + 1.8% ad val.
Molybdenum ore and concentrates, other	2613.90.0000	17.8¢/kg.
Molybdenum chemicals:		
Molybdenum oxides and hydroxides	2825.70.0000	3.2% ad val.
Molybdates of ammonium	2841.70.1000	4.3% ad val.
Molybdates, all others	2841.70.5000	3.7% ad val.
Molybdenum pigments:		
Molybdenum orange	3206.20.0020	3.7% ad val.
Ferroalloys:		
Ferromolybdenum	7202.70.0000	4.5% ad val.
Molybdenum metals:		
Powders	8102.10.0000	9.1¢/kg + 1.2% ad val.
Unwrought	8102.94.0000	13.9¢/kg + 1.9% ad val.
Wrought bars and rods	8102.95.3000	6.6% ad val.
Wrought plates, sheets, strips, etc.	8102.95.6000	6.6% ad val.
Wire	8102.96.0000	4.4% ad val.
Waste and scrap	8102.97.0000	Free.
Other	8102.99.0000	3.7% ad val.

Depletion Allowance: 22% (Domestic); 14% (Foreign).

Government Stockpile: None.

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MOLYBDENUM

Events, Trends, and Issues: U.S. mine output of molybdenum in 2005 increased about 37% from that of 2004. U.S. imports for consumption increased an estimated 38% from those of 2004, while the U.S. exports increased 33% from those of 2004. The increase in exports reflects the return to full production levels by the beginning of 2005 of most byproduct molybdenum producers and increased production by primary producers. U.S. reported consumption increased 10% from that of 2004. Mine capacity utilization in 2005 was about 77%.

China continued its high level of steel production and consumption, thus providing strong demand for molybdenum. High copper prices and a deficit of refined copper allowed the Bagdad and Sierrita Mines in Arizona to return to full production capacity, thus increasing byproduct molybdenum production. The Bingham Canyon Mine near Salt Lake City, UT, optimized its mill operation to maximize molybdenum recovery and began mining a high-molybdenum zone of the deposit. The mine was expected to triple its output of molybdenum in 2005 as compared with that of 2004. With the continuing high price of nickel-bearing stainless steel in 2005, consumers increasingly considered use of duplex stainless steel, with higher molybdenum content.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[3]	Reserve base[3]
	2004	2005[e]	(thousand metric tons)	
United States	41,500	56,900	2,700	5,400
Armenia	3,000	2,800	200	400
Canada	5,700	9,800	450	910
Chile	41,483	45,500	1,100	2,500
China	29,000	28,500	3,300	8,300
Iran	1,500	1,500	50	140
Kazakhstan	230	210	130	200
Kyrgyzstan	250	250	100	180
Mexico	3,700	3,500	90	230
Mongolia	1,700	1,300	30	50
Peru	9,600	9,700	140	230
Russia[e]	2,900	3,000	240	360
Uzbekistan[e]	500	500	60	150
World total (rounded)	141,000	163,000	8,600	19,000

World Resources: Identified resources amount to about 5.4 million tons of molybdenum in the United States and about 13 million tons in the rest of the world. Molybdenum occurs as the principal metal sulfide in large low-grade porphyry molybdenum deposits and as an associated metal sulfide in low-grade porphyry copper deposits. Resources of molybdenum are adequate to supply world needs for the foreseeable future.

Substitutes: There is little substitution for molybdenum in its major application as an alloying element in steels and cast irons. In fact, because of the availability and versatility of molybdenum, industry has sought to develop new materials that benefit from the alloying properties of the metal. Potential substitutes for molybdenum include chromium, vanadium, columbium (niobium), and boron in alloy steels; tungsten in tool steels; graphite, tungsten, and tantalum for refractory materials in high-temperature electric furnaces; and chrome-orange, cadmium-red, and organic-orange pigments for molybdenum orange.

[e]Estimated. E Net exporter.

[1]Time-average price per kilogram of molybdenum contained in technical-grade molybdic oxide, as reported by Platts Metals Week.

[2]Defined as imports – exports + adjustments for Government and industry stock changes.

[3]See Appendix C for definitions.

NICKEL

(Data in metric tons of nickel content unless otherwise noted)

Domestic Production and Use: The United States did not have any active nickel mines in 2005. Limited amounts of byproduct nickel, though, were recovered from copper and palladium-platinum ores mined in the Western United States. On a monthly or annual basis, 200 facilities reported nickel consumption. The principal consuming State was Pennsylvania, followed by Kentucky, West Virginia, and Indiana. Approximately 45% of the primary nickel consumed went into nonferrous alloy and superalloy production, 36% into stainless and alloy steels, 14% into electroplating, and 5% into other uses. End uses were as follows: transportation, 33%; chemical industry, 13%; electrical equipment, 11%; construction, 9%; fabricated metal products, 7%; household appliances, 6%; machinery, 6%; petroleum industry, 6%; and other, 9%. Estimated value of apparent primary consumption was $1.98 billion.

Salient Statistics—United States:[1]	2001	2002	2003	2004	2005[e]
Production, refinery byproduct	W	W	W	W	W
Shipments of purchased scrap[2]	121,000	114,000	119,000	113,000	121,000
Imports: Primary	136,000	121,000	125,000	136,000	148,000
Imports: Secondary	8,760	9,110	11,500	18,800	16,500
Exports: Primary	8,450	6,520	6,330	8,000	10,900
Exports: Secondary	48,600	39,400	47,300	48,300	51,900
Consumption: Reported, primary	98,800	88,200	87,400	98,800	105,000
Consumption: Reported, secondary	81,200	83,900	83,500	83,300	85,200
Consumption: Apparent, primary	129,000	121,000	117,000	129,000	136,000
Consumption: Total[3]	210,000	205,000	200,000	212,000	221,000
Price, average annual, London Metal Exchange:					
Cash, dollars per metric ton	5,945	6,772	9,629	13,823	14,538
Cash, dollars per pound	2.696	3.072	4.368	6.270	6.594
Stocks: Consumer, yearend	12,500	11,600	10,900	10,600	11,500
Stocks: Producer, yearend[4]	12,600	6,150	8,040	6,580	7,310
Net import reliance[5] as a percentage of apparent consumption	52	52	50	55	54

Recycling: About 85,200 tons of nickel was recovered from purchased scrap in 2005. This represented about 39% of reported secondary plus apparent primary consumption for the year.

Import Sources (2001-04): Canada, 41%; Russia, 14%; Norway, 11%; Australia, 9%; and other, 25%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Nickel oxide, chemical grade	2825.40.0000	Free.
Ferronickel	7202.60.0000	Free.
Nickel oxide, metallurgical grade	7501.20.0000	Free.
Unwrought nickel, not alloyed	7502.10.0000	Free.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: The U.S. Government sold the last of the nickel in the National Defense Stockpile in 1999. The U.S. Department of Energy is holding 9,400 tons of nickel ingot contaminated by low-level radioactivity plus 6,000 tons of contaminated shredded nickel scrap. Planned decommissioning activities at former nuclear defense sites are expected to generate an additional 20,000 tons of shredded scrap.

Events, Trends, and Issues: Stainless steel accounts for two-thirds of the world primary nickel use. U.S. production of austenitic (nickel-bearing) stainless steel reached a record high of 1.60 million tons in 2005—3% more than the previous record of 1.55 million tons set in 2004. World nickel mine production was at an alltime high in 2005. Since 1950, stainless steel production in the Western World has been growing at an average rate of 6.0% per year. Demand for stainless steel in China has been particularly robust since 2000 and exceeded that of Germany in 2005. Chinese and Australian companies have teamed up to explore for nickel in China. China imported nickel from Cuba and a new mine in Spain to help supply its growing stainless steel-producing industry. Nickel prices reached their highest level since 1989 ($16,920 per metric ton) by mid-2005. For the week ending November 25, 2005, the London Metal Exchange cash price for 99.8% pure nickel averaged $12,636 per metric ton ($5.73 per pound). High prices have encouraged substitution of lower nickel-containing grades of stainless for higher grades in some applications. For example, type 201 (3.5% to 5.5% nickel) was being substituted for type 304 (8.0% to 10.5% nickel).

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NICKEL

Some nickel consumers were concerned that global demand for the metal would outstrip supply before several new mining projects could be completed. A major Canadian-based producer began shipping concentrate from its new Voisey's Bay Mine in northeastern Labrador. The Canadian-based company was also constructing a laterite mining complex at Goro near the southeastern tip of New Caledonia. The New Caledonian nickel was to be recovered onsite using advanced pressure acid leach (PAL) technology. The same company proposed the friendly takeover of Canada's second largest nickel producer. Regulatory authorities in Canada, the European Union, and the United States were evaluating the proposed takeover from an antitrust viewpoint. Australia's leading nickel producer was developing a large laterite deposit near Ravensthorpe, Western Australia. The concentrate from Ravensthorpe was to be shipped to Yabulu in Queensland for refining. Several other companies were considering employing some form of acid leach technology to recover nickel at greenfield sites in Cuba, Indonesia, Kazakhstan, and the Philippines. A new type of heap-leaching process was being used to recover nickel in Turkey. At least five automobile manufacturers planned to use nickel-metal hydride (NiMH) batteries to power their gasoline-electric hybrid vehicles for the 2007 and 2008 model years. Demand for gasoline-electric hybrid vehicles has been gradually building in the United States since their introduction in late 1999 and has dramatically accelerated with the sharp increases in gasoline prices in 2005. At least 14 light-duty models were being offered in North America—8 of Japanese design. A leading NiMH battery manufacturer was producing battery modules at a new facility in Springboro, OH. Modules were being manufactured for a variety of applications in addition to the transportation market, including stationary backup or uninterruptible power supply systems for telecommunications.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[6]	Reserve base[6]
	2004	2005[e]		
United States	—	—	—	—
Australia	178,000	210,000	22,000,000	27,000,000
Botswana	33,000	37,100	490,000	920,000
Brazil	45,200	46,000	4,500,000	8,300,000
Canada	187,000	196,000	4,900,000	15,000,000
China	64,000	71,000	1,100,000	7,600,000
Colombia	75,000	72,500	830,000	1,100,000
Cuba	72,400	75,000	5,600,000	23,000,000
Dominican Republic	47,000	47,000	720,000	1,000,000
Greece	21,700	22,100	490,000	900,000
Indonesia	133,000	140,000	3,200,000	13,000,000
New Caledonia[7]	118,000	122,000	4,400,000	12,000,000
Philippines	17,000	22,000	940,000	5,200,000
Russia	315,000	315,000	6,600,000	9,200,000
South Africa	39,900	41,700	3,700,000	12,000,000
Venezuela	20,500	22,000	560,000	630,000
Zimbabwe	9,520	9,800	15,000	260,000
Other countries	11,000	26,000	2,100,000	5,900,000
World total (rounded)	1,400,000	1,500,000	62,000,000	140,000,000

World Resources: Identified land-based resources averaging 1% nickel or greater contain at least 130 million tons of nickel. About 60% is in laterites and 40% in sulfide deposits. In addition, extensive deep-sea resources of nickel are in manganese crusts and nodules covering large areas of the ocean floor, particularly in the Pacific Ocean.

Substitutes: With few exceptions, substitutes for nickel would result in increased cost or a tradeoff in the performance of the product. Aluminum, coated steels, and plastics can replace stainless steel to a limited extent in many construction and transportation applications. Nickel-free specialty steels are sometimes used in place of stainless steel within the power generating, petrochemical, and petroleum industries. Titanium alloys or specialty plastics can substitute for nickel metal or nickel-base alloys in highly corrosive chemical environments. Recent cost savings in manufacturing lithium ion batteries allow them to compete against NiMH in certain applications.

[e]Estimated. W Withheld to avoid disclosing company proprietary data. — Zero.
[1]Changes in this section are due to revisions of 2001-03 ferrous scrap data.
[2]Scrap receipts – shipments by consumers + exports – imports + adjustments for consumer stock changes.
[3]Apparent primary consumption + reported secondary consumption.
[4]Stocks of producers, agents, and dealers held only in the United States.
[5]Defined as imports – exports + adjustments for Government and industry stock changes.
[6]See Appendix C for definitions.
[7]Overseas territory of France.

NITROGEN (FIXED)—AMMONIA

(Data in thousand metric tons of nitrogen unless otherwise noted)

Domestic Production and Use: Ammonia was produced by 15 companies at 26 plants in 16 States in the United States during 2005. Fifty-seven percent of total U.S. ammonia production capacity was centered in Louisiana, Oklahoma, and Texas because of their large reserves of natural gas, the dominant domestic feedstock. In 2005, U.S. producers operated at about 66% of their rated capacity. The United States remained the world's second largest ammonia producer and consumer following China. Urea, ammonium nitrate, ammonium phosphates, nitric acid, and ammonium sulfate were the major derivatives of ammonia in the United States, in descending order of importance.

Approximately 90% of apparent domestic ammonia consumption was for fertilizer use, including anhydrous ammonia for direct application, urea, ammonium nitrates, ammonium phosphates, and other nitrogen compounds. Ammonia also was used to produce plastics, synthetic fibers and resins, explosives, and numerous other chemical compounds.

Salient Statistics—United States:[1]	2001	2002	2003	2004	2005[e]
Production[2]	9,120	10,300	8,600	8,850	8,700
Imports for consumption	4,550	4,670	5,720	5,900	6,500
Exports	647	437	400	381	540
Consumption, apparent	13,200	14,500	14,000	14,300	14,700
Stocks, producer, yearend	261	286	197	274	175
Price, dollars per ton, average, f.o.b. Gulf Coast[3]	183	137	245	274	295
Employment, plant, number[e]	1,800	1,700	1,550	1,300	1,150
Net import reliance[4] as a percentage of apparent consumption	31	29	39	38	41

Recycling: None.

Import Sources (2001-04): Trinidad and Tobago, 53%; Canada, 17%; Russia, 16%; and other, 14%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Ammonia, anhydrous	2814.10.0000	Free.
Urea	3102.10.0000	Free.
Ammonium sulfate	3102.21.0000	Free.
Ammonium nitrate	3102.30.0000	Free.

Depletion Allowance: Not applicable.

Government Stockpile: None.

Events, Trends, and Issues: Although they did not significantly damage ammonia plants in the Gulf Coast area, Hurricanes Katrina and Rita disrupted natural gas supplies and led to increased prices for natural gas. Hurricane Katrina initially reduced natural gas supplies by an estimated 8.8 billion cubic feet per day because of shut-ins and direct damage. Hurricane Rita resulted in more than a dozen natural gas processing plants going offline because of either flooding, lack of supplies, an inability to move stored liquids, or safety precautions. Natural gas pipelines sustained significant damage, and the Sabine Pipeline, operator of the Henry Hub, implemented a force majeure.

In September, the U.S. Department of Energy, Energy Information Administration forecast that the Henry Hub natural gas price would average about $9.00 per million cubic feet in 2005 and $8.70 per million cubic feet in 2006. Henry Hub prices were expected to remain above $12 per million cubic feet until peak winter demand was over. Although most of the leading ammonia-producing companies purchase natural gas under contract, sustained high natural gas prices could lead to more closures of U.S. ammonia plants.

The second largest ammonia producer mothballed its 454,000-ton-per-year Donaldsonville, LA, ammonia plant in May; the plant had last operated in December 2004 as a swing ammonia producer. Volatile natural gas prices were cited as the principal reason for the closure. The Donaldsonville site will operate solely as a distribution and storage terminal. The operator of the ammonia plant in Alaska closed 650,000 tons per year of capacity (about one-half of the total at the site). The company, which had been having difficulties securing a steady supply of natural gas, signed contracts with Cook Inlet natural gas producers that would allow it to operate at the reduced level through November 2006. Most of the plant's ammonia production is shipped to the Republic of Korea.

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NITROGEN (FIXED)—AMMONIA

Several North American companies announced that they would no longer produce or market agricultural-grade ammonium nitrate. Rising security concerns and costs associated with security regulations were cited as the principal reasons for the decisions.

Two ammonia plants outside the United States were closed in 2005—a 280,000-ton-per-year plant in Canada and a 386,000-ton-per-year plant in Indonesia. Companies announced plans to build ammonia plants, the largest of which were a 1.5-million-ton per year plant in Trinidad and Tobago, a 1.1-million-ton-per-year plant in Algeria due onstream in 2009, and a 1-million-ton-per-year plant in Qatar due onstream in 2010. Smaller capacity plants were announced in China, Trinidad and Tobago, and the United Arab Emirates; these plants were scheduled to be completed in 2007 and 2008.

According to long-term projections by the U.S. Department of Agriculture's Economic Research Service, projected plantings for the eight major field crops in the United States would increase slowly from 2005-14, and the crop mix was expected to shift to corn and away from soybeans. Domestic corn use was projected to grow throughout the period, particularly for feed use and ethanol. Feed use of corn would rise as the U.S. livestock sector grows in response to increases in domestic demand for and exports of beef, pork, and poultry. As incomes grow in the rest of the world, especially in developing economies, consumers would shift to more meat in their diets, which requires more feed grains for meat production. Significant increases are projected in corn use for ethanol production during the next several years, reflecting continued expansion of production capacity. State-level bans on methyl tertiary butyl ether as a fuel oxygenate have increased incentives for ethanol expansion in recent years, and high petroleum prices have led to additional support for ethanol use.

Nitrogen compounds also are an environmental concern. Overfertilization and the subsequent runoff of excess fertilizer may contribute to nitrogen accumulation in watersheds. Nitrogen in excess fertilizer runoff is suspected to be a cause of the hypoxic zone that takes place in the Gulf of Mexico during the summer. Scientists continue to study the effects of fertilization on the Nation's environmental health.

World Ammonia Production, Reserves, and Reserve Base:

	Plant production		Reserves and reserve base[5]
	2004	2005[e]	
United States	8,850	8,700	Available atmospheric nitrogen and sources of natural gas for production of ammonia are considered adequate for all listed countries.
Canada	4,110	3,900	
China	34,800	34,000	
Egypt	1,680	1,700	
Germany	2,740	2,800	
India	10,700	9,500	
Indonesia	4,120	4,400	
Netherlands	1,970	1,800	
Pakistan	2,360	2,100	
Poland	1,980	2,000	
Russia	9,800	9,800	
Saudi Arabia	1,730	1,900	
Trinidad and Tobago	3,880	4,200	
Ukraine	3,900	3,800	
Other countries	24,600	25,000	
World total (rounded)	117,000	115,000	

World Resources: The availability of nitrogen from the atmosphere for fixed nitrogen production is unlimited. Mineralized occurrences of sodium and potassium nitrates, found in the Atacama Desert of Chile, contribute minimally to global nitrogen supply.

Substitutes: Nitrogen is an essential plant nutrient that has no substitute. Also, there are no known practical substitutes for nitrogen explosives and blasting agents.

[e]Estimated.
[1]U.S. Department of Commerce (DOC) data unless otherwise noted.
[2]Annual and preliminary data as reported in Current Industrial Reports MQ325B (DOC).
[3]Source: Green Markets.
[4]Defined as imports – exports + adjustments for Government and industry stock changes.
[5]See Appendix C for definitions.

PEAT

(Data in thousand metric tons unless otherwise noted)[1]

Domestic Production and Use: The estimated f.o.b. plant value of marketable peat production in the conterminous United States was $18 million in 2005. Peat was harvested and processed by about 52 companies in 15 of the conterminous States. The Alaska Department of Commerce, Office of Minerals Development, which conducted its own canvass of producers, reported that 159,000 cubic meters of peat was produced in 2004; output was reported only by volume.[2] A production estimate for 2005 was unavailable for Alaska. Florida, Michigan, and Minnesota were the leading producing States, in order of quantity harvested. Reed-sedge peat accounted for approximately 86% of the total volume produced, followed by hypnum moss 6%, and humus and sphagnum moss, each with 4%. More than 85% of domestic peat was sold for horticultural use, including general soil improvement, potting soils, earthworm culture, nurseries, and golf course construction. Other applications included seed inoculants, vegetable cultivation, mushroom culture, mixed fertilizers, and packing for flowers and plants. In the industrial sector, peat was used as oil absorbent and as an efficient filtration medium for the removal of waterborne contaminants in mine waste streams, municipal storm drainage, and septic systems.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production	736	642	634	696	690
Commercial sales	820	728	632	741	827
Imports for consumption	776	763	767	786	850
Exports	31	32	29	29	30
Consumption, apparent[3]	1,500	1,420	1,400	1,380	1,540
Price, average value, f.o.b. mine, dollars per ton	25.75	28.85	29.74	28.64	29.00
Stocks, producer, yearend	257	207	180	251	225
Employment, mine and plant, number[e]	800	750	700	700	700
Net import reliance[4] as a percentage of apparent consumption	47	55	55	50	55

Recycling: None.

Import Sources (2001-04): Canada, 99%; and other, 1%.

Tariff: **Item**	**Number**	**Normal Trade Relations 12-31-05**
Peat	2703.00.0000	Free.

Depletion Allowance: 5% (Domestic).

Government Stockpile: None.

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PEAT

Events, Trends, and Issues: Consumption, imports, and sales of peat were estimated to have increased in 2005. Most domestic peat is used in bulk for potting soil and general soil improvement.

Peat is an important component of growing media and the demand for peat generally follows that of horticultural applications. In the United States, the short-term outlook is for steady to slightly lower production and imported peat from Canada accounting for a greater percentage of domestic consumption.

World Mine Production, Reserves, and Reserve Base: Reserve and reserve base data have been revised to exclude deposits located in agricultural areas, forests, parks, and other protected regions; in Mineral Commodity Summaries 2005, the reserve and reserve base included such deposits. Countries that reported by volume only and had insufficient data for conversion to tons were combined and included with “Other countries.”

	Mine production		Reserves[5]	Reserve base[5]
	2004	2005[e]		
United States	696	690	150,000	10,000,000
Belarus	1,900	1,800	400,000	4,000,000
Canada	1,180	1,350	720,000	30,000,000
Estonia	1,000	1,000	60,000	2,000,000
Finland	7,620	7,600	6,000,000	6,400,000
Germany	2,500	850	([6])	([6])
Ireland	5,600	5,600	([6])	([6])
Latvia	1,000	1,000	76,000	1,300,000
Lithuania	380	400	190,000	300,000
Moldova	475	475	([6])	([6])
Russia	2,100	2,100	1,000,000	60,000,000
Sweden	890	1,000	([6])	([6])
Ukraine	1,000	1,000	([6])	([6])
Other countries	1,200	1,200	1,400,000	6,000,000
World total (rounded)	27,600	26,000	10,000,000	120,000,000

World Resources: Peat is a renewable resource, continuing to accumulate on 60% of global peatlands. However, the volume of global peatlands has decreasing at a rate of 0.05% annually owing to harvesting and land development. Many countries evaluate peat resources based on volume or area, because the variations in densities and thickness of peat deposits make it difficult to estimate tonnage. Volume data have been converted using the average bulk density of peat produced in that county. Reserve and reserve base data were revised using data from International Peat Society publications and were estimated based on the percentage of peat resources available for peat extraction. More than 50% of the U.S. reserve base is contained in peatlands located in undisturbed areas of Alaska. Total world resources of peat were estimated to be between 5 trillion to 6 trillion tons, covering about 400 million hectares.[7]

Substitutes: Natural organic materials such as composted yard waste and coir (coconut fiber) compete with peat in horticultural applications. Shredded paper is used to hold moisture for some grass-seeding applications. The superior water-holding capacity and physiochemical properties of peat limit substitution alternatives.

[e]Estimated.
[1]See Appendix A for conversion to short tons.
[2]Alaska Department of Commerce, Community & Economic Development Office of Economic Development, unpub. data, October 28, 2005.
[3]Defined as production + imports – exports + adjustments for industry stocks.
[4]Defined as imports – exports + adjustments for Government and industry stock changes.
[5]See Appendix C for definitions.
[6]Included with “Other countries.”
[7]Lappalainen, Eino, 1996, Global peat resources: Jyvaskyla, Finland, International Peat Society, p. 55.

PERLITE

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: The estimated value (f.o.b. mine) of processed perlite produced in 2005 was $21 million. Crude ore production came from 10 mines operated by 7 companies in 7 Western States. New Mexico continued to be the major producing State. Processed ore was expanded at 61 plants in 30 States. The principal end uses were building construction products, 62%; horticultural aggregate, 14%; fillers, 11%; filter aid, 7%; and other, 6%.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production[1]	588	521	493	508	506
Imports for consumption[e]	175	224	245	238	196
Exports[e]	43	42	37	37	37
Consumption, apparent	720	703	701	709	665
Price, average value, dollars per ton, f.o.b. mine	36.31	36.45	38.20	40.57	42.08
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, mine and mill	188	189	194	133	131
Net import reliance[2] as a percentage of apparent consumption	18	26	30	28	24

Recycling: Not available.

Import Sources (2001-04): Greece, 100%.

Tariff: Item	**Number**	**Normal Trade Relations 12-31-05**
Mineral substances, not specifically provided for	2530.10.0000	Free.

Depletion Allowance: 10% (Domestic and foreign).

Government Stockpile: None.

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PERLITE

Events, Trends, and Issues: Production of domestic perlite decreased slightly compared with that of 2004. Imports decreased about 18% compared with the near-record-high levels reached in 2004. Domestic apparent consumption dropped about 6% compared with that of 2004, continuing a general trend that began in 2001. Since 2000, domestic apparent consumption has dropped about 18%. Consumption has declined mainly because of weak demand from perlite used in construction-related materials.

The cost of rail transportation from the mines in the Western United States to some areas of the Eastern United States continued to burden domestic perlite producers with strong cost disadvantages compared with Greek perlite exporters. However, U.S. perlite exports to Canada partially offset losses from competition with imports in Eastern U.S. markets.

Perlite mining generally takes place in remote areas, and its environmental impact is not severe. The mineral fines, overburden, and reject ore produced during ore mining and processing are used to reclaim the mined-out areas, and, therefore, little waste remains. Airborne dust is captured by baghouses, and there is practically no runoff that contributes to water pollution.

World Processed Perlite Production, Crude Ore Reserves, and Reserve Base:

	Production		Reserves[3]	Reserve base[3]
	2004	2005[e]		
United States	508	506	50,000	200,000
Greece	525	525	50,000	300,000
Hungary	145	60	3,000	([4])
Japan	240	200	([4])	([4])
Turkey	140	130	([4])	5,700,000
Other countries	392	500	600,000	1,500,000
World total (rounded)	1,950	1,920	700,000	7,700,000

World Resources: Insufficient information is available to make reliable estimates of resources in perlite-producing countries.

Substitutes: Alternative materials can be substituted for all uses of perlite, if necessary. Long-established competitive commodities include diatomite, expanded clay and shale, pumice, slag, and vermiculite.

[e]Estimated. NA Not available.
[1]Processed perlite sold and used by producers.
[2]Defined as imports - exports + adjustments for Government and industry stock changes; changes in stocks not available and assumed to be zero for apparent consumption and net import reliance calculations.
[3]See Appendix C for definitions.
[4]Included with "Other countries."

PHOSPHATE ROCK

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: Phosphate rock ore was mined by 6 firms at 15 mines in 4 States, and upgraded to an estimated 38.3 million tons of marketable product valued at $1.1 billion, f.o.b. mine. Florida and North Carolina accounted for more than 85% of total domestic output; the remainder was produced in Idaho and Utah. More than 95% of the U.S. phosphate rock ore mined was used to manufacture wet-process phosphoric acid and superphosphoric acid, which were used as intermediate feedstocks in the manufacture of granular and liquid ammonium phosphate fertilizers and animal feed supplements. Approximately 45% of the wet-process phosphoric acid produced was exported in the form of upgraded granular diammonium and monoammonium phosphate (DAP and MAP, respectively) fertilizer, merchant-grade phosphoric acid, and triple superphosphate fertilizer. The balance of the phosphate rock mined was for the manufacture of elemental phosphorus, which was used to produce phosphorus compounds for a variety of food-additive and industrial applications.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production, marketable	31,900	36,100	35,000	35,800	38,300
Sold or used by producers	32,800	34,700	36,400	36,500	37,700
Imports for consumption	2,500	2,700	2,400	2,500	2,800
Exports	9	62	64	—	—
Consumption[1]	35,300	37,400	37,400	39,000	40,500
Price, average value, dollars per ton, f.o.b. mine[2]	26.82	27.47	27.01	27.79	27.89
Stocks, producer, yearend	7,510	8,860	7,540	7,220	7,100
Employment, mine and beneficiation plant, number[e]	3,400	3,200	3,200	3,100	2,900
Net import reliance[3] as a percentage of apparent consumption	9	3	9	7	7

Recycling: None.

Import Sources (2001-04): Morocco, 99%; and other, 1%.

Tariff: Item	**Number**	**Normal Trade Relations 12-31-05**
Natural calcium phosphates:		
Unground	2510.10.0000	Free.
Ground	2510.20.0000	Free.

Depletion Allowance: 14% (Domestic), 14% (Foreign).

Government Stockpile: None.

Events, Trends, and Issues: Phosphate rock production, sales, and consumption increased in 2005 owing to higher exports of phosphate fertilizer, primarily DAP. The leading producer of phosphate rock closed one mine in Florida because of depleted reserves; however, it increased production at other mines to compensate for the closure.

U.S. phosphate fertilizer production from the Gulf of Mexico region was lower for the year because of damage to facilities from Hurricane Katrina in late August. Most plants in Louisiana resumed operations in several weeks; however, one plant in Mississippi sustained $15 million to $25 million in damage and was closed for several months.

U.S. production of marketable phosphate rock is not likely to rise above much 40 million tons per year because of gradual depletion of high-quality deposits in Florida and the subsequent decreases in production capacity. Three new mines are in the development and permitting stages in Florida. These mines will be needed in the next decade to replace existing mines after they are depleted. However, the time necessary to complete the permitting process has increased significantly because of opposition from local governments and regional environmental organizations in southwestern Florida. There are concerns that new mines in DeSoto and Hardee Counties may adversely affect downstream water resources in the Peace River, which is a major source of drinking water.

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PHOSPHATE ROCK

The International Fertilizer Industry Association has predicted that worldwide demand for phosphate fertilizers will grow at an average rate of 2.3 % per year during the next 5 years. In the United States, phosphate fertilizer consumption was expected to remain slightly above 4 million tons per year of phosphorus pentoxide (P_2O_5) nutrient content. The United States is the leading supplier of processed phosphates in the world, accounting for about 45% of world trade. Since 2000, increased exports of MAP, primarily to South America, have helped to offset lower exports of DAP to markets in Asia. Continued growth in world population and the need for dependable food supplies ensures the importance of phosphate fertilizers.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[4]	Reserve base[4]
	2004	2005[e]		
United States	35,800	38,300	1,200,000	3,400,000
Australia	2,010	2,000	77,000	1,200,000
Brazil	5,400	6,400	260,000	370,000
Canada	1,000	1,000	25,000	200,000
China	25,500	26,000	6,600,000	13,000,000
Egypt	2,220	2,230	100,000	760,000
India	1,180	1,200	90,000	160,000
Israel	2,950	3,200	180,000	800,000
Jordan	6,220	7,000	900,000	1,700,000
Morocco and Western Sahara	26,700	28,000	5,700,000	21,000,000
Russia	11,000	11,000	200,000	1,000,000
Senegal	1,600	1,800	50,000	160,000
South Africa	2,740	2,000	1,500,000	2,500,000
Syria	2,880	3,000	100,000	800,000
Togo	1,120	1,120	30,000	60,000
Tunisia	8,050	8,000	100,000	600,000
Other countries	4,820	4,900	800,000	2,000,000
World total (rounded)	141,000	148,000	18,000,000	50,000,000

World Resources: Foreign reserve data were derived from information received from Government sources, individual companies, and independent sources. Reserve data for China were based on official government data and included deposits of low-grade ore. Domestic reserve data were based on U.S. Geological Survey and individual company information. Phosphate rock resources occur principally as sedimentary marine phosphorites. The largest deposits are found in northern Africa, China, the Middle East, and the United States. Significant igneous occurrences are found in Brazil, Canada, Russia, and South Africa. Large phosphate resources have been identified on the continental shelves and on seamounts in the Atlantic Ocean and the Pacific Ocean, but cannot be recovered economically with current technology.

Substitutes: There are no substitutes for phosphorus in agriculture.

[e]Estimated. — Zero.

[1]Defined as sold or used + imports – exports.

[2]Marketable phosphate rock, weighted value, all grades, domestic and export.

[3]Defined as imports – exports + adjustments for Government and industry stock changes.

[4]See Appendix C for definitions.

PLATINUM-GROUP METALS

(Platinum, palladium, rhodium, ruthenium, iridium, osmium)
(Data in kilograms unless otherwise noted)

Domestic Production and Use: The Stillwater and East Boulder Mines in south-central Montana are the only primary platinum-group metals (PGMs) producers in the United States and were owned by Stillwater Mining Company. Stillwater and East Boulder Mines milled more than 1,200,000 metric tons of ore and recovered more than 18,400 kilograms of palladium and platinum in 2005.[1] Small quantities of PGMs were also recovered as byproducts of copper refining by companies in Texas and Utah. Catalysts for air pollution abatement continued to be the leading demand sector for PGMs. In the United States, more than 90,000 kilograms of PGMs was used by the automotive industry in the manufacture of catalytic converters. Catalysts were also used in other air-pollution-abatement processes to remove organic vapors, odors, and carbon monoxide. Chemical uses include catalysts for organic synthesis, production of nitric acid, and fabrication of laboratory equipment. Platinum alloys, in cast or wrought form, are commonly used for jewelry. Platinum, palladium, and a variety of complex gold-silver-copper alloys are used as dental restorative materials.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Mine production:[2]					
Platinum	3,610	4,390	4,170	4,040	4,200
Palladium	12,100	14,800	14,000	13,700	14,200
Imports for consumption:					
Platinum	84,200	84,700	88,500	86,400	89,000
Palladium	160,000	117,000	105,000	127,000	103,000
Rhodium	12,400	8,630	12,000	13,200	14,000
Ruthenium	8,170	9,890	15,900	18,800	24,000
Iridium	3,110	2,100	2,200	3,230	3,600
Osmium	77	36	53	75	50
Exports:					
Platinum	29,300	27,800	22,200	20,000	21,000
Palladium	36,800	42,700	22,300	31,400	25,000
Rhodium	982	349	479	311	300
Other PGMs	252	94	145	677	700
Price,[3] dollars per troy ounce:					
Platinum	533.29	542.56	694.44	848.76	890.00
Palladium	610.71	339.68	203.00	232.93	190.00
Rhodium	1,600.00	838.88	530.28	983.24	2,000.00
Ruthenium	130.67	66.33	35.43	64.22	70.00
Iridium	415.25	294.62	93.02	185.33	160.00
Employment, mine, number[2]	1,620	1,580	1,540	1,580	1,600
Net import reliance as a percentage of apparent consumption:[e]					
Platinum	92	91	91	92	91
Palladium	88	82	82	83	78

Recycling: An estimated 9,800 kilograms of PGMs was recovered from new and old scrap in 2005.

Import Sources (2001-04): Platinum: South Africa, 45%; United Kingdom, 16%; Germany, 12%; Canada, 6%; and other, 21%. Palladium: Russia, 33%; South Africa, 22%; United Kingdom, 15%; Belgium, 8%; and other, 22%.

Tariff: All unwrought and semimanufactured forms of PGMs can be imported duty free.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile:

Stockpile Status—9-30-05[4]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Platinum	261	—	[5]3,110	388	388
Palladium	—	—	[5]778	756	756
Iridium	282	56	186	254	219

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PLATINUM-GROUP METALS

Events, Trends, and Issues: After recovering in 2004, palladium prices fell in 2005 because of weak demand and oversupply. Meanwhile, the platinum price continued to climb for the fourth year in a row owing to a perceived imbalance in the supply and demand. With a short supply, the price of rhodium surged to a 5-year high.

An increase in diesel car sales in Europe can be expected to cause a strong increase in use of platinum in the region in 2005 and beyond. The tightening of emissions regulations in China, Europe, Japan, and other parts of the world is also expected to lead to higher average platinum loadings on catalysts, especially on light-duty diesel vehicles, as particulate matter emissions become more closely controlled. In the United States, thrifting is continuing at most manufacturers and is likely to lead to a reduction in the use of platinum in autocatalysts. The price differential of more than $600 per troy ounce between platinum and palladium has led to the assumption that automobile manufacturers will change PGMs ratios on gasoline-engine vehicles in favor of palladium, reversing the trend of the past 4 years. Many U.S. automobile manufacturers have yet to make the switch because of the history of high and volatile prices in the past. The sales of platinum jewelry are expected to drop worldwide as the price continues to be high and white gold and palladium are substituted for platinum.

In 2005, there were about nine potential PGMs projects in some stage of development in South Africa. Many of the current mines in South Africa were also expanding capacity to compensate for lower grade ore. The continuing strengthening of the South African rand could, however, raise the cost of future PGMs projects.

The desire for an alternative fuel for automobiles has led to a large global public and private effort to develop fuel-cell technology. Platinum is the catalyst used by fuel cells to convert hydrogen and oxygen to electricity. Palladium will also likely play a role in the fuel cell.

World Mine Production, Reserves, and Reserve Base:

	Mine production				PGMs	
	Platinum		Palladium		Reserves[6]	Reserve base[6]
	2004	2005[e]	2004	2005[e]		
United States	4,040	4,200	13,700	14,200	900,000	2,000,000
Canada	7,000	9,000	12,000	13,500	310,000	390,000
Russia	36,000	27,000	74,000	96,000	6,200,000	6,600,000
South Africa	160,000	170,000	78,500	81,700	63,000,000	70,000,000
Other countries	7,400	7,600	9,900	10,400	800,000	850,000
World total (rounded)	214,000	218,000	188,000	216,000	71,000,000	80,000,000

World Resources: World resources of PGMs in mineral concentrations that can be mined economically are estimated to total more than 100 million kilograms. The largest reserves are in the Bushveld Complex in South Africa. In 2005, there were 17 producing mining areas in the Bushveld Complex; of these 12 produced from the Merensky Reef and the UG2 Chromite Layer, and 1 produced from the Platreef on the northern limb of the Complex.

Substitutes: Some motor vehicle manufacturers have substituted palladium for the more expensive platinum in catalytic converters. Until recently, only platinum could be used in diesel catalytic converters; however, new technologies allow palladium to be used. For most other end uses, PGMs can be substitute for other PGMs, with some losses in efficiency. In addition, electronic parts manufacturers are reducing the average palladium content of the conductive pastes used to form the electrodes of multilayer ceramic capacitors by substituting base metals or silver-palladium pastes that contain significantly less palladium.

[e]Estimated. — Zero.

[1]Stillwater Mining Company, 2005, Annual report—2004: Billings, MT, Stillwater Mining Company, 100 p.

[2]Estimates from published sources.

[3]Engelhard Corporation unfabricated metal.

[4]See Appendix B for definitions.

[5]Actual quantity will be limited to remaining monetary sales authority or inventory.

[6]See Appendix C for definitions.

POTASH

(Data in thousand metric tons of K_2O equivalent unless otherwise noted)

Domestic Production and Use: In 2005, the production value of marketable potash, f.o.b. mine, was about $325 million. Domestic potash was produced in Michigan, New Mexico, and Utah. Most of the production was from southeastern New Mexico, where two companies operated three mines. New Mexico sylvinite and langbeinite ores were beneficiated by flotation, dissolution-recrystallization, heavy-media separations, or combinations of these processes, and provided more than 70% of total U.S. producer sales. In Utah, which has three operations, one company extracted underground sylvinite ore by deep-well solution mining. Solar evaporation crystallized the sylvinite ore from the brine solution, and a flotation process separated the potassium chloride (muriate of potash or MOP) from byproduct sodium chloride. Two companies processed surface and subsurface brines by solar evaporation and flotation to produce MOP, potassium sulfate (sulfate of potash or SOP) and byproducts. In Michigan, a company used deep-well solution mining and mechanical evaporation for crystallization of MOP and byproduct sodium chloride.

The fertilizer industry used about 85% of U.S. potash sales, and the chemical industry used the remainder. More than 60% of the produced potash was MOP. Potassium magnesium sulfate (sulfate of potash-magnesia or SOPM) and SOP, which are required by certain crops and soils, also were produced.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production, marketable[1]	1,200	1,200	1,100	1,300	1,200
Imports for consumption	4,540	4,620	4,720	4,920	5,100
Exports	366	371	329	235	200
Consumption, apparent[2]	5,300	5,300	5,400	6,000	6,100
Price, dollars per metric ton of K_2O, average, muriate, f.o.b. mine[3]	155	155	170	200	270
Employment, number:					
Mine	585	540	520	520	500
Mill	670	645	620	620	630
Net import reliance[4, 5] as a percentage of apparent consumption	80	80	80	80	80

Recycling: None.

Import Sources (2001-04): Canada, 91%; Belarus, 3%; Russia, 3%; Germany, 1%; and other, 2%.

Tariff: **Item**	**Number**	**Normal Trade Relations 12-31-05**
Crude salts, sylvinite, etc.	3104.10.0000	Free.
Potassium chloride	3104.20.0000	Free.
Potassium sulfate	3104.30.0000	Free.
Potassium nitrate	2834.21.0000	Free.
Potassium-sodium nitrate mixtures	3105.90.0010	Free.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: About 93% of the world potash production was consumed by the fertilizer industry. The United States ranked sixth in world production. Potassium chloride is the main fertilizer product, containing an average 61% of K_2O equivalent. The rising trend of potash consumption that began in 2004 continued throughout 2005 as world crop production increased, especially in Brazil, China, and India. Aside from strong GDP growth in these countries, their foreign currencies rose against the U.S. dollar, giving fertilizer consumers greater buying power and therefore the opportunity to buy more potash.

Weather conditions throughout the world continued to be a problem in the global farm economy. The 2005 harvest for corn, cotton, and soybeans deteriorated because of drought. Rising energy, equipment, and labor costs caused fertilizer prices to increase as well.

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POTASH

A major U.S. potash company announced plans that it would make some design changes to its langbeinite (potassium magnesium sulfate) production plant in Carlsbad, NM. The changes will raise the plant capacity to 610,000 tons; 370,000 tons (62% K_2O equivalent) of white muriate of potash, of which 240,000 tons could be converted to granular potash to meet demand if needed, and 240,000 tons of langbeinite, of which 120,000 tons will be a natural granular product.

Because of a tax relief announcement by the Saskatchewan Provincial government in Canada, two potash producers announced in April that they would commence work on adding new capacity to their operations in Esterhazy and Vanscoy. At Esterhazy, 400,000 tons of annual capacity should be completed by fall 2006 with another 1.6 million tons in the engineering phase. At Vanscoy, a 310,000-ton expansion was underway, the majority of which should be completed in late 2006.

The outlook for the U.S. potash industry in 2006 is optimistic because of a strong international demand and limited supply of potash. Domestic potash inventories declined in 2005, but stocks are expected to rise as production expansions come onstream in the next couple of years.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[6]	Reserve base[6]
	2004	2005[e]		
United States	[1]1,300	[1]1,200	90,000	300,000
Belarus	4,300	4,500	750,000	1,000,000
Brazil	340	400	300,000	600,000
Canada	9,150	10,700	4,400,000	9,700,000
Chile	360	370	10,000	50,000
China	550	600	8,000	450,000
Germany	3,500	3,800	710,000	850,000
Israel	2,060	2,100	[7]40,000	[7]580,000
Jordan	1,230	1,200	[7]40,000	[7]580,000
Russia	5,000	5,000	1,800,000	2,200,000
Spain	500	500	20,000	35,000
Ukraine	50	60	25,000	30,000
United Kingdom	600	600	22,000	30,000
Other countries	—	—	50,000	140,000
World total (rounded)	28,900	31,000	8,300,000	17,000,000

World Resources: Estimated domestic potash resources total about 6 billion tons. Most of this lies at depths between 1,800 and 3,100 meters in a 3,110-square-kilometer area of Montana and North Dakota as an extension of the Williston Basin deposits in Saskatchewan, Canada. The Paradox Basin in Utah contains approximately 2 billion tons, mostly at depths of more than 1,200 meters. A large potash resource lies about 2,100 meters under central Michigan. The U.S. reserve figure above includes approximately 62 million tons in central Michigan. Estimated world resources total about 250 billion tons. The potash deposits in Russia and Thailand contain large amounts of carnallite; it is not clear if this can be mined profitably in a free market economy.

Substitutes: There are no substitutes for potassium as an essential plant nutrient and an essential nutritional requirement for animals and humans. Manure and glauconite (greensand) are low-potassium-content sources that can be profitably transported only short distances to the crop fields.

[e]Estimated. — Zero.
[1]Rounded to within 0.1 million tons to avoid disclosing company proprietary data.
[2]Rounded to within 0.2 million tons to avoid disclosing company proprietary data.
[3]Average prices based on actual sales; excludes soluble and chemical muriates.
[4]Defined as imports – exports + adjustments for Government and industry stock changes.
[5]Rounded to one significant digit to avoid disclosing company proprietary data.
[6]See Appendix C for definitions.
[7]Total reserves and reserve base in the Dead Sea are arbitrarily divided equally between Israel and Jordan for inclusion in this tabulation.

PUMICE AND PUMICITE

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: The estimated value of pumice and pumicite sold or used in 2005 was about $26 million. Domestic output came from 16 producers at 17 mines in 7 States. Pumice and pumicite was mined in Arizona, Oregon, Idaho, California, New Mexico, Nevada, and Kansas, in descending order of significance. About 66% of production came from Arizona, Oregon, and Idaho. About 76% of the pumice was consumed for building blocks, and the remaining 24% was used in abrasives, concrete, horticulture, landscaping, stone-washing laundries, and other applications.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production, mine[1]	920	956	870	1,490	1,360
Imports for consumption	379	360	366	402	410
Exports[e]	27	30	25	27	30
Consumption, apparent	1,270	1,320	1,210	1,870	1,740
Price, average value, dollars per ton, f.o.b. mine or mill	21.42	20.69	25.19	16.80	19.26
Stocks, yearend	NA	NA	NA	NA	NA
Employment, mine and mill, number	105	100	100	100	110
Net import reliance[2] as a percentage of apparent consumption	28	25	28	20	22

Recycling: Not available.

Import Sources (2001-04): Greece, 76%; Italy, 19%; Turkey, 4%; and other, 1%.

Tariff:

Item	**Number**	**Normal Trade Relations 12-31-05**
Crude or in irregular pieces, including crushed pumice	2513.11.0000	Free.
Other	2513.19.0000	0.2¢/kg.

Depletion Allowance: 5% (Domestic and foreign).

Government Stockpile: None.

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PUMICE AND PUMICITE

Events, Trends, and Issues: The amount of domestically produced pumice and pumicite sold or used in 2005 decreased 9% compared with that of 2004. Imports increased by about 2% compared with those of 2004 as more Greek and Italian pumice was brought into Eastern U.S. ports to supply markets primarily in the Eastern United States and Gulf Coast. Total apparent consumption in 2005 fell about 6% compared with that of 2004. Use of substitutes in the horticultural market in the Western United States may have caused this decrease in consumption.

In 2006, domestic mine production of pumice and pumicite is expected to increase slightly to about 1.4 million tons, with U.S. apparent consumption rising to 1.8 million tons. Although pumice and pumicite is plentiful in the Western United States, changes in laws and public land designations could decrease access to many deposits. Pumice and pumicite is sensitive to mining and transportation costs, and, if domestic production costs were to increase, imports and competing materials might replace pumice in many domestic markets.

All domestic mining of pumice in 2005 was by open pit methods and was generally in remote areas where land-use conflicts were not severe. Although the generation and disposal of reject fines in mining and milling resulted in a dust problem at some operations, the environmental impact was restricted to a small geographic area.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[3]	Reserve base[3]
	2004	2005[e]		
United States[1]	1,490	1,360	Large	Large
Algeria	400	450	NA	NA
Chile	1,250	1,300	NA	NA
Ecuador	710	488	NA	NA
France	450	450	NA	NA
Greece	1,600	2,000	NA	NA
Guadeloupe	210	210	NA	NA
Guatemala	270	226	NA	NA
Iran	1,200	1,200	NA	NA
Italy	4,600	4,600	NA	NA
Spain	600	600	NA	NA
Turkey	900	1050	NA	NA
Other countries	2,000	2,000	NA	NA
World total (rounded)	15,700	15,900	NA	NA

World Resources: The identified U.S. resources of pumice and pumicite in the West are estimated to be more than 25 million tons. The estimated total resources (identified and undiscovered) in the Western and Great Plains States are at least 250 million tons and may total more than 1 billion tons. Italy and Greece, and Iran remain the leading producers of pumice and pumicite, followed by the United States. Recent analysis shows that the production estimates of past years for pumice and pumicite from some countries, notably Greece, may have been erroneous. Reliable sources were used for the current production figures. There are large resources of pumice and pumicite on all continents.

Substitutes: The costs of transportation determine the maximum distance that pumice and pumicite can be shipped and still remain competitive with alternate materials. Competitive materials that can be substituted for pumice and pumicite for several end uses include crushed aggregates, diatomite, expanded shale and clay, and vermiculite.

[e]Estimated. NA Not available.
[1]Quantity sold and used by producers.
[2]Defined as imports – exports + adjustments for Government and industry stock changes.
[3]See Appendix C for definitions.

QUARTZ CRYSTAL (INDUSTRIAL)

(Data in metric tons unless otherwise noted)

Domestic Production and Use: Lascas[1] mining and processing in Arkansas was stopped at the end of 1997, and in 2005, no U.S. firms reported the production of cultured quartz crystals. Cultured quartz crystal production capacity still exists in the United States using imported and stockpiled lascas as feed material. In the past several years, cultured quartz crystal was increasingly produced overseas, primarily in Asia. Electronic applications accounted for most industrial uses of quartz crystal; other uses included special optical applications.

Virtually all quartz crystal used for electronics was cultured rather than natural crystal. Electronic-grade quartz crystal was essential for making filters, frequency controls, and timers in electronic circuits employed for a wide range of products, such as communications equipment, computers, and many consumer goods, such as electronic games and television receivers.

Salient Statistics—United States: Production statistics for cultured quartz crystals were withheld to avoid disclosing company proprietary data. The U.S. Department of Commerce (DOC), which is the major Government source of U.S. trade data, does not provide specific import or export statistics on lascas. The DOC also collects export and import statistics on electronic and optical-grade quartz crystal; however, the quartz crystal export and import quantities and values reported in previous years included zirconia and were inadvertently reported to be quartz crystal not including mounted piezoelectric crystals. The average value of as-grown cultured quartz and lumbered quartz, which is as-grown quartz that has been processed by sawing and grinding, was estimated to be about $186 per kilogram in 2005. Other salient statistics were not available.

Recycling: None.

Import Sources (2001-04): The United States is 100% import reliant. Brazil, Germany, and Madagascar are reportedly the major sources for lascas with Canada becoming an increasingly important supplier. Other possible sources of lascas include China, South Africa, and Venezuela.

Tariff:

Item	Number	Normal Trade Relations 12-31-05
Sands:		
95% or greater silica	2505.10.10.00	Free.
Less than 95% silica	2505.10.50.00	Free.
Quartz (including lascas)	2506.10.00.50	Free.
Piezoelectric quartz	7104.10.00.00	3% ad val.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile:

Stockpile Status—9-30-05[2]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Quartz crystal	7	15	([3])	11	28

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QUARTZ CRYSTAL (INDUSTRIAL)

Events, Trends, and Issues: Trends indicate that demand for quartz crystal devices should continue to grow, and consequently, quartz crystal production should remain strong well into the future. Growth of the consumer electronics market (for products such as personal computers, electronic games, and cellular telephones) will continue to promote global production. The growing global electronics market may require additional production capacity worldwide.

World Mine Production, Reserves, and Reserve Base:[4] This information is unavailable, but the global reserve base for lascas is thought to be large.

World Resources: Limited resources of natural quartz crystal suitable for direct electronic or optical use are available throughout the world. World dependence on these resources will continue to decline because of the increased acceptance of cultured quartz crystal as an alternative material; however, use of cultured quartz crystal will mean an increased dependence on lascas for growing cultured quartz.

Substitutes: Quartz crystal is the best material for frequency-control oscillators and frequency filters in electronic circuits. Other materials, such as aluminum orthophosphate (e.g., the very rare mineral berlinite) and lithium tantalate, which have larger piezoelectric coupling constants, have been studied.

[1]Lascas is a nonelectronic-grade quartz used as a feedstock for growing cultured quartz crystal and for production of fused quartz.
[2]See Appendix B for definitions.
[3]Less than ½ unit.
[4]See Appendix C for definitions.

RARE EARTHS[1]

(Data in metric tons of rare-earth oxide (REO) content unless otherwise noted)

Domestic Production and Use: Rare earths were not mined domestically in 2005. Bastnäsite, a rare-earth fluocarbonate mineral, was previously mined and processed as a primary product at Mountain Pass, CA. Rare-earth concentrates, intermediate compounds, and individual oxides were available from stocks. The United States continued to be a major exporter and consumer of rare-earth products in 2005. The estimated value of refined rare earths consumed in the United States was more than $1 billion. Based on final 2004 reported data, the estimated 2004 distribution of rare earths by end use was as follows: automotive catalytic converters, 32%; metallurgical additives and alloys, 16%; glass polishing and ceramics, 12%; rare-earth phosphors for lighting, televisions, computer monitors, radar, and X-ray intensifying film, 15%; permanent magnets, 4%; petroleum refining catalysts, 4%; and other, 17%.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production, bastnäsite concentrates[e]	5,000	5,000	—	—	—
Imports:[2]					
Thorium ore (monazite)	—	—	—	—	—
Rare-earth metals, alloy	1,420	1,450	1,130	804	945
Cerium compounds	3,850	2,540	2,630	1,880	2,210
Mixed REOs	2,040	1,040	2,150	1,660	753
Rare-earth chlorides	2,590	1,800	1,890	1,310	2,330
Rare-earth oxides, compounds	9,150	7,260	10,900	11,400	9,800
Ferrocerium, alloys	118	89	111	105	142
Exports:[2]					
Rare-earth metals, alloys	884	1,300	1,190	1,010	637
Cerium compounds	4,110	2,740	1,940	2,280	2,060
Other rare-earth compounds	1,600	1,340	1,450	4,800	1,450
Ferrocerium, alloys	2,500	2,830	2,800	3,720	4,030
Consumption, apparent	15,100	11,000	9,340	5,480	8,240
Price, dollars per kilogram, yearend:					
Bastnäsite concentrate, REO basis[e]	4.08	4.08	4.08	4.08	4.08
Monazite concentrate, REO basis	0.73	0.73	0.73	0.73	0.73
Mischmetal, metal basis, metric ton quantity[3]	5-7	5-6	5-6	5-6	5-6
Stocks, producer and processor, yearend	W	W	W	W	W
Employment, mine and mill, number	90	95	90	NA	NA
Net import reliance[4] as a percentage of apparent consumption	67	54	100	100	100

Recycling: Small quantities, mostly permanent magnet scrap.

Import Sources (2001-04): Rare-earth metals, compounds, etc.: China, 76%; France, 14%; Japan, 6%; Austria, 2%; and other, 2%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Thorium ores and concentrates (monazite)	2612.20.0000	Free.
Rare-earth metals, whether or not intermixed or interalloyed	2805.30.0000	5.0% ad val.
Cerium compounds	2846.10.0000	5.5% ad val.
Mixtures of REOs except cerium oxide	2846.90.2010	Free.
Mixtures of rare-earth chlorides except cerium chloride	2846.90.2050	Free.
Rare-earth compounds, individual REOs (excludes cerium compounds)	2846.90.8000	3.7% ad val.
Ferrocerium and other pyrophoric alloys	3606.90.3000	5.9% ad val.

Depletion Allowance: Monazite, 22% on thorium content and 14% on rare-earth content (Domestic), 14% (Foreign); bastnäsite and xenotime, 14% (Domestic and foreign).

Government Stockpile: None.

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RARE EARTHS

Events, Trends, and Issues: Domestic demand for rare earths in 2005 was higher overall because of increased demand for rare-earth oxides and other refined rare-earth compounds used in automotive catalytic converters, fiber optics, lasers, oxygen sensors, phosphors for fluorescent lighting, color television, electronic thermometers, and X-ray intensifying screens, pigments, superconductors, and other applications. U.S. demand, however, was higher for cerium compounds used in glass polishing and glass additives, rare-earth chlorides used in the production of fluid cracking catalysts, and rare-earth metals and alloys used in metallurgical applications and permanent magnets. U.S. imports of rare earths decreased in two trade categories, mixed rare-earth oxides and rare-earth compounds. Although the rare-earth separation plant at Mountain Pass, CA, remained on a care-and-maintenance basis, it is expected to resume operations. Bastnäsite concentrates and other rare-earth intermediates and refined products continued to be sold from the mine stocks at Mountain Pass. The trend is for a continued increase in the use of rare earths in many applications, especially automotive catalytic converters, permanent magnets, and rechargeable batteries.

World Mine Production, Reserves, and Reserve Base:

	Mine production[e]		Reserves[5]	Reserve base[5]
	2004	2005		
United States	—	—	13,000,000	14,000,000
Australia	—	—	5,200,000	5,800,000
China	95,000	98,000	27,000,000	89,000,000
Commonwealth of Independent States	2,000	2,000	19,000,000	21,000,000
India	2,700	2,700	1,100,000	1,300,000
Malaysia	250	250	30,000	35,000
Thailand	2,200	2,200	NA	NA
Other countries	—	—	22,000,000	23,000,000
World total (rounded)	102,000	105,000	88,000,000	150,000,000

World Resources: Rare earths are relatively abundant in the Earth's crust, but discovered minable concentrations are less common than for most other ores. U.S. and world resources are contained primarily in bastnäsite and monazite. Bastnäsite deposits in China and the United States constitute the largest percentage of the world's rare-earth economic resources, while monazite deposits in Australia, Brazil, China, India, Malaysia, South Africa, Sri Lanka, Thailand, and the United States constitute the second largest segment. Apatite, cheralite, eudialyte, secondary monazite, loparite, phosphorites, rare-earth-bearing (ion adsorption) clays, spent uranium solutions, and xenotime make up most of the remaining resources. Undiscovered resources are thought to be very large relative to expected demand.

Substitutes: Substitutes are available for many applications, but generally are less effective.

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data. — Zero.
[1]Data includes lanthanides and yttrium, but excludes most scandium. See also Scandium and Yttrium.
[2]REO equivalent or contents of various materials were estimated. Data from U.S. Census Bureau.
[3]Price range from Elements—Rare Earths, Specialty Metals and Applied Technology, Trade Tech, Denver, CO, and Web-based High Tech Materials, Longmont, CO.
[4]Defined as imports – exports + adjustments for Government and industry stock changes.
[5]See Appendix C for definitions.

RHENIUM

(Data in kilograms of rhenium content unless otherwise noted)

Domestic Production and Use: During 2005, ores containing rhenium were mined by five operations (two in Arizona, one each in Montana, New Mexico, and Utah). Rhenium compounds are included in molybdenum concentrates derived from porphyry copper deposits, and rhenium is recovered as a byproduct from roasting such molybdenum concentrates. Rhenium-containing products included ammonium perrhenate, perrhenic acid, and metal powder. The major uses of rhenium were in petroleum-reforming catalysts and in superalloys used in high-temperature, turbine engine components, representing about 40% and 50%, respectively, of the total demand. Rhenium was used in petroleum-reforming catalysts for the production of high-octane hydrocarbons, which are used in the production of lead-free gasoline. Bimetallic platinum-rhenium catalysts have replaced many of the monometallic catalysts. Rhenium improves the high-temperature (1,000° C) strength properties of some nickel-base superalloys. Rhenium alloys were used in crucibles, electrical contacts, electromagnets, electron tubes and targets, heating elements, ionization gauges, mass spectrographs, metallic coatings, semiconductors, temperature controls, thermocouples, vacuum tubes, and other applications. The estimated value of rhenium consumed in 2005 was about $32 million.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production[1]	5,500	4,000	3,900	5,900	6,900
Imports for consumption	23,400	16,900	14,500	20,200	28,900
Exports	NA	NA	NA	NA	NA
Consumption, apparent	28,900	20,900	18,400	26,100	35,800
Price,[2] average value, dollars per kilogram, gross weight:					
Metal powder, 99.99% pure	910	1,030	1,090	1,090	1,170
Ammonium perrhenate	790	820	790	630	670
Stocks, yearend, consumer, producer, dealer	NA	NA	NA	NA	NA
Employment, number	Small	Small	Small	Small	Small
Net import reliance[3] as a percentage of apparent consumption	81	81	79	77	81

Recycling: Small amounts of molybdenum-rhenium and tungsten-rhenium scrap have been processed by several companies during the past few years. All spent platinum-rhenium catalysts were recycled.

Import Sources (2001-04): Rhenium metal: Chile, 91%; Kazakhstan, 3%; Germany, 3%; and other, 3%. Ammonium perrhenate: Kazakhstan, 48%; Germany, 15%; Netherlands, 14%; Estonia, 10%; and other, 13%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Other inorganic acids, other—rhenium, etc.	2811.19.6050	4.2% ad val.
Salts of peroxometallic acids, other—ammonium perrhenate	2841.90.2000	3.1% ad val.
Rhenium, etc., (metals) waste and scrap	8112.92.0500	Free.
Rhenium, (metals) unwrought; powders	8112.92.5000	3% ad val.
Rhenium, etc., (metals) wrought; etc.	8112.99.0100	4% ad val.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

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RHENIUM

Events, Trends, and Issues: During 2005, average rhenium metal price was about $1,170 per kilogram, about 7% more than that of 2004. Rhenium imports increased by about 43% owing to a strong recovery in the superalloy market and improved demand in the catalyst market. Rhenium recovery in the United States increased by about 17% owing to increased production of byproduct molybdenum concentrates from porphyry copper deposits. Byproduct molybdenum production from the five working copper-molybdenum mines increased to near capacity in 2005. The United States relied on imports for much of its supply of rhenium. Chile and Kazakhstan supplied the majority of the rhenium imported. Recent analysis has indicated that rhenium production in Kazakhstan increased significantly as a result of the formation of the Republican State Company Zhezkazganredmet under the Ministry of Industry and Trade in Kazakhstan.

Owing to the scarcity and minor output of rhenium, its production and processing pose no known threat to the environment. In areas where it is recovered, pollution control equipment for sulfur dioxide removal also prevents most of the rhenium from escaping into the atmosphere.

World Mine Production, Reserves, and Reserve Base:

	Mine production[4]		Reserves[5]	Reserve base[5]
	2004	2005		
United States	5,900	6,900	390,000	4,500,000
Armenia	1,000	1,000	95,000	120,000
Canada	1,700	1,000	—	1,500,000
Chile	18,100	18,900	1,300,000	2,500,000
Kazakhstan	2,600	8,000	190,000	250,000
Peru	5,000	5,000	45,000	550,000
Russia	1,400	1,400	310,000	400,000
Other countries	1,000	1,000	91,000	360,000
World total (rounded)	36,700	43,200	2,400,000	10,000,000

World Resources: Most rhenium occurs with molybdenum in porphyry copper deposits. Identified U.S. resources are estimated to be about 5 million kilograms, and the identified resources of the rest of the world are approximately 6 million kilograms. In Kazakhstan, rhenium also exists in sedimentary copper deposits.

Substitutes: Substitutes for rhenium in platinum-rhenium catalysts are being evaluated continually. Iridium and tin have achieved commercial success in one such application. Other metals being evaluated for catalytic use include gallium, germanium, indium, selenium, silicon, tungsten, and vanadium. The use of these and other metals in bimetallic catalysts may decrease rhenium's share of the catalyst market. Materials that can substitute for rhenium in various end uses are as follows: cobalt and tungsten for coatings on copper X-ray targets, rhodium and rhodium-iridium for high-temperature thermocouples, tungsten and platinum-ruthenium for coatings on electrical contacts, and tungsten and tantalum for electron emitters.

[e]Estimated. NA Not available. — Zero.

[1]Based on estimated rhenium contained in MoS_2 concentrates assuming 90% recovery of rhenium content.

[2]Average price per kilogram of rhenium in pellets or ammonium perrhenate, based on U.S. Census Bureau customs value.

[3]Defined as imports – exports + adjustments for Government and industry stock changes.

[4]Estimated amount of rhenium extracted in association with copper and molybdenum production.

[5]See Appendix C for definitions.

RUBIDIUM

(Data in kilograms of rubidium content unless otherwise noted)

Domestic Production and Use: Rubidium is not mined in the United States; however, there are rubidium occurrences in Maine and South Dakota. This metal may occur with cesium or lithium minerals such as pollucite or lepidolite, respectively, commonly in association with pegmatites. There are also occurrences with evaporite minerals. There are only a few U.S. companies that process rubidium concentrate, all of which is imported from Canada. The use of rubidium and its compounds is limited, and applications include DNA separation, fiber optics, inorganic chemicals, lamps, night vision devices, and as standards for atomic absorption analysis. Rubidium and cesium are used in atomic clocks. Rubidium-82 is a decay product of strontium-82 and is used in imaging technology for diagnosis of heart conditions. The decay of radioactive rubidium-87 to strontium-87 is an important tool in geochronology.

Salient Statistics—United States: U.S. supplies of rubidium come from only one mine in Canada, as a byproduct. Production data from this mine are not available. Similarly, consumption, export, and import data are not available. Annual U.S. rubidium consumption is small and may only amount to a few thousand kilograms. No market price is available because the metal is not traded. Rubidium and rubidium compound prices are unlisted but have remained stable. In 2005, 1-gram ampoules of 99.75%-grade rubidium (metal) were offered at $56.50 each, and the price for 100 grams of the same material was $1,085.00.

Recycling: None.

Import Sources (2001-04): The United States is 100% import reliant. Canada is the chief source of rubidium ore imported by the United States.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Alkali metals, other	2805.19.9000	5.5% ad val.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

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RUBIDIUM

Events, Trends, and Issues: There have been no environmental or human health issues associated with the processing or use of rubidium; however, the combustion of coal may release small amounts of rubidium to the atmosphere. Consumption and use of this metal and its compounds are not commercially significant, and no change in use patterns is anticipated. Rubidium halide cathodes are being researched for use in low-pressure, mercury-free lamps.

World Mine Production, Reserves, and Reserve Base:[1] Rubidium may be found in trace amounts in potassium-bearing minerals such as feldspar and mica that formed during the crystallization of pegmatites. Zoned pegmatites and their associated rubidium-bearing minerals, lepidolite and pollucite, are the chief sources of rubidium. These very coarse-grained granitic rocks, which form late in the crystallization of a silicic magma, may concentrate rare minerals such as lepidolite, a lithium-bearing mica. This mineral is also the principal ore mineral of rubidium and may contain up to 3.15% rubidium. Rubidium may also be obtained as a byproduct from another pegmatite mineral, pollucite, which is a cesium aluminosilicate that may contain up to 1.35% rubidium. There are no minerals in which rubidium is the predominant metallic element. Canada is the world's leading producer of rubidium, and supplies of rubidium-bearing lepidolite from Canada are adequate for current use patterns.

World Resources: World resources of rubidium are unknown. In addition to several significant occurrences of rubidium-bearing pegmatites in Canada, there are pegmatite occurrences in Afghanistan, Namibia, Peru, Zambia, and other countries. Rubidium occurrences have been reported in brines in northern Chile and in China and also in salt beds in France, Germany, and the United States (New Mexico and Utah).

Substitutes: Rubidium and cesium may be used interchangeably in most applications because the properties of rubidium are similar to those of cesium. Cesium is less expensive.

[1]See Appendix C for definitions.

SALT

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: Domestic production of salt increased slightly in 2005. The total value was estimated to be $1.2 billion. Twenty-nine companies operated 64 plants in 15 States. The estimated percentage of salt sold or used, by type, was salt in brine, 46%; rock salt, 39%; vacuum pan, 8%; and solar salt, 7%.

The chemical industry consumed nearly 39% of total salt sales, with salt in brine representing about 90% of the type of salt used for feedstock. The chlorine and caustic soda manufacturing sector was the main consumer within the chemical industry. Salt for highway deicing accounted for 37% of U.S. demand. The remaining markets for salt, in declining order, were distributors, 8%; industrial, 7%; agricultural, 3%; food, 3%; water treatment, 2%; and other combined with exports, 1%.

Salient Statistics—United States:[1]	2001	2002	2003	2004	2005[e]
Production	44,800	40,300	43,700	46,500	45,900
Sold or used by producers	42,200	37,700	41,100	45,000	42,600
Imports for consumption	12,900	8,160	12,900	11,900	12,000
Exports	1,120	689	718	1,110	1,000
Consumption:					
Reported	48,700	43,600	50,200	51,500	53,600
Apparent	54,000	45,100	53,200	55,800	53,600
Price, average value of bulk, pellets and packaged salt, dollars per ton, f.o.b. mine and plant:					
Vacuum and open pan salt	120.02	120.02	124.24	128.39	130.00
Solar salt	52.33	53.93	53.42	49.25	52.00
Rock salt	21.84	21.62	23.11	25.83	25.00
Salt in brine	6.26	5.89	7.21	7.01	7.00
Stocks, producer, yearend[e, 2]	NA	NA	NA	NA	NA
Employment, mine and plant, number	4,100	4,100	4,100	4,100	4,100
Net import reliance[3] as a percentage of apparent consumption	22	17	23	19	21

Recycling: None.

Import Sources (2001-04): Canada, 36%; Chile, 28%; Mexico, 10%; The Bahamas, 8%; and other, 18%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Iodized salt	2501.00.0000	Free.

Depletion Allowance: 10% (Domestic and foreign).

Government Stockpile: None.

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SALT

Events, Trends, and Issues: Despite the heavy devastation in Louisiana caused by Hurricane Katrina in August, the rock salt producers were undamaged. The storm, however, did affect the region's truck and barge transportation system that ships rock salt to northern markets. Combined with the high cost of fuel and delivery fees, it was uncertain what the total effect would be on the price of rock salt for the upcoming winter.

A large salt deposit with proven reserves of 14.5 billion tons was discovered in the Xinjiang Uygur Autonomous Region of northwest China. A new salt mine known as the Qiao'erhe Salt Mine was constructed in the deposit 50 kilometers southwest of Baicheng, Aksu Prefecture. Aksu ranked first in total salt reserves in China, but total production in the area was relatively low. Many industrial projects in China depend on salt as feedstock, and the discovery of this deposit may alleviate some of the supply shortages within the country. China has become the second ranked salt producer in the world.

Domestic consumption of salt in 2006 is expected to be similar to that of 2005. No supply shortage of rock salt is anticipated for the winter of 2005-06.

World Production, Reserves, and Reserve Base:

	Production		Reserves and reserve base[4]
	2004	2005[e]	
United States[1]	46,500	45,900	Large. Economic and subeconomic deposits of salt are substantial in principal salt-producing countries. The oceans contain an inexhaustible supply of salt.
Australia	11,200	10,000	
Brazil	6,500	6,100	
Canada	14,100	13,300	
Chile	6,000	5,000	
China	37,100	38,000	
Egypt	2,400	2,400.	
France	7,000	7,000	
Germany	16,000	18,700	
India	15,000	15,500	
Iran	2,000	1,600	
Italy	3,600	3,600	
Mexico	8,200	8,200	
Netherlands	5,000	5,000	
Poland	1,500	2,000	
Romania	2,450	2,550	
Russia	2,800	2,800	
Spain	3,200	3,200	
Turkey	2,250	2,200	
Ukraine	2,300	2,500	
United Kingdom	5,800	5,800	
Other countries	7,100	9,000	
World total (rounded)	208,000	210,000	

World Resources: World continental resources of salt are practically unlimited, and the salt content in the oceans is virtually inexhaustible. Domestic resources of rock salt and salt from brine are in the Northeast, Central Western, and southern Gulf Coast States. Saline lakes and solar evaporation salt facilities are near populated regions in the Western United States. Almost every country in the world has salt deposits or solar evaporation operations of various sizes.

Substitutes: There are no economic substitutes or alternates for salt. Calcium chloride and calcium magnesium acetate, hydrochloric acid, and potassium chloride can be substituted for salt in deicing, certain chemical processes, and food flavoring, but at a higher cost.

[e]Estimated. NA Not available.
[1]Excludes Puerto Rico production.
[2]Reported stock data are incomplete. For apparent consumption and net import reliance calculations, changes in annual stock totals are assumed to be the difference between salt produced and salt sold or used.
[3]Defined as imports – exports + adjustments for Government and industry stock changes.
[4]See Appendix C for definitions.

SAND AND GRAVEL (CONSTRUCTION)[1]

(Data in million metric tons unless otherwise noted)[2]

Domestic Production and Use: Construction sand and gravel valued at $7.2 billion was produced by an estimated 3,900 companies from about 6,300 operations in 50 States. Leading producing States, in order of decreasing tonnage, were California, Texas, Arizona, Michigan, Minnesota, Ohio, Wisconsin, Nevada, Washington, and Colorado, which together accounted for about 54% of the total output. It is estimated that about 53% of the 1.26 billion tons of construction sand and gravel produced in 2005 was for unspecified uses. Of the remaining total, about 45% was used as concrete aggregates; 24% for road base and coverings and road stabilization; 13% as asphaltic concrete aggregates and other bituminous mixtures; 13% as construction fill; 2% for plaster and gunite sands; 1% for concrete products, such as blocks, bricks, and pipes; and the remaining 2% for filtration, railroad ballast, roofing granules, snow and ice control, and other miscellaneous uses.

The estimated output of construction sand and gravel in the 48 conterminous States, shipped for consumption in the first 9 months of 2005, was about 941 million tons, a slight increase from the revised total for the same period of 2004. Additional production information by quarter for each State, geographic region, and the United States is published by the U.S. Geological Survey (USGS) in its quarterly Mineral Industry Surveys for Crushed Stone and Sand and Gravel.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production	1,130	1,130	1,160	1,240	1,260
Imports for consumption	4	4	4	5	5
Exports	3	3	1	1	1
Consumption, apparent	1,130	1,130	1,160	1,240	1,260
Price, average value, dollars per ton	5.02	5.07	5.16	5.33	5.70
Stocks, yearend	NA	NA	NA	NA	NA
Employment, mines, mills, and shops, number	37,500	37,100	36,500	37,000	36,900
Net import reliance[3] as a percentage of apparent consumption	([4])	([4])	([4])	([4])	([4])

Recycling: Asphalt road surface layers and cement concrete surface layers and structures were recycled on an increasing basis.

Import Sources (2001-04): Canada, 83%; Mexico, 10%; The Bahamas, 2%; and other, 5%.

Tariff: **Item**	**Number**	**Normal Trade Relations 12-31-05**
Sand, construction	2505.90.0000	Free.
Gravel, construction	2517.10.0000	Free.

Depletion Allowance: Common varieties, 5% (Domestic and foreign).

Government Stockpile: None.

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SAND AND GRAVEL (CONSTRUCTION)

Events, Trends, and Issues: Construction sand and gravel output increased to approximately 1.26 billion tons, about 1.6% more than that of 2004. It is estimated that 2006 domestic production and U.S. apparent consumption will increase slightly to about 1.28 billion tons each. Aggregate consumption is expected to continue to grow slowly in response to a growing economy and outlays for road and other construction. Most areas of the country will likely experience increased sales and consumption of sand and gravel. Crushed stone, the other major construction aggregate, has been replacing natural sand and gravel, especially in more densely populated areas of the Eastern United States.

The construction sand and gravel industry continues to be concerned with safety, health, and environmental regulations. Movement of sand and gravel operations away from densely populated centers is expected to continue where local zoning, environmental, and land development regulations discourage sand and gravel operations. Consequently, shortages of construction sand and gravel in urban and industrialized areas also are expected to increase.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves and reserve base[5]
	2004	2005[e]	
United States	1,240	1,260	The reserves and reserve base are controlled largely by land use and/or environmental concerns.
Other countries[6]	NA	NA	
World total	NA	NA	

World Resources: Sand and gravel resources of the world are large. However, because of their geographic distribution, environmental restrictions, and quality requirements for some uses, sand and gravel extraction is uneconomic in some cases. The most important commercial sources of sand and gravel have been river flood plains, river channels, and glacial deposits. Use of offshore deposits in the United States is mostly restricted to beach erosion control and replenishment. Other countries routinely mine offshore deposits of aggregates for onshore construction projects.

Substitutes: Crushed stone remains the predominant choice for construction aggregate use. Increasingly, recycled asphalt and portland cement concretes are being substituted for virgin aggregate although the percentage of total aggregate supplied by recycled materials remained very small in 2005.

[e]Estimated. NA Not available.
[1]See also Sand and Gravel (Industrial).
[2]See Appendix A for conversion to short tons.
[3]Defined as imports – exports + adjustments for Government and industry stock changes; changes in stocks are not available and assumed to be zero.
[4]Less than ½ unit.
[5]See Appendix C for definitions.
[6]No reliable production information for other countries is available owing to the wide variation of ways in which countries report their sand and gravel production. Some countries do not report production for this mineral commodity. Production information for some countries is available in the country chapters of the USGS Minerals Yearbook.

SAND AND GRAVEL (INDUSTRIAL)

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: Industrial sand and gravel valued at about $700 million was produced by 69 companies from 153 operations in 35 States. Leading States, in order of tonnage, were Illinois, Texas, Wisconsin, New Jersey, California, Michigan, North Carolina, and Oklahoma. Combined production from these States represented 61% of the domestic total. About 35% of the U.S. tonnage was used as glassmaking sand, 19% as foundry sand, 12% as hydraulic fracturing sand, 10% as building products, 3% as abrasive sand, and 21% was for other uses.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production	27,900	27,300	27,500	29,700	31,300
Imports for consumption	172	250	440	490	717
Exports	1,540	1,410	2,620	1,790	2,460
Consumption, apparent	26,500	26,100	25,300	28,400	29,600
Price, average value, dollars per ton	20.64	20.98	22.14	23.06	22.50
Stocks, yearend	NA	NA	NA	NA	NA
Employment, quarry and mill, number[e]	1,400	1,400	1,400	1,400	1,400
Net import reliance[1] as a percentage of apparent consumption	E	E	E	E	E

Recycling: There is some recycling of foundry sand, and recycled cullet (pieces of glass) represents a significant proportion of reused silica.

Import Sources (2001-04): Mexico, 59%; Canada, 35%; and other, 6%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
95% or more silica and not more than 0.6% iron oxide	2505.10.1000	Free.

Depletion Allowance: Industrial sand or pebbles, 14% (Domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: Domestic sales of industrial sand and gravel in 2005 increased by about 3% compared with those of 2004, owing to a robust construction sector of the U.S. economy. U.S. apparent consumption was 29.6 million tons in 2005, a 4% increase from than the previous year. Imports of industrial sand and gravel in 2005 increased by about 46% compared with those of 2004. Mexico's share of imports increased, and Canada's share decreased. Imports of silica are generally of two types: small shipments of very high-purity silica or a few large shipments of lower grade silica shipped only under special circumstances (for example, very low freight rates). Exports of industrial sand and gravel in 2005 increased by about 37% compared with those of 2004.

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SAND AND GRAVEL (INDUSTRIAL)

The United States was the world's leading producer and consumer of industrial sand and gravel based on estimated world production figures. It was difficult to collect definitive numbers on silica sand and gravel production in most nations because of the wide range of terminology and specifications from country to country. The United States remained a major exporter of silica sand and gravel, shipping it to almost every region of the world. This was attributed to the high quality and advanced processing techniques for a large variety of grades of silica sand and gravel, meeting virtually every specification.

The industrial sand and gravel industry continued to be concerned with safety and health regulations and environmental restrictions in 2005. Local shortages were expected to continue to increase owing to local zoning regulations and land development alternatives. These situations are expected to cause future sand and gravel operations to be located farther from high-population centers.

World Mine Production, Reserves, and Reserve Base:

	Mine production[e] 2004	Mine production[e] 2005	Reserves and reserve base[2]
United States	29,700	31,300	
Australia	4,500	4,500	Large. Industrial sand and gravel deposits are widespread. Calculation of the reserves and reserve base is determined mainly by the location of population centers.
Austria	6,800	6,800	
Belgium	1,800	1,800	
Brazil	1,600	1,600	
Canada	1,600	1,600	
France	6,500	6,500	
Gambia	1,500	1,500	
Germany	7,500	7,500	
India	1,500	1,500	
Iran	1,700	1,700	
Italy	3,000	3,000	
Japan	4,500	4,500	
Mexico	2,000	2,000	
Norway	1,500	1,500	
Poland	1,500	1,500	
Romania	1,100	1,100	
Slovakia	2,200	2,200	
Slovenia	11,000	11,000	
South Africa	2,400	2,400	
Spain	6,500	6,500	
Thailand	1,300	1,300	
Turkey	1,300	1,300	
United Kingdom	4,500	4,500	
Other countries	7,900	7,900	
World total (rounded)	115,000	117,000	

World Resources: Sand and gravel resources of the world are large. However, because of their geographic distribution, environmental restrictions, and quality requirements for some uses, extraction of these resources is sometimes uneconomic. Quartz-rich sand and sandstones, the main sources of industrial silica sand, occur throughout the world.

Substitutes: Alternative materials that can be used for glassmaking and for foundry and molding sands are chromite, olivine, staurolite, and zircon sands.

[e]Estimated. E Net exporter. NA Not available.
[1]Defined as imports – exports + adjustments for Government and industry stock changes.
[2]See Appendix C for definitions.

SCANDIUM[1]

(Data in kilograms of scandium oxide content unless otherwise noted)

Domestic Production and Use: Demand for scandium increased slightly in 2005. Although scandium was not mined domestically in 2005, quantities sufficient to meet demand were available in domestic tailings. Principal sources were imports from China, Russia, and Ukraine. Domestic companies with scandium-processing capabilities were located in Mead, CO; Urbana, IL; and Knoxville, TN. Capacity to produce ingot and distilled scandium metal was located in Phoenix, AZ; Urbana, IL; and Ames, IA. Scandium used in the United States was essentially derived from foreign sources. Principal uses for scandium in 2005 were aluminum alloys for sporting equipment (baseball and softball bats, bicycle frames, golf clubs, gun frames, lacrosse shafts, and tent poles), metallurgical research, high-intensity metal halide lamps, analytical standards, electronics, oil well tracers, and lasers.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Price, yearend, dollars:					
Per kilogram, oxide, 99.0% purity	700	700	500	500	500
Per kilogram, oxide, 99.9% purity	2,300	2,000	1,300	1,300	1,300
Per kilogram, oxide, 99.99% purity	2,700	2,500	2,500	2,500	2,500
Per kilogram, oxide, 99.999% purity	4,100	3,200	3,200	3,200	3,000
Per gram, dendritic, metal[2]	279.00	178.00	185.00	193.60	162.50
Per gram, metal, ingot[3]	198.00	198.00	119.00	124.00	131.00
Per gram, scandium bromide, 99.99% purity[4]	94.60	94.60	98.40	NA	NA
Per gram, scandium chloride, 99.9% purity[4]	40.80	40.80	42.40	44.30	48.70
Per gram, scandium fluoride, 99.9% purity[4]	173.00	173.00	180.00	188.20	193.80
Per gram, scandium iodide, 99.999% purity[4]	156.00	156.00	162.00	169.00	174.00
Net import reliance[5] as a percentage of apparent consumption	100	100	100	100	100

Recycling: None.

Import Sources (2001-04): Not available.

Tariff: **Item**	**Number**	**Normal Trade Relations 12-31-05**
Mineral substances not elsewhere specified or included:		
Including scandium ores	2530.90.8050	Free.
Rare-earth metals, scandium and yttrium, whether or not intermixed or interalloyed including scandium	2805.30.0000	5.0% ad val.
Mixtures of rare-earth oxides except cerium oxide, including scandium oxide mixtures	2846.90.2010	Free.
Rare-earth compounds, including individual rare-earth oxides, hydroxides, nitrates, and other individual compounds, including scandium oxide	2846.90.8000	3.7% ad val.
Aluminum alloys, other:		
Including scandium-aluminum	7601.20.9090	Free.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: Nominal prices for domestically produced scandium compounds decreased from the previous year. The supply of domestic and foreign scandium remained strong despite increased demand. Although demand increased in 2005, the total market remained very small. Domestic increases in demand were primarily from recently developed applications in welding wire, scandium-aluminum baseball and softball bats, scandium-aluminum bicycle frames, and high-strength, lightweight handgun frames and cylinders. New demand is expected to come from future fuel-cell markets and aerospace applications.

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SCANDIUM

Scandium's use continued to increase in metal halide lighting. Scandium, as the metal or the iodide, mixed with other elements, was added to halide light bulbs to adjust the color to simulate natural sunlight. Demand also continued to increase for scandium-aluminum alloys in sports equipment. Future development of alloys for aerospace and specialty markets is expected. Scandium's availability from Kazakhstan, Russia, and Ukraine increased substantially in 1992, after export controls were relaxed, and sales continue to provide the Western World with most of its scandium alloys, compounds, and metal. China also continued to supply scandium compounds and metal to the U.S. market.

World Mine Production, Reserves, and Reserve Base:[6] Scandium was produced as a byproduct material in China, Kazakhstan, Russia, and Ukraine. Foreign mine production data were not available. No scandium was mined in the United States in 2005. Scandium occurs in many ores in trace amounts, but has not been found in sufficient quantities to be considered as a reserve or reserve base. As a result of its low concentration, scandium has been produced exclusively as a byproduct during processing of various ores or recovered from previously processed tailings or residues.

World Resources: Resources of scandium are abundant, especially when considered in relation to actual and potential demand. Scandium is rarely concentrated in nature due to its lack of affinity to combine with the common ore-forming anions. It is widely dispersed in the lithosphere and forms solid solutions in more than 100 minerals. In the Earth's crust, scandium is primarily a trace constituent of ferromagnesium minerals. Concentrations in these minerals (amphibole-hornblende, biotite, and pyroxene) typically range from 5 to 100 parts per million equivalent Sc_2O_3. Ferromagnesium minerals commonly occur in the igneous rocks, basalt and gabbro. Enrichment of scandium also occurs in aluminum phosphate minerals, beryl, cassiterite, columbite, garnet, muscovite, rare-earth minerals, and wolframite. Recent domestic production has primarily been from the scandium-yttrium silicate mineral, thortveitite, and from byproduct leach solutions from uranium operations. One of the principal domestic scandium resources is the fluorite tailings from the mined-out Crystal Mountain deposit near Darby, MT. Tailings from the mined-out fluorite operations, which were generated from 1952 to 1971, contain thortveitite and associated scandium-enriched minerals. Resources also are contained in the tantalum residues previously processed at Muskogee, OK. Smaller resources are associated with molybdenum, titanium-tungsten, and tungsten minerals from the Climax molybdenum deposit in Colorado and in crandallite, kolbeckite, and varisite at Fairfield, UT. Other lower grade domestic resources are present in ores of aluminum, cobalt, iron, molybdenum, nickel, phosphate, tantalum, tin, titanium, tungsten, zinc, and zirconium. Process residues from tungsten operations in the United States also contain significant amounts of scandium.

Foreign resources are known in Australia, China, Kazakhstan, Madagascar, Norway, Russia, and Ukraine. Resources in Australia are contained in nickel and cobalt deposits in Syerston and Lake Innes, New South Wales. China's resources are in iron, tin, and tungsten deposits in Fujian, Guangdong, Guangxi, Jiangxi, and Zhejian Provinces. Resources in Russia and Kazakhstan are in the Kola Peninsula apatites and in uranium-bearing deposits, respectively. Scandium in Madagascar is contained in pegmatites in the Befanomo area. Resources in Norway are dispersed in the thortveitite-rich pegmatites of the Iveland-Evje Region and a deposit in the northern area of Finnmark. In Ukraine, scandium is recovered as a byproduct of iron ore processing at Zheltye Voda. An occurrence of the mineral thortveitite is reported from Kobe, Japan. Undiscovered scandium resources are thought to be very large.

Substitutes: In applications, such as lighting and lasers, scandium is generally not subject to substitution. In metallurgical applications, titanium and aluminum high-strength alloys and carbon fiber may substitute in sporting goods, especially bicycle frames.

[e]Estimated. NA Not available.
[1]See also Rare Earths.
[2]Scandium pieces, 99.9% purity, distilled dendritic, 2001-05 prices converted from 0.5-gram price, from Alfa Aesar, a Johnson Matthey company.
[3]Metal ingot pieces 99.9% purity 2001-05, from Alfa Aesar, a Johnson Matthey company.
[4]Bromide, chloride, and fluoride in crystalline or crystalline aggregate form and scandium iodide as ultradry powder from Alfa Aesar, a Johnson Matthey company.
[5]Defined as imports – exports + adjustments for Government and industry stock changes.
[6]See Appendix C for definitions.

SELENIUM

(Data in metric tons of selenium content unless otherwise noted)

Domestic Production and Use: Primary selenium was recovered from anode slimes generated in the electrolytic refining of copper. One copper refinery in Texas reported domestic production of primary selenium. One producer exported semirefined selenium for toll-refining in Asia, and two other companies generated selenium-containing slimes, which were exported for processing.

The estimated consumption of selenium by end use was as follows: glass manufacturing, 40%; chemicals and pigments, 20%; electronics, 10%; and other, including agriculture and metallurgy, 30%. In glass manufacturing, selenium is used to decolorize the green tint caused by iron impurities in glass containers and other soda-lime silica glass and is used in architectural plate glass to reduce solar heat transmission. Cadmium sulfoselenide pigments are used in plastics, ceramics, art glass, and other glasses, such as that used in traffic lights to produce a ruby-red color. Selenium is used in catalysts to enhance selective oxidation; in plating solutions, where it improves appearance and durability; in blasting caps and gun bluing; in rubber compounding chemicals; in the electrolytic production of manganese to increase yields; and in brass alloys to improve machinability.

Selenium is used as a human dietary supplement and in antidandruff shampoos. The leading agricultural uses are as a dietary supplement for livestock and as a fertilizer additive to enrich selenium-poor soils. It is used as a metallurgical additive to improve machinability of copper, lead, and steel alloys. Its primary electronic use is as a photoreceptor on the replacement drums for older plain paper photocopiers, which are gradually being replaced by newer models that do not use selenium in the reproduction process. A new use for selenium is in amorphous selenium (aSe) detector technology. The aSe detector enables the direct conversion of X-ray to digital information.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production, refinery	W	W	W	W	W
Imports for consumption, metal and dioxide	483	422	367	412	440
Exports, metal, waste and scrap	41	87	249	160	315
Consumption, apparent	W	W	W	W	W
Price, dealers, average, dollars per pound, 100-pound lots, refined	3.80	4.27	5.68	24.86	52.00
Stocks, producer, refined, yearend	W	W	W	W	W
Employment, number	NA	NA	NA	NA	NA
Net import reliance[1] as a percentage of apparent consumption	W	W	W	W	W

Recycling: The amount of domestic production of secondary selenium was unknown. Scrap xerographic materials were exported for recovery of the contained selenium. As electronic recycling continues to increase, a small amount of selenium may become available from other electronics.

Import Sources (2001-04): Canada, 43%; Belgium, 19%; Philippines, 19%; Germany, 6%; and other, 13%.

Tariff: **Item**	**Number**	**Normal Trade Relations 12-31-05**
Selenium metal	2804.90.0000	Free.
Selenium dioxide	2811.29.2000	Free.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: The supply of selenium is directly affected by the supply of the materials from which it is a byproduct—copper, and to a lesser extent, nickel and cobalt. Continued concern about the adequacy of the selenium supply caused the price of selenium to rise to $53 per pound by the end of the first quarter 2005, where it remained through the end of the third quarter.

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SELENIUM

Estimated domestic selenium production decreased in 2005 as compared with that of 2004 owing to a labor strike at the major domestic producer that began in July and continued at least until October, when the producer announced that it had filed for bankruptcy protection. The future of U.S. production is therefore uncertain. Despite the declining domestic production, selenium exports rose to the highest level since 1996. It was believed that domestic exports shipped to Australia, Hong Kong, the Philippines, and other Southeast Asian countries were further processed and reexported to China. It was estimated that more than 50% of domestic exports of selenium eventually were consumed in China.

China continued to use selenium as a fertilizer supplement, as an ingredient in glassmaking, and as a substitute for sulfur dioxide in the form of selenium dioxide in the manganese smelting process. It has been estimated that China's consumption of selenium increased in 2004 and in the first quarter of 2005. In the early part of 2005, however, consumption of selenium used by the electrolytic manganese metal producers dropped drastically as many of the manganese refineries were closed by the Chinese Government because of enforcement of new environmental practices. Other manganese refineries closed owing to higher selenium and electricity costs.

Domestic use of selenium in glass remained unchanged, while use in copiers continued to decline. The use of selenium as a substitute for lead in free-machining brasses continued to increase as more stringent regulations on the use of lead were implemented. Selenium's higher cost, however, has limited its use in many of its applications. The use of selenium in fertilizers and supplements in the plant-animal-human food chain and as human vitamin supplements increased as its health benefits were documented. Although small amounts of selenium are considered beneficial, it can be hazardous in larger quantities.

World Refinery Production, Reserves, and Reserve Base:

	Refinery production		Reserves[2]	Reserve base[2]
	2004	2005[e]		
United States	W	W	10,000	19,000
Belgium	200	200	—	—
Canada	250	250	6,000	10,000
Chile	40	84	16,000	37,000
Finland	40	40	—	—
Germany	100	14	—	—
India	12	12	—	—
Japan	600	650	—	—
Peru	21	26	5,000	8,000
Philippines	40	40	2,000	3,000
Serbia and Montenegro	10	9	1,000	2,000
Sweden	20	20	—	—
Other countries[3]	NA	NA	42,000	90,000
World total (rounded)	[4]1,330	[4]1,350	82,000	170,000

World Resources: The reserve base for selenium is based on identified economic copper deposits. An additional 2.5 times this reserve base is estimated to exist in copper and other metal deposits that have not yet been discovered. Coal generally contains between 0.5 and 12 parts per million of selenium, or about 80 to 90 times the average for copper deposits. The recovery of selenium from coal, although technically feasible, does not appear likely in the foreseeable future.

Substitutes: High-purity silicon has replaced selenium in high-voltage rectifiers. Silicon is also the major substitute for selenium in low- and medium-voltage rectifiers and solar photovoltaic cells. Amorphous silicon and organic photoreceptors are substitutes in plain paper photocopiers. Organic pigments have been developed as substitutes for cadmium sulfoselenide pigments. Other substitutes include cerium oxide as either a colorant or decolorant in glass; tellurium in pigments and rubber; bismuth, lead, and tellurium in free-machining alloys; and bismuth and tellurium in lead-free brasses.

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data. — Zero.

[1]Defined as imports – exports + adjustments for Government and industry stock changes.

[2]See Appendix C for definitions.

[3]In addition to the countries listed, Australia, China, Kazakhstan, Russia, and the United Kingdom are known to produce refined selenium, but output is not reported, and information is inadequate for formulation of reliable production estimates.

[4]Excludes U.S. production.

SILICON

(Data in thousand metric tons of silicon content unless otherwise noted)

Domestic Production and Use: Estimated value of silicon metal and alloys (excluding semiconductor-grade silicon) produced in the United States in 2005 was about $412 million. Five companies produced silicon materials in six plants. Of those companies, four produced ferrosilicon in four plants. Silicon metal was produced by three companies in four plants. Two of the five companies in the industry produced both products at two plants. All of the active ferrosilicon and silicon metal plants were east of the Mississippi River. Most ferrosilicon was consumed in the ferrous foundry and steel industries, predominantly in the eastern half of the United States. The main consumers of silicon metal were producers of aluminum and aluminum alloys and the chemical industry. The semiconductor industry, which manufactures chips for computers from high-purity silicon, accounted for only a few percent of silicon demand.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production	282	261	253	275	276
Imports for consumption	231	285	315	338	330
Exports	23	22	26	24	23
Consumption, apparent	502	540	544	595	577
Price,[1] average, cents per pound Si:					
Ferrosilicon, 50% Si	42.8	41.1	47.7	58.2	56
Ferrosilicon, 75% Si	31.9	32.8	45.3	55.4	48
Silicon metal	50.5	53.2	61.3	81.9	77
Stocks, producer, yearend	40	25	22	16	22
Net import reliance[2] as a percentage of apparent consumption	44	52	54	54	52

Recycling: Insignificant.

Import Sources (2001-04): Brazil, 16%; South Africa, 14%; Canada, 11%; Venezuela, 10%; and other, 49%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Ferrosilicon, 55%-80% Si:		
More than 3% Ca	7202.21.1000	1.1% ad val.
Other	7202.21.5000	1.5% ad val.
Ferrosilicon, 80%-90% Si	7202.21.7500	1.9% ad val.
Ferrosilicon, more than 90% Si	7202.21.9000	5.8% ad val.
Ferrosilicon, other:		
More than 2% Mg	7202.29.0010	Free.
Other	7202.29.0050	Free.
Silicon, more than 99.99% Si	2804.61.0000	Free.
Silicon, 99.00%-99.99% Si	2804.69.1000	5.3% ad val.
Silicon, other	2804.69.5000	5.5% ad val.

Depletion Allowance: Quartzite, 15% (Domestic and foreign); gravel, 5% (Domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: Domestic apparent consumption of silicon materials in 2005 was projected to be slightly less than that of 2004. Ferrosilicon accounted for 52% of the apparent consumption, up from 51% in 2004. The annual growth rate for ferrosilicon demand usually falls in the range of 1% to 2%, in line with long-term trends in steel production, but through the first 9 months of 2005, domestic steel production was 6% lower than that for the same period in 2004. Domestic shipments of silicon metal through the first 8 months in 2005 were about 1% higher than those of the same period in 2004. Demand for silicon metal comes primarily from the aluminum and chemical industries. In the first 9 months of 2005, the consumption increase in domestic specialty chemicals, which include silicones, was about 5.3% compared with that during the same period in 2004. Domestic primary aluminum production was projected to remain flat in 2005, as was secondary aluminum production. Global primary aluminum production in 2005 was projected to be 5% higher than that of 2004.

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SILICON

Domestic production in 2005, expressed in terms of contained silicon, was expected to increase slightly. Production in 2004 and 2005 was about 11% greater than that in 2003. Companies adjusted their product mix at some plants to meet changes in demand.

Through the first 9 months of 2005, prices trended downward in the U.S. market for silicon materials. Compared with those at the beginning of the year, weekly average prices as of the end of September were lower for 50% ferrosilicon (9%), 75% ferrosilicon (10%), and silicon metal (4%). Year-average prices were projected to be lower for 50% ferrosilicon, 75% ferrosilicon, and silicon metal than those for 2004. At the end of September, the range in dealer import price, in cents per pound of contained silicon, was 47 to 49 for 50% ferrosilicon, 42 to 44 for 75% ferrosilicon, and 70 to 72 for silicon metal.

U.S. imports and exports of silicon materials in 2005, projected on the basis of data for the first 7 months of the year, were 3% and 4% less, respectively, than those in 2004. These trends were attributable primarily to decreases in silicon metal imports and exports. Decreases in silicon metal imports also led to a reduction in net import reliance as a percentage of apparent consumption compared with that of 2004.

World Production, Reserves, and Reserve Base:

	Production[e, 3]		Reserves and reserve base[4]
	2004	**2005**	
United States	275	276	The reserves and reserve base in most major producing countries are ample in relation to demand. Quantitative estimates are not available.
Brazil	225	230	
Canada	66	66	
China	2,490	2,700	
France	139	140	
Iceland	78	78	
India	36	36	
Kazakhstan	67	68	
Norway	298	280	
Russia	513	520	
South Africa	149	140	
Spain	55	55	
Ukraine	161	160	
Venezuela	60	62	
Other countries	255	270	
World total (rounded)	4,900	5,100	

Poland (ferrosilicon and silicon metal) and Slovakia (ferrosilicon) production is now included in “other countries.” Ferrosilicon accounts for about four-fifths of world production (gross-weight basis). The leading countries for ferrosilicon production, in descending order of production, were China, Russia, Norway, Ukraine, and the United States, and for silicon metal, China, the United States, Brazil, and Norway. China was by far the leading producer of both ferrosilicon and silicon metal. An estimated 550,000 tons of silicon metal is included in China’s production of silicon materials for 2005.

World Resources: World and domestic resources for making silicon metal and alloys are abundant, and, in most producing countries, adequate to supply world requirements for many decades. The source of the silicon is silica in various natural forms, such as quartzite.

Substitutes: Aluminum, silicon carbide, and silicomanganese can be substituted for ferrosilicon in some applications. Gallium arsenide and germanium are the principal substitutes for silicon in semiconductor and infrared applications.

[e]Estimated.
[1]Based on U.S. dealer import price.
[2]Defined as imports – exports + adjustments for Government and industry stock changes.
[3]Production quantities are combined totals of estimated silicon content for ferrosilicon and silicon metal, as applicable.
[4]See Appendix C for definitions.

SILVER

(Data in metric tons[1] of silver content unless otherwise noted)

Domestic Production and Use: In 2005, mines in the United States produced approximately 1,300 tons of silver with an estimated value of $295 million. Alaska was the country's leading silver-producing State; however, production data were withheld to protect company proprietary data. Approximately 99% of domestic silver was produced as a byproduct from base-metal ores at 12 mines and from precious-metal ores at 13 mines. Placer mines accounted for 1% or less of total silver production. There were 21 principal refiners of commercial-grade silver, with an estimated total output of 3,000 tons from domestic and foreign ores and concentrates and from old and new scrap. Silver's properties include relatively high ductility, electrical conductivity, malleability, and reflectivity. Silver is mainly used in industrial applications, photography, jewelry and silverware, and coins. Silver is also used for batteries, bearings, brazing and soldering, catalysts, dental amalgam, electronics, electroplating, medical and wound care, mirrors, solar energy, and water purification.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production:					
Mine	1,740	1,350	1,240	1,250	1,300
Refinery:					
Primary	2,640	2,580	2,580	1,140	1,080
Secondary	1,060	1,030	1,010	1,920	2,000
Imports for consumption[2]	3,340	4,300	4,510	4,100	4,530
Exports[2]	783	680	181	422	390
Consumption, apparent[e]	5,460	5,980	6,440	6,700	7,720
Price, dollars per troy ounce[3]	4.39	4.62	4.91	6.69	7.15
Stocks, yearend:					
Treasury Department[4]	220	220	220	220	220
COMEX, CBT[5]	3,250	3,290	3,430	3,580	3,300
National Defense Stockpile	21	—	—	—	—
Employment, mine and mill,[6] number	1,120	910	840	900	860
Net import reliance[7] as a percentage of apparent consumption[e]	49	60	65	53	57

Recycling: Approximately 2,000 tons of silver was recovered from old and new scrap in 2005.

Import Sources (2001-04):[2] Mexico, 48%; Canada, 37%; Peru, 9%; Chile, 2%; and other, 4%.

Tariff: No duties are imposed on imports of unrefined silver or refined bullion.

Depletion Allowance: 15% (Domestic), 14% (Foreign).

Government Stockpile: All of the remaining silver in the National Defense Stockpile was transferred to the U.S. Mint by the Defense Logistics Agency for use in the manufacture of numismatic and bullion coins in 2004. This transfer marked the end of silver requirements for the National Defense Stockpile.

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SILVER

Events, Trends, and Issues: In 2005, silver prices continued to rise and averaged $7.15 per troy ounce, which surpassed 2004's 17-year high of $6.69 and 1987's high of $6.99. Prices rose to above $8.00 per troy ounce in November. The 2005 average price of $7.15 per troy ounce was in response to investment and fabrication demand, especially in the jewelry and silverware market. Silver use in photography fell again in 2005 mainly owing to the growth of digital photography in the amateur market. Competition from the growing digital camera market combined with weak sales of film caused the overall demand to be lower. Declines were also seen in silver-containing color negative paper, consumer film, and health and commercial photography. The antibacterial use of silver in trace amounts in wound care is increasing. Silver ions embedded in clothing help regulate body heat and odor. Silver is also being used in manufactured products such as washing machines that release silver to sterilize clothing. The deficit between world silver fabrication demand and world silver supply (mine production and scrap) remained large in 2005 at about 1,700 tons.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[8]	Reserve base[8]
	2004	2005[e]		
United States	1,250	1,300	25,000	80,000
Australia	2,240	2,250	31,000	37,000
Canada	1,340	1,330	16,000	35,000
Chile	1,360	1,400	NA	NA
China	2,450	2,800	26,000	120,000
Mexico	2,700	2,700	37,000	40,000
Peru	3,060	3,060	36,000	37,000
Poland	1,250	1,300	51,000	140,000
South Africa	72	80	NA	NA
Other countries	3,960	4,100	50,000	80,000
World total (rounded)	19,700	20,300	270,000	570,000

World Resources: More than two-thirds of U.S. and world resources of silver are in deposits from which silver is obtained as a byproduct from copper, lead, and zinc processing. The remaining silver reserves are associated with veins in which gold is the primary commodity. Most recent silver discoveries have been associated with gold deposits, and major base-metal discoveries that contain byproduct silver will account for a significant share of reserves and resources in the future.

Substitutes: Silver used in mirrors and other reflecting surfaces may be replaced by aluminum and rhodium. Tantalum may be used in place of silver for surgical plates and pins. Stainless steel may be substituted for silver in tableware. Nonsilver batteries being developed may replace silver batteries in some applications. Digital imaging, film with reduced silver content, silverless black and white film, and xerography are alternatives to some uses of silver in photography.

[e]Estimated. NA Not available. — Zero.
[1]One metric ton (1,000 kilograms) = 32,150.7 troy ounces.
[2]Refined bullion, doré, and other unwrought silver; excludes coinage, waste, and scrap material.
[3]Handy & Harman quotations.
[4]Balance in U.S. Mint only.
[5]COMEX: Commodity Exchange Inc., New York. CBT: Chicago Board of Trade.
[6]Source: U.S. Department of Labor, Mine Safety and Health Administration.
[7]Defined as imports – exports + adjustments for Government and industry stock changes.
[8]Includes silver recoverable from base-metal ores. See Appendix C for definitions.

SODA ASH

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: The total value of domestic soda ash (sodium carbonate) produced in 2005 was estimated to be about $905 million.[1] The U.S. soda ash industry comprised four companies in Wyoming operating five plants, one company in California with one plant, and one company with one mothballed plant in Colorado that owns one of the Wyoming plants. The five producers have a combined annual nameplate capacity of 14.5 million tons. Salt, sodium sulfate, and borax were produced as coproducts of sodium carbonate production in California. Sodium bicarbonate, sodium sulfite, and chemical caustic soda were manufactured as coproducts at several of the Wyoming soda ash plants. Sodium bicarbonate was produced at the Colorado operation using soda ash feedstock shipped from the company's Wyoming facility.

Based on final 2004 reported data, the estimated 2005 distribution of soda ash by end use was glass, 50%; chemicals, 26%; soap and detergents, 11%; distributors, 5%; miscellaneous uses, 4%; flue gas desulfurization, 2%; and pulp and paper and water treatment, 1% each.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production[2]	10,300	10,500	10,600	11,000	11,100
Imports for consumption	33	9	5	6	8
Exports	4,090	4,250	4,450	4,670	4,600
Consumption:					
Reported	6,380	6,430	6,270	6,260	6,500
Apparent	6,310	6,250	6,090	6,290	6,500
Price:					
Quoted, yearend, soda ash, dense, bulk,					
f.o.b. Green River, WY, dollars per short ton	105.00	105.00	105.00	105.00	155.00
f.o.b. Searles Valley, CA, same basis	130.00	130.00	130.00	130.00	180.00
Average sales value (natural source),					
f.o.b. mine or plant, same basis	67.79	68.00	65.21	63.75	74.00
Stocks, producer, yearend	226	222	330	338	300
Employment, mine and plant, number	2,700	2,600	2,600	2,600	2,500
Net import reliance[3] as a percentage of apparent consumption	E	E	E	E	E

Recycling: There is no recycling of soda ash by producers; however, glass container producers are using cullet glass, thereby reducing soda ash consumption.

Import Sources (2001-04): Canada, 99%; and other, 1%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Disodium carbonate	2836.20.0000	1.2% ad val.

Depletion Allowance: Natural, 14% (Domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: The soda ash plant in Granger, WY, that was mothballed several years ago was brought back onstream in June at a reduced annual nameplate capacity of 200,000 short tons. The decision to reactivate some of the original 1.3 million short tons of capacity was made because of the forecast increase in domestic consumption, particularly in glass for automotive and building construction, and the growth in the export market beginning in 2005.

China continued to be the world's leader in soda ash production. A major glass company in China postponed its decision to construct a large flat glass manufacturing facility because of difficulties in obtaining bank loans as lending institutions review requests for major expenditures. New soda ash manufacturing plants, however, secured financing for new plant construction such as the facility in Dalingha City, Qinghai Province, that will have an annual capacity of 1.8 million tons. Investing in new soda ash projects appears to be favorable at this time because of an upturn in soda ash prices beginning in early 2005.

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SODA ASH

Increased soda ash sales in the domestic and export markets in 2004 continued into 2005 resulting in several soda ash price increase announcements. From May 2004 to September 2005, there was a cumulative off-list price increase of $60. As in past years, it was unclear by yearend how much of this was actually realized by the soda ash industry.

Notwithstanding economic and energy problems in certain areas of the world, overall global demand for soda ash is expected to grow from 1.5% to 2% annually. Domestic demand may be slightly higher in 2006.

World Production, Reserves, and Reserve Base:

	Production		Reserves[4, 5]	Reserve base[5]
Natural:	2004	2005[e]		
United States	11,000	11,100	[6]23,000,000	[6]39,000,000
Botswana	300	290	400,000	NA
Kenya	353	360	7,000	NA
Mexico	—	—	200,000	450,000
Turkey	—	—	200,000	240,000
Uganda	NA	NA	20,000	NA
Other countries	—	—	260,000	220,000
World total, natural (rounded)	11,700	11,800	24,000,000	40,000,000
World total, synthetic (rounded)	28,600	30,200	XX	XX
World total (rounded)	40,300	42,000	XX	XX

World Resources: Soda ash is obtained from trona and sodium carbonate-rich brines. The world's largest deposit of trona is in the Green River Basin of Wyoming. About 47 billion tons of identified soda ash resources could be recovered from the 56 billion tons of bedded trona and the 47 billion tons of interbedded or intermixed trona and halite that are in beds more than 1.2 meters thick. About 34 billion tons of reserve base soda ash could be obtained from the 36 billion tons of halite-free trona and the 25 billion tons of interbedded or intermixed trona and halite that are in beds more than 1.8 meters thick. Underground room-and-pillar mining, using conventional and continuous mining, is the primary method of mining Wyoming trona ore. The method has an average 45% mining recovery, whereas average recovery from solution mining is 30%. Improved solution-mining techniques, such as horizontal drilling to establish communication between well pairs, could increase this extraction rate and entice companies to develop some of the deeper trona beds. Wyoming trona resources are being depleted at the rate of about 15 million tons per year (8.3 million tons of soda ash). Searles Lake and Owens Lake in California contain an estimated 815 million tons of soda ash reserves. There are at least 62 identified natural sodium carbonate deposits in the world, some of which have been quantified. Although soda ash can be manufactured from salt and limestone, both of which are practically inexhaustible, synthetic soda ash is more costly to produce and generates environmentally deleterious wastes.

Substitutes: Caustic soda can be substituted for soda ash in certain uses, particularly in the pulp and paper, water treatment, and certain chemical sectors. Soda ash, soda liquors, or trona can be used as feedstock to manufacture chemical caustic soda, which is an alternative to electrolytic caustic soda.

[e]Estimated. E Net exporter. NA Not available. XX Not applicable. — Zero.
[1]Does not include values for soda liquors and mine waters.
[2]Natural only.
[3]Defined as imports – exports + adjustments for Government and industry stock changes.
[4]The reported quantities are sodium carbonate only. About 1.8 tons of trona yields 1 ton of sodium carbonate.
[5]See Appendix C for definitions.
[6]From trona, nahcolite, and dawsonite sources.

SODIUM SULFATE

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: The domestic natural sodium sulfate industry consisted of two producers operating two plants, one each in California and Texas. Fourteen companies operating 17 plants in 14 States recovered byproduct sodium sulfate from various manufacturing processes or products, including ascorbic acid, battery reclamation, cellulose, rayon, and silica pigments. About one-half of the total output in 2005 was a byproduct of these plants. The total value of natural and synthetic sodium sulfate sold was an estimated $65 million. Estimates of U.S. sodium sulfate consumption by end use were soap and detergents, 46%; pulp and paper, 13%; textiles, 12%; glass, 11%; carpet fresheners, 7%; and miscellaneous, 11%.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production, total (natural and synthetic)[1]	512	500	466	467	480
Imports for consumption	34	51	45	49	45
Exports	191	139	154	138	140
Consumption, apparent (natural and synthetic)	355	412	357	378	385
Price, quoted, sodium sulfate (100% Na_2SO_4), bulk, f.o.b. works, East, dollars per short ton	114.00	114.00	114.00	134.00	134.00
Employment, well and plant, number[e]	225	225	225	225	225
Net import reliance[2] as a percentage of apparent consumption	E	E	E	E	E

Recycling: There was some recycling of sodium sulfate by consumers, particularly in the pulp and paper industry, but no recycling by sodium sulfate producers.

Import Sources (2001-04): Canada, 90%; Mexico, 6%; and other, 4%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Disodium sulfate:		
Saltcake (crude)	2833.11.1000	Free.
Other:	2833.11.5000	0.4% ad val.
Anhydrous	2833.11.5010	0.4% ad val.
Other	2833.11.5050	0.4% ad val.

Depletion Allowance: Natural, 14% (Domestic and foreign); synthetic, none.

Government Stockpile: None.

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SODIUM SULFATE

Events, Trends, and Issues: A major chemical company in China and in Indonesia completed construction of a natural sodium sulfate plant in Xishunhe, Hongze County, in Jiangsu Province. The facility's annual capacity was 200,000 tons of anhydrous sodium sulfate. Combined with an existing facility that is a joint venture between a Chinese and Spanish natural sodium sulfate producer, the total annual production capacity in Hongze County was 800,000 tons, establishing that region as the world's leading sodium sulfate location.

The powdered detergent market is the main use of sodium sulfate in the world. Sodium sulfate is a low-cost, inert, white filler in home laundry detergents. Although powdered home laundry detergents may contain as much as 50% sodium sulfate in their formulation, the market for liquid detergents, which do not contain any sodium sulfate, continued to grow. Asia and Latin America are major markets for sodium sulfate consumption because of the growing demand for packaged powder detergents. Sodium sulfate consumption in the domestic textile industry also has been declining because imports of less expensive textile products.

The outlook for sodium sulfate in 2006 is expected to be comparable with that of 2005, with detergents remaining the leading sodium-sulfate-consuming sector. If the winter of 2005-06 is relatively mild, byproduct recovery of sodium sulfate from automobile batteries may decline because fewer battery failures during mild winter weather reduce recycling. World production and consumption of sodium sulfate have been stagnant but are expected to grow in the next few years, especially in Asia and South America.

World Production, Reserves, and Reserve Base: Although data on mine production for natural sodium sulfate are not available, total world production of natural sodium sulfate is estimated to be about 4 million tons. Total world production of byproduct sodium sulfate is estimated to be between 1.5 million and 2.0 million tons.

	Reserves[3]	Reserve base[3]
United States	860,000	1,400,000
Canada	84,000	270,000
Mexico	170,000	230,000
Spain	180,000	270,000
Turkey	100,000	NA
Other countries	1,900,000	2,400,000
World total (rounded)	3,300,000	4,600,000

World Resources: Sodium sulfate resources are sufficient to last hundreds of years at the present rate of world consumption. In addition to the countries listed above with reserves, the following countries also contain identified resources of sodium sulfate: Botswana, China, Egypt, Italy, Mongolia, Romania, and South Africa. Commercial production from domestic resources is from deposits in California and Texas. The brine in Searles Lake, CA, contains about 450 million tons of sodium sulfate resource, representing about 35% of the lake's brine. In Utah, about 12% of the dissolved salts in the Great Salt Lake is sodium sulfate, representing about 400 million tons of resource. An irregular, 21-meter-thick mirabilite deposit is associated with clay beds 4.5 to 9.1 meters below the lake bottom near Promontory Point, UT. Several playa lakes in west Texas contain underground sodium-sulfate-bearing brines and crystalline material. Other economic and subeconomic deposits of sodium sulfate are near Rhodes Marsh, NV, Grenora, ND, Okanogan County, WA, and Bull Lake, WY. Sodium sulfate also can be obtained as a byproduct from the production of ascorbic acid, battery recycling, boric acid, cellulose, chromium chemicals, lithium carbonate, rayon, resorcinol, and silica pigments. The quantity and availability of byproduct sodium sulfate are dependent on the production capabilities of the primary industries and the sulfate recovery rates.

Substitutes: In pulp and paper, emulsified sulfur and caustic soda (sodium hydroxide) can replace sodium sulfate. In detergents, a variety of products can substitute for sodium sulfate. In glassmaking, soda ash and calcium sulfate have been substituted for sodium sulfate with less effective results.

[e]Estimated. E Net exporter. NA Not available.
[1]Source: U.S. Census Bureau. Synthetic production data are revised in accordance with recent updated Census statistics.
[2]Defined as imports – exports + adjustments for Government and industry stock changes (if available).
[3]See Appendix C for definitions.

STONE (CRUSHED)[1]

(Data in million metric tons unless otherwise noted)[2]

Domestic Production and Use: Crushed stone valued at $10.2 billion was produced by 1,300 companies operating 3,100 active quarries, 70 underground mines, and 190 sales/distribution yards in 49 States. Leading States, in order of production, were Texas, Florida, Pennsylvania, Illinois, Georgia, Virginia, Missouri, North Carolina, Ohio, and Tennessee, together accounting for 53.8% of the total output. Of the total crushed stone produced in 2005, about 70% was limestone and dolomite; 16%, granite; 8%, traprock; and the remaining 6% was shared, in descending order of tonnage, by sandstone and quartzite, miscellaneous stone, marble, volcanic cinder and scoria, calcareous marl, slate, and shell. It is estimated that of the 1.66 billion tons of crushed stone consumed in 2005, 37% was for unspecified uses, and 16% was estimated for nonrespondents to the U.S. Geological Survey (USGS) canvasses. Of the remaining 775 million tons reported by uses, 84% was used as construction aggregates mostly for highway and road construction and maintenance; 13% for chemical and metallurgical uses, including cement and lime manufacture; 1% for agricultural uses; and 2% for special and miscellaneous uses and products. To provide a more accurate estimate of the consumption patterns for crushed stone, the “unspecified uses—reported and estimated” as defined in the USGS Minerals Yearbook, are not included in the above percentages.

The estimated output of crushed stone in the 48 conterminous States shipped for consumption in the first 9 months of 2005 was 1.2 billion tons, a 3.5% increase compared with the same period of 2004. The third quarter shipments for consumption remained unchanged compared with the same period of 2004. Additional production information, by quarter for each State, geographic division, and the United States, is reported in the USGS quarterly Mineral Industry Surveys for Crushed Stone and Sand and Gravel.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production	1,590	1,510	1,530	1,590	1,650
Imports for consumption	14	14	15	16	15
Exports	4	3	1	1	1
Consumption, apparent[3]	1,600	1,530	1,540	1,600	1,660
Price, average value, dollars per metric ton	5.57	5.71	5.98	6.01	6.17
Stocks, yearend	NA	NA	NA	NA	NA
Employment, quarry and mill, number[e, 4]	79,200	79,000	78,500	79,600	79,700
Net import reliance[5] as a percentage of apparent consumption	([6])	([6])	([6])	([6])	([6])

Recycling: Road surfaces made of asphalt and crushed stone and, to a lesser extent, cement concrete surface layers and structures were recycled on a limited but increasing basis in most States.

Import Sources (2001-04): Canada, 41%; Mexico, 38%; The Bahamas, 20%; and other, 1%.

Tariff: **Item**	**Number**	**Normal Trade Relations 12-31-05**
Crushed stone	2517.10.00	Free.

Depletion Allowance: (Domestic) 14% for some special uses; 5% if used as ballast, concrete aggregate, riprap, road material, and similar purposes.

Government Stockpile: None.

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STONE (CRUSHED)

Events, Trends, and Issues: Crushed stone output increased 3.8% in 2005 to 1.65 billion tons compared with that of 2004. It is estimated that in 2006, domestic production and apparent consumption will be about 1.75 billion tons, a 6% increase. Gradual increases in demand for construction aggregates are anticipated after 2006 based on the expected volume of work on the infrastructure and an expanding U.S. economy. Long-term projected increases will be influenced by activity in the public and private construction sectors as well as by construction work related to security measures being implemented around the Nation. Crushed stone f.o.b. prices are not expected to increase significantly, but the delivered prices of crushed stone are expected to increase, especially in and near metropolitan areas, mainly because more aggregates are being transported longer distances.

The crushed stone industry continued to be concerned with safety and health and environmental regulations. Shortages in some urban and industrialized areas are expected to continue to increase owing to local zoning regulations and land-development alternatives. These issues are expected to continue and to cause crushed stone quarries to relocate away from large-population centers.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves and reserve base[7]
	2004	2005[e]	
United States	1,590	1,650	Adequate except where special
Other countries[8]	NA	NA	types are needed or where
World total	NA	NA	local shortages exist.

World Resources: Stone resources of the world are very large. High-purity limestone and dolomite suitable for specialty uses are limited in many geographic areas. The largest resources of high-purity limestone and dolomite in the United States are in the central and eastern parts of the country.

Substitutes: Crushed stone substitutes for roadbuilding include sand and gravel and slag. Substitutes for crushed stone used as construction aggregates include sand and gravel, iron and steel slag, sintered or expanded clay or shale, and perlite or vermiculite.

[e]Estimated. NA Not available.
[1]See also Stone (Dimension).
[2]See Appendix A for conversion to short tons.
[3]Data rounded to no more than three significant digits.
[4]Including office staff.
[5]Defined as imports – exports + adjustments for Government and industry stock changes. Changes in stocks were assumed to be zero in the net import reliance and apparent consumption calculations because data on stocks were not available.
[6]Less than ½ unit.
[7]See Appendix C for definitions.
[8]No reliable production information for other countries is available owing to a wide variation of ways in which countries report their crushed stone production. Some countries do not report production for this mineral commodity. Production information for some countries is available in the country chapters of the USGS Minerals Yearbook.

STONE (DIMENSION)[1]

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: Approximately 1.46 million tons of dimension stone, valued at $285 million, was sold or used in 2005. Dimension stone was produced by 102 companies, operating 140 quarries, in 34 States. Leading producer States, in descending order by tonnage, were Indiana, Wisconsin, Georgia, Vermont, and Massachusetts. These five States accounted for about 55% of the production. Leading producer States, in descending order by value, were Indiana, Vermont, Wisconsin, South Dakota, and Georgia. These States contributed about 50% of the value of domestic production. Approximately 39%, by tonnage, of dimension stone sold or used was limestone, followed by granite (29%), sandstone (14%), miscellaneous stone (10%), marble (7%), and slate (1%). By value, the leading sales or uses were for granite (39%), followed by limestone (34%), sandstone (9%), miscellaneous stone (7%), marble (6%), and slate (5%). Rough block represented 61% of the tonnage and 45% of the value of all the dimension stone sold or used by domestic producers, including exports. The leading uses of rough block, by tonnage, were in construction (47%) and flagging, exports, and unlisted and unspecified (29%) applications. Dressed stone mainly was sold for flagging (30%), curbing (23%), and ashlars and partially squared pieces (18%), by tonnage.

Salient Statistics—United States:[2]	**2001**	**2002**	**2003**	**2004**	**2005**[e]
Production:					
Tonnage	1,220	1,260	1,340	1,460	1,460
Value, million dollars	263	254	268	281	285
Imports for consumption, value, million dollars	1,070	1,190	1,390	1,790	2,400
Exports, value, million dollars	74	64	64	64	146
Consumption, apparent, value, million dollars	1,260	1,380	1,590	2,010	2,540
Price	Variable, depending on type of product				
Stocks, yearend	NA	NA	NA	NA	NA
Employment, quarry and mill, number[3]	3,000	3,000	3,000	3,000	3,000
Net import reliance[4] as a percentage of apparent consumption (based on value)	79	82	83	86	88
Granite only:					
Production	408	431	463	429	429
Imports for consumption	NA	NA	NA	NA	NA
Exports (rough and finished)	141	140	144	143	143
Consumption, apparent	NA	NA	NA	NA	NA
Price	Variable, depending on type of product				
Stocks, yearend	NA	NA	NA	NA	NA
Employment, quarry and mill, number[3]	1,500	1,500	1,500	1,500	1,500
Net import reliance[4] as a percentage of apparent consumption (based on tonnage)	NA	NA	NA	NA	NA

Recycling: Small amounts of dimension stone were recycled principally by restorers of old stone work.

Import Sources (2001-04 by value): Dimension stone: Italy, 38%; India, 19%; Canada, 10%; Spain, 7%; and other, 26%. Granite only: Italy, 35%; Brazil, 22%; India, 14%; China, 12%; and other, 17%.

Tariff: Dimension stone tariffs ranged from free to 6.5% ad valorem, according to type, degree of preparation, shape, and size, for countries with normal trade relations in 2005. Most crude or rough trimmed stone was imported for 3.0% ad valorem or less.

Depletion Allowance: 14% (Domestic and foreign); slate used or sold as sintered or burned lightweight aggregate, 7.5% (Domestic and foreign); dimension stone used for rubble and other nonbuilding purposes, 5% (Domestic and foreign).

Government Stockpile: None.

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STONE (DIMENSION)

Events, Trends, and Issues: Domestic production tonnage remained steady at about 1.46 million tons, with value increasing to $285 million in 2005. Imports of dimension stone continued to increase. Imports increased by 34% in value to about $2.4 billion. Dimension stone exports increased to about $146 million. Apparent consumption, by value, was $2.5 billion in 2005—a $530 million increase from 2004. Dimension stone for new construction and refurbishment is being used more commonly in both commercial and residential markets. Increased domestic production and imports, along with improved quarrying, finishing, handling technology, greater varieties of stone, and the rising costs of alternative construction materials, are among the factors that suggest the demand for dimension stone will continue to increase during the next 5 years.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves and reserve base[5]
	2004	2005[e]	
United States	1,460	1,460	Adequate except for certain
Other countries	NA	NA	special types and local
World total	NA	NA	shortages.

World Resources: Dimension stone resources of the world are sufficient. Resources can be limited on a local level or occasionally on a regional level by the lack of a particular kind of stone that is suitable for dimension purposes.

Substitutes: In some applications, substitutes for dimension stone include aluminum, brick, ceramic tile, concrete, glass, plastics, resin-agglomerated stone, and steel.

[e]Estimated. NA Not available.
[1]See also Stone (Crushed).
[2]Includes Puerto Rico.
[3]Excluding office staff.
[4]Defined as imports – exports + adjustments for Government and industry stock changes. Changes in stocks were assumed to be zero in the net import reliance and apparent consumption calculations because data on stocks were not available.
[5]See Appendix C for definitions.

STRONTIUM

(Data in metric tons of strontium content[1] unless otherwise noted)

Domestic Production and Use: No strontium minerals have been produced in the United States since 1959. The most common strontium mineral, celestite, which consists primarily of strontium sulfate, was imported exclusively from Mexico. A company in Georgia was the only major U.S. producer of strontium compounds, and analysis of celestite import data indicates that production at this operation has decreased substantially since 2001. Primary strontium compounds were used in the faceplate glass of color television picture tubes, 68%; ferrite ceramic magnets, 11%; pyrotechnics and signals, 14%; and other applications, 7%.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production	—	—	—	—	—
Imports for consumption:					
Strontium minerals	5,640	1,150	1,020	2,760	700
Strontium compounds	26,500	25,400	23,300	14,500	13,000
Exports, compounds	929	340	693	552	300
Shipments from Government stockpile excesses	—	—	—	—	—
Consumption, apparent, celestite and compounds	31,200	26,500	23,600	16,700	13,400
Price, average value of mineral imports at port of exportation, dollars per ton	63	60	58	53	57
Net import reliance[2] as a percentage of apparent consumption	100	100	100	100	100

Recycling: None.

Import Sources (2001-04): Strontium minerals: Mexico, 100%. Strontium compounds: Mexico, 89%; Germany, 5%; and other, 6%. Total imports: Mexico, 92%; Germany, 5%; and other, 3%.

Tariff:

Item	Number	Normal Trade Relations 12-31-05
Celestite	2530.90.8010	Free.
Strontium metal	2805.19.1000	3.7% ad val.
Compounds:		
Strontium carbonate	2836.92.0000	4.2% ad val.
Strontium nitrate	2834.29.2000	4.2% ad val.
Strontium oxide, hydroxide, peroxide	2816.40.1000	4.2% ad val.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: About 11,600 tons of nonstockpile-grade celestite containing about 5,100 tons of strontium is in the National Defense Stockpile. Its total value is listed as zero. The stockpile goal for celestite was reduced to zero in 1969, and at that time, the stockpile contained stockpile- and nonstockpile-grade material. Since then, all the stockpile-grade celestite has been sold. Although the nonstockpile-grade celestite has been offered for sale, none has been sold since 1979. The fiscal year 2006 Annual Materials Plan, announced in October 2005 by the Defense National Stockpile Center, listed 5,440 tons of stockpiled celestite as available for disposal. Because the remaining material does not meet the quality specifications of celestite purchasers, the material will be difficult to dispose of in the traditional markets. It might be attractive as a low-cost replacement for barite in drilling mud applications.

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STRONTIUM

Events, Trends, and Issues: China is the world's leading producer of strontium carbonate with the plant capacity to produce 200,000 tons per year, followed by Germany and Mexico with 70,000 and 127,000 tons per year, respectively. China uses domestic and imported celestite to supply its plants, the German producer uses imported celestite, and Mexican producers use domestic ore to supply their plants. The Chinese strontium carbonate is marketed in Asia and Europe, causing decreases in celestite and strontium carbonate prices in those regions. Chinese celestite reserves are smaller and of lower quality than the ores in major producing countries including Mexico, Spain, and Turkey, raising the question of whether Chinese producers will be able to maintain high production levels to meet the demand at strontium carbonate plants for an extended period of time.

The demand for strontium carbonate for television faceplate glass continues, but appears to be decreasing as the popularity of flat panel television monitors grows. Domestic consumption of strontium carbonate decreased in the past 5 years as a result of a shift in production facilities for color televisions to other countries that has resulted in the closure of all but one television glass plant in the United States. China, Europe, and North America are the most important markets for televisions. Southeast Asia and Latin America have higher growth rates, potentially representing huge markets for television manufacturers and thus the strontium carbonate industry. Flat-screen technology, which does not require strontium carbonate, likely will continue to diminish the demand for strontium carbonate for television displays as the technology becomes more affordable and commonplace.

World Mine Production, Reserves, and Reserve Base:[3]

	Mine production		Reserves[4]	Reserve base[4]
	2004	2005[e]		
United States	—	—	—	1,400,000
Argentina	3,400	6,700	All other:	All other:
China[e]	130,000	140,000	6,800,000	11,000,000
Iran	2,000	7,000		
Mexico	181,000	143,000		
Morocco	2,700	2,700		
Pakistan	2,000	2,000		
Spain	160,000	160,000		
Tajikistan	NA	NA		
Turkey	70,000	60,000		
World total (rounded)	[5]551,000	[5]520,000	6,800,000	12,000,000

World Resources: Resources in the United States are several times the reserve base. Although not thoroughly evaluated, world resources are thought to exceed 1 billion tons.

Substitutes: Although it is possible to substitute other materials for strontium in some of its applications, such a change would adversely affect product performance and/or cost. For example, barium could replace strontium in color television picture tube glass only after extensive circuit redesign to reduce operating voltages that produce harmful secondary X-rays. Barium replacement of strontium in ferrite ceramic magnets would decrease the maximum energy and temperature characteristics of the magnets. Substituting for strontium in pyrotechnics would be impractical because the desired brilliance and visibility are imparted only by strontium and its compounds.

[e]Estimated. NA Not available. — Zero.

[1]The strontium content of celestite is 43.88%; this factor was used to convert units of celestite.

[2]Defined as imports – exports + adjustments for Government and industry stock changes.

[3]Metric tons of strontium minerals.

[4]See Appendix C for definitions.

[5]Excludes Tajikistan.

SULFUR

(Data in thousand metric tons of sulfur unless otherwise noted)

Domestic Production and Use: In 2005, elemental sulfur and byproduct sulfuric acid were produced at 115 operations in 29 States and the U.S. Virgin Islands. Total shipments were valued at about $400 million. Elemental sulfur production was 8.8 million tons; Louisiana and Texas accounted for about 45% of domestic production. Elemental sulfur was recovered at petroleum refineries, natural-gas-processing plants, and coking plants by 38 companies at 109 plants in 26 States and the U.S. Virgin Islands. Byproduct sulfuric acid, representing about 8% of production of sulfur in all forms, was recovered at six nonferrous smelters in five States by six companies. Domestic elemental sulfur provided 66% of domestic consumption, and byproduct acid accounted for 6%. The remaining 28% of sulfur consumed was provided by imported sulfur and sulfuric acid. About 90% of sulfur was consumed in the form of sulfuric acid. Agricultural chemicals (primarily fertilizers) composed 62% of reported sulfur demand; petroleum refining, 29%; and metal mining, 3%. Other uses, accounting for 6% of demand, were widespread because a multitude of industrial products required sulfur in one form or another during some stage of their manufacture.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production:					
Recovered elemental	8,490	8,500	8,920	9,380	8,840
Other forms	982	772	683	739	750
Total (may be rounded)	9,470	9,270	9,600	10,100	9,600
Shipments, all forms	9,450	9,260	9,600	10,100	9,600
Imports for consumption:					
Recovered, elemental[e]	1,730	2,560	2,870	2,850	2,800
Sulfuric acid, sulfur content	462	346	297	784	700
Exports:					
Recovered, elemental	711	709	840	949	650
Sulfuric acid, sulfur content	69	48	67	67	20
Consumption, apparent, all forms	10,900	11,400	12,000	12,800	12,400
Price, reported average value, dollars per ton of elemental sulfur, f.o.b., mine and/or plant	10.01	11.84	28.71	32.50	35.00
Stocks, producer, yearend	232	181	206	185	170
Employment, mine and/or plant, number	2,700	2,700	2,700	2,700	2,700
Net import reliance[1] as a percentage of apparent consumption	13	19	20	21	23

Recycling: Between 3 million and 5 million tons of spent sulfuric acid was reclaimed from petroleum refining and chemical processes.

Import Sources (2001-04): Elemental: Canada, 72%; Mexico, 19%; Venezuela, 7%; and other, 2%. Sulfuric acid: Canada, 52%; Mexico, 19%; Germany, 6%; and other, 23%. Total sulfur imports: Canada, 70%; Mexico, 19%; Venezuela, 7%; and other, 4%.

Tariff: **Item**	**Number**	**Normal Trade Relations 12-31-05**
Sulfur, crude or unrefined	2503.00.0010	Free.
Sulfur, all kinds, other	2503.00.0090	Free.
Sulfur, sublimed or precipitated	2802.00.0000	Free.
Sulfuric acid	2807.00.0000	Free.

Depletion Allowance: 22% (Domestic and foreign).

Government Stockpile: None.

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SULFUR

Events, Trends, and Issues: Total U.S. sulfur production was 5% lower in 2005 than it was in 2004 because two hurricanes hit the Gulf Coast region, causing major shutdowns of refining capacity in the region. Because most domestic sulfur production comes from refineries, sulfur production was curtailed at some refineries for an extended period of time. In addition, reinjection of acid gases at a major natural-gas-processing plant in Wyoming resulted in decreased sulfur production from natural gas operations. Decreased production of elemental sulfur from petroleum refineries is not expected to establish a new trend, but rather a temporary downturn. Recovery from refineries is expected to return to normal early in 2006 and to resume its upward trend, supported by new facilities being installed to increase refining capacity and the capability of current operations to handle higher sulfur crude oil. Recovered sulfur from domestic natural gas processing is expected to decline as a result of the natural depletion of some large natural gas deposits and projects to reinject acid gas. Byproduct sulfuric acid production is expected to remain relatively stable unless one or more of the remaining nonferrous smelters closes. World sulfur production did not change because the decreased production in the United States countered increases in other parts of the world.

Domestic phosphate rock consumption was slightly higher in 2005 than in 2004, with a slight increase in demand for sulfur to process the phosphate rock into phosphate fertilizers, although the severe weather negatively affected the sulfur industry around the Gulf of Mexico. Increased worldwide sulfur demand drove prices higher, which encouraged expansion in world trade. Canadian sulfur stocks were remelted to meet increased demand for overseas trade.

World Production, Reserves, and Reserve Base:

	Production—All forms 2004	Production—All forms 2005[e]
United States	10,100	9,600
Australia	925	950
Canada	8,890	8,900
Chile	1,510	1,500
China	6,630	6,700
Finland	702	720
France	961	900
Germany	2,150	2,100
India	1,070	1,100
Iran	1,460	1,500
Italy	688	650
Japan	3,150	3,200
Kazakhstan	1,980	2,000
Korea, Republic of	1,680	1,700
Kuwait	682	700
Mexico	1,820	1,800
Netherlands	547	550
Poland	1,180	1,300
Russia	6,920	7,100
Saudi Arabia	2,230	2,200
Spain	634	630
United Arab Emirates	1,930	1,900
Other countries	6,290	6,300
World total (rounded)	64,100	64,000

Reserves and reserve base[2]

Previously published reserve and reserve base data are outdated and inadequate for this tabulation because of changes in the world sulfur industry. For this reason, specific country data have been omitted from this report.

Reserves of sulfur in crude oil, natural gas, and sulfide ores are large. Because most sulfur production is a result of the processing of fossil fuels, supplies should be adequate for the foreseeable future. Because petroleum and sulfide ores can be processed long distances from where they are produced, actual sulfur production may not be in the country for which the reserves were attributed. For instance, sulfur reserves from Saudi Arabia actually may be recovered at oil refineries in the United States.

World Resources: Resources of elemental sulfur in evaporite and volcanic deposits and sulfur associated with natural gas, petroleum, tar sands, and metal sulfides amount to about 5 billion tons. The sulfur in gypsum and anhydrite is almost limitless, and some 600 billion tons is contained in coal, oil shale, and shale rich in organic matter, but low-cost methods have not been developed to recover sulfur from these sources. The domestic resource is about one-fifth of the world total.

Substitutes: Substitutes for sulfur at present or anticipated price levels are not satisfactory; some acids, in certain applications, may be substituted for sulfuric acid.

[e]Estimated. — Zero.
[1]Defined as imports – exports + adjustments for Government and industry stock changes.
[2]See Appendix C for definitions.

TALC AND PYROPHYLLITE

(Data in thousand metric tons unless noted)

Domestic Production and Use: The total estimated crude ore value of 2005 domestic talc production was $23.5 million. There were 11 talc-producing mines in 6 States in 2005. Companies in Montana, New York, Texas, and Vermont accounted for most of the domestic production. Domestically produced ground talc was used in ceramics, 33%; paint, 20%; paper, 16%; roofing, 6%; plastics, 4%; rubber, 2%; cosmetics, 1%; and other, 18%. Two companies in North Carolina mined pyrophyllite. Production of pyrophyllite increased slightly from that of 2004. Consumption was, in decreasing order by tonnage, in refractory products, ceramics, and paint.

Salient Statistics—United States:[1]	2001	2002	2003	2004	2005[e]
Production, mine	863	828	840	857	842
Sold by producers	784	764	845	838	827
Imports for consumption	180	232	237	226	234
Exports	137	166	192	202	208
Shipments from Government stockpile excesses	—	—	—	([2])	—
Consumption, apparent	906	894	885	881	868
Price, average, processed dollars per ton	108	98	89	88	83
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, mine and mill	520	510	460	470	470
Net import reliance[3] as a percentage of apparent consumption	5	7	5	3	3

Recycling: Insignificant.

Import Sources (2001-04): China, 48%; Canada, 34%; France, 4%; Japan, 1%; and other, 13%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Crude, not ground	2526.10.0000	Free.
Ground, washed, powdered	2526.20.0000	Free.
Cut or sawed	6815.99.2000	Free.

Depletion Allowance: Block steatite talc: 22% (Domestic), 14% (Foreign). Other: 14% (Domestic and foreign).

Government Stockpile:

Stockpile Status—9-30-05[4]
(Metric tons)

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Talc, block and lump	867	—	867	[5]907	—
Talc, ground	1,050	—	1,050	—	—

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TALC AND PYROPHYLLITE

Events, Trends, and Issues: Production and sales of talc decreased slightly from those of 2004. Apparent consumption decreased slightly. Exports increased by 3% to 208,000 tons compared with those of 2004. Canada remained the major destination for U.S. talc exports, accounting for about 45% of the tonnage. U.S. imports of talc increased by 4% to 234,000 tons compared with those of 2004. In 2005, Canada and China supplied approximately 70% of the imported talc.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[6]	Reserve base[6]
	2004	2005[e]		
United States[1]	857	842	140,000	540,000
Brazil	570	600	180,000	250,000
China	3,000	3,000	Large	Large
India	636	630	4,000	9,000
Japan	585	642	100,000	160,000
Korea, Republic of	958	930	14,000	18,000
Other countries	1,710	1,710	Large	Large
World total (rounded)	8,320	8,360	Large	Large

World Resources: The United States is self-sufficient in most grades of talc and related minerals. Domestic and world resources are estimated to be approximately five times the quantity of reserves.

Substitutes: The major substitutes for talc are clays and pyrophyllite in ceramics, kaolin and mica in paint, kaolin in paper, clays and mica in plastics, and kaolin and mica in rubber.

[e]Estimated. NA Not available. — Zero.
[1]Excludes pyrophyllite.
[2]Less than ½ unit.
[3]Defined as imports – exports + adjustments for Government and industry stock changes.
[4]See Appendix B for definitions.
[5]Includes lump and block talc and ground talc.
[6]See Appendix C for definitions.

TANTALUM

(Data in metric tons of tantalum content unless otherwise noted)

Domestic Production and Use: No significant U.S. tantalum mine production has been reported since 1959. Domestic tantalum resources are of low grade, some mineralogically complex, and most are not commercially recoverable. Three companies produced tantalum alloys, compounds, and metal from imported concentrates; and metal and alloys were recovered from foreign and domestic scrap. Tantalum was consumed mostly in the form of alloys, compounds, fabricated forms, ingot, and metal powder. Tantalum capacitors accounted for more than 60% of tantalum use. Major end uses for tantalum capacitors include automotive electronics, pagers, personal computers, and portable telephones. The value of tantalum consumed in 2005 was estimated at about $170 million.

Salient Statistics—United States:[1]	2001	2002	2003	2004	2005[e]
Production, mine	—	—	—	—	—
Imports for consumption:					
Mineral concentrates[e]	700	730	480	450	425
Tantalum metal and tantalum-bearing alloys[e]	400	257	251	628	546
Exports, concentrate, metal, alloys, waste, scrap[e]	636	496	538	711	636
Government stockpile releases[e, 2]	56	18	218	205	250
Consumption, apparent	640	621	523	649	646
Price, tantalite, dollars per pound[3]	37.00	31.00	28.00	30.80	34.50
Net import reliance[4] as a percentage of apparent consumption	81	82	79	88	91

Recycling: Tantalum was recycled mostly from new scrap that was generated during the manufacture of tantalum-containing electronic components and from tantalum-containing cemented carbide and superalloy scrap. Tantalum in this scrap represented about 20% of apparent consumption.

Import Sources (2001-04): Australia, 70%; Canada, 13%; and other, 17%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Synthetic tantalum-columbium concentrates	2615.90.3000	Free.
Tantalum ores and concentrates	2615.90.6060	Free.
Tantalum oxide	2825.90.9000	3.7% ad val.
Potassium fluotantalate	2826.90.0000	3.1% ad val.
Tantalum, unwrought:		
Powders	8103.20.0030	2.5% ad val.
Alloys and metal	8103.20.0090	2.5% ad val.
Tantalum, waste and scrap	8103.30.0000	Free.
Tantalum, other	8103.90.0000	4.4% ad val.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: For fiscal year 2005, the Defense National Stockpile Center (DNSC), Defense Logistics Agency, sold about 6 tons of tantalum capacitor-grade metal, about 9 tons of tantalum metal ingots, about 225 tons of tantalum contained in tantalum-columbium minerals, and about 9 tons of tantalum contained in tantalum oxide from the National Defense Stockpile. There were no sales of tantalum carbide powder in fiscal year 2005. The DNSC announced maximum disposal limits for fiscal year 2006 of about 2 tons[5] of tantalum contained in tantalum carbide powder, about 18 tons[5] of tantalum contained in tantalum metal ingots, about 18 tons[5] of tantalum contained in tantalum metal powder, about 227 tons[5] of tantalum contained in tantalum minerals, and about 9 tons[5] of tantalum contained in tantalum oxide.

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TANTALUM

Stockpile Status—9-30-05[6]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Tantalum:					
Carbide powder	6	—	6	[7]2	—
Metal:					
Powder	9	—	9	[7]18	6
Ingots	—	1	—	[7]18	9
Minerals	348	—	348	227	227
Oxide	11	—	11	9	9

Events, Trends, and Issues: U.S. apparent consumption of tantalum in 2005 was about the same as that in 2004. Australia supplied about 78% of tantalum mineral concentrate imports for consumption, by weight, and about 87% of the value. Brazil, Germany, Israel, Japan, Kazakhstan, and the United Kingdom were the major destinations for the tantalum exports. In September, quoted spot price ranges for tantalum minerals (per pound tantalum pentoxide content), in three published sources, were $30 to $35, $30 to $40, and $34 to $38. Public information on current prices for tantalum products was not available. According to industry sources, the pricing for tantalum products is mostly established by negotiation between buyer and seller; product specifications, volume, and processing requirements influence the negotiated price.

World Mine Production, Reserves, and Reserve Base:

	Mine production[8] 2004	Mine production[8] 2005[e]	Reserves[9]	Reserve base[9]
United States	—	—	—	Negligible
Australia	730	1,200	40,000	80,000
Brazil	250	215	NA	73,000
Burundi	6	6	NA	NA
Canada	69	65	3,000	NA
Congo (Kinshasa)	60	60	NA	NA
Ethiopia	35	35	NA	NA
Mozambique	280	260	NA	NA
Namibia	11	5	NA	NA
Nigeria	21	5	NA	NA
Rwanda	40	40	NA	NA
Uganda	5	1	NA	NA
Zimbabwe	4	15	NA	NA
Other countries[10]	NA	NA	NA	NA
World total (rounded)	1,510	1,910	43,000	150,000

World Resources: Identified resources of tantalum, most of which are in Australia, Brazil, and Canada, are considered adequate to meet projected needs. The United States has about 1,500 tons of tantalum resources in identified deposits, all of which were considered uneconomic at 2005 prices.

Substitutes: The following materials can be substituted for tantalum, but usually with less effectiveness: columbium in carbides; aluminum and ceramics in electronic capacitors; columbium, glass, platinum, titanium, and zirconium in corrosion-resistant equipment; and columbium, hafnium, iridium, molybdenum, rhenium, and tungsten in high-temperature applications.

[e]Estimated. NA Not available. — Zero.
[1]Revisions principally based on reevaluation of import and export data.
[2]Disposals reported by DNSC, net quantity (uncommitted inventory).
[3]Yearend average price from trade journals, per pound of contained pentoxides.
[4]Defined as imports – exports + adjustments for Government and industry stock changes.
[5]Actual quantity limited to remaining sales authority; additional legislative authority is required.
[6]See Appendix B for definitions.
[7]Actual quantity limited to remaining sales authority or inventory.
[8]Excludes production of tantalum contained in tin slags.
[9]See Appendix C for definitions.
[10]Bolivia, China, Russia, and Zambia also produce (or are believed to produce) tantalum mineral concentrates, but available information is inadequate to make reliable estimates of output levels.

TELLURIUM

(Data in metric tons of tellurium content unless otherwise noted)

Domestic Production and Use: In the United States, one firm produced commercial-grade tellurium at its refinery complex, mainly from copper anode slimes but also from lead refinery skimmings, both of domestic origin. Primary and intermediate producers further refined domestic and imported commercial-grade metal and tellurium dioxide, producing tellurium and tellurium compounds in high-purity form for specialty applications.

Tellurium's major use is as an alloying additive in steel to improve machining characteristics. It is also used as a minor additive in copper alloys to improve machinability without reducing conductivity; in lead alloys to improve resistance to vibration and fatigue; in cast iron to help control the depth of chill; and in malleable iron as a carbide stabilizer. It is used in the chemical industry as a vulcanizing agent and accelerator in the processing of rubber and as a component of catalysts for synthetic fiber production. Tellurium's other uses include those in photoreceptor and thermoelectric electronic devices, as an ingredient in blasting caps, and as a pigment to produce various colors in glass and ceramics.

In 2005, the estimated distribution of uses, worldwide, was as follows: iron and steel products, 48%; catalysts and chemicals, 25%; photoreceptors and thermoelectric devices, 12%; additives to nonferrous alloys, 8%; and other, 7%.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production, refinery	W	W	W	W	W
Imports for consumption, unwrought, waste and scrap	32	34	55	75	60
Exports	8	3	10	6	58
Consumption, apparent	W	W	W	W	W
Price, dollars per pound, 99.95% minimum[1]	7	7	10	13	96
Stocks, producer, refined, yearend	W	W	W	W	W
Employment, number	NA	NA	NA	NA	NA
Net import reliance[2] as a percentage of apparent consumption	W	W	W	W	W

Recycling: There is little or no scrap from which to extract secondary tellurium because the uses of tellurium are nearly all dissipative in nature. Currently, none is recovered in the United States, but a small amount may be recovered in Europe or elsewhere from scrapped selenium-tellurium photoreceptors employed in older plain paper copiers.

Import Sources (2001-04): Germany, 24%; Belgium, 21%; Philippines, 18%; Canada, 15%; and other, 22%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Tellurium	2804.50.0020	Free.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

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TELLURIUM

Events, Trends, and Issues: Estimated domestic tellurium production decreased in 2005 as compared with that of 2004 owing to a labor strike that began in July and continued at least until October at the one domestic producer. Domestic consumption, however, was estimated to have increased significantly during the same period. Though detailed information on the world tellurium market was not available, world tellurium consumption was estimated to have increased significantly in 2005. World production of tellurium, a byproduct of copper refining, was believed to have increased owing to an increase in world copper production. Russian tellurium production in 2005 reportedly was much higher than in 2004. Selenium, a coproduct which was in strong demand, experienced a surge in production from waste and anode slimes that contained tellurium. In 2005, the U.S. producer of tellurium announced that it had filed for bankruptcy protection. The future of American production is therefore uncertain.

Tellurium supply and demand has remained in fairly close balance for the past decade in the United States. In 2005, however, demand greatly outstripped supply. There was a significant increase in demand for high-purity tellurium for cadmium telluride solar cells. Tellurium consumption also increased in thermal elements for small ice packs and refrigerators. The large supply imbalance led to a large price jump starting in late 2004 and extending through 2005.

Currently, tellurium alloyed with germanium and antimony used in digital video discs (DVDs) consumes only small amounts of tellurium. New developments in coupling materials, however, which consist of bismuth, germanium, and tellurium and enable DVDs to be rewritable at high and low recording speeds, could have an impact on future world demand.

World Refinery Production, Reserves, and Reserve Base:

	Refinery production		Reserves[3]	Reserve base[3]
	2004	2005[e]		
United States	W	W	3,000	6,000
Canada	40	50	700	1,500
Japan	33	35	—	—
Peru	20	28	1,600	2,800
Other countries[4]	NA	NA	16,000	37,000
World total (rounded)	[5]93	[5]113	21,000	47,000

World Resources: The figures shown for reserves and reserve base include only tellurium contained in economic copper deposits. These estimates assume that less than one-half of the tellurium contained in unrefined copper anodes is actually recovered.

More than 90% of tellurium is produced from anode slims collected from electrolytic copper refining, and the remainder is derived from skimmings at lead refineries and from flue dusts and gases generated during the smelting of bismuth, copper, and lead ores. In copper production, tellurium is recovered only from the electrolytic refining of smelted copper. Growth in the global use of the leaching solvent extraction-electrowinning processes for copper extraction has limited the growth of tellurium supply.

Substitutes: Several materials can replace tellurium in most of it uses, but usually with losses in production efficiency or product characteristics. Bismuth, calcium, lead, phosphorus, selenium, and sulfur can be used in place of tellurium in many free-machining steels. Several of the chemical process reactions catalyzed by tellurium can be carried out with other catalysts or by means of noncatalyzed processes. In rubber compounding, sulfur and/or selenium can act as vulcanization agents in place of tellurium. The selenides of the refractory metals can function as high-temperature, high-vacuum lubricants in place of tellurides. The selenides and sulfides of niobium and tantalum can serve as electrically conducting solid lubricants in place of tellurides of those metals.

The selenium-tellurium photoreceptors used in some xerographic copiers and laser printers have been mostly being replaced by organic photoreceptors in newer machines. Amorphous silicon and copper indium diselenide are the two principal competitors to cadmium telluride in photovoltaic power cells.

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data. — Zero.
[1]Average yearend price published by Mining Journal for United Kingdom lump and powder, 99.95% tellurium.
[2]Defined as imports – exports + adjustments for Government and industry stock changes.
[3]See Appendix C for definitions. Estimates include tellurium contained in copper resources only.
[4]In addition to the countries listed, Australia, Belgium, China, Germany, Kazakhstan, the Philippines, and Russia produce refined tellurium, but output is not reported, and available information is inadequate for formulation of reliable production estimates.
[5]Excludes refinery production from the United States.

THALLIUM

(Data in kilograms of thallium content unless otherwise noted)

Domestic Production and Use: Thallium is a byproduct metal recovered in some countries from flue dusts and residues collected in the smelting of copper, zinc, and lead ores. Although thallium was contained in ores mined or processed in the United States, it has not been recovered domestically since 1981. Consumption of thallium metal and thallium compounds continued for most of its established end uses. These included the use of radioactive thallium isotope 201 for medical purposes in cardiovascular imaging; thallium as an activator (sodium iodide crystal doped with thallium) in gamma radiation detection equipment (scintillometer); thallium-barium-calcium-copper oxide high-temperature superconductor (HTS) used in filters for wireless communications; thallium in lenses, prisms and windows for infrared detection and transmission equipment; thallium-arsenic-selenium crystal filters for light diffraction in acousto-optical measuring devices; and thallium as an alloying component with mercury for low-temperature measurements. Other uses included an additive in glass to increase its refractive index and density, a catalyst or intermediate in the synthesis of organic compounds, and a component in high-density liquids for sink-float separation of minerals.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production, mine	([1])	([1])	([1])	([1])	([1])
Imports for consumption[2]					
Unwrought powders	NA	49	36	117	35
Formed and articles	NA	258	45	98	318
Waste and scrap	NA	—	—	110	—
Total	2,110	307	81	325	353
Exports[3]					
Unwrought powders	NA	—	490	224	35
Formed and articles	NA	463	1,560	965	228
Waste and scrap	NA	188	39	—	—
Total	NA	651	2,090	1,190	263
Consumption[4]	800	500	NA	900	300
Price, metal, dollars per kilogram[5]	1,295	1,250	1,300	1,600	1,900
Net import reliance[6]	100	100	100	100	100

Recycling: None.

Import Sources (2001-04): Belgium, 89%; Russia, 4%; Netherlands, 4%; France, 3%; and other, less than 1%.

Tariff: Item	**Number**	**Normal Trade Relations 12-31-05**
Unwrought and powders	8112.51.0000	4.0% ad val.
Waste and scrap	8112.52.0000	Free.
Other	8112.59.0000	4.0% ad val.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: The annual thallium consumption and trade numbers found in the "Salient Statistics—United States" table are relatively low in comparison with other mineral commodities, and their changes do not conform to the normal supply-demand economic model. A phone survey of several chemical and specialty metal providers found a scarcity of thallium metal in stock and relatively high prices. The lowest price found was $424 for 225-gram rods or $1,884.44 per kilogram, and most prices were significantly higher—some more than $2,000 per kilogram.

Research and development activities of both a basic and applied nature were conducted during 2005 that could expand the use of thallium. These activities included the development of HTS materials for such applications as magnetic resonance imaging, storage of magnetic energy, magnetic propulsion, more efficient electrical motors, and electric power generation and transmission. Materials are considered HTS if they have a critical transition (to superconductivity) temperature (Tc) above 77 K, the boiling temperature of liquid nitrogen. Presently, the HTS material attaining the highest Tc, 138 K, is a mercury-thallium-barium-calcium-copper oxide mix. Improved methods for manufacturing high-temperature superconductor tapes and films, such as thallium-barium-calcium-copper oxides with a Tc of 133 K, were under development. These tapes and films could be significant energy savers if used in ultrafast computers and power transmission systems.

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THALLIUM

A broad range of commercial applications would become available if HTS materials could be fabricated on a large scale into wires having a certain degree of flexibility and strength. Currently, HTS materials are relatively brittle metal-oxide ceramics. There are now more than 50 known HTS materials, but only a few (nonthallium) have been used successfully to form long-length wires.

In medical applications, dipyridamole-thallium imaging continued to be a useful preoperative procedure for assessing long-term cardiac risks in patients with coronary artery disease or diabetes who are undergoing peripheral vascular surgery. Further use of radioactive thallium in clinical diagnostic applications, including cardiovascular and oncological imaging, was studied during 2005.

Thallium metal and its compounds are highly toxic materials and are strictly controlled to prevent a threat to humans and the environment. Thallium and its compounds can be absorbed into the human body by skin contact, ingestion, or inhalation of dust or fumes. Further information on thallium toxicity can be found in the U.S. Environmental Protection Agency (EPA) Integrated Risk Information System (IRIS) database. The EPA initiated studies at its National Risk Management Research Laboratory on thallium removal from mine wastewaters. The U.S. Department of Health and Human Services, Food and Drug Administration, issued a guidance document announcing an approved drug for treatment of internal bodily contamination by radioactive or nonradioactive thallium. The drug, a form of industrial and artists' pigment (Prussian blue), effectively increases the rate of elimination of thallium from the body by interrupting readsorption in the intestine by fixing the metal through ion exchange with the drug.

World Mine Production, Reserves, and Reserve Base:[7]

	Mine production 2004	Mine production 2005[e]	Reserves[8]	Reserve base[8]
United States	([1])	([1])	32,000	120,000
Other countries	12,000	10,000	350,000	530,000
World total (rounded)	12,000	10,000	380,000	650,000

World Resources: World resources of thallium contained in zinc resources total about 17 million kilograms; most are located in Canada, Europe, and the United States. An additional 630 million kilograms is in world coal resources. The average thallium content of the Earth's crust has been estimated to be 0.7 part per million.

Substitutes: The apparent leading potential new demand for thallium could be in the area of HTS materials; but demand will be based on which HTS formulation has a combination of favorable electric and physical qualities and is best suited for fabrication. A firm presently using a thallium HTS material in filters for wireless communications is considering using a nonthallium HTS. While research in HTS continues, and thallium is part of that research effort, it is not guaranteed that HTS products will be a large user of thallium in the future.

While other materials and formulations can substitute for thallium in gamma radiation detection equipment and optics used for infrared detection and transmission, thallium materials are presently superior and more cost effective for these very specialized uses.

While thallium is still used in high-density liquids for sink-float separation of minerals, nonpoisonous substitutes like tungsten compounds are being marketed.

[e]Estimated. NA Not available. — Zero.
[1]No reported mine production; flue dust and residues from base-metal smelters, from which thallium metal and compounds may be recovered, are being exported to Canada, France, the United Kingdom, and other countries.
[2]Reported only as total unwrought, powders, and waste and scrap prior to 2002.
[3]Export data not available prior to 2002.
[4]Estimated based on reported imports, exports, and estimated drawdown of private stocks.
[5]Estimated price of 99.999%-pure granules or rods in 100- to 250-gram or larger lots.
[6]Defined as imports – exports + adjustments for Government and industry stock changes. Since thallium has not been produced domestically since 1981, it was assumed that consumption and exports of unwrought thallium were from imported material or from a drawdown in unreported inventories.
[7]Estimates are based on thallium content of zinc ores.
[8]See Appendix C for definitions.

THORIUM

(Data in metric tons of thorium oxide (ThO_2) equivalent unless otherwise noted)

Domestic Production and Use: The primary source of the world's thorium is the rare-earth and thorium phosphate mineral, monazite. In the United States, thorium has been a byproduct of refining monazite for its rare-earth content. Monazite itself is recovered as a byproduct of processing heavy-mineral sands for titanium and zirconium minerals. In 2005, monazite was not recovered domestically as a salable product. Essentially all thorium compounds and alloys consumed by the domestic industry were derived from imports, stocks of previously imported materials, or materials previously shipped from U.S. Government stockpiles. About eight companies processed or fabricated various forms of thorium for nonenergy uses, such as high-temperature ceramics, catalysts, and welding electrodes. Thorium's use in most products has decreased because of its naturally occurring radioactivity. The value of thorium alloys, compounds, and metal used by the domestic industry was estimated to have decreased to about $160,000.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production, refinery[1]	—	—	—	—	—
Imports for consumption:					
Thorium ore and concentrates (monazite), gross weight	—	—	—	—	—
Thorium ore and concentrates (monazite), ThO_2 content	—	—	—	—	—
Thorium compounds (oxide, nitrate, etc.), gross weight	1.85	0.65	4.14	5.32	5.67
Thorium compounds (oxide, nitrate, etc.), ThO_2 content	1.37	0.48	3.06	3.94	4.20
Exports:					
Thorium ore and concentrates (monazite), gross weight	—	—	—	—	—
Thorium ore and concentrates (monazite), ThO_2 content	—	—	—	—	—
Thorium compounds (oxide, nitrate, etc.), gross weight	7.30	0.88	0.59	0.73	0.90
Thorium compounds (oxide, nitrate, etc.), ThO_2 content	5.40	0.65	0.44	0.54	0.67
Shipments from Government stockpile excesses ($ThNO_3$)	—	—	—	—	—
Consumption:					
Reported, (ThO_2 content[e])	—	NA	NA	NA	NA
Apparent	NA	NA	NA	NA	NA
Price, yearend, dollars per kilogram:					
Nitrate, welding-grade[2]	5.46	5.46	5.46	5.46	5.46
Nitrate, mantle-grade[3]	27.00	27.00	27.00	27.00	27.00
Oxide, yearend:					
99.9% purity[4]	82.50	82.50	82.50	82.50	82.50
99.99% purity[4]	107.25	107.25	107.25	107.25	107.25
Net import reliance[5] as a percentage of apparent consumption	100	100	100	100	100

Recycling: None.

Import Sources (2001-04): Monazite: None. Thorium compounds: France, 99.6%; and other, 0.4%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Thorium ores and concentrates (monazite)	2612.20.0000	Free.
Thorium compounds	2844.30.1000	5.5% ad val.

Depletion Allowance: Monazite, 23% on thorium content, 15% on rare-earth and yttrium content (Domestic); 14% (Foreign).

Government Stockpile:

Stockpile Status—9-30-05[6]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Thorium nitrate (gross weight)	864	—	864	[7]3,221	[7]2,355

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THORIUM

Events, Trends, and Issues: Domestic mine production of thorium-bearing monazite ceased at the end of 1994 as world demand for ores containing naturally occurring radioactive thorium declined. Imports and existing stocks supplied essentially all thorium consumed in the United States in 2005. Domestic demand for thorium ores, compounds, metals, and alloys has exhibited a long-term declining trend. No thorium consumption was reported in the United States in 2004, according to the U.S. Geological Survey's canvass of mines and processors. In 2005, consumption was believed to be primarily by catalyst manufacturers and was estimated to have increased. On the basis of data through August 2005, the average value of imported thorium compounds decreased to $29.11 per kilogram from the 2004 average of $31.90 per kilogram (gross weight). The average value of exported thorium compounds was $328.18 per kilogram based on data through August 2005. The use of thorium in the United States decreased significantly since the 1980s, when consumption averaged 45 tons per year. Increased costs to monitor and dispose of thorium have caused domestic processors to switch to thorium-free materials. Real and potential costs related to compliance with State and Federal regulations, proper disposal, and monitoring of thorium's radioactivity have limited its commercial value. It is forecast that thorium's use will continue to decline unless a low-cost disposal process is developed or new technology creates renewed demand.

World Refinery Production, Reserves, and Reserve Base:[8]

	Refinery production		Reserves[9]	Reserve base[9]
	2004	2005		
United States	—	—	160,000	300,000
Australia	—	—	300,000	340,000
Brazil	NA	NA	16,000	18,000
Canada	NA	NA	100,000	100,000
India	NA	NA	290,000	300,000
Malaysia	—	—	4,500	4,500
Norway	—	—	170,000	180,000
South Africa	—	—	35,000	39,000
Other countries	NA	NA	90,000	100,000
World total	NA	NA	1,200,000	1,400,000

Reserves and reserve base are contained primarily in the rare-earth ore mineral, monazite. Without demand for the rare earths, monazite would probably not be recovered for its thorium content. Other ore minerals with higher thorium contents, such as thorite, would be more likely sources if demand significantly increased. No new demand, however, is expected. Reserves exist primarily in recent and ancient placer deposits. Lesser quantities of thorium-bearing monazite reserves occur in vein deposits and carbonatites.

World Resources: Thorium resources occur in geologic provinces similar to those that contain reserves. The leading share is contained in placer deposits. Resources of more than 500,000 tons are contained in placer, vein, and carbonatite deposits. Disseminated deposits in various other alkaline igneous rocks contain additional resources of more than 2 million tons. Large thorium resources are found in Australia, Brazil, Canada, Greenland, India, South Africa, and the United States.

Substitutes: Nonradioactive substitutes have been developed for many applications of thorium. Yttrium compounds have replaced thorium compounds in incandescent lamp mantles. A magnesium alloy containing lanthanides, zirconium, and yttrium can substitute for magnesium-thorium alloys in aerospace applications.

[e]Estimated. NA Not available. — Zero.
[1]All domestically consumed thorium was derived from imported materials.
[2]Source: U.S. Department of Defense, Defense Logistics Agency. Based on sales from the National Defense Stockpile.
[3]Source: Rhodia Canada, Inc. and Rhodia Electronics and Catalysis, Inc., f.o.b. port of entry, duty paid, ThO_2 basis.
[4]Source: Rhodia Electronics and Catalysis, Inc., 1-950 kilogram quantities, f.o.b. port of entry, duty paid.
[5]Defined as imports – exports + adjustments for Government and industry stock changes.
[6]See Appendix B for definitions.
[7]Disposals from the National Defense Stockpile in FY 2005 were shipped to the Nevada Test Site, NV, for low-level radioactive waste disposal.
[8]Estimates, based on thorium contents of rare-earth ores.
[9]See Appendix C for definitions.

TIN

(Data in metric tons of tin content unless otherwise noted)

Domestic Production and Use: Tin has not been mined or smelted in the United States since 1993 and 1989, respectively. Twenty-five firms used about 81% of the primary tin consumed domestically in 2005. The major uses were as follows: cans and containers, 27%; electrical, 23%; construction, 10%; transportation, 10%; and other, 30%. On the basis of the average New York composite price, the estimated values of some critical items were as follows: primary metal consumed, $438 million; imports for consumption, refined tin, $644 million; and secondary production (old scrap), $59 million.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production:					
Secondary (old scrap)	6,700	6,760	5,500	4,850	5,000
Secondary (new scrap)	7,200	3,790	3,570	3,590	4,000
Imports for consumption, refined tin	37,500	42,200	37,100	47,600	54,800
Exports, refined tin	4,350	2,940	3,690	3,650	4,600
Shipments from Government stockpile excesses	12,000	8,960	8,880	10,600	11,000
Consumption, reported:					
Primary	34,200	34,000	32,900	33,300	37,300
Secondary	7,630	5,830	4,510	5,670	6,000
Consumption, apparent	48,300	55,700	48,700	59,200	65,800
Price, average, cents per pound:					
New York market	211	195	232	414	369
New York composite	315	292	340	555	534
London	203	184	222	388	344
Kuala Lumpur	201	184	222	392	343
Stocks, consumer and dealer, yearend	9,620	8,910	7,960	8,170	8,000
Net import reliance[1] as a percentage of apparent consumption	86	88	89	92	93

Recycling: About 9,000 tons of tin from old and new scrap was recycled in 2005. Of this, about 5,000 tons was recovered from old scrap at 2 detinning plants and 91 secondary nonferrous metal processing plants.

Import Sources (2001-04): Peru, 44%; China, 14%; Bolivia, 14%; Indonesia, 11%; and other, 17%.

Tariff: Most major imports of tin, including unwrought metal, waste and scrap, and unwrought tin alloys, enter the United States duty free.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: The Defense National Stockpile Center (DNSC) continued its long-term tin sales program. The DNSC Annual Materials Plan for tin sales for fiscal year 2005 (October 1, 2004, through September 30, 2005) remained at 12,000 tons. DNSC planned to continue to have at least one long-term negotiated "contract" sale for each fiscal year until inventories are exhausted. The remaining tonnage will be sold using the DNSC Basic Ordering Agreement (BOA). Under the BOA approach, DNSC posts the amount of tin that it wants to sell on its Web site every Tuesday. Interested parties submit a quote, and DNSC makes a sales determination by the end of the business day. BOA sales began in June 2002. In fiscal year 2005, DNSC had only one long-term sale, and that was in September. Tin is held in Federal depots at three locations: Hammond, IN; New Haven, IN; and Point Pleasant, WV.

Stockpile Status—9-30-05[2]

Material	**Uncommitted inventory**	**Committed inventory**	**Authorized for disposal**	**Disposal plan FY 2005**	**Disposals FY 2005**
Pig tin	16,651	9,812	16,651	12,000	8,354

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TIN

Events, Trends, and Issues: The Steel Recycling Institute announced that the steel can (usually tinplated) recycling rate in the United States was 61% for 2004, compared with 60% in 2003. Tin, as well as steel, is recovered in can recycling.

Developments accelerated in major tin-consuming countries in moving to new lead-free solders that usually contain greater amounts of tin than leaded solders.

During 2005, there were several closed or partially disabled tin mines that reopened to take advantage of higher tin prices that have been sustained during the past 2 years.

The price of tin rose during the first 3 months of 2005, then declined steadily through August. Industry observers thought that on average during 2005 world tin production was insufficient to meet demand, continuing a moderate production deficit from 2004.

The world tinplate industry continued to undergo mergers and consolidations. In most cases, this resulted in the loss of tin mill capacity. During the past 4 years, several domestic steel producers that make tinplate have declared bankruptcy. During 2005, domestic tinplate capacity began to stabilize with the buyout of several large domestic bankrupt tinplate producers by a major foreign producer.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[3]	Reserve base[3]
	2004	2005[e]		
United States	—	—	20,000	40,000
Australia	800	800	145,000	300,000
Bolivia	16,800	17,000	450,000	900,000
Brazil	12,200	12,300	540,000	2,500,000
China	110,000	115,000	1,700,000	3,500,000
Congo (Kinshasa)	2,000	2,000	NA	NA
Indonesia	66,000	80,000	800,000	900,000
Malaysia	3,000	2,000	1,000,000	1,200,000
Peru	42,000	42,000	710,000	1,000,000
Portugal	500	500	70,000	80,000
Russia	2,500	3,000	300,000	350,000
Thailand	600	650	170,000	200,000
Vietnam	4,000	4,000	NA	NA
Other countries	4,000	1,200	180,000	200,000
World total (rounded)	264,000	280,000	6,100,000	11,000,000

World Resources: U.S. resources of tin, primarily in Alaska, were insignificant compared with those of the rest of the world. World resources, principally in western Africa, southeastern Asia, Australia, Bolivia, Brazil, China, and Russia, are sufficient to sustain recent annual production rates well into the 21st century.

Substitutes: Aluminum, glass, paper, plastic, or tin-free steel substitute for tin in cans and containers. Other materials that substitute for tin are epoxy resins for solder; aluminum alloys, copper-base alloys, and plastics for bronze; plastics for bearing metals that contain tin; and compounds of lead and sodium for some tin chemicals.

[e]Estimated. NA Not available. — Zero.
[1]Defined as imports - exports + adjustments for Government and industry stock changes.
[2]See Appendix B for definitions.
[3]See Appendix C for definitions.

TITANIUM MINERAL CONCENTRATES[1]

(Data in thousand metric tons of contained TiO_2 unless otherwise noted)

Domestic Production and Use: Two firms produced ilmenite and rutile concentrates from surface mining operations in Florida, Georgia, and Virginia. The value of titanium mineral concentrates consumed in the United States in 2005 was about $480 million. The major coproduct of mining from ilmenite and rutile deposits was zircon. About 97% of titanium mineral concentrates was consumed by domestic TiO_2 pigment producers. The remaining 3% of consumption was used in welding rod coatings and for manufacturing carbides, chemicals, and metal.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production[2] (ilmenite and rutile, rounded)	300	300	300	300	300
Imports for consumption:					
Ilmenite and slag	737	599	569	535	570
Rutile, natural and synthetic	303	368	397	337	305
Exports,[e] all forms	5	2	7	6	8
Consumption, reported:					
Ilmenite and slag[3]	856	951	959	1,080	994
Rutile, natural and synthetic	448	452	453	414	381
Price, dollars per metric ton, yearend:					
Ilmenite, bulk, minimum 54% TiO_2, f.o.b. Australia	100	93	90	81	80
Rutile, bulk, minimum 95% TiO_2, f.o.b. Australia	475	450	430	455	470
Slag, 80%-95% TiO_2[4]	335-518	340-527	385-444	347-466	390-555
Stocks, mine, consumer, yearend:					
Ilmenite	221	197	200	299	300
Rutile	118	75	74	70	70
Employment, mine and mill, number[e]	359	349	344	300	286
Net import reliance[5] as a percentage of reported consumption	78	74	68	58	63

Recycling: None.

Import Sources (2001-04): South Africa, 44%; Australia, 34%; Canada, 12%; Ukraine, 6%; and other, 4%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Synthetic rutile	2614.00.3000	Free.
Ilmenite and ilmenite sand	2614.00.6020	Free.
Rutile concentrate	2614.00.6040	Free.
Titanium slag	2620.99.5000	Free.

Depletion Allowance: Ilmenite and rutile; 22% (Domestic), 14% (Foreign).

Government Stockpile: None.

Events, Trends, and Issues: Owing to new mining capacity in Georgia and Virginia, domestic production of titanium mineral concentrates increased compared with that of 2004. In August, Hurricane Katrina disrupted TiO_2 pigment production in Mississippi. Consequently, domestic consumption of titanium mineral concentrates decreased in 2005 compared with that of 2004. Global consumption of titanium mineral concentrates was estimated to have increased slightly in 2004 compared with that of 2003. International exploration and development projects for producing titanium minerals were underway in Australia (Coburn, Douglas, Eucla Basin, Goondicum, Ludlow, Mindarie, Wemen), Canada (Athabasca, Truro), Chile (Cerro Blanco), The Gambia (Sanyang), India (Tamil Nadu), Kenya (Kwale), Madagascar (Fort-Dauphin), Malawi (Lake Malawi), Mozambique (Corridor Sands, Moebase), Senegal (Grande Côte), and South Africa (Xolobeni). In the Murray Basin, Australia, mine construction was completed at the Ginkgo mine site (Pooncarie Project). In Canada, chloride-grade slag capacity at Sorel was increased to 325,000 tons per year. A further capacity expansion was expected in late 2006. In Mozambique, construction of the 700,000-ton-per-year ilmenite mine near Moma was underway and scheduled for completion in 2006. Efforts were underway to restart the rutile mine in Sierra Leone, which has been idle since 1995.

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TITANIUM MINERAL CONCENTRATES

World Mine Production, Reserves, and Reserve Base: The reserves and reserve base estimates for Australia and Mozambique have been revised based on new information from those countries.

	Mine production		Reserves[6]	Reserve base[6]
	2004	2005[e]		
Ilmenite:				
United States[2]	[7]300	[7]300	6,000	59,000
Australia	1,110	1,140	130,000	160,000
Brazil	130	130	12,000	12,000
Canada[8]	735	809	31,000	36,000
China	400	400	200,000	350,000
India	281	280	85,000	210,000
Mozambique	—	—	16,000	21,000
Norway[8]	381	380	37,000	60,000
South Africa[8]	865	952	63,000	220,000
Ukraine	217	220	5,900	13,000
Vietnam	98	100	2,400	5,900
Other countries	120	120	15,000	78,000
World total (ilmenite, rounded)	4,600	4,800	600,000	1,200,000
Rutile:				
United States	([9])	([9])	400	1,800
Australia	154	160	19,000	31,000
Brazil	3	3	3,500	3,500
India	18	20	7,400	20,000
Mozambique	—	—	480	570
South Africa	105	115	8,300	24,000
Ukraine	57	60	2,500	2,500
Other countries	—	—	8,100	17,000
World total (rutile, rounded)	[10]340	[10]360	50,000	100,000
World total (ilmenite and rutile, rounded)	5,000	5,200	650,000	1,300,000

World Resources: Ilmenite supplies about 90% of the world's demand for titanium minerals. World resources of anatase, ilmenite, and rutile total more than 2 billion tons.

Substitutes: Ilmenite, leucoxene, rutile, slag, and synthetic rutile compete as feedstock sources for producing TiO_2 pigment, titanium metal, and welding rod coatings.

[e]Estimated. — Zero.
[1]See also Titanium and Titanium Dioxide.
[2]Rounded to nearest 0.1 million ton to avoid disclosing company proprietary data.
[3]Excludes ilmenite used to produce synthetic rutile.
[4]Landed duty-paid value based on U.S. imports for consumption.
[5]Defined as imports – exports + adjustments for Government and industry stock changes.
[6]See Appendix C for definitions.
[7]Includes rutile.
[8]Mine production is primarily used to produce titaniferous slag.
[9]Included with ilmenite to avoid disclosing company proprietary data.
[10]Excludes U.S. production.

TITANIUM AND TITANIUM DIOXIDE[1]

(Data in metric tons unless otherwise noted)

Domestic Production and Use: Titanium sponge metal was produced by two operations in Nevada and Utah. Ingot was made by the two sponge producers and by nine other firms in seven States. Numerous firms consumed ingot to produce forged components, mill products, and castings. In 2005, an estimated 65% of the titanium metal was used in aerospace applications. The remaining 35% was used in armor, chemical processing, marine, medical, power generation, sporting goods, and other nonaerospace applications. The value of sponge metal consumed was about $216 million, assuming an average selling price of $8.00 per kilogram.

In 2005, titanium dioxide (TiO_2) pigment, valued at about $3.1 billion, was produced by four companies at eight facilities in seven States. Estimated use of TiO_2 pigment by end use was paint (includes lacquers and varnishes) 54%; plastic, 27%; paper, 16%; and other, 3%. Other uses of TiO_2 included catalysts, ceramics, coated fabrics and textiles, floor coverings, printing ink, and roofing granules.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Titanium sponge metal:					
Production	W	W	W	W	W
Imports for consumption	13,300	10,700	9,590	11,900	15,000
Exports	2,170	2,810	5,000	2,410	2,000
Shipments from Government stockpile excesses	7,640	5,400	6,820	3,910	2,510
Consumption, reported	26,200	17,300	17,100	21,200	27,000
Price, dollars per kilogram, yearend	7.89	8.02	6.50	8.50	7.90
Stocks, industry yearend[e]	6,340	11,700	8,180	7,660	7,000
Employment, number[e]	300	300	300	300	300
Net import reliance[2] as a percentage of reported consumption	67	46	89	66	60
Titanium dioxide:					
Production	1,330,000	1,410,000	1,420,000	1,540,000	1,420,000
Imports for consumption	209,000	231,000	240,000	264,000	330,000
Exports	415,000	540,000	584,000	635,000	560,000
Consumption, apparent	1,100,000	1,110,000	1,070,000	1,170,000	1,190,000
Price, rutile, list, dollars per pound, yearend	1.05	0.90	0.88	1.00	1.03
Stocks, producer, yearend	159,000	145,000	156,000	NA	NA
Employment, number[e]	4,600	4,500	4,500	4,400	4,300
Net import reliance[2] as a percentage of apparent consumption	E	E	E	E	E

Recycling: New scrap metal recycled by the titanium industry totaled about 24,000 tons in 2005. Estimated use of titanium as scrap and ferrotitanium by the steel industry was about 8,700 tons; by the superalloy industry, 600 tons; and, in other industries, 800 tons. Old scrap reclaimed totaled about 500 tons.

Import Sources (2001-04): Sponge metal: Kazakhstan, 49%; Japan, 39%; Russia, 10%; and other, 2%. Titanium dioxide pigment: Canada, 29%; Germany, 11%; France, 9%; China, 7%; and other, 44%.

Tariff: **Item**	**Number**	**Normal Trade Relations 12-31-05**
Titanium oxides (unfinished TiO_2 pigments)	2823.00.0000	5.5% ad val.
TiO_2 pigments, 80% or more TiO_2	3206.11.0000	6.0% ad val.
TiO_2 pigments, other	3206.19.0000	6.0% ad val.
Ferrotitanium and ferrosilicon titanium	7202.91.0000	3.7% ad val.
Titanium waste and scrap metal	8108.30.0000	Free.
Unwrought titanium metal	8108.20.0000	15.0% ad val.
Wrought titanium metal	8108.90.6000	15.0% ad val.
Other titanium metal articles	8108.90.3000	5.5% ad val.

Depletion Allowance: Not applicable.

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TITANIUM AND TITANIUM DIOXIDE

Government Stockpile: The Defense National Stockpile Center continued the sale of titanium sponge held in the Government stockpile. In fiscal year 2006, the remaining inventory of sponge will be exhausted.

Stockpile Status—9-30-05[3]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Titanium sponge	679	—	679	6,350	1,845

Events, Trends, and Issues: In August, hurricanes disrupted production at two TiO_2 pigment plants in Mississippi. Although one plant was restarted in October, the other affected plant remained idle for the rest of the year. Domestic production of TiO_2 pigment was an estimated 1.42 million tons, an 8% decrease compared with that of 2004. Global production of TiO_2 was estimated to have increased slightly compared with that of 2004. A U.S. TiO_2 pigment producer announced plans to construct a 200,000-ton-per-year TiO_2 pigment plant near Dongying, China, by 2010.

Driven by rising demand from commercial aircraft and military markets, domestic production and consumption of titanium sponge metal continued to rise in 2005. Fueled by increased demand, U.S. titanium producers announced several plans to expand production capacity. In Henderson, NV, plans were underway to increase titanium sponge capacity to 12,600 tons per year by 2007. A 3,400-ton-per-year sponge plant at Albany, OR, was being refurbished and was expected to be operational by the second half of 2006. In Japan, sponge capacity was being increased to 39,000 tons per year by April 2006. Sponge capacity in Russia was expected to rise to 32,000 tons per year by 2007. Efforts to develop a low-cost method for producing titanium metal were ongoing.

World Sponge Metal Production and Sponge and Pigment Capacity:

	Sponge production		Capacity 2005[4]	
	2004	2005[e]	Sponge	Pigment
United States	W	W	8,940	1,580,000
Australia	—	—	—	241,000
Belgium	—	—	—	74,000
Canada	—	—	—	90,000
China[e]	4,800	6,500	9,500	500,000
Finland	—	—	—	130,000
France	—	—	—	225,000
Germany	—	—	—	440,000
Italy	—	—	—	80,000
Japan	23,100	29,000	37,000	317,000
Kazakhstan[e]	16,500	19,000	22,000	1,000
Mexico	—	—	—	125,000
Russia[e]	23,000	25,000	28,000	20,000
Spain	—	—	—	80,000
Ukraine[e]	7,500	8,100	8,100	120,000
United Kingdom	—	—	—	290,000
Other countries	—	—	—	670,000
World total (rounded)	[5]75,000	[5]88,000	110,000	5,000,000

World Resources:[6] Resources and reserves of titanium minerals are discussed in Titanium Mineral Concentrates. The commercial feedstock sources for titanium are ilmenite, leucoxene, rutile, slag, and synthetic rutile.

Substitutes: There are few materials that possess titanium metal's strength to weight ratio and corrosion resistance. In high-strength applications, titanium competes with aluminum, composites, intermetallics, steel, and superalloys. For applications that require corrosion resistance, aluminum, nickel, specialty steels, and zirconium alloys may be substituted for titanium. Ground calcium carbonate, precipitated calcium carbonate, kaolin, and talc compete with titanium dioxide as a white pigment.

[e]Estimated. E Net exporter. NA Not available. W Withheld to avoid disclosing company proprietary data. — Zero.
[1]See also Titanium Mineral Concentrates.
[2]Defined as imports – exports + adjustments for Government and industry stock changes.
[3]See Appendix B for definitions.
[4]Operating capacity.
[5]Excludes U.S. production.
[6]See Appendix C for definitions.

TUNGSTEN

(Data in metric tons of tungsten content unless otherwise noted)

Domestic Production and Use: The last reported U.S. production of tungsten concentrates was in 1994. In 2005, approximately eight companies in the United States processed tungsten concentrates, ammonium paratungstate, tungsten oxide, and/or scrap to make tungsten powder, tungsten carbide powder, and/or tungsten chemicals. Approximately 65 industrial consumers were surveyed on a monthly or annual basis. Data reported by these consumers indicate that more than one-half of the tungsten consumed in the United States was used in cemented carbide parts for cutting and wear-resistant materials primarily in the metalworking, mining, oil- and gas-drilling, and construction industries. The remaining tungsten was consumed to make tungsten heavy alloys for applications requiring high density; electrodes, filaments, wires, and other components for electrical, electronic, heating, lighting, and welding applications; steels, superalloys, and wear-resistant alloys; and chemicals for various applications. The estimated value of apparent consumption in 2005 was $260 million.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production:					
Mine	—	—	—	—	—
Secondary	5,390	4,380	4,130	4,000	4,600
Imports for consumption:					
Concentrate	2,680	4,090	4,690	2,310	2,000
Other forms	8,150	6,510	7,620	8,240	9,800
Exports:					
Concentrate	220	94	20	43	40
Other forms	4,860	3,220	5,070	3,730	6,100
Government stockpile shipments:					
Concentrate	2,200	1,140	710	979	2,300
Other forms	986	177	182	80	350
Consumption:					
Reported, concentrate	W	W	W	W	W
Apparent,[1] all forms	14,500	11,900	10,100	12,600	11,600
Price, concentrate, dollars per mtu WO_3,[2] average:					
U.S. spot market, Platts Metals Week	64	55	50	49	140
European market, Metal Bulletin	65	38	45	55	123
Stocks, industry, yearend:					
Concentrate	W	W	W	W	W
Other forms	2,110	1,610	1,820	1,780	2,200
Net import reliance[3] as a percentage of apparent consumption	64	69	63	73	70

Recycling: In 2005, the tungsten contained in scrap consumed by processors and end users represented approximately 40% of apparent consumption of tungsten in all forms.

Import Sources (2001-04): Tungsten contained in ores and concentrates, intermediate and primary products, wrought and unwrought tungsten, and waste and scrap: China, 46%; Canada, 20%; Germany, 6%; Portugal, 5%; and other, 23%.

Tariff: **Item**	**Number**	**Normal Trade Relations[4] 12-31-05**
Ore	2611.00.3000	Free.
Concentrate	2611.00.6000	Free.[5]
Ferrotungsten	7202.80.0000	5.6% ad val.
Tungsten powders	8101.10.0000	7.0% ad val.
Ammonium tungstate	2841.80.0010	5.5% ad val.
Tungsten carbide	2849.90.3000	5.5% ad val.
Tungsten oxide	2825.90.3000	5.5% ad val.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: Sales of National Defense Stockpile tungsten began in 1999. Included in the data listed in the following table, as of September 30, 2005, are 5,750 tons of tungsten contained in uncommitted nonstockpile-grade ores and concentrates authorized for disposal.

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TUNGSTEN

Stockpile Status—9-30-05[6]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Ferrotungsten	105	—	105	[7]136	121
Metal powder	266	147	266	[7]136	147
Ores and concentrates	26,300	403	26,300	[7]2,270	2,250

Events, Trends, and Issues: World tungsten supply continued to be dominated by Chinese production and exports. Beginning in 1999 and continuing into 2005, the Chinese Government took several steps to control the release of Chinese tungsten into the world market. In addition to regulating tungsten production and the total volume of tungsten exports, the Government was gradually shifting the balance of export quotas towards value-added downstream tungsten materials and products. China was also becoming a large tungsten consumer. During the past decade, the growth in China's economy has resulted in a significant increase in consumption of tungsten materials to produce finished products for the domestic market, such as cemented carbide tools.

In 2005, inadequate supplies of tungsten concentrates within China combined with increased demand for tungsten materials in China and elsewhere resulted in steep increases in the prices of tungsten concentrates, ammonium paratungstate, and ferrotungsten. The sole Canadian tungsten mine restarted operations. Various companies worked towards developing tungsten deposits or reopening inactive tungsten mines in Australia, China, Peru, Russia, the United States, and Vietnam.

Health, safety, and environmental issues are becoming increasingly significant to metals such as tungsten.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[8]	Reserve base[8]
	2004	2005[e]		
United States	—	—	140,000	200,000
Austria	1,400	1,400	10,000	15,000
Bolivia	440	400	53,000	100,000
Canada	—	750	260,000	490,000
China	67,000	69,000	1,800,000	4,200,000
Korea, North	600	600	NA	35,000
Portugal	750	850	25,000	25,000
Russia	3,000	3,000	250,000	420,000
Other countries	510	510	360,000	700,000
World total (rounded)	73,700	76,500	2,900,000	6,200,000

World Resources: World tungsten resources are geographically widespread. China ranks number one in the world in terms of tungsten resources and reserves and has some of the largest deposits. Canada, Kazakhstan, Russia, and the United States also have significant tungsten resources.

Substitutes: Potential substitutes include cemented carbides based on molybdenum carbide and titanium carbide, ceramics, ceramic-metallic composites (cermets), diamond tools, and tool steels for cemented tungsten carbides; molybdenum for certain tungsten mill products; molybdenum steels for tungsten steels; lighting based on carbon nanotube filaments, induction technology, and light-emitting diodes (LEDs) for lighting based on tungsten electrodes or filaments; depleted uranium for tungsten alloys or unalloyed tungsten in weights and counterweights; and depleted uranium alloys for cemented tungsten carbides or tungsten alloys in armor-piercing projectiles. In some applications, substitution would result in increased cost or a loss in product performance.

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data. — Zero.
[1]The sum of U.S. secondary production, as estimated from scrap consumption, and net import reliance.
[2]A metric ton unit (mtu) of tungsten trioxide (WO_3) contains 7.93 kilograms of tungsten.
[3]Defined as imports – exports + adjustments for Government and industry stock changes.
[4]Special tariff rates apply for Canada and Mexico. Tariffs for other countries for some items may be eliminated under special trade agreements.
[5]Special tariff rate effective on or before December 31, 2003, under number 9902.26.1100.
[6]See Appendix B for definitions.
[7]Actual quantity limited to remaining sales authority.
[8]See Appendix C for definitions.

VANADIUM

(Data in metric tons of vanadium content unless otherwise noted)

Domestic Production and Use: Eight U.S. firms that make up the domestic vanadium industry produced ferrovanadium, vanadium pentoxide, vanadium metal, and vanadium-bearing chemicals or specialty alloys by processing materials such as petroleum residues, spent catalysts, utility ash, and vanadium-bearing pig iron slag. Metallurgical use, primarily as an alloying agent for iron and steel, accounted for about 94% of the domestic vanadium consumption. Of the other uses for vanadium, the major nonmetallurgical use was in catalysts for the production of maleic anhydride and sulfuric acid.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production, mine, mill[1]	—	—	—	—	—
Imports for consumption:					
Ash, ore, residues, slag	1,670	1,870	3,060	2,350	3,370
Vanadium pentoxide, anhydride	804	455	679	1,230	1,520
Oxides and hydroxides, other	57	66	74	133	234
Aluminum-vanadium master alloys (gross weight)	10	98	232	19	—
Ferrovanadium	2,550	2,520	1,360	3,020	4,460
Exports:					
Vanadium pentoxide, anhydride	71	91	185	240	232
Oxides and hydroxides, other	63	203	284	584	819
Aluminum-vanadium master alloys (gross weight)	363	529	677	887	1920
Ferrovanadium	70	142	397	267	488
Consumption, reported	3,210	3,080	3,240	4,050	4,180
Price, average, dollars per pound V_2O_5	1.37	1.34	2.21	5.28	17.50
Stocks, consumer, yearend	251	221	250	305	275
Employment, mine and mill, number[1]	—	—	—	—	—
Net import reliance[2] as a percentage of reported consumption	100	100	100	100	100

Recycling: Some tool steel scrap was recycled primarily for its vanadium content, and vanadium was recycled from spent chemical process catalysts, but these two sources together accounted for only a very small percentage of total vanadium used. The vanadium content of other recycled steels was lost to slag during processing and was not recovered.

Import Sources (2001-04): Ferrovanadium: Czech Republic, 33%; Canada, 16%; South Africa, 14%; Swaziland, 14%; and other, 23%. Vanadium pentoxide: South Africa, 92%; Mexico, 2%; and other, 6%.

Tariff: Ash, residues, slag, and waste and scrap enter duty-free.

Item	Number	Normal Trade Relations 12-31-05
Vanadium pentoxide anhydride	2825.30.0010	6.6% ad val.
Vanadium oxides and hydroxides, other	2825.30.0050	6.6% ad val.
Vanadates	2841.90.1000	6.1% ad val.
Ferrovanadium	7202.92.0000	4.2% ad val.
Aluminum-vanadium master alloys	7601.20.9030	Free.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: None.

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VANADIUM

Events, Trends, and Issues: Preliminary data indicate that U.S. vanadium consumption in 2005 increased about 3% from that of the previous year. Among the major uses for vanadium, production of carbon, full-alloy, and high-strength low-alloy steels accounted for 34%, 28%, and 30% of domestic consumption, respectively. Steel production in 2005 was expected to be 2% to 3% higher than that of 2004.

Both ferrovanadium and vanadium pentoxide prices increased significantly during 2005. Industry analysts attributed the price rise primarily to strong demand in the steel and aerospace industries and the inability of producers to increase production of vanadium in a timely manner. Prices spiked in the second quarter of 2005 but dropped by about 50% by the end of the year. Closure of the Windimurra Mine in Australia and the Vantec Mine in South Africa in 2004, which rectified oversupply on the world market that had existed from 1999 to 2003, combined with increasing demand resulted in supply shortages in 2005.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[3]	Reserve base[3]
	2004	2005[e]		
United States	—	—	45,000	4,000,000
China	14,000	14,500	5,000,000	14,000,000
Russia	8,000	9,000	5,000,000	7,000,000
South Africa	17,200	18,000	3,000,000	12,000,000
Other countries	1,000	1,000	NA	1,000,000
World total (rounded)	40,200	42,500	13,000,000	38,000,000

World Resources: World resources of vanadium exceed 63 million tons. Vanadium occurs in deposits of titaniferous magnetite, phosphate rock, and uraniferous sandstone and siltstone, in which it constitutes less than 2% of the host rock. Significant amounts are also present in bauxite and carboniferous materials, such as crude oil, coal, oil shale, and tar sands. Because vanadium is usually recovered as a byproduct or coproduct, demonstrated world resources of the element are not fully indicative of available supplies. While domestic resources and secondary recovery are adequate to supply a large portion of domestic needs, a substantial part of U.S. demand is currently met by foreign material because it is currently uneconomic to mine vanadium in the United States.

Substitutes: Steels containing various combinations of other alloying elements can be substituted for steels containing vanadium. Metals, such as columbium (niobium), manganese, molybdenum, titanium, and tungsten, are to some degree interchangeable with vanadium as alloying elements in steel. Platinum and nickel can replace vanadium compounds as catalysts in some chemical processes. There is currently no acceptable substitute for vanadium in aerospace titanium alloys.

[e]Estimated. NA Not available. — Zero.

[1]Domestic vanadium mine production stopped in 1999.

[2]Defined as imports – exports + adjustments for Government and industry stock changes.

[3]See Appendix C for definitions.

VERMICULITE

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: Two companies with mining and processing facilities in South Carolina and Virginia produced vermiculite concentrate. Most of the vermiculite concentrate was shipped to 19 exfoliating plants in 11 States. The end uses for exfoliated vermiculite were estimated to be agricultural, insulation, and other, 73%; and lightweight concrete aggregates (including cement premixes, concrete, and plaster), 27%.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production[e, 1]	110	100	110	100	105
Imports for consumption[e]	65	56	37	69	70
Exports[e]	7	10	15	10	10
Consumption, apparent, concentrate[e]	170	150	130	160	165
Consumption, exfoliated[e]	140	115	95	90	95
Price, base value, concentrate, dollars per ton, ex-plant	143	143	143	[2]143	[3]125
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, mine and mill, number[e]	100	90	90	[4]100	[4]100
Net import reliance[5] as a percentage of apparent consumption[e]	35	30	20	35	35

Recycling: Insignificant.

Import Sources (2001-04): South Africa, 70%; China, 28%; and other, 2%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Vermiculite, perlite and chlorites, unexpanded	2530.10.0000	Free.
Exfoliated vermiculite, expanded clays, foamed slag, and similar expanded materials	6806.20.0000	Free.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

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VERMICULITE

Events, Trends, and Issues: Canada's sole vermiculite mine and mill operation, Vermiculite Canada, was shipping vermiculite concentrate to Montreal where it is mixed with gypsum to produce fire-resistant wallboard. Concentrate also was being shipped to metropolitan Toronto, New England, and the Midwestern United States for such uses as brake pads and garden and potting soils.[6]

U.S. imports of vermiculite are not collected as a separate category by the U.S. Census Bureau. However, according to a nongovernmental source, U.S. imports, excluding those from Canada and Mexico, were about 52,000 tons for the first 8 months of 2005. Two countries supplied most of this material: South Africa provided 67% and China, 31%.[7]

South Africa continued to be the leading producer of vermiculite with an estimated 200,000 tons in 2005. Most of the output was exported to such markets as Europe, North America, and Southeast Asia. Chinese production of vermiculite may be as high as 100,000 tons per year, although official data were not available.[8] Export destinations included Japan and the Republic of Korea.[9]

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves[10]	Reserve base[10]
	2004	2005[e]		
United States[e]	100	105	25,000	100,000
Brazil	26	26	NA	NA
China	100	100	NA	NA
Russia	25	25	NA	NA
South Africa	195	200	14,000	80,000
Zimbabwe	27	25	NA	NA
Other countries	37	39	NA	NA
World total (rounded)	510	520	NA	NA

World Resources: Marginal reserves of vermiculite that occur in Colorado, Nevada, North Carolina, Texas, and Wyoming are estimated to be 2 million to 3 million tons. Reserves have been reported in Australia, Brazil, China, Russia, South Africa, Uganda, the United States, Zimbabwe, and some other countries. However, reserve information comes from many sources, and in most cases it is not clear whether the numbers refer to vermiculite alone or vermiculite plus host rock and/or overburden.[9]

Substitutes: Expanded perlite is a substitute for vermiculite in lightweight concrete and plaster. Other more dense but less costly material substitutes in these applications are expanded clay, shale, slag, and slate. Alternate materials for loosefill fireproofing insulation include fiberglass, perlite, and slag wool. In agriculture, substitutes include peat, perlite, sawdust, bark and other plant materials, and synthetic soil conditioners.

[e]Estimated. NA Not available.
[1]Concentrate sold and used by producers.
[2]Industrial Minerals, 2004, Prices: Industrial Minerals, no. 442, July, p. 64-65.
[3]Moeller, Eric, and Hindman, James, 2005, Vermiculite: Mining Engineering, v. 57, no. 6, June, p. 60-61. (Average of prices from range of sized grades.)
[4]Mine, mill, and office.
[5]Defined as imports – exports + adjustments for Government and industry stock changes.
[6]Hughes, Bob, 2005 (May 6), Canada's vermiculite mine in production in Cavendish, article in the Lakefield Herald, accessed July 8, 2005, via URL http://www.vermiculitecanada.com.
[7]Commonwealth Business Media, Inc., 2005, Port Import/Export Reporting Service, accessed November 2, 2005, at URL http://www.piers.com.
[8]Dickson, Ted, 2004, Vermiculite, *in* Industrial minerals annual review supplement: London, United Kingdom, Mining Journal Ltd. CD-ROM.
[9]Roskill Information Services Ltd., 2004, The economics of vermiculite (8th ed.): London, United Kingdom, Roskill Information Services Ltd., 126 p. plus appendices.
[10]See Appendix C for definitions.

YTTRIUM[1]

(Data in metric tons of yttrium oxide (Y_2O_3) content unless otherwise noted)

Domestic Production and Use: The rare-earth element yttrium was not mined in the United States in 2005. All yttrium metal and compounds used in the United States were imported. Principal uses were in phosphors for color televisions and computer monitors, trichromatic fluorescent lights, temperature sensors, and X-ray-intensifying screens. Yttrium also was used as a stabilizer in zirconia, in alumina-zirconia abrasives, wear-resistant and corrosion-resistant cutting tools, seals and bearings, high-temperature refractories for continuous-casting nozzles, jet engine coatings, oxygen sensors in automobile engines, and simulant gemstones. In electronics, yttrium-iron-garnets were components in microwave radar to control high-frequency signals. Yttrium was an important component in yttrium-aluminum garnet laser crystals used in industrial cutting and welding, medical and dental surgical procedures, temperature and distance sensing, photoluminescence, photochemistry, digital communications, and nonlinear optics. Yttrium also was used in heating-element alloys, superalloys, and high-temperature superconductors. The approximate distribution in 2004 by end use was as follows: lamp and cathode-ray-tube phosphors, 98%; alloys, 1%; and miscellaneous, 1%.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production, mine	—	—	—	—	—
Imports for consumption:					
In monazite	—	—	—	—	—
Yttrium, alloys, compounds, and metal[e, 2]	470	330	380	619	600
Exports, in ore and concentrate	NA	NA	NA	NA	NA
Consumption, estimated[3]	470	330	380	619	600
Price, dollars:					
Monazite concentrate, per metric ton[4]	400	400	400	400	400
Yttrium oxide, per kilogram, 99.0% to 99.99% purity[5]	22-88	22-88	22-88	10-85	10-85
Yttrium metal, per kilogram, 99.0% to 99.9% purity[5]	95-115	95-115	95-115	96	96
Stocks, processor, yearend	NA	NA	NA	NA	NA
Net import reliance[e, 6] as a percentage of apparent consumption	100	100	100	100	100

Recycling: Small quantities, primarily from laser crystals and synthetic garnets.

Import Sources (2001-04):[e] Yttrium compounds, >19% to < 85% weight percent yttrium oxide equivalent: China, 85%; Japan, 8%; France, 5%; Austria, 1%; and other, 1%. Import sources based on Journal of Commerce data (2004 only): China, 85%; Netherlands, 8%; Japan, 4%; Austria, 1%; and other, 2%.

Tariff: **Item**	**Number**	**Normal Trade Relations 12-31-05**
Thorium ores and concentrates (monazite)	2612.20.0000	Free.
Rare-earth metals, scandium and yttrium, whether or not intermixed or interalloyed	2805.30.0000	5.0% ad val.
Yttrium-bearing materials and compounds containing by weight >19% to < 85% Y_2O_3	2846.90.4000	Free.
Other rare-earth compounds, including yttrium oxide $\geq$ 85% Y_2O_3, yttrium nitrate, and other individual compounds	2846.90.8000	3.7% ad val.

Depletion Allowance: Monazite, thorium content, 22% (Domestic), 14% (Foreign); yttrium, rare-earth content, 14% (Domestic and foreign); and xenotime, 14% (Domestic and foreign).

Government Stockpile: None.

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YTTRIUM

Events, Trends, and Issues: Yttrium demand in the United States increased in 2004 and remained high in 2005. The United States required increased amounts for use in various phosphors and in electronics, especially those used in defense applications. Yttrium production and marketing within China continued to be competitive keeping international prices low, although China was the source of most of the world's supply. Yttrium was consumed primarily in the form of high-purity oxide and nitrate compounds.

World Mine Production, Reserves, and Reserve Base:

	Mine production[e, 7] 2004	Mine production[e, 7] 2005	Reserves[8]	Reserve base[8]
United States	—	—	120,000	130,000
Australia	—	—	100,000	110,000
Brazil	—	—	2,200	6,200
China	2,300	2,300	220,000	240,000
India	55	55	72,000	80,000
Malaysia	5	5	13,000	21,000
Sri Lanka	—	—	240	260
Other	26	26	17,000	20,000
World total (rounded)	2,400	2,400	540,000	610,000

World Resources: Large resources of yttrium in monazite and xenotime are available worldwide in ancient and recent placer deposits, weathered clay deposits (ion-adsorption ore), carbonatites, and uranium ores. Additional large subeconomic resources of yttrium occur in other monazite-bearing deposits, apatite-magnetite rocks, sedimentary phosphate deposits, deposits of columbium-tantalum minerals, and certain uranium ores, especially those of the Blind River District in Canada. It is probable that the world's resources are very large.

Substitutes: Substitutes for yttrium are available for some applications but generally are much less effective. In most uses, especially in electronics, lasers, and phosphors, yttrium is not subject to substitution by other elements. As a stabilizer in zirconia ceramics, yttria (yttrium oxide) may be substituted with calcia (calcium oxide) or magnesia (magnesium oxide), but they generally have lower toughness.

[e]Estimated. NA Not available. — Zero.
[1]See also Rare Earths and Scandium.
[2]Imports based on data from the Port Import/Export Reporting Service (PIERS).
[3]Essentially all yttrium consumed domestically was imported or refined from imported ores and concentrates.
[4]Monazite concentrate prices derived from U.S. Census Bureau data.
[5]Yttrium oxide and metal prices from Elements—Rare Earths, Specialty Metals and Applied Technology (a High Tech Materials online publication at www.rareearthsmarketplace.com), Rhodia Rare Earths, Inc., Shelton, CT; the China Rare Earth Information Center, Baotou, China; Hefa Rare Earth Canada Co., Ltd., Vancouver, Canada; and Stanford Materials Corp., Aliso Viejo, CA.
[6]Defined as imports – exports + adjustments for Government and industry stock changes.
[7]Includes yttrium contained in rare-earth ores.
[8]See Appendix C for definitions.

ZINC

(Data in thousand metric tons of zinc content unless otherwise noted)

Domestic Production and Use: The value of zinc mined in 2005, based on contained zinc recoverable from concentrate, was about $1.06 billion. It was produced in 5 States by 10 mines operated by 5 companies. Alaska, Missouri, Montana, and Washington accounted for about 99.9% of domestic mine output; the Red Dog Mine in Alaska accounted for 86% of total U.S. production. Two primary and 12 large- and medium-sized secondary smelters refined zinc metal of commercial grade in 2005. Of zinc metal consumed, about 75% was used in Illinois, Indiana, Michigan, New York, Ohio, and Pennsylvania, mostly by steel companies. Of the total zinc consumed, about 55% was used in galvanizing, 21% in zinc-base alloys, 16% in brass and bronze, and 8% in other uses. Zinc compounds and dust were used principally by the agriculture, chemical, paint, and rubber industries. Major coproducts of zinc mining and smelting, in order of decreasing tonnage, were lead, sulfur, cadmium, silver, gold, and germanium.

Salient Statistics—United States:	2001	2002	2003	2004	2005[e]
Production:					
Mine, zinc in ore[1]	842	780	768	739	760
Primary slab zinc	203	182	187	189	250
Secondary slab zinc	108	113	116	117	155
Imports for consumption:					
Ore and concentrate	84	122	164	231	180
Refined zinc	813	874	758	812	700
Exports:					
Ore and concentrate	696	822	841	745	900
Refined zinc	1	1	2	3	1
Shipments from Government stockpile	18	11	14	29	18
Consumption:					
Apparent, refined zinc	1,140	1,180	1,080	1,140	1,120
Apparent, all forms	1,410	1,420	1,340	1,400	1,370
Price, average, cents per pound:					
Domestic producers[2]	44.0	38.6	40.6	52.5	63.2
London Metal Exchange, cash	40.2	35.3	37.5	47.5	60.5
Stocks, slab zinc, yearend	75	78	73	73	74
Employment:					
Mine and mill, number[e]	2,400	1,500	1,000	600	600
Smelter primary, number[e]	900	600	600	600	600
Net import reliance[3] as a percentage of apparent consumption:					
Refined zinc	73	75	72	73	64
All forms of zinc	59	62	58	60	52

Recycling: In 2005, an estimated 360,000 tons of zinc was recovered from waste and scrap; about 30% was recovered in the form of slab zinc and the remainder in alloys, oxide, and chemicals. Of the total amount of scrap recycled, 311,000 tons was derived from new scrap, and 49,000 tons was derived from old scrap. About 45,000 tons of scrap was exported, mainly to China, and 8,000 tons was imported, most of which came from Canada (84%).

Import Sources (2001-04): Ore and concentrate: Peru, 61%; Australia, 22%; Ireland, 10%; and other, 7%. Metal: Canada, 60%; Mexico, 17%; Kazakhstan, 6%; and other, 17%. Combined total: Canada, 54%; Mexico, 16%; Peru, 14%; and other, 16%.

Tariff: Item	Number	Normal Trade Relations[4] 12-31-05
Ore and concentrate	2608.00.0030	Free.
Unwrought metal	7901.11.0000	1.5% ad val.
Alloys, casting-grade	7901.12.1000	3% ad val.
Alloys	7901.20.0000	3% ad val.
Waste and scrap	7902.00.0000	Free.
Hard zinc spelter	2620.11.0000	Free.
Zinc oxide	2817.00.0000	Free.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

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ZINC

Government Stockpile:

Stockpile Status—9-30-05[5]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2005	Disposals FY 2005
Zinc	49	7	49	45	15

Events, Trends, and Issues: The zinc producers worldwide continue to benefit from a major price recovery that started in the third quarter of 2004 and picked up renewed momentum in the second half of 2005. World zinc consumption for the year 2005 was larger than world refined zinc metal production. Consequently, London Metal Exchange stocks were drawn down by more than 200,000 tons in 2005. These are both positive signs for continued strength of the zinc market well into 2006.

The United States remained one of the leading consumers of zinc and zinc products. However, domestic metal production capacity, both primary and secondary, accounts for less than one-third of the quantity consumed domestically. Canada and Mexico are the leading sources of zinc for the United States because of their geographical proximity and because of trade agreements. Concentrate, metal, and scrap can be imported duty free from those sources.

World Mine Production, Reserves, and Reserve Base:

	Mine production[6]		Reserves[7]	Reserve base[7]
	2004	2005[e]		
United States	739	760	30,000	90,000
Australia	1,300	1,400	33,000	80,000
Canada	790	790	11,000	31,000
China	2,300	2,300	33,000	92,000
Kazakhstan	360	370	30,000	35,000
Mexico	460	380	8,000	25,000
Peru	1,200	1,300	16,000	20,000
Other countries	2,400	2,800	59,000	87,000
World total (rounded)	9,600	10,100	220,000	460,000

World Resources: Identified zinc resources of the world are about 1.9 billion tons.

Substitutes: Aluminum, steel, and plastics substitute for galvanized sheet. Aluminum, plastics, and magnesium are major competitors as diecasting materials. Plastic coatings, paint, and cadmium and aluminum alloy coatings replace zinc for corrosion protection; aluminum alloys are used in place of brass. Many elements are substitutes for zinc in chemical, electronic, and pigment uses.

[e]Estimated.
[1]Zinc recoverable after smelting and refining was reported for mine production prior to Mineral Commodity Summaries 2001.
[2]Platts Metals Week price for North American Special High Grade zinc.
[3]Defined as imports – exports + adjustments for Government and industry stock changes.
[4]No tariff for Canada and Mexico for items shown.
[5]See Appendix B for definitions.
[6]Zinc content of concentrate and direct shipping ore.
[7]See Appendix C for definitions.

ZIRCONIUM AND HAFNIUM

(Data in metric tons unless otherwise noted)

Domestic Production and Use: The zirconium-silicate mineral zircon is produced as a coproduct from the mining and processing of heavy minerals. Two firms produced zircon from surface mining operations in Florida, Georgia, and Virginia. Zirconium and hafnium elements were produced from zircon by two domestic producers, one in Oregon and the other in Utah. Typically, both elements are in the ore in a zirconium to hafnium ratio of about 50:1. Primary zirconium chemicals were produced by the Oregon metal producer and at a plant in New Jersey. Secondary zirconium chemicals were produced by 10 other companies. Zirconia (ZrO_2) was produced from zircon at plants in Alabama, New Hampshire, New York, Ohio, and by the metal producer in Oregon. Zircon ceramics, opacifiers, refractories, and foundry applications are the leading end uses for zirconium. Other end uses of zirconium include abrasives, chemicals, metal alloys, welding rod coatings, and sandblasting. The leading market for hafnium metal is as an addition in superalloys.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production, zircon (ZrO_2 content)	W	W	W	W	W
Imports:					
Zirconium, ores and concentrates (ZrO_2 content)	39,400	22,900	24,300	22,900	19,400
Zirconium, unwrought, powder, and waste and scrap	145	82	75	89	266
Zirconium, wrought	571	474	468	708	643
Zirconium oxide (ZrO_2 content)[1]	2,950	2,900	2,350	3,960	3,190
Hafnium, unwrought, waste and scrap	5	5	5	4	6
Exports:					
Zirconium ores and concentrates (ZrO_2 content)	43,500	30,600	45,900	44,700	55,600
Zirconium, unwrought, powder, and waste and scrap	186	208	204	233	310
Zirconium, wrought	1,190	1,430	1,490	1,470	1,660
Zirconium oxide (ZrO_2 content)[1]	2,400	1,950	1,520	1,600	2,340
Consumption, zirconium ores and concentrates, apparent (ZrO_2 content)	W	W	W	W	W
Prices:					
Zircon, dollars per metric ton (gross weight):					
Domestic[2]	340	350	360	557	662
Imported, f.o.b.[3]	356	397	396	477	673
Zirconium, unwrought, dollars per kilogram[4]	31	39	44	31	22
Hafnium, unwrought, dollars per kilogram[4]	138	199	226	269	238
Net import reliance[5] as a percentage of apparent consumption:					
Zirconium	E	E	E	E	E
Hafnium	NA	NA	NA	NA	NA

Recycling: Scrap zirconium metal and alloys was recycled by four companies, one each in California, Michigan, New York, and Texas. In-plant recycled zirconium came from scrap generated during metal production and fabrication and was recycled by companies in Oregon and Utah. Zircon foundry mold cores and spent or rejected zirconia refractories are often recycled. Recycling of hafnium metal was insignificant.

Import Sources (2001-04):[6] Zirconium ores and concentrates: Australia, 56%; South Africa, 38%; and other, 6%. Zirconium, unwrought, including powder: Germany, 44%; China, 26%; Canada, 12%; Japan, 11%; and other, 7%. Hafnium, unwrought, including powder: France, 58%; Canada, 27%; China, 7%; Japan, 5%, and other, 3%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
Zirconium ores and concentrates	2615.10.0000	Free.
Germanium oxides and zirconium dioxide	2825.60.0000	3.7% ad val.
Ferrozirconium	7202.99.1000	4.2% ad val.
Zirconium, unwrought, zirconium powders	8109.20.0000	4.2% ad val.
Zirconium waste and scrap	8109.30.0000	Free.
Other zirconium articles	8109.90.0000	3.7% ad val.
Hafnium, unwrought, hafnium powders	8112.92.2000	Free.

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ZIRCONIUM AND HAFNIUM

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: None.

Events, Trends, and Issues: Global production of zircon increased to 870,000 tons, slightly more than that of 2004, while demand increased 3% compared with that of 2004. Demand for zircon continued to surpass the available supply in 2005. The shortage was caused by increased demand, the closure of several zircon-producing mines, and reduced zircon output because of lower grades at a few foreign mines. Prices for zircon concentrate increased to record-high levels in 2005 in response to the worldwide supply shortfall. In 2005, U.S. imports of zirconium ores and concentrates decreased about 15%, while exports increased 24%. Imports declined as a result of continued high output from recent expansions in Georgia and Virginia and lower domestic demand. A number of new projects to expand the availability of zircon are underway in Australia, Canada, Kenya, Madagascar, Malawi, and Mozambique. Production from a number of these projects was expected to begin in 2006. The availability of hafnium, produced as a byproduct during zirconium metal processing, continued to exceed demand. Russia was the sole producer of baddeleyite in 2005.

World Mine Production, Reserves, and Reserve Base: World primary hafnium production statistics are not available. Hafnium occurs with zirconium in the minerals zircon and baddeleyite.

	Zirconium				Hafnium	
	Mine production (thousand metric tons)		Reserves[7] (million metric tons, ZrO_2)	Reserve base[7]	Reserves[7] (thousand metric tons, HfO_2)	Reserve base[7]
	2004	2005[e]				
United States[1]	W	W	3.4	5.7	68	97
Australia	441	450	9.1	30	180	600
Brazil	26	35	2.2	4.6	44	91
China	17	15	0.5	3.7	NA	NA
India	20	20	3.4	3.8	42	46
South Africa	300	305	14	14	280	290
Ukraine	35	35	4.0	6.0	NA	NA
Other countries	10	10	0.9	4.1	NA	NA
World total (rounded)	850	870	38	72	610	1,100

World Resources: Resources of zircon in the United States included about 14 million tons associated with titanium resources in heavy-mineral sand deposits. Phosphate and sand and gravel deposits have the potential to yield substantial amounts of zircon as a future byproduct. Eudialyte and gittinsite are zirconium silicate minerals that have a potential for zirconia production. Identified world resources of zircon exceed 60 million tons.

Resources of hafnium in the United States are estimated to be about 130,000 tons, available in the 14-million-ton domestic resources of zircon. World resources of hafnium are associated with those of zircon and baddeleyite and exceed 1 million tons.

Substitutes: Chromite and olivine can be used instead of zircon for some foundry applications. Dolomite and spinel refractories can also substitute for zircon in certain high-temperature applications. Columbium (niobium), stainless steel, and tantalum provide limited substitution in nuclear applications, while titanium and synthetic materials may substitute in some chemical plant uses.

Silver-cadmium-indium control rods are used in lieu of hafnium at numerous nuclear powerplants. Zirconium can be used interchangeably with hafnium in certain superalloys; in others, only hafnium produces the desired or required grain boundary refinement.

[e]Estimated. E Net exporter. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Includes germanium oxides and zirconium oxides.
[2]E.I. du Pont de Nemours & Co. and Iluka Resources, Inc., average price.
[3]U.S. Census Bureau trade data.
[4]Unit value based on U.S. imports for consumption.
[5]Defined as imports – exports.
[6]Data for the new trade categories “Zirconium, unwrought, powder” and “Hafnium, unwrought, including powder” are based on 2002-03 only.
[7]See Appendix C for definitions.

APPENDIX A

Abbreviations and Units of Measure

1 carat (metric) (diamond)	= 200 milligrams
1 flask (fl)	= 76 pounds, avoirdupois
1 karat (gold)	= one twenty-fourth part
1 kilogram (kg)	= 2.2046 pounds, avoirdupois
1 long ton (lt)	= 2,240 pounds, avoirdupois
1 long ton unit (ltu)	= 1% of 1 long ton or 22.4 pounds avoirdupois
long calcined ton (lct)	= excludes water of hydration
long dry ton (ldt)	= excludes excess free moisture
Mcf	= 1,000 cubic feet
1 metric ton (t)	= 2,204.6 pounds, avoirdupois or 1,000 kilograms
1 metric ton (t)	= 1.1023 short ton
1 metric ton unit (mtu)	= 1% of 1 metric ton or 10 kilograms
1 pound (lb)	= 453.6 grams
1 short ton (st)	= 2,000 pounds, avoirdupois
1 short ton unit (stu)	= 1% of 1 short ton or 20 pounds, avoirdupois
1 short dry ton (sdt)	= 2,000 pounds, avoirdupois, excluding moisture content
1 troy ounce (tr oz)	= 1.09714 avoirdupois ounces or 31.103 grams
1 troy pound	= 12 troy ounces

APPENDIX B

Definitions of Selected Terms Used in This Report

Terms Used for Materials in the National Defense Stockpile and Helium Stockpile

Uncommitted inventory refers to the quantity of mineral materials held in the National Defense Stockpile. Nonstockpile-grade materials may be included in the table; where significant, the quantities of these stockpiled materials will be specified in the text accompanying the table.

Committed inventory refers to materials that have been sold or traded from the stockpile, either in the current fiscal year (FY 2005) or in prior years, but not yet removed from stockpile facilities as of September 30, 2005.

Authorized for disposal refers to quantities that are in excess of the stockpile goal for a material, and for which Congress has authorized disposal over the long term at rates designed to maximize revenue but avoid undue disruption of the usual markets and financial loss to the United States.

Disposal plan FY 2005 indicates the total amount of a material in the National Defense Stockpile that the U.S. Department of Defense is permitted to sell under the Annual Materials Plan approved by Congress for the fiscal year. Fiscal year 2005 is the period October 1, 2004, through September 30, 2005. For mineral commodities that have a disposal plan greater than the inventory, actual quantity will be limited to remaining disposal authority or inventory. Note that, unlike the National Defense Stockpile, helium stockpile sales by the Bureau of Land Management under the Helium Privatization Act of 1996 are permitted to exceed disposal plans.

Disposals FY 2005 refers to material sold or traded from the stockpile in fiscal year 2005.

Depletion Allowance

The depletion allowance is a business tax deduction analogous to depreciation, but applies to an ore reserve rather than equipment or production facilities. Federal tax law allows this deduction from taxable corporate income, recognizing that an ore deposit is a depletable asset that must eventually be replaced.

APPENDIX C

A Resource/Reserve Classification for Minerals[1]

INTRODUCTION

Through the years, geologists, mining engineers, and others operating in the minerals field have used various terms to describe and classify mineral resources, which as defined herein include energy materials. Some of these terms have gained wide use and acceptance, although they are not always used with precisely the same meaning.

The U.S. Geological Survey (USGS) collects information about the quantity and quality of all mineral resources. In 1976, the USGS and the U.S. Bureau of Mines developed a common classification and nomenclature, which was published as USGS Bulletin 1450-A—*"Principles of the Mineral Resource Classification System of the U.S. Bureau of Mines and U.S. Geological Survey."* Experience with this resource classification system showed that some changes were necessary in order to make it more workable in practice and more useful in long-term planning. Therefore, representatives of the USGS and the U.S. Bureau of Mines collaborated to revise Bulletin 1450-A. Their work was published in 1980 as USGS Circular 831—*"Principles of a Resource/Reserve Classification for Minerals."*

Long-term public and commercial planning must be based on the probability of discovering new deposits, on developing economic extraction processes for currently unworkable deposits, and on knowing which resources are immediately available. Thus, resources must be continuously reassessed in the light of new geologic knowledge, of progress in science and technology, and of shifts in economic and political conditions. To best serve these planning needs, known resources should be classified from two standpoints: (1) purely geologic or physical/chemical characteristics—such as grade, quality tonnage, thickness, and depth—of the material in place: and (2) profitability analyses based on costs of extracting and marketing the material in a given economy at a given time. The former constitutes important objective scientific information of the resource and a relatively unchanging foundation upon which the latter more valuable economic delineation can be based.

The revised classification system, designed generally for all mineral materials, is shown graphically in figures 1 and 2; its components and their usage are described in the text. The classification of mineral and energy resources is necessarily arbitrary, because definitional criteria do not always coincide with natural boundaries. The system can be used to report the status of mineral and energy-fuel resources for the Nation or for specific areas.

RESOURCE/RESERVE DEFINITIONS

A dictionary definition of resource, "something in reserve or ready if needed," has been adapted for mineral and energy resources to comprise all materials, including those only surmised to exist, that have present or anticipated future value.

Resource.—A concentration of naturally occurring solid, liquid, or gaseous material in or on the Earth's crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible.

Original Resource.—The amount of a resource before production.

Identified Resources.—Resources whose location, grade, quality, and quantity are known or estimated from specific geologic evidence. Identified resources include economic, marginally economic, and sub-economic components. To reflect varying degrees of geologic certainty, these economic divisions can be subdivided into measured, indicated, and inferred.

Demonstrated.—A term for the sum of measured plus indicated.

Measured.—Quantity is computed from dimensions revealed in outcrops, trenches, workings, or drill holes; grade and(or) quality are computed from the results of detailed sampling. The sites for inspection, sampling, and measurements are spaced so closely and the geologic character is so well defined that size, shape, depth, and mineral content of the resource are well established.

Indicated.—Quantity and grade and(or) quality are computed from information similar to that used for measured resources, but the sites for inspection, sampling, measurement are farther apart or are otherwise less adequately spaced. The degree of assurance, although lower than that for measured resources, is high enough to assume continuity between points of observation.

Inferred.—Estimates are based on an assumed continuity beyond measured and(or) indicated resources, for which there is geologic evidence. Inferred resources may or may not be supported by samples or measurements.

Reserve Base.—That part of an identified resource that meets specified minimum physical and chemical criteria related to current mining and production practices, including those for grade, quality, thickness, and depth. The reserve base is the in-place demonstrated (measured plus indicated) resource from which reserves are estimated. It may encompass those parts of the resources that have a reasonable potential for becoming economically available within planning horizons beyond those that assume proven technology and current economics. The reserve base includes those resources that are currently economic (reserves), marginally economic (marginal reserves), and some of those that are currently subeconomic (subeconomic resources). The term "geologic reserve" has been applied by others generally to the reserve-base category, but it

[1]Based on U.S. Geological Survey Circular 831, 1980.

also may include the inferred-reserve-base category; it is not a part of this classification system.

Inferred Reserve Base.—The in-place part of an identified resource from which inferred reserves are estimated. Quantitative estimates are based largely on knowledge of the geologic character of a deposit and for which there may be no samples or measurements. The estimates are based on an assumed continuity beyond the reserve base, for which there is geologic evidence.

Reserves.—That part of the reserve base which could be economically extracted or produced at the time of determination. The term reserves need not signify that extraction facilities are in place and operative. Reserves include only recoverable materials; thus, terms such as “extractable reserves” and “recoverable reserves” are redundant and are not a part of this classification system.

Marginal Reserves.—That part of the reserve base which, at the time of determination, borders on being economically producible. Its essential characteristic is economic uncertainty. Included are resources that would be producible, given postulated changes in economic or technological factors.

Economic.—This term implies that profitable extraction or production under defined investment assumptions has been established, analytically demonstrated, or assumed with reasonable certainty.

Subeconomic Resources.—The part of identified resources that does not meet the economic criteria of reserves and marginal reserves.

Undiscovered Resources.—Resources, the existence of which are only postulated, comprising deposits that are separate from identified resources. Undiscovered resources may be postulated in deposits of such grade and physical location as to render them economic, marginally economic, or subeconomic. To reflect varying degrees of geologic certainty, undiscovered resources may be divided into two parts:

Hypothetical Resources.—Undiscovered resources that are similar to known mineral bodies and that may be reasonably expected to exist in the same producing district or region under analogous geologic conditions. If exploration confirms their existence and reveals enough information about their quality, grade, and quantity, they will be reclassified as identified resources.

Speculative Resources.—Undiscovered resources that may occur either in known types of deposits in favorable geologic settings where mineral discoveries have not been made, or in types of deposits as yet unrecognized for their economic potential. If exploration confirms their existence and reveals enough information about their quantity, grade, and quality, they will be reclassified as identified resources.

Restricted Resources/Reserves.—That part of any resource/reserve category that is restricted from extraction by laws or regulations. For example, restricted reserves meet all the requirements of reserves except that they are restricted from extraction by laws or regulations.

Other Occurrences.—Materials that are too low grade or for other reasons are not considered potentially economic, in the same sense as the defined resource, may be recognized and their magnitude estimated, but they are not classified as resources. A separate category, labeled other occurrences, is included in figures 1 and 2. In figure 1, the boundary between subeconomic and other occurrences is limited by the concept of current or potential feasibility of economic production, which is required by the definition of a resource. The boundary is obviously uncertain, but limits may be specified in terms of grade, quality, thickness, depth, percent extractable, or other economic-feasibility variables.

Cumulative Production.—The amount of past cumulative production is not, by definition, a part of the resource. Nevertheless, a knowledge of what has been produced is important to an understanding of current resources, in terms of both the amount of past production and the amount of residual or remaining in-place resource. A separate space for cumulative production is shown in figures 1 and 2. Residual material left in the ground during current or future extraction should be recorded in the resource category appropriate to its economic-recovery potential.

FIGURE 1.—Major Elements of Mineral-Resource Classification, Excluding *Reserve Base* and *Inferred Reserve Base*

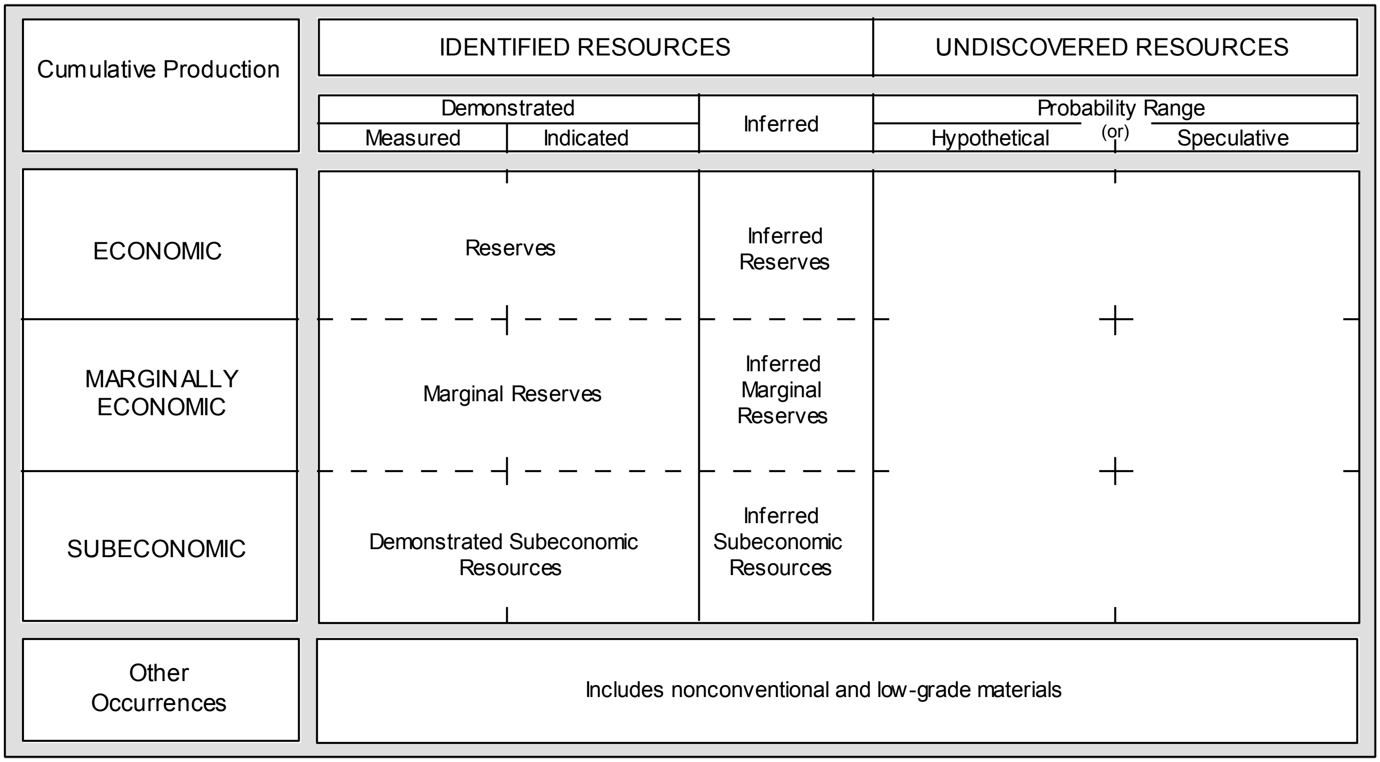
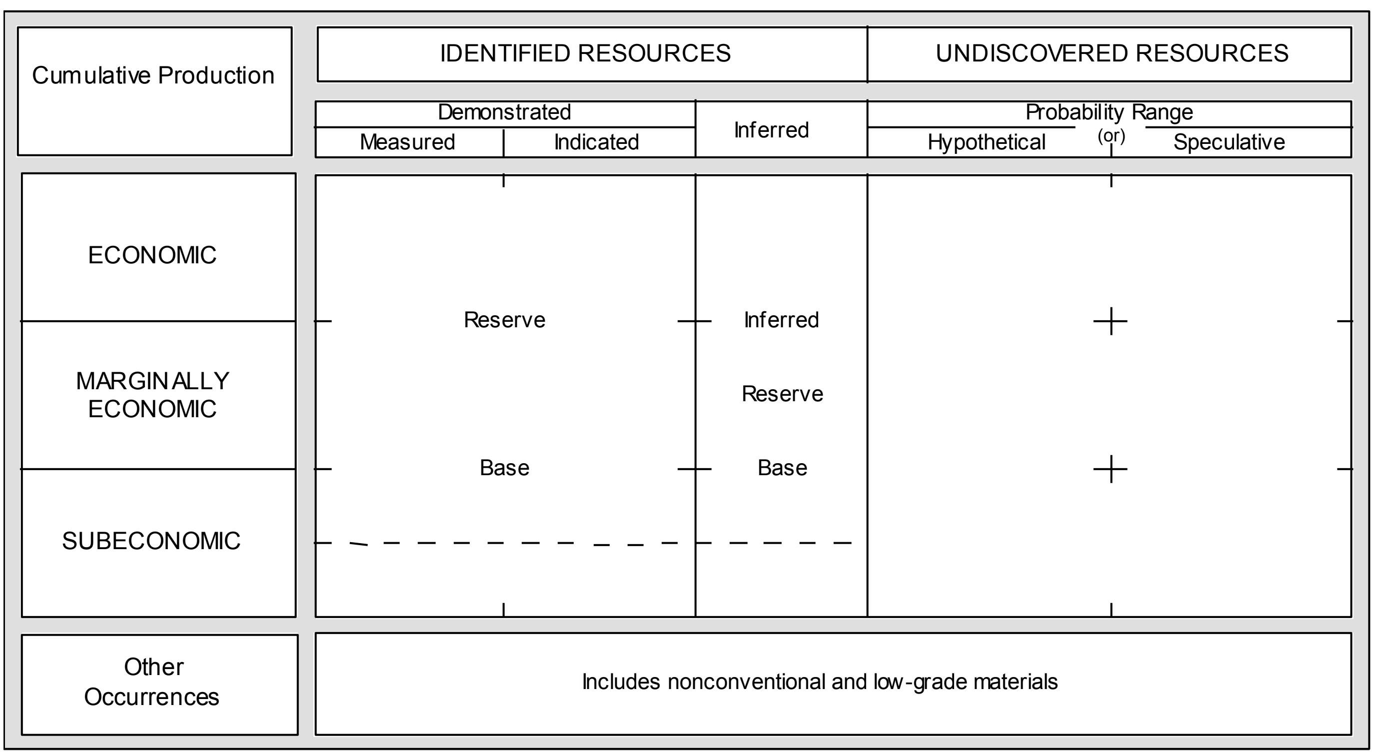


FIGURE 2.—*Reserve Base* and *Inferred Reserve Base* Classification Categories



APPENDIX D

Country Specialists Directory

Minerals information country specialists at the U.S. Geological Survey collect and analyze information on the mineral industries of more than 170 nations throughout the world. The specialists are available to answer minerals-related questions concerning individual countries.

Africa and the Middle East

Algeria	Philip M. Mobbs
Angola	Omayra Bermúdez-Lugo
Bahrain	Philip M. Mobbs
Benin	Omayra Bermúdez-Lugo
Botswana	Philip M. Mobbs
Burkina Faso	Omayra Bermúdez-Lugo
Burundi	Thomas R. Yager
Cameroon	Omayra Bermúdez-Lugo
Cape Verde	Omayra Bermúdez-Lugo
Central African Republic	Omayra Bermúdez-Lugo
Chad	Philip M. Mobbs
Comoros	Thomas R. Yager
Congo (Brazzaville)	Philip M. Mobbs
Congo (Kinshasa)	Thomas R. Yager
Côte d'Ivoire	Omayra Bermúdez-Lugo
Cyprus	Philip M. Mobbs
Djibouti	Thomas R. Yager
Egypt	Harold R. Newman
Equatorial Guinea	Philip M. Mobbs
Eritrea	Thomas R. Yager
Ethiopia	Thomas R. Yager
Gabon	Omayra Bermúdez-Lugo
The Gambia	Omayra Bermúdez-Lugo
Ghana	Omayra Bermúdez-Lugo
Guinea	Omayra Bermúdez-Lugo
Guinea-Bissau	Omayra Bermúdez-Lugo
Iran	Philip M. Mobbs
Iraq	Philip M. Mobbs
Israel	Thomas R. Yager
Jordan	Thomas R. Yager
Kenya	Thomas R. Yager
Kuwait	Philip M. Mobbs
Lebanon	Thomas R. Yager
Lesotho	Thomas R. Yager
Liberia	Omayra Bermúdez-Lugo
Libya	Philip M. Mobbs
Madagascar	Thomas R. Yager
Malawi	Thomas R. Yager
Mali	Omayra Bermúdez-Lugo
Mauritania	Omayra Bermúdez-Lugo
Mauritius	Thomas R. Yager
Morocco & Western Sahara	Omayra Bermúdez-Lugo
Mozambique	Thomas R. Yager
Namibia	Philip M. Mobbs
Niger	Omayra Bermúdez-Lugo
Nigeria	Philip M. Mobbs
Oman	Philip M. Mobbs
Qatar	Philip M. Mobbs
Reunion	Thomas R. Yager
Rwanda	Thomas R. Yager
São Tomé & Principe	Omayra Bermúdez-Lugo
Saudi Arabia	Philip M. Mobbs
Senegal	Omayra Bermúdez-Lugo
Seychelles	Thomas R. Yager
Sierra Leone	Omayra Bermúdez-Lugo
Somalia	Thomas R. Yager
South Africa	Thomas R. Yager
Sudan	Thomas R. Yager
Swaziland	Thomas R. Yager
Syria	Thomas R. Yager
Tanzania	Thomas R. Yager
Togo	Omayra Bermúdez-Lugo
Tunisia	Philip M. Mobbs
Turkey	Philip M. Mobbs
Uganda	Thomas R. Yager
United Arab Emirates	Philip M. Mobbs
Yemen	Philip M. Mobbs
Zambia	Philip M. Mobbs
Zimbabwe	Philip M. Mobbs

Asia and the Pacific

Afghanistan	Travis Q. Lyday
Australia	Travis Q. Lyday
Bangladesh	Chin S. Kuo
Bhutan	Chin S. Kuo
Brunei	Pui-Kwan Tse
Burma	Yolanda Fong-Sam
Cambodia	John C. Wu
China	Pui-Kwan Tse
Christmas Island	Travis Q. Lyday
Fiji	Travis Q. Lyday
India	Chin S. Kuo
Indonesia	Pui-Kwan Tse
Japan	John C. Wu
Korea, North	John C. Wu
Korea, Republic of	John C. Wu
Laos	John C. Wu
Malaysia	Pui-Kwan Tse
Mongolia	Pui-Kwan Tse
Nepal	Chin S. Kuo
New Caledonia	Travis Q. Lyday
New Zealand	Travis Q. Lyday
Pakistan	Travis Q. Lyday
Papua New Guinea	Travis Q. Lyday
Philippines	Travis Q. Lyday
Singapore	Pui-Kwan Tse
Solomon Islands	Travis Q. Lyday
Sri Lanka	Chin S. Kuo
Taiwan	Pui-Kwan Tse
Thailand	John C. Wu
Timor, East	Pui-Kwan Tse
Tonga	Travis Q. Lyday
Vanuatu	Travis Q. Lyday
Vietnam	John C. Wu

Europe and Central Eurasia

Albania	Walter G. Steblez
Armenia	Richard M. Levine
Austria	Harold R. Newman
Azerbaijan	Richard M. Levine

Belarus	Richard M. Levine
Belgium	Harold R. Newman
Bosnia and Herzegovina	Walter G. Steblez
Bulgaria	Walter G. Steblez
Croatia	Walter G. Steblez
Czech Republic	Walter G. Steblez
Denmark, Faroe Island, and Greenland	Chin S. Kuo
Estonia	Chin S. Kuo
Finland	Chin S. Kuo
France	Harold R. Newman
Georgia	Richard M. Levine
Germany	Steven T. Anderson
Greece	Harold R. Newman
Hungary	Walter G. Steblez
Iceland	Chin S. Kuo
Ireland	Harold R. Newman
Italy	Harold R. Newman
Kazakhstan	Richard M. Levine
Kyrgyzstan	Richard M. Levine
Latvia	Chin S. Kuo
Lithuania	Chin S. Kuo
Luxembourg	Harold R. Newman
Macedonia	Walter G. Steblez
Malta	Harold R. Newman
Moldova	Richard M. Levine
Netherlands	Harold R. Newman
Norway	Chin S. Kuo
Poland	Walter G. Steblez
Portugal	Harold R. Newman
Romania	Walter G. Steblez
Russia	Richard M. Levine
Serbia and Montenegro	Walter G. Steblez
Slovakia	Walter G. Steblez
Slovenia	Walter G. Steblez
Spain	Harold R. Newman
Sweden	Chin S. Kuo
Switzerland	Harold R. Newman
Tajikistan	Richard M. Levine
Turkmenistan	Richard M. Levine
Ukraine	Richard M. Levine
United Kingdom	Harold R. Newman
Uzbekistan	Richard M. Levine

North America, Central America, and the Caribbean

Antigua and Barbuda	Omayra Bermúdez-Lugo
Aruba	Omayra Bermúdez-Lugo
The Bahamas	Omayra Bermúdez-Lugo
Barbados	Omayra Bermúdez-Lugo
Belize	Steven T. Anderson
Bermuda	Omayra Bermúdez-Lugo
Canada	Alfredo C. Gurmendi
Costa Rica	Steven T. Anderson
Cuba	Omayra Bermúdez-Lugo
Dominica	Omayra Bermúdez-Lugo
Dominican Republic	Omayra Bermúdez-Lugo
El Salvador	Steven T. Anderson
Grenada	Omayra Bermúdez-Lugo
Guadeloupe	Omayra Bermúdez-Lugo
Guatemala	Steven T. Anderson Haiti
Omayra Bermúdez-Lugo	
Honduras	Steven T. Anderson
Jamaica	Omayra Bermúdez-Lugo
Martinique	Omayra Bermúdez-Lugo
Mexico	Ivette E. Torres
Montserrat	Omayra Bermúdez-Lugo
Netherlands Antilles	Omayra Bermúdez-Lugo
Nicaragua	Steven T. Anderson
Panama	Steven T. Anderson
St. Kitts and Nevis	Omayra Bermúdez-Lugo
St. Lucia	Omayra Bermúdez-Lugo
St. Vincent & the Grenadines	Omayra Bermúdez-Lugo
Trinidad and Tobago	Omayra Bermúdez-Lugo

South America

Argentina	Ivette E. Torres
Bolivia	Steven T. Anderson
Brazil	Alfredo C. Gurmendi
Chile	Steven T. Anderson
Colombia	Ivette E. Torres
Ecuador	Steven T. Anderson
French Guiana	Yolanda Fong-Sam
Guyana	Yolanda Fong-Sam
Paraguay	Yolanda Fong-Sam
Peru	Alfredo C. Gurmendi
Suriname	Yolanda Fong-Sam
Uruguay	Yolanda Fong-Sam
Venezuela	Ivette E. Torres

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